
DETRAFFORD ESTATES

Environmental Standards Statement

Mixed use development @ Phoenix Works, Ellesmere Street, Manchester, M15

14 September 2020

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CIBSE Accreditation Nos:

LCCSIM084077

LCCD084077

LCEA084077

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Issue Status

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First Issue Date	Revision Issue Date	Issue Revision	Issued By
September 14, 2020			DW



Index

Section

1. Executive Summary
2. Planning Statement
 - 2.1. The Site and Proposed Development
 - 2.2. Relevant Policies and Guidance
 - 2.2.1. Local Planning Policy
 - 2.2.1.1. Manchester Core Strategy
 - 2.2.1.2. Guide to Development in Manchester, Supplementary Planning Document
 - 2.2.1.3. Manchester Residential Quality Guide
 - 2.2.1.4. Manchester's Great Outdoors
 - 2.2.1.5. Manchester Climate Change Framework 2020-25
 - 2.2.2. Manchester City Council's Planning Document Targets
 - 2.2.3. National Planning Policy
 - 2.3. Sustainable Design Strategy
 - 2.3.1. Energy and Carbon Emissions
 - 2.3.2. Choice and Impact of Renewable Technology
 - 2.3.3. Energy and CO₂ Reduction Summary
 - 2.3.4. Manchester City Council' Policy and Targets Summary
 - 2.4. Adaptation to Climate Change
 - 2.4.1. Grid Decarbonisation and SAP
 - 2.4.2. Flood Risk Zone
 - 2.4.3. Green Blue Infrastructure
 - 2.4.3.1. Sustainable Drainage Systems (SUDs)
 - 2.4.3.2. Biodiversity
 - 2.4.4. Internal Water Efficiency
 - 2.4.5. Waste Management
 - 2.4.5.1. Occupational Waste
 - 2.4.5.2. Construction Waste
 - 2.4.6. Materials
 - 2.4.7. Pollution Control
 - 2.4.8. Health and Wellbeing
 - 2.4.9. Sustainable Transport
3. Feasibility Assessment of Renewable Energy and Low Carbon Technologies
4. Conclusion

Appendices

- A - Energy Demand Assessment Spreadsheet
- B – PV Roof Layout
- B - Example SAP Compliance Report
- C - Example PEA
- D - Example SAP Input
- E - Example Improved SAP Calculation Worksheet
- F - Example Baseline SAP Calculation



1. Executive Summary

This Environmental Standards Statement has been prepared by Watt Energy on behalf of DeTrafford Estates to support a planning application for the development of Phoenix Works. 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.

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, it is proposed that the development will also benefit from a site wide **48kWp PV array**, which will be located on the main flat roof and orientated south.



As a result of the above the predicted site wide reduction in CO₂ over Part L 2013 of the Building Regulations is **9.1%** with SAP 10.0 carbon factors and **32.6%** with SAP 10.1 carbon factors, with a renewable energy contribution of **6.0%**.

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
- Pollution Control
- 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

2.1 The Site and Proposed Development

The site is located on the south western periphery of the City Centre within the Castlefield regeneration area, adjacent to the Bridgewater Canal which flows east through the city centre and west alongside River Irwell. The site occupies approximately 0.29 hectares of land. A site location plan, with the site's extents denoted by the red outline seen in Figure 1 (shown later in this subsection).

The site is bounded to the north by Ellesmere Street, and newly formed Bentick Street and Spinners Way to the east and south, respectively. Notable nearby developments which are currently under construction/ completed are DeTrafford's Gallery Gardens development, located directly to the west, DeTrafford's Sky, City and St George's Gardens' developments, all situated directly south and the completed DeTrafford development Roof Gardens located to the east of the site, across Bentick Street. The site location plan shown in Figure 1 outlines the Phoenix Works proposal in proximity to these adjacent developments.

The site is located in area that has undergone a number of transitions in recent history; originally being an undeveloped area of Castlefield until the introduction of the railways in the late 19th century at which point rows of residential terraced housing was erected to house workers. The site remained in this state until the late 20th century when it was cleared and the commercial property 'Phoenix House' was constructed. Which is currently derelict and unused but has previously housed Phoenix Gallery, Grove Galleries and Realist Academy Manchester. The wider area has followed a similar history but has recently become a significant area of redevelopment to accommodate more city centre living and mixed used, which the proposal aims to add to.

The development being applied for is the Erection of a residential-led mixed use development comprising 2 no. facing podiums reaching 10 and 12 storeys, to form 240 residential single storey apartments, duplex penthouse apartments and duplex townhouse accommodation (Use Class C3) together with commercial accommodation (436 sqm) (Use Classes A1,A2,A3,A4,A5,B1, D1 and D2)); with associated residential amenity areas, refuse storage, plant (including substation), car parking, cycle storage, external circulation and extensive landscaping.

Figure 1 below shows the location of the site and surrounding development areas.

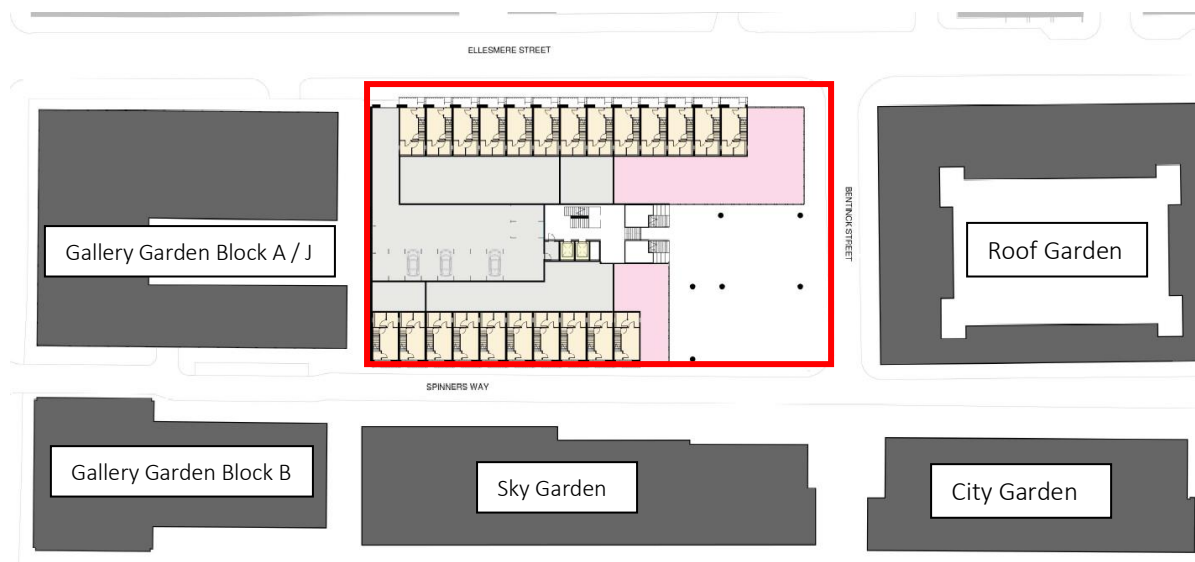


Figure 1: Site Plan (not to scale)

Table 1 below sets out a schedule of the accommodation.

Area Use	Quantum
Residential Units (Use Class C3)	Duplex Townhouses: 23 1 Bed Apartments: 89 2 Bed Apartments: 116 2 Bed Penthouse Duplex Apartments: 12 Total: 240
Ground floor commercial floor space (Use Classes A1-A5, B1, D1 and D2)	436m ² (Net Internal Area (NIA))

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

Table 2: Overview of Manchester Planning Documents Carbon Targets



2.2.3 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, including high performance curtain walling and triple glazing. For example, the design has utilised unitised curtain walling as a method of construction that can provide a higher degree of certainty over the thermal performance standards of the façade due to the off-site manufacturing nature of the system which maximises the quality assurance of the product.

Meet demands efficiently – Specification of energy efficient decentralised plant, heating, ventilation, lighting and system controls to facilitate efficient operation. For example, the 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 noisy city-centre location as far as possible while minimising the risk of overheating.

The inclusion of a high-quality unitised façade on the scheme will deliver high levels of airtightness and build quality. Safety, buildability, and speed of construction can be improved with off-site fabrication of building elements, meaning it is less reliant on site-based workmanship. These are key elements of ensuring a responsible approach to the CDM regulations.

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

Roof-mounted PV panels, are provided in this project on suitable roof-top areas and contribute significantly to the emissions performance of the development.



Efficient and Sustainable Design Measures

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

- 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
- PV array installed onto available roof space

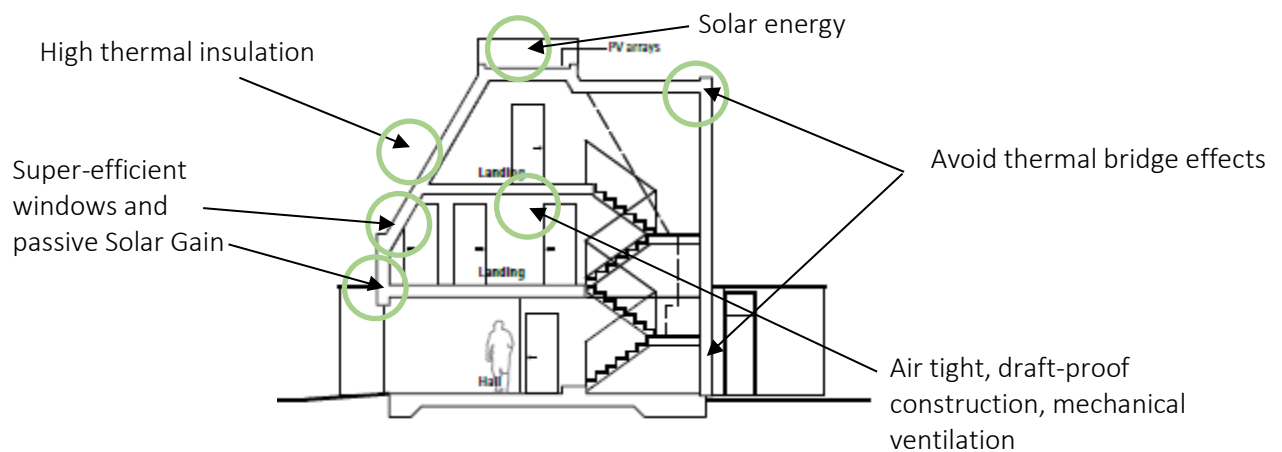


Fig 3: Examples of Efficient Design Measures

The 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 $0.2 \text{ W/m}^2\text{K}$
- Roof (all types) U-values of $0.15 \text{ W/m}^2\text{K}$
- 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 and Door 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 (150L/180L/210L)
- 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

2.3.2 Choice and Impact of Renewable Technology

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

In addition to energy efficiency measures, it is proposed that the development will feature the following Low/Zero carbon Technologies:

- **48kWp Site Wide PV Array (Approx. 160no. 300W Panels) implemented onto the main flat roof area orientated south.**

The above LZC contribution has provided a **6.0%** reduction in CO₂ following Energy Efficiency Measures.

- Energy Saving from onsite LZC Technologies = **41452.8 kWh/Yr**
- CO₂ Saving from onsite LZC Technologies = **21514.0 kgCO₂/Yr**

See Appendices for the proposed PV layout on the roof plan.



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)	
	SAP 10.0 Carbon Factors	SAP 10.1 Carbon Factors
Baseline emissions	371443.9	224898.1
Improved emissions (after application of energy efficiency measures)	359055.8	161194.6
Improved emissions (after incorporation of efficient energy supply)	359055.8	161194.6
Improved emissions (after incorporation of renewable energy technology) % CO ₂ displaced in total	337541.8	151536.1
% CO ₂ displaced in total	9.1%	32.6%
% CO ₂ displaced by energy efficiency measures	3.3%	28.3%
% CO ₂ displaced by efficient supply of energy	0.00%	0.00%
% CO ₂ displaced by renewable energy	6.0%	6.0%

Table 3: 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)	1061372.7		371443.9	
Proposed scheme after energy efficiency measures and CHP ("Residual" energy demand & emissions)	691822.4	34.8%	359055.8	3.3%
Proposed scheme after on-site renewables	650369.6	38.7%	337541.8	6.0%
Proposed scheme offset for financial contribution or other "allowable solution"	-	-	-	-
Total savings on carbon emissions		38.7%		9.1%

Table 4: Total Energy Demand and Carbon Emission Savings



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

Baseline energy demand

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

Baseline energy demand (kWh pa)	1061372.7
Regulated emissions (kg pa)	371443.9

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)	371443.9

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)	369550.3
Emission savings from energy efficiency measures (kg pa)	12388.1
Total regulated emissions after CHP savings and energy efficiency measures (kg pa) (“residual emissions”)	359055.8

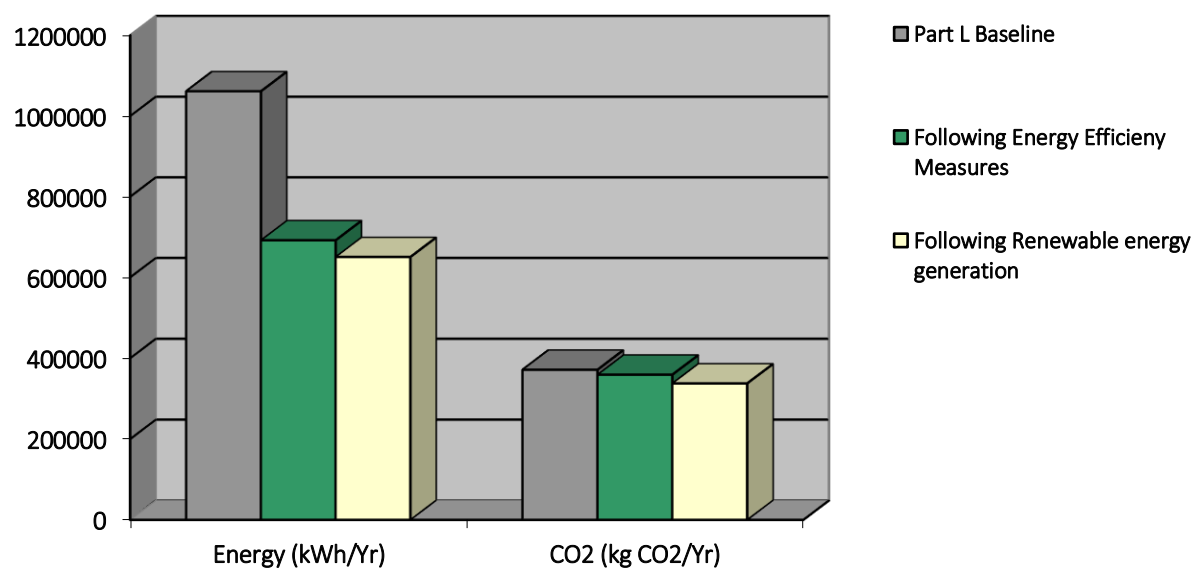


On-site renewables

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)	41452.8
Saving on residual emissions from the use of renewables (kg)	21514.0
Saving on residual emissions from the use of renewables (%)	6.0%

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



2.3.4 Manchester City Council Policy and Targets Summary

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

Planning Document:	Sustainable Design Strategy
Manchester Council's Core Strategy 2012-2027	The Sustainable Design Strategy achieves a 9.1% 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 9.1% 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 9.1% reduction in carbon emissions over Part L 2013 – exceeding the documents Low Carbon target of 9% over Part L 2013.

Table 5: Summary of results against MCC carbon targets

As a result of the sustainable design parameters outlined within section 2.3.1 and the energy and CO2 reduction figures summarised above, the construction of 240 residential dwellings for the Phoenix Works development achieves a total reduction of **9.1%** in carbon emissions over Part L 2013 based of SAP10.0 carbon factors, however when SAP 10.1 figures are used, this reduction rises to **32.6%** which is significantly more than the requirements stipulated in planning documents..

This improvement has been achieved as a result of the prioritisation of fabric first carbon reduction through aspiring to exceed Building Regulations standards, before the incorporation of on-site renewable technologies.



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.

2.4.1 Grid Decarbonisation and SAP

Notwithstanding the building's carbon footprint reducing over its useful life, carbon factors in SAP 10.0 and SAP 10.1 are more representative of and show that an all-electric energy source for modern, fabric first high-quality buildings is appropriate at reducing reliance on fossil fuels and moving towards use of the ever-decarbonising electricity grid.

Therefore, to be more representative, robust and provide an up-to-date assessment, the emissions in this report have been calculated using SAP 10.0 and SAP 10.1 standards.

The calculations appropriately demonstrate improvement in CO₂ emissions in excess of the Building Regulations Part L 2013 and Core Strategy Policy EN6 targets. Using the SAP 10.0 carbon emissions factor for electricity, the improvement over Part L 2013 is 9.1%. Using the SAP 10.1 factor, this improvement is at least 32.6%.

These improvements are in excess of the Policy EN6 requirements.

Furthermore, the proposed building services strategy will enable the development to track the ongoing carbon reductions being delivered by grid-scale infrastructure. Therefore, the development's carbon footprint will continue to improve over its useful life.



2.4.2 Flood Risk Zone

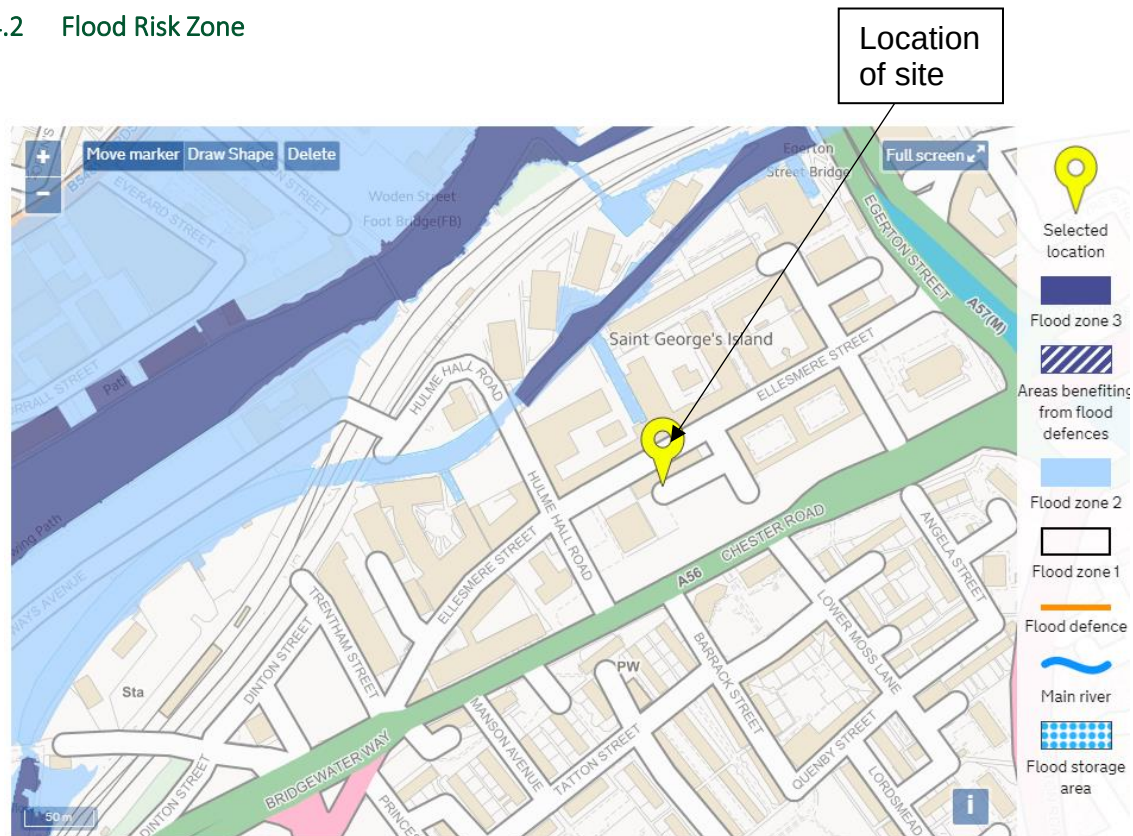


Fig 4: Flood Risk Map

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

2.4.3 Green Blue Infrastructure

2.4.3.1 Sustainable Drainage Systems (SUDs)

Even though it has been shown that the proposed scheme is located on a site with a low to zero flood risk, it should not detract from the need to ensure that the levels of surface water run-off do not increase from the existing development to the proposed, especially due to the new scheme having a different footprint and resulting in new areas of impermeable surfacing. Therefore a SUDs strategy should be determined by a suitably qualified professional at the earliest stage possible and then implemented throughout construction and beyond.

By incorporating SuDs, flood risk can be managed and mitigated. Section 1.1 of the SuDs Manual (Ciria C753) states the following:

“Sustainable drainage systems (SuDs) can deliver multiple benefits.

Surface water is a valuable resource, and this should be reflected in the way it is managed and used in the built environment. It can add to and enhance biodiversity, beauty, tranquillity and the natural

aesthetic of buildings, places and landscapes and it can help make them more resilient to the changing climate.”

The general concept of SUDs is to manage the flood and pollution risks in developed areas. This is done by efficiently managing surface water run-off by either slowing down the surface water run-off, or by reducing the quantity of surface water run-off. There are different methods to achieve this such as:

- Harvesting – capturing rainwater and facilitate its use within the development
- Infiltrating – rainwater infiltrates into the ground
- Storing – capturing rainwater and control the flow through the means of storing and releasing it slowly i.e. attenuation
- Conveying & treating – capturing rainwater and removing any contaminants, then convey the flow towards a downstream system

The SuDS Manual describes the four pillars of SuDS design as Water Quality, Water Quantity, Amenity and Biodiversity as illustrated in Figure 3 below:

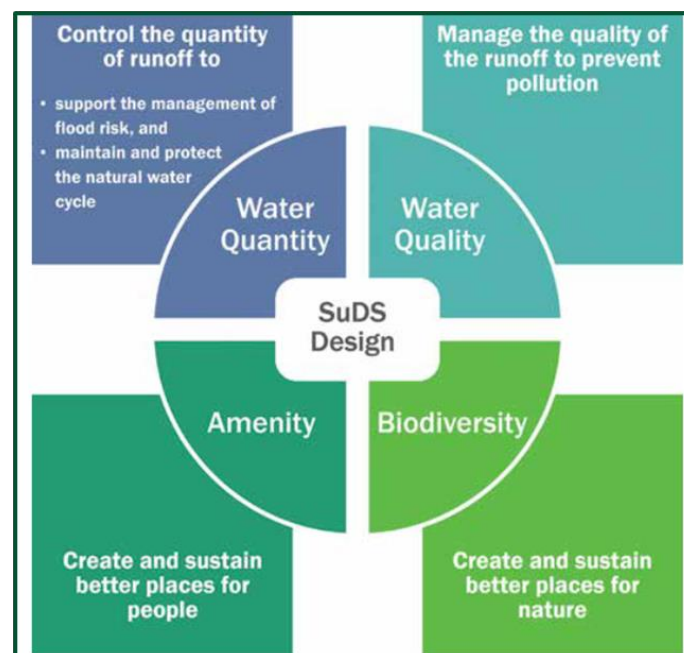


Fig 5: Representation of figure 2.1 of the SUDs Manual

SuDS are increasingly gaining popularity as a holistic solution to a wide range of pressing issues including flood risk, water pollution, groundwater depletion, biodiversity loss and urban decline.

Drainage Hierarchy

To alleviate pressure on existing sewer networks and to address issues of climate change the following hierarchy has been developed and implemented from a planning perspective.

The Planning Practice Guidance, states that:

“generally, the aim should be to discharge surface run-off as high up the following hierarchy of drainage options as reasonable practicably:

1. *Into the ground (infiltration)*
2. *To a surface water body*
3. *To a surface water sewer*
4. *To a combined sewer”*

The “Building Regulations Approved Document H” refer to this discharge hierarchy.

Description	Benefit
Flood risk management	SuDS aim to have an attenuating affect by slowing down and storing surface water run-off
Drainage resilience	Future proofing designed to be resilient against climate change
Natural flow regime protection	Mimic natural drainage arrangements to emulate natural flow
Water quality	Filter out pollutants and discharge cleaner water
Water reuse	Can be strategically placed to clean and capture water for reuse
Biodiversity and ecology	SuDS use vegetation and natural landscape to support biodiversity and ecology
Amenity	Improve visual integrity and desirability of the site by implementing green and blue features
Carbon reduction	SuDS can reduce carbon use throughout the life cycle including construction, maintenance, and demolition
Microclimate	Aim in reducing heat island effects
Education	Educate and engage the general public about surface water management

Table 6: Outline of types of green/blue infrastructure and associated benefit



2.4.3.2 Biodiversity

Similarly, to the previous section on SUDs, the nature of the proposal: including the demolishing of an existing building and 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 new habitat creation, planting schemes, green wall areas.

It is also currently proposed that there will be extensive planting as part of the development, which will aim to promote the health and wellbeing of residents due to an increased number working from home.

2.4.4 Internal Water Efficiency

Part G of the Building Regulations requires all new dwellings 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	5
Kitchen taps	Flow rate l/min	6
Bath	Capacity to Overflow	170
Shower	Flow rate l/min	8
Washing Machine	Litres / kg dry load	8.17
Dishwasher	Litres / place setting	1.25

Table 7: Internal Water Efficiency Flow Rates

The above rates will achieve a total internal water consumption of 106.31 with a bath present and 98.25 with only a shower present.

The specifying of 'A' rated appliances should be prioritised where possible.



2.4.5 Waste Management

2.4.5.1 Occupational Waste

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.

As Phoenix Works can be categorised as a high-rise domestic development, the following requirements will be adhered to:

- The storage space must be identified clearly on plans.
- The refuse storage provides 0.43m² of space per apartments.
- Sufficient space for the manoeuvring of bins is required.
- Sufficient space to access each bin individually is required.
- There must be at least a 1.3m wide walkway between bins.
- A Site Waste Management Plan (SWMP) or similar will be produced to set clear targets and monitoring procedures on diverting waste from Landfill
- Consideration to ensure, where practicable, that recycling facilities should be within a closer proximity than refuse facilities (to ensure that residents are not inconvenienced by recycling)

As part of this waste management strategy, adequately sized bin storage will be provided to accommodate the required number of bins for each residential block and commercial space.

The proposed refuse strategy will be informed by pre-application discussions with MCC and accords with the guidance document GD04 issued by MCC, along with guidance on refuse outlined in the Manchester Residential Quality Guidance. GD04 provides guidance on waste storage and collection for new developments within the city.

2.4.5.2 Construction Waste

A target of at least 90% of waste generated on site, throughout the construction stage of the development, to be diverted from landfill' will be included as part of a Construction Environmental Management Plan (CEMP) to be agreed with MCC. A CEMP framework is provided at Section 7 of the SPS.

The proposal will also endeavour to maximise the use of recycled materials on site, whereby further promoting the minimising of waste production.

2.4.6 Materials

The construction of new buildings and building elements has the potential for environmental impacts in terms of both energy and embodied carbon of new materials. Therefore, MCC, through Policy EN4 and DM1 of the Core Strategy require developments to incorporate sustainable construction



techniques, in line with relevant assessment methods, and the use of materials that have low embodied carbon.

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 are used. 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, key elements of the scheme should be specified to achieve ratings of between A+ and C under The Green Guide's ratings where possible. 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, and secondly should attempt to prioritise the use of new materials from local sources to reduce the transportation time.

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

2.4.7 Pollution Control

To reduce emissions of gases with high global warming potential (GWP) and nitrogen oxide (NOx) into the atmosphere, new buildings will be specified with insulating materials that have a GWP of less than 5. This will follow throughout the development to reduce the impact that the construction phase has upon climate change.

Additionally, the following measures will be implemented:

- Pollution Prevention Guidance will be adhered to in respects of air (dust) and water (ground and surface) pollution during the demolition and construction phase.
- External light fittings will be controlled through a time switch, or daylight sensor, to prevent operation during daylight hours to limit the impact of artificial lighting for the development's residents and surrounding environment.
- The development Site is within the locality of the River Irk. Where necessary, temporary drainage and pollution prevention measures should be introduced to Site, this may include, for example, bunded areas and spill kits to prevent harmful chemicals / materials from draining to natural watercourses; and silt traps to ensure that suspended solids are removed from the drainage water.



- Dust suppression measures will also be put in place as part of the Main Contractor's Environmental Management Plan, this will reduce the potential risk to local watercourses (River Irk) and neighbouring properties.

Sound insulation will be specified to achieve Building Regulation Part E compliance standard (this will be verified by pre-completion testing) in addition to meeting the requirements of the council. This will reduce the impact of sound pollution for the occupants within adjoining dwellings.

2.4.8 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 pronanbly 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.
- Enhancing the green infrastructure of the site by introducing extensive planting throughout, therefore improving the physical and mental wellbeing of residents, visitors, and workers.
- The layout of the site will facilitate natural surveillance by creating busy, overlooked within the site and routes to the site. As a result, this will promote a safer and more secure environment.
- The construction of the development will also create external circulation and stoops to courtyards which will help instil a sense of community.
- 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.

2.4.9 Sustainable Transport

A key message from all climate change adaptation plans, specifically the 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 this push for sustainable transport by providing significant cycle storage provision in the form of a 175.3sqm store located on the ground floor.



Transport Links

Further to providing significant cycle provision, the site is located within central Manchester and therefore has excellent sustainable transport links:

- **Train:** The closest train station to the site is Manchester Deansgate, which is located approximately 0.5 miles east of the site, taking no more than 10 minutes to walk to. This station provides access to all other both additional Manchester stations, Manchester Airport, Leeds and other regional and national destinations.
- **Bus:** The nearest bus stops are located on Chester Road which are roughly 0.1 miles south from the site. These will provide frequent services to The Trafford Centre, Partington, in addition to links to Piccadilly Gardens, where further buses can be caught to more regional destinations.
- **Metrolink:** The closest Metrolink station to the site is Cornbrook Tram Stop. This provides an additional means of public transport to locations within central Manchester and also further afield to Altrincham, Bury, Eccles, East Didsbury, Rochdale, Ashton-Under-Lyne and Manchester Airport.

Local Amenities

- St George's Park is situated south of the site and providing excellent recreational space for residents, visitors and workers.
- The site is also on Ellesmere Street which has a number of shops and bars and next to Chester Road which has further amenities.
- The site is also only 0.8 miles from the centre of Manchester where a multitude of shops and amenities can be accessed.
- Manchester Metropolitan and Manchester University are both less than 2 miles from the proposed development providing good access to higher education. In addition, there are several schools and colleges within a 15-minute walk from the site, including: Manchester Federation of EBSD Schools, Saint Wilfrid's Roman Catholic Primary School, St Peter's Schools and Manchester School of Acting.
- Due to its proximity to the centre of Manchester, the site has excellent access to music, theatre and art venues, places of religion and Manchester's City Library.



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 **48kWp Site Wide PV Array (Approx. 160no. 300W Panels) implemented onto the main roof areas orientated south.**

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.

Air Source heat pumps are a good option to provide heating and cooling however, as previously mentioned the development is already achieving the required reduction through efficient design measures.

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 all dwellings on the site.

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 wouldn't be feasible.

Renewable Technology Not Viable



4. Conclusion

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

As part of this process, the development was designed with a fabric first approach; with U-values, 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 and house, in order 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 a 48kWp system can be proposed at this stage, which would equate to 160No panels and would provide an additional 6.0% reduction in carbon emissions over the residual emissions: bringing the total carbon reduction to **9.1%** when based off SAP 10.0 carbon factors and **32.6%** when using, the soon to be national standard, SAP 10.1 carbon factors.

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:

- The proposal sits within Flood Risk Zone 1 and therefore has minimal to no risk of flooding.
- 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 in the form of extensive planting that will instil a sense of wellbeing whilst also assisting with offsetting carbon dioxide and balancing local temperatures through evapotranspiration.
- 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 chutes will be installed on each floor to promote recycling.



- Residents will benefit from living in a diverse, vibrant, and inclusive new community that will form part of a new public realm in Manchester.
- 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.
- The buildings will have a daylight and sunlight analysis carried out and will aim to achieve high pass rates. Additionally, 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 central location of 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 Deansgate Train Station and Cornbrook Metrolink Station, multiple bus stops and additional Metrolink stations, 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 – Phoenix Works, Ellesmere Street

House Type	2B-TH-T1-EndTce-North x1	2B-TH-T1-MidTce-North x8	2B-TH-T1-EndTce-North-adjCommercial x1	2B-TH-T1-MidTce-North-adjCommercial x4	2B-TH-T1-EndTce-South x1	2B-TH-T1-MidTce-South x7	2B-TH-T1-EndTce-South-adjCommercial x1
Frequency	1	8	1	4	1	7	1
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)	Total Energy Demand (kWh/yr)
Main Heating Fuel Requirement (DER)	3560.0	2751.0	2712.0	2261.3	3105.4	2369.6	2331.7
Secondary Main Heating Fuel Requirement (DER)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Secondary Heating Fuel Requirement (DER)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water Fuel Requirement (DER)	2290.0	2303.4	2304.2	2314.2	2297.3	2312.0	2312.9
Electricity Pumps Fans Requirement (DER)	75.0	75.0	75.0	75.0	75.0	75.0	75.0
Electricity Lighting Requirement (DER)	315.2	315.2	315.2	315.2	315.2	315.2	315.2
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)	Total Energy Demand (kWh/yr)
Main Heating Fuel Requirement (DER)	2421.1	1529.37	1519.72	1044.25	2000.84	1215.25	1206.33
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0	0	0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0	0	0
Water Fuel Requirement (DER)	1666.85	1666.85	1666.85	1666.85	1666.85	1666.85	1666.85
Electricity Pumps Fans Requirement (DER)	189.36	189.36	189.36	189.36	189.36	189.36	189.36
Electricity Lighting Requirement (DER)	315.23	315.23	315.23	315.23	315.23	315.23	315.23
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)	Total Energy Demand (kWh/yr)
Main Heating Fuel Requirement (DER)	2421.1	1529.37	1519.72	1044.25	2000.84	1215.25	1206.33
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0	0	0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0	0	0
Water Fuel Requirement (DER)	1666.85	1666.85	1666.85	1666.85	1666.85	1666.85	1666.85
Electricity Pumps Fans Requirement (DER)	189.36	189.36	189.36	189.36	189.36	189.36	189.36
Electricity Lighting Requirement (DER)	315.23	315.23	315.23	315.23	315.23	315.23	315.23
PV Energy Produced (DER)	-172.7	-172.7	-172.7	-172.7	-172.7	-172.7	-172.7
TOTAL PER DEVELOPMENT							



Appendix B – PV Roof Layout

1B-AP-T1-South-1stF x1	1B-AP-T1-West-1stF x2	1B-AP-T1-West-2ndF-8thF x14	1B-AP-T1-West-9thF x2	1B-AP-T1-North-2ndF-7thF x60	1B-AP-T1-North-8thF x10	2B-AP-T1-EndTce-North-2ndF-7thF x6	2B-AP-T1-MidTce-North-2ndF-7thF x6	2B-AP-T1-EndTce-North-8thF x1
1	2	14	2	60	10	6	6	1
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)	Total Energy Demand (kWh/yr)
2241.5	2296.8	1503.5	2467.4	923.6	1361.7	2426.7	1913.1	3655.3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1961.4	1961.6	1981.5	1958.4	2001.6	2018.0	2362.7	2376.1	2340.2
75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
218.5	218.5	218.5	218.5	218.5	228.6	333.1	333.1	333.1
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)	Total Energy Demand (kWh/yr)
1563.87	1622.77	838.1	1147.17	325.54	467.02	1318.85	847.61	1789.93
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1359.59	1359.59	1359.59	1359.59	1359.59	1386.76	1709	1709	1709
98.22	98.22	98.22	98.22	98.22	103.45	181.54	181.54	181.54
218.49	218.49	218.49	218.49	218.49	228.63	333.08	333.08	333.08
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)	Total Energy Demand (kWh/yr)
1563.87	1622.77	838.1	1147.17	325.54	467.02	1318.85	847.61	1789.93
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1359.59	1359.59	1359.59	1359.59	1359.59	1386.76	1709	1709	1709
98.22	98.22	98.22	98.22	98.22	103.45	181.54	181.54	181.54
218.49	218.49	218.49	218.49	218.49	228.63	333.08	333.08	333.08
-172.7	-172.7	-172.7	-172.7	-172.7	-172.7	-172.7	-172.7	-172.7



Appendix B – PV Roof Layout

2B-AP-T1-MidTce-North-8thF x1	2B-AP-T1-EndTce-South-2ndF-9thF x8	2B-AP-T1-MidTce-South-2ndF-9thF x24	2B-AP-T1-EndTce-South-10thF x1	2B-AP-T1-MidTce-South-10thF x3	2B-AP-T1-East-2ndF x1	2B-AP-T1-East-3rdF-8thF x6	2B-AP-T1-East-9thF x1	2B-AP-T2-EndTce-North-2ndF-7thF x6
1	8	24	1	3	1	6	1	6
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)	Total Energy Demand (kWh/yr)
2550.2	1980.1	1499.3	3168.4	2097.1	3401.3	2329.7	3581.4	2064.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2359.8	2374.9	2390.3	2348.2	2371.6	2346.2	2367.7	2343.5	2346.6
75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
333.1	333.1	333.1	333.1	333.1	333.1	333.1	333.1	324.7
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)	Total Energy Demand (kWh/yr)
1094.49	959.41	559.43	1382.27	765.33	2329.07	1268.43	1776.21	1006.94
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1709	1709	1709	1709	1709	1708.92	1708.92	1709	1688.92
181.54	181.54	181.54	181.54	181.54	181.52	181.52	181.54	175.64
333.08	333.08	333.08	333.08	333.08	333.05	333.05	333.08	324.67
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)	Total Energy Demand (kWh/yr)
1094.49	959.41	559.43	1382.27	765.33	2329.07	1268.43	1776.21	1006.94
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1709	1709	1709	1709	1709	1708.92	1708.92	1709	1688.92
181.54	181.54	181.54	181.54	181.54	181.52	181.52	181.54	175.64
333.08	333.08	333.08	333.08	333.08	333.05	333.05	333.08	324.67
-172.7	-172.7	-172.7	-172.7	-172.7	-172.7	-172.7	-172.7	-172.7



Appendix B – PV Roof Layout

2B-AP-T2-MidTce-North-2ndF-7thF x6	2B-AP-T2-EndTce-North-8thF x1	2B-AP-T2-MidTce-North-8thF x1	2B-AP-T2-EndTce-South-2ndF-9thF x8	2B-AP-T2-MidTce-South-2ndF-9thF x24	2B-AP-T2-EndTce-South-10thF x1	2B-AP-T2-MidTce-South-10thF x3	2B-AP-T2-East-2ndF x1	2B-AP-T2-East-3rdF-8thF x6
6	1	1	8	24	1	3	1	6
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)	Total Energy Demand (kWh/yr)
1558.8	3225.8	2157.7	2160.9	1648.3	3330.8	2255.7	3298.9	2225.1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2362.1	2321.8	2344.0	2343.9	2358.9	2320.1	2341.3	2322.3	2344.4
75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
324.7	324.7	324.7	324.7	324.7	324.7	324.7	324.6	324.6
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)	Total Energy Demand (kWh/yr)
569.68	1393.08	768.81	1082.12	628	1477.75	835.89	2231.71	1159.01
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1688.92	1688.92	1688.92	1688.92	1688.92	1688.92	1688.92	1688.84	1688.84
175.64	175.64	175.64	175.64	175.64	175.64	175.64	175.62	175.62
324.67	324.67	324.67	324.67	324.67	324.67	324.67	324.64	324.64
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)	Total Energy Demand (kWh/yr)
569.68	1393.08	768.81	1082.12	628	1477.75	835.89	2231.71	1159.01
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
1688.92	1688.92	1688.92	1688.92	1688.92	1688.92	1688.92	1688.84	1688.84
175.64	175.64	175.64	175.64	175.64	175.64	175.64	175.62	175.62
324.67	324.67	324.67	324.67	324.67	324.67	324.67	324.64	324.64
-172.7	-172.7	-172.7	-172.7	-172.7	-172.7	-172.7	-172.7	-172.7

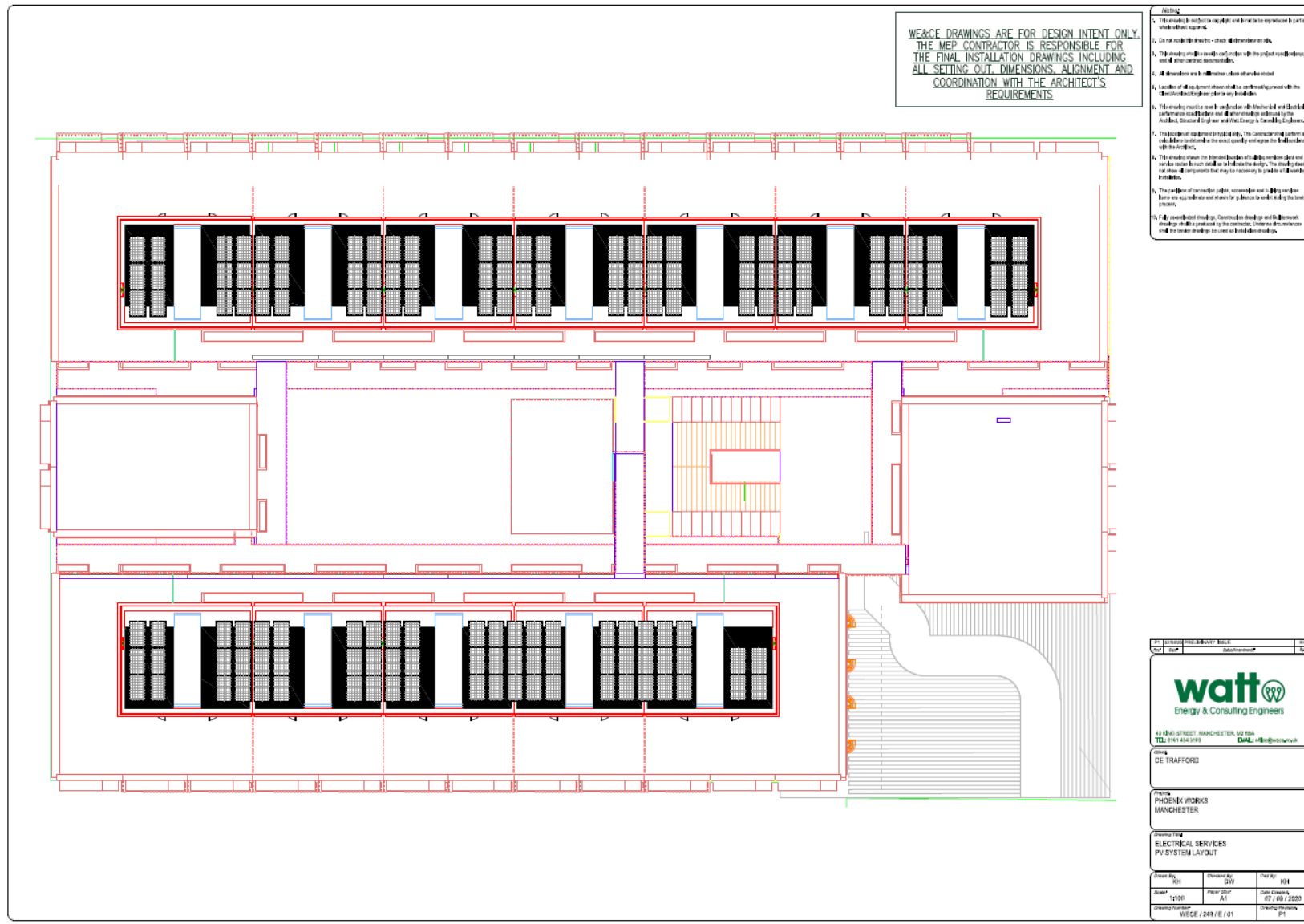


Appendix B – PV Roof Layout

2B-AP-T2-East-9thF x1	2B-PH-T1-EndTce-North x2	2B-PH-T1-MidTce-North x5	2B-PH-T1-EndTce-South x2	2B-PH-T1-MidTce-South x3	TOTAL (kWh/yr)		TOTAL (kgCO2/yr)
1	2	5	2	3	240	SAP 10.0	
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)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
3482.0	4651.5	3999.1	4416.8	3767.8	439322.2	0.216	147085.1
0.0	0.0	0.0	0.0	0.0	0.0	0.519	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.216	0.0
2319.4	2458.6	2466.6	2461.4	2470.0	534665.5	0.216	179006.0
75.0	75.0	75.0	75.0	75.0	18000.0	0.519	9342.0
324.6	369.9	369.9	369.9	369.9	69385.0	0.519	36010.8
					1061372.7		371443.9
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)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
1661.96	2828.25	2354.04	2551.77	2092.76	206477.6	0.519	107161.9
0	0	0	0	0	0.0	0.519	0.0
0	0	0	0	0	0.0	0.519	0.0
1688.84	1825.01	1825.01	1825.01	1825.01	378591.0	0.519	196488.7
175.62	291.95	291.95	291.95	291.95	37368.7	0.519	19394.4
324.64	369.89	369.89	369.89	369.89	69385.0	0.519	36010.8
					691822.4		359055.8
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)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
1661.96	2828.25	2354.04	2551.77	2092.76	206477.6	0.519	107161.9
0	0	0	0	0	0.0	0.519	0.0
0	0	0	0	0	0.0	0.519	0.0
1688.84	1825.01	1825.01	1825.01	1825.01	378591.0	0.519	196488.7
175.62	291.95	291.95	291.95	291.95	37368.7	0.519	19394.4
324.64	369.89	369.89	369.89	369.89	69385.0	0.519	36010.8
-172.7	-172.7	-172.7	-172.7	-172.7	-41452.8	0.519	-21514.0
					650369.6		337541.8



Appendix B – PV Roof Layout



Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.26
Printed on 11 September 2020 at 15:18:47

Project Information:

Assessed By: Daniel Watt (STRO026464)

Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 46.74m²

Site Reference : Phoenix Works

Plot Reference: 1B-AP-T1-North-2ndF-7thF x60

Address : 1B-AP-T1-North-2ndF-7thF, Ellesmere Street, MANCHESTER, M15

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) 24.21 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 20.31 kg/m² **OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 31.2 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 25.4 kWh/m² **OK**

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Floor	(no floor)		
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: 1.03 kWh/day
Permitted by DBSCG: 1.66 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:	0.53	
Maximum	1.5	OK
MVHR efficiency:	89%	
Minimum	70%	OK

9 Summertime temperature

Overheating risk (North West England):	Not significant	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: North	5.34m ²	
Windows facing: South	5.75m ²	
Ventilation rate:	4.00	

10 Key features

Air permeability	3.0 m ³ /m ² h
Photovoltaic array	

Predicted Energy Assessment



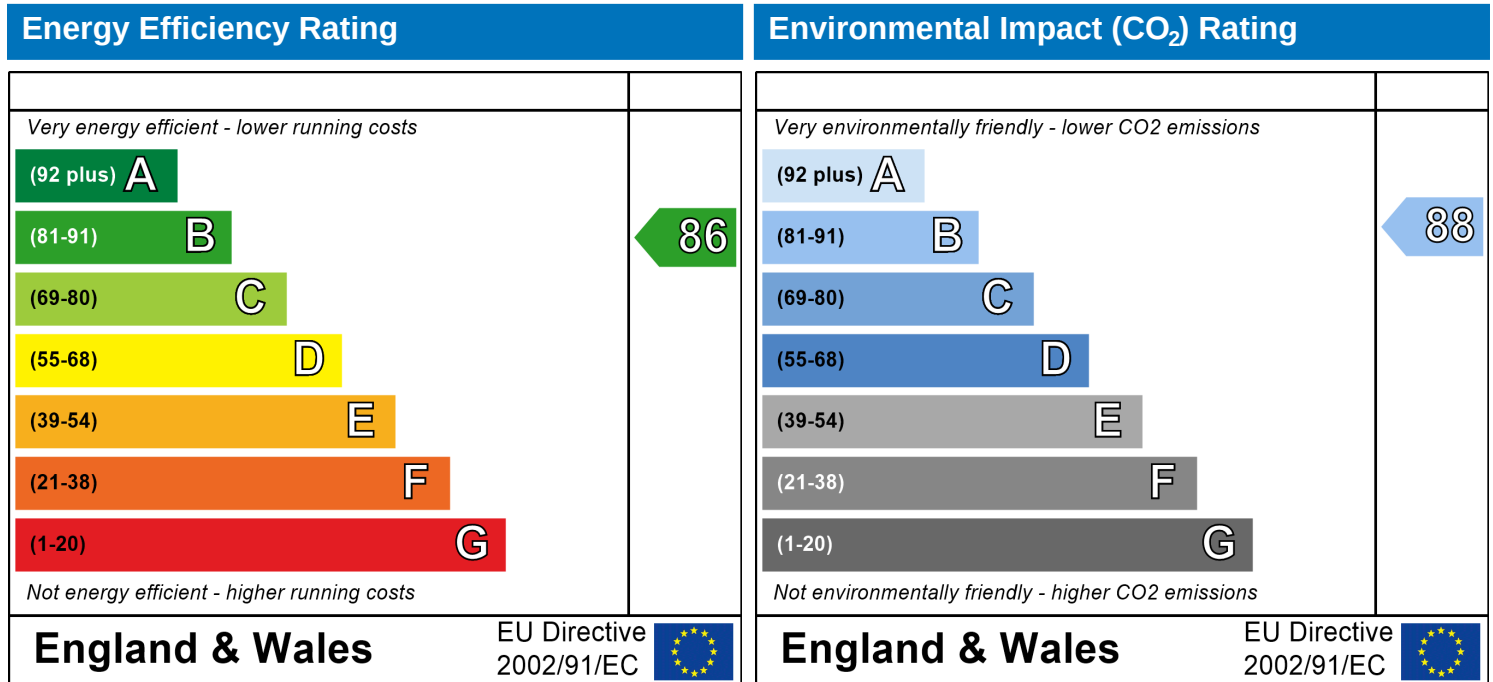
1B-AP-T1-North-2ndF-7thF
Ellesmere Street
MANCHESTER
M15

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

Mid floor Flat
02 September 2020
Daniel Watt
46.74 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: 1B-AP-T1-North-2ndF-7thF x60

Address: 1B-AP-T1-North-2ndF-7thF, Ellesmere Street, MANCHESTER, M15
 Located in: England
 Region: North West England
 UPRN:
 Date of assessment: 02 September 2020
 Date of certificate: 11 September 2020
 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: 465

Property description:

Dwelling type: Flat
 Detachment:
 Year Completed: 2020
 Floor Location: Floor area: Storey height:
 Floor 0 46.74 m² 2.6 m
 Living area: 29.9 m² (fraction 0.64)
 Front of dwelling faces: South

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Living area window	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
South glazing/door	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Living area window	16mm or more	0.7	0.63	1.4	5.34	1
South glazing/door	16mm or more	0.7	0.63	1.4	5.75	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Living area window		External walls	North	2.485	2.15
South glazing/door		External walls	South	2.255	2.55

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	19.76	11.09	8.67	0.2	0	False	N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.1389

	Length	Psi-value		
	4.74	0.03	E2	Other lintels (including other steel lintels)
[Approved]	4.74	0.04	E3	Sill
[Approved]	14.5	0.05	E4	Jamb
[Approved]	15.2	0.07	E7	Party floor between dwellings (in blocks of flats)
[Approved]	10.4	0.06	E18	Party wall between dwellings

SAP Input

49.2 0 P3 Intermediate floor between dwellings (in blocks of flats)

Ventilation:

Pressure test: Yes (As designed)
 Ventilation: Balanced with heat recovery
 Number of wet rooms: Kitchen + 1
 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

Water heating:

Water heating: Electric immersion (on-peak or off-peak)
 Water code: 903
 Fuel :Electricity
 Hot water cylinder
 Cylinder volume: 120 litres
 Cylinder insulation: Measured loss, 1.03kWh/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
 Low energy lights: 100%
 Terrain type: Low rise urban / suburban
 EPC language: English
 Wind turbine: No
 Photovoltaics: Photovoltaic 1
 Installed Peak power: 0.2
 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: 1.0.4.26

Property Address: 1B-AP-T1-North-2ndF-7thF x60

Address : 1B-AP-T1-North-2ndF-7thF, Ellesmere Street, MANCHESTER, M15

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	46.74 (1a) x	2.6 (2a) =	121.52 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	46.74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	121.52 (5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0 (8)
<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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

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

SAP WorkSheet: New dwelling 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) =

75.65 (23c)

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

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

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

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

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

if (22b)m < 0.5 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= 0.28 0.28 0.28 0.26 0.26 0.24 0.24 0.24 0.25 0.26 0.27 0.27 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.34	x1/[1/(1.4)+0.04] =	7.08		(27)
Windows Type 2			5.75	x1/[1/(1.4)+0.04] =	7.62		(27)
Walls	19.76	11.09	8.67	x 0.2 =	1.73		(29)
Total area of elements, m²			19.76				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 16.44 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 121.38 (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 2.74 (36)

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

Total fabric heat loss (33) + (36) = 19.18 (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=	11.4	11.27	11.15	10.51	10.38	9.74	9.74	9.61	10	10.38	10.63	10.89

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

(39)m=	30.58	30.46	30.33	29.69	29.56	28.92	28.92	28.79	29.18	29.56	29.82	30.07		
	Average = Sum(39) _{1...12} /12=												29.66	(39)

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

(40)m=	0.65	0.65	0.65	0.64	0.63	0.62	0.62	0.62	0.62	0.63	0.64	0.64		
Average = Sum(40) _{1...12} /12=													0.63	(40)

SAP WorkSheet: New dwelling design stage

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

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

if $TFA \leq 13.9$, $N = 1$

1.59

(42)

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

72.07

(43)

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

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

Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$

(44)m=	79.28	76.4	73.52	70.63	67.75	64.87	64.87	67.75	70.63	73.52	76.4	79.28	
Total = Sum(44) _{1...12} =												864.9	(44)

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

(45)m=	117.57	102.83	106.11	92.51	88.77	76.6	70.98	81.45	82.42	96.06	104.85	113.86	
Total = Sum(45) _{1...12} =												1134.02	(45)

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

(46)m=	17.64	15.42	15.92	13.88	13.31	11.49	10.65	12.22	12.36	14.41	15.73	17.08	(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Water storage loss:

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

120

(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):

1.03

(48)

Temperature factor from Table 2b

0.6

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0.62

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

(47) x (51) x (52) x (53) =

0

(54)

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

0.62

(55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=	19.16	17.3	19.16	18.54	19.16	18.54	19.16	19.16	18.54	19.16	18.54	19.16	(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=	19.16	17.3	19.16	18.54	19.16	18.54	19.16	19.16	18.54	19.16	18.54	19.16	(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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

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

SAP WorkSheet: New dwelling design stage

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

(62)m=

136.73	120.13	125.27	111.05	107.92	95.14	90.14	100.61	100.96	115.21	123.39	133.02
--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------

 (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=

136.73	120.13	125.27	111.05	107.92	95.14	90.14	100.61	100.96	115.21	123.39	133.02
--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------

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

1359.59

 (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=

54.42	48.03	50.61	45.59	44.84	40.3	38.93	42.41	42.24	47.27	49.7	53.19
-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------	-------

 (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
95.68	95.68	95.68	95.68	95.68	95.68	95.68	95.68	95.68	95.68	95.68	95.68

 (66)

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

(67)m=

30.93	27.47	22.34	16.91	12.64	10.67	11.53	14.99	20.12	25.55	29.82	31.79
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (67)

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

(68)m=

207.13	209.28	203.86	192.33	177.78	164.1	154.96	152.81	158.22	169.75	184.31	197.99
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------

 (68)

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

(69)m=

46.16	46.16	46.16	46.16	46.16	46.16	46.16	46.16	46.16	46.16	46.16	46.16
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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=

-63.79	-63.79	-63.79	-63.79	-63.79	-63.79	-63.79	-63.79	-63.79	-63.79	-63.79	-63.79
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

73.14	71.48	68.02	63.32	60.27	55.97	52.32	57	58.66	63.53	69.02	71.49
-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------

 (72)

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

(73)m=

389.26	386.29	372.28	350.62	328.75	308.8	296.87	302.86	315.07	336.89	361.21	379.32
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------

 (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	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>10.63</td></tr></table>	10.63	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>17.35</td></tr></table>	17.35	(74)
0.77																			
5.34																			
10.63																			
0.63																			
0.7																			
17.35																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>20.32</td></tr></table>	20.32	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>33.16</td></tr></table>	33.16	(74)
0.77																			
5.34																			
20.32																			
0.63																			
0.7																			
33.16																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>34.53</td></tr></table>	34.53	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>56.35</td></tr></table>	56.35	(74)
0.77																			
5.34																			
34.53																			
0.63																			
0.7																			
56.35																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>55.46</td></tr></table>	55.46	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>90.52</td></tr></table>	90.52	(74)
0.77																			
5.34																			
55.46																			
0.63																			
0.7																			
90.52																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>74.72</td></tr></table>	74.72	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>121.93</td></tr></table>	121.93	(74)
0.77																			
5.34																			
74.72																			
0.63																			
0.7																			
121.93																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>79.99</td></tr></table>	79.99	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>130.53</td></tr></table>	130.53	(74)
0.77																			
5.34																			
79.99																			
0.63																			
0.7																			
130.53																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>74.68</td></tr></table>	74.68	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>121.87</td></tr></table>	121.87	(74)
0.77																			
5.34																			
74.68																			
0.63																			
0.7																			
121.87																			
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>59.25</td></tr></table>	59.25	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>96.69</td></tr></table>	96.69	(74)
0.77																			
5.34																			
59.25																			
0.63																			
0.7																			
96.69																			

SAP WorkSheet: New dwelling design stage

North	0.9x	0.77	x	5.34	x	41.52	x	0.63	x	0.7	=	67.75	(74)
North	0.9x	0.77	x	5.34	x	24.19	x	0.63	x	0.7	=	39.48	(74)
North	0.9x	0.77	x	5.34	x	13.12	x	0.63	x	0.7	=	21.41	(74)
North	0.9x	0.77	x	5.34	x	8.86	x	0.63	x	0.7	=	14.47	(74)
South	0.9x	0.77	x	5.75	x	46.75	x	0.63	x	0.7	=	82.16	(78)
South	0.9x	0.77	x	5.75	x	76.57	x	0.63	x	0.7	=	134.55	(78)
South	0.9x	0.77	x	5.75	x	97.53	x	0.63	x	0.7	=	171.39	(78)
South	0.9x	0.77	x	5.75	x	110.23	x	0.63	x	0.7	=	193.71	(78)
South	0.9x	0.77	x	5.75	x	114.87	x	0.63	x	0.7	=	201.86	(78)
South	0.9x	0.77	x	5.75	x	110.55	x	0.63	x	0.7	=	194.26	(78)
South	0.9x	0.77	x	5.75	x	108.01	x	0.63	x	0.7	=	189.81	(78)
South	0.9x	0.77	x	5.75	x	104.89	x	0.63	x	0.7	=	184.33	(78)
South	0.9x	0.77	x	5.75	x	101.89	x	0.63	x	0.7	=	179.04	(78)
South	0.9x	0.77	x	5.75	x	82.59	x	0.63	x	0.7	=	145.13	(78)
South	0.9x	0.77	x	5.75	x	55.42	x	0.63	x	0.7	=	97.38	(78)
South	0.9x	0.77	x	5.75	x	40.4	x	0.63	x	0.7	=	70.99	(78)

Solar gains in watts, calculated for each month

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

(83)m=	99.51	167.71	227.75	284.23	323.79	324.8	311.68	281.02	246.79	184.6	118.79	85.46	(83)
--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	-------	------

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

(84)m=	488.77	554	600.03	634.85	652.54	633.6	608.55	583.87	561.86	521.49	480	464.78	(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=	0.91	0.83	0.72	0.56	0.42	0.29	0.21	0.23	0.36	0.59	0.82	0.92	(86)

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

(87)m=	20.85	20.93	20.98	21	21	21	21	21	21	21	20.95	20.83	(87)
--------	-------	-------	-------	----	----	----	----	----	----	----	-------	-------	------

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

(88)m=	20.38	20.38	20.39	20.4	20.4	20.41	20.41	20.42	20.41	20.4	20.4	20.39	(88)
--------	-------	-------	-------	------	------	-------	-------	-------	-------	------	------	-------	------

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

(89)m=	0.89	0.81	0.69	0.54	0.39	0.27	0.18	0.2	0.33	0.55	0.79	0.91	(89)
--------	------	------	------	------	------	------	------	-----	------	------	------	------	------

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

(90)m=	20.2	20.3	20.36	20.4	20.4	20.41	20.41	20.42	20.41	20.4	20.34	20.18	(90)
--------	------	------	-------	------	------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.64

(91)

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

(92)m=	20.62	20.71	20.76	20.78	20.78	20.79	20.79	20.79	20.79	20.78	20.73	20.6	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(93)m=	20.62	20.71	20.76	20.78	20.78	20.79	20.79	20.79	20.79	20.78	20.73	20.6	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

8. Space heating requirement

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

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

SAP WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.9	0.82	0.71	0.55	0.41	0.28	0.2	0.22	0.35	0.57	0.8	0.92	(94)
--------	-----	------	------	------	------	------	-----	------	------	------	-----	------	------

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

(95)m=	439.33	453.37	423.51	351.5	268.43	178.98	121.14	126.39	195.08	299.63	386.34	425.62	(95)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	499.06	481.35	432.36	352.7	268.53	178.98	121.14	126.39	195.1	300.95	406.4	493.16	(97)
--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	-------	--------	------

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

(98)m=	44.44	18.8	6.58	0.87	0.07	0	0	0	0	0.98	14.44	50.25	(98)
--------	-------	------	------	------	------	---	---	---	---	------	-------	-------	------

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 136.44 (98)

Space heating requirement in kWh/m²/year

2.92 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = 1 – (201) =

1 (202)

Fraction of total heating from main system 1

(204) = (202) × [1 – (203)] =

1 (204)

Efficiency of main space heating system 1

100 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

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

Space heating requirement (calculated above)

44.44	18.8	6.58	0.87	0.07	0	0	0	0	0.98	14.44	50.25
-------	------	------	------	------	---	---	---	---	------	-------	-------

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

(211)

44.44	18.8	6.58	0.87	0.07	0	0	0	0	0.98	14.44	50.25
-------	------	------	------	------	---	---	---	---	------	-------	-------

Total (kWh/year) =Sum(211)_{1...5,10...12} = 136.44 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)

136.73	120.13	125.27	111.05	107.92	95.14	90.14	100.61	100.96	115.21	123.39	133.02
--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------

Efficiency of water heater

100 (216)

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

(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	136.73	120.13	125.27	111.05	107.92	95.14	90.14	100.61	100.96	115.21	123.39	133.02
---------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} = 1359.59 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

136.44

Water heating fuel used

1359.59

Electricity for pumps, fans and electric keep-hot

SAP WorkSheet: New dwelling design stage

mechanical ventilation - balanced, extract or positive input from outside		98.22	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	98.22	(231)
Electricity for lighting		218.49	(232)
Electricity generated by PVs		-172.72	(233)

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 = 18 (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 = 179.33 (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 = 12.96 (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 = 28.82 (250)
Additional standing charges (Table 12)			0 (251)
	one of (233) to (235) x	13.19	x 0.01 = -22.78 (252)
Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)...(254) =		216.32 (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] =	0.99	(257)
SAP rating (Section 12)		86.18	(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	= 70.81 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 705.63 (264)
Space and water heating	(261) + (262) + (263) + (264) =		776.44 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 50.98 (267)
Electricity for lighting	(232) x	0.519	= 113.4 (268)
Energy saving/generation technologies			

SAP WorkSheet: New dwelling design stage

Item 1	0.519	=	-89.64	(269)
Total CO ₂ , kg/year	sum of (265)...(271) =		851.17	(272)
CO₂ emissions per m²	(272) ÷ (4) =		18.21	(273)
El rating (section 14)			88	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	3.07	=	418.87	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	4173.94	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4592.82	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	301.54	(267)
Electricity for lighting	(232) x	0	=	670.77	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-530.26	(269)
'Total Primary Energy	sum of (265)...(271) =			5034.87	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			107.72	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.26

Property Address: 1B-AP-T1-North-2ndF-7thF x60

Address : 1B-AP-T1-North-2ndF-7thF, Ellesmere Street, MANCHESTER, M15

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	46.74 (1a)	2.6 (2a)	121.52 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	46.74 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	121.52 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 x 40 =	0 (6a)
Number of open flues	0	0	0	0 x 20 =	0 (6b)
Number of intermittent fans				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.16 (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)			0.41 (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) =		0.35 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

TER WorkSheet: New dwelling design stage

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

0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.33	0.35	0.38	0.4	0.41
------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) 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= 0.6 0.6 0.59 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (24d)

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.34	x1/[1/(1.4)+0.04] =	7.08		(27)
Windows Type 2			5.75	x1/[1/(1.4)+0.04] =	7.62		(27)
Walls	19.76	11.09	8.67	x 0.18 =	1.56		(29)
Total area of elements, m²			19.76				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 16.26 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 121.38 (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 2.89 (36)

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

Total fabric heat loss (33) + (36) = 19.15 (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=	24.1	23.94	23.79	23.06	22.93	22.3	22.3	22.18	22.54	22.93	23.2	23.49

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

(39)m= 43.25 43.09 42.94 42.21 42.08 41.45 41.45 41.33 41.69 42.08 42.35 42.64
Average = Sum(39)_{1...12} /12= 42.21 (39)

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

(40)m= 0.93 0.92 0.92 0.9 0.9 0.89 0.89 0.88 0.89 0.9 0.91 0.91
Average = Sum(40)_{1...12} /12= 0.9 (40)

TER WorkSheet: New dwelling design stage

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

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

if TFA ≤ 13.9, N = 1

1.59

(42)

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

72.07

(43)

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

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

Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$

(44)m=	79.28	76.4	73.52	70.63	67.75	64.87	64.87	67.75	70.63	73.52	76.4	79.28	
Total = Sum(44) _{1...12} =												864.9	(44)

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

(45)m=	117.57	102.83	106.11	92.51	88.77	76.6	70.98	81.45	82.42	96.06	104.85	113.86	
Total = Sum(45) _{1...12} =												1134.02	(45)

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

(46)m=	17.64	15.42	15.92	13.88	13.31	11.49	10.65	12.22	12.36	14.41	15.73	17.08	(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):

1.22

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0.66

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

(47) x (51) x (52) x (53) =

0

(54)

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

0.66

(55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=	20.5	18.52	20.5	19.84	20.5	19.84	20.5	20.5	19.84	20.5	19.84	20.5	(56)
--------	------	-------	------	-------	------	-------	------	------	-------	------	-------	------	------

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

(57)m=	20.5	18.52	20.5	19.84	20.5	19.84	20.5	20.5	19.84	20.5	19.84	20.5	(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)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

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

TER WorkSheet: New dwelling design stage

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

(62)m=

161.34	142.36	149.88	134.86	132.53	118.95	114.74	125.21	124.77	139.82	147.2	157.63
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

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

 (63)

Output from water heater

(64)m=

161.34	142.36	149.88	134.86	132.53	118.95	114.74	125.21	124.77	139.82	147.2	157.63
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

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

1649.3

 (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=

74.1	65.81	70.29	64.64	64.53	59.35	58.61	62.09	61.29	66.95	68.74	72.87
------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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
79.74	79.74	79.74	79.74	79.74	79.74	79.74	79.74	79.74	79.74	79.74	79.74

 (66)

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

(67)m=

12.37	10.99	8.94	6.77	5.06	4.27	4.61	6	8.05	10.22	11.93	12.72
-------	-------	------	------	------	------	------	---	------	-------	-------	-------

 (67)

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

(68)m=

138.78	140.22	136.59	128.86	119.11	109.94	103.82	102.38	106.01	113.74	123.49	132.65
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

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

(69)m=

30.97	30.97	30.97	30.97	30.97	30.97	30.97	30.97	30.97	30.97	30.97	30.97
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

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

(71)m=

-63.79	-63.79	-63.79	-63.79	-63.79	-63.79	-63.79	-63.79	-63.79	-63.79	-63.79	-63.79
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

99.6	97.94	94.48	89.78	86.73	82.43	78.78	83.46	85.12	89.99	95.48	97.94
------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (72)

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

(73)m=

300.67	299.06	289.92	275.33	260.82	246.57	237.13	241.76	249.1	263.86	280.82	293.23
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

 (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	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>10.63</td></tr></table>	10.63	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>17.35</td></tr></table> (74)	17.35
0.77																		
5.34																		
10.63																		
0.63																		
0.7																		
17.35																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>20.32</td></tr></table>	20.32	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>33.16</td></tr></table> (74)	33.16
0.77																		
5.34																		
20.32																		
0.63																		
0.7																		
33.16																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>34.53</td></tr></table>	34.53	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>56.35</td></tr></table> (74)	56.35
0.77																		
5.34																		
34.53																		
0.63																		
0.7																		
56.35																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>55.46</td></tr></table>	55.46	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>90.52</td></tr></table> (74)	90.52
0.77																		
5.34																		
55.46																		
0.63																		
0.7																		
90.52																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>74.72</td></tr></table>	74.72	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>121.93</td></tr></table> (74)	121.93
0.77																		
5.34																		
74.72																		
0.63																		
0.7																		
121.93																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>79.99</td></tr></table>	79.99	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>130.53</td></tr></table> (74)	130.53
0.77																		
5.34																		
79.99																		
0.63																		
0.7																		
130.53																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>74.68</td></tr></table>	74.68	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>121.87</td></tr></table> (74)	121.87
0.77																		
5.34																		
74.68																		
0.63																		
0.7																		
121.87																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>5.34</td></tr></table>	5.34	x	<table><tr><td>59.25</td></tr></table>	59.25	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>96.69</td></tr></table> (74)	96.69
0.77																		
5.34																		
59.25																		
0.63																		
0.7																		
96.69																		

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	5.34	x	41.52	x	0.63	x	0.7	=	67.75	(74)
North	0.9x	0.77	x	5.34	x	24.19	x	0.63	x	0.7	=	39.48	(74)
North	0.9x	0.77	x	5.34	x	13.12	x	0.63	x	0.7	=	21.41	(74)
North	0.9x	0.77	x	5.34	x	8.86	x	0.63	x	0.7	=	14.47	(74)
South	0.9x	0.77	x	5.75	x	46.75	x	0.63	x	0.7	=	82.16	(78)
South	0.9x	0.77	x	5.75	x	76.57	x	0.63	x	0.7	=	134.55	(78)
South	0.9x	0.77	x	5.75	x	97.53	x	0.63	x	0.7	=	171.39	(78)
South	0.9x	0.77	x	5.75	x	110.23	x	0.63	x	0.7	=	193.71	(78)
South	0.9x	0.77	x	5.75	x	114.87	x	0.63	x	0.7	=	201.86	(78)
South	0.9x	0.77	x	5.75	x	110.55	x	0.63	x	0.7	=	194.26	(78)
South	0.9x	0.77	x	5.75	x	108.01	x	0.63	x	0.7	=	189.81	(78)
South	0.9x	0.77	x	5.75	x	104.89	x	0.63	x	0.7	=	184.33	(78)
South	0.9x	0.77	x	5.75	x	101.89	x	0.63	x	0.7	=	179.04	(78)
South	0.9x	0.77	x	5.75	x	82.59	x	0.63	x	0.7	=	145.13	(78)
South	0.9x	0.77	x	5.75	x	55.42	x	0.63	x	0.7	=	97.38	(78)
South	0.9x	0.77	x	5.75	x	40.4	x	0.63	x	0.7	=	70.99	(78)

Solar gains in watts, calculated for each month

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

(83)m=	99.51	167.71	227.75	284.23	323.79	324.8	311.68	281.02	246.79	184.6	118.79	85.46	(83)
--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	-------	------

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

(84)m=	400.18	466.78	517.67	559.56	584.61	571.36	548.81	522.77	495.9	448.46	399.61	378.69	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.92	0.82	0.65	0.46	0.33	0.36	0.57	0.85	0.97	0.99	(86)

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

(87)m=	20.31	20.49	20.7	20.89	20.98	21	21	21	20.99	20.88	20.58	20.28	(87)
--------	-------	-------	------	-------	-------	----	----	----	-------	-------	-------	-------	------

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

(88)m=	20.15	20.15	20.15	20.16	20.17	20.18	20.18	20.18	20.17	20.17	20.16	20.16	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.98	0.96	0.91	0.78	0.6	0.4	0.27	0.3	0.51	0.81	0.96	0.99	(89)
--------	------	------	------	------	-----	-----	------	-----	------	------	------	------	------

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

(90)m=	19.25	19.51	19.79	20.05	20.15	20.18	20.18	20.18	20.17	20.05	19.64	19.21	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.64

(91)

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

(92)m=	19.93	20.14	20.37	20.58	20.68	20.7	20.7	20.7	20.69	20.58	20.24	19.9	(92)
--------	-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	------	------

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

(93)m=	19.93	20.14	20.37	20.58	20.68	20.7	20.7	20.7	20.69	20.58	20.24	19.9	(93)
--------	-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	------	------

8. Space heating requirement

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

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

TER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.98	0.96	0.91	0.8	0.63	0.44	0.31	0.34	0.55	0.83	0.96	0.99	(94)
--------	------	------	------	-----	------	------	------	------	------	------	------	------	------

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

(95)m=	392.98	447.75	471.38	447.74	368.17	252.03	170.02	177.77	271.71	372.32	383.14	373.43	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	676.03	656.61	595.58	493.27	377.73	252.92	170.1	177.91	274.94	419.94	556.41	669.35	(97)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

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

(98)m=	210.59	140.35	92.41	32.78	7.11	0	0	0	0	35.43	124.76	220.16	(98)
--------	--------	--------	-------	-------	------	---	---	---	---	-------	--------	--------	------

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 863.58 (98)

Space heating requirement in kWh/m²/year

18.48 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = 1 – (201) =

1 (202)

Fraction of total heating from main system 1

(204) = (202) × [1 – (203)] =

1 (204)

Efficiency of main space heating system 1

93.5 (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)

210.59	140.35	92.41	32.78	7.11	0	0	0	0	35.43	124.76	220.16
--------	--------	-------	-------	------	---	---	---	---	-------	--------	--------

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

(211)

225.23	150.11	98.83	35.06	7.61	0	0	0	0	37.89	133.43	235.47
--------	--------	-------	-------	------	---	---	---	---	-------	--------	--------

Total (kWh/year) =Sum(211)_{1...5,10...12} = 923.62 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)

161.34	142.36	149.88	134.86	132.53	118.95	114.74	125.21	124.77	139.82	147.2	157.63
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

Efficiency of water heater

79.8 (216)

(217)m=	85.53	84.78	83.57	81.69	80.28	79.8	79.8	79.8	79.8	81.75	84.38	85.71	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	188.64	167.92	179.34	165.09	165.08	149.06	143.79	156.91	156.36	171.02	174.46	183.92
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} = 2001.6 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

923.62

Water heating fuel used

2001.6

Electricity for pumps, fans and electric keep-hot

TER WorkSheet: New dwelling design stage

central heating pump:		30	(230c)
boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
Electricity for lighting		218.49	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	199.5 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	432.35 (264)
Space and water heating	(261) + (262) + (263) + (264) =			631.85 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93 (267)
Electricity for lighting	(232) x	0.519	=	113.4 (268)
Total CO2, kg/year		sum of (265)...(271) =		784.17 (272)
TER =				24.21 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.26
Printed on 11 September 2020 at 15:17:37

Project Information:

Assessed By: Daniel Watt (STRO026464)

Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 73.83m²

Site Reference : Phoenix Works

Plot Reference: 2B-AP-T2-EndTce-South-2ndF-9

Address : 2B-AP-T2-EndTce-South-2ndF-9thF, Ellesmere Street, MANCHESTER, M15

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) 23.24 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 21.78 kg/m² **OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 39.7 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 33.0 kWh/m² **OK**

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Floor	(no floor)		
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: 1.27 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: South	5.34m ²	
Windows facing: South	1.84m ²	
Windows facing: North	4.18m ²	
Windows facing: North	4.71m ²	
Ventilation rate:	4.00	

10 Key features

Air permeability	3.0 m ³ /m ² h
Photovoltaic array	

Predicted Energy Assessment



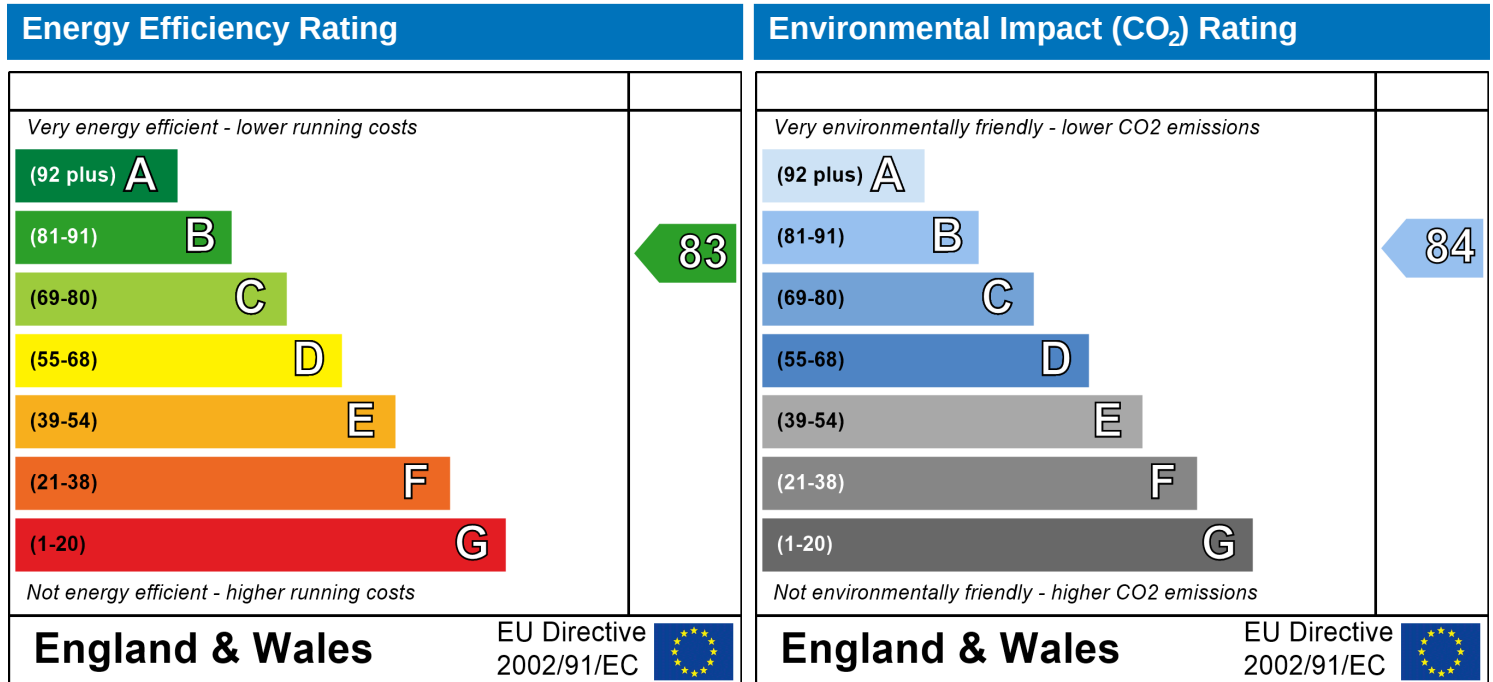
2B-AP-T2-EndTce-South-2ndF-9thF
Ellesmere Street
MANCHESTER
M15

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

Mid floor Flat
02 September 2020
Daniel Watt
73.83 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: 2B-AP-T2-EndTce-South-2ndF-9thF x8

Address: 2B-AP-T2-EndTce-South-2ndF-9thF, Ellesmere Street, MANCHESTER, M15
Located in: England
Region: North West England
UPRN:
Date of assessment: 02 September 2020
Date of certificate: 11 September 2020
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: 465

Property description:

Dwelling type: Flat
Detachment:
Year Completed: 2020
Floor Location: Floor area: Storey height:
 Floor 0 73.83 m² 2.6 m
Living area: 30.1 m² (fraction 0.408)
Front of dwelling faces: North

Opening types:

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

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
North glazing (large)	16mm or more	0.7	0.63	1.4	5.34	1
North glazing (small)	16mm or more	0.7	0.63	1.4	1.84	1
South glazing (large)	16mm or more	0.7	0.63	1.4	4.18	1
South glazing (small)	16mm or more	0.7	0.63	1.4	1.57	3

Name:	Type-Name:	Location:	Orient:	Width:	Height:
North glazing (large)		External walls	South	2.485	2.15
North glazing (small)		External walls	South	0.855	2.15
South glazing (large)		External walls	North	1.64	2.55
South glazing (small)		External walls	North	0.615	2.55

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	62.4	16.07	46.33	0.2	0	False	N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0972

Length	Psi-value
6.825	0.03

 E2 Other lintels (including other steel lintels)

SAP Input

[Approved]	6.825	0.04	E3	Sill
[Approved]	29	0.05	E4	Jamb
[Approved]	48	0.07	E7	Party floor between dwellings (in blocks of flats)
[Approved]	5.2	0.09	E16	Corner (normal)
[Approved]	5.2	0.06	E18	Party wall between dwellings
	32.8	0	P3	Intermediate floor between dwellings (in blocks of flats)

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:	1
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
---------------------------	------

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, 1.27kWh/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
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	<u>Photovoltaic 1</u>
	Installed Peak power: 0.2
	Tilt of collector: 30°
	Overshading: None or very little

SAP Input

Assess Zero Carbon Home:	Collector Orientation: South
	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.26

Property Address: 2B-AP-T2-EndTce-South-2ndF-9thF x8

Address : 2B-AP-T2-EndTce-South-2ndF-9thF, Ellesmere Street, MANCHESTER, M15

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	73.83 (1a) x	2.6 (2a) =	191.96 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.83 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	191.96 (5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0 (8)
<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		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

SAP WorkSheet: New dwelling design stage

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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) 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= 0.3 0.3 0.3 0.28 0.28 0.26 0.26 0.25 0.26 0.28 0.28 0.29 (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= 0.3 0.3 0.3 0.28 0.28 0.26 0.26 0.25 0.26 0.28 0.28 0.29 (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			5.34	$x1/[1/(1.4)+0.04] =$	7.08		(27)
Windows Type 2			1.84	$x1/[1/(1.4)+0.04] =$	2.44		(27)
Windows Type 3			4.18	$x1/[1/(1.4)+0.04] =$	5.54		(27)
Windows Type 4			1.57	$x1/[1/(1.4)+0.04] =$	2.08		(27)
Walls	62.4	16.07	46.33	x 0.2	9.27		(29)
Total area of elements, m²			62.4				(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) = 30.57 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 648.62 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.07 (36)

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

Total fabric heat loss (33) + (36) = 36.64 (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=	19.19	18.97	18.75	17.65	17.43	16.33	16.33	16.11	16.77	17.43	17.87	18.31

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

(39)m= 55.83 55.61 55.39 54.29 54.07 52.97 52.97 52.75 53.41 54.07 54.51 54.95
Average = Sum(39)_{1...12} /12= 54.23 (39)

SAP WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.76	0.75	0.75	0.74	0.73	0.72	0.72	0.71	0.72	0.73	0.74	0.74		
Average = Sum(40) _{1...12} /12=													0.73	(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

2.34

(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

89.67

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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		
(44)m=	98.63	95.05	91.46	87.87	84.29	80.7	80.7	84.29	87.87	91.46	95.05	98.63		
Total = Sum(44) _{1...12} =													1075.99	(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=	146.27	127.93	132.01	115.09	110.43	95.29	88.3	101.33	102.54	119.5	130.44	141.65		
Total = Sum(45) _{1...12} =													1410.79	(45)

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

(46)m=	21.94	19.19	19.8	17.26	16.56	14.29	13.25	15.2	15.38	17.93	19.57	21.25		(46)
--------	-------	-------	------	-------	-------	-------	-------	------	-------	-------	-------	-------	--	------

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.27	(48)
---	------	------

Temperature factor from Table 2b

0.6

(49)

Energy lost from water storage, kWh/year

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

0.76

(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)

0.76

(55)

Water storage loss calculated for each month

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

(56)m=	23.62	21.34	23.62	22.86	23.62	22.86	23.62	23.62	22.86	23.62	22.86	23.62		(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=	23.62	21.34	23.62	22.86	23.62	22.86	23.62	23.62	22.86	23.62	22.86	23.62		(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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

SAP WorkSheet: New dwelling design stage

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=	169.89	149.26	155.63	137.95	134.05	118.15	111.93	124.95	125.4	143.12	153.3	165.28	(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=	169.89	149.26	155.63	137.95	134.05	118.15	111.93	124.95	125.4	143.12	153.3	165.28	
Output from water heater (annual) _{1...12}												1688.92	(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=	67.53	59.6	62.79	56.56	55.62	49.97	48.26	52.59	52.38	58.63	61.66	66	(65)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	------

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	140.12	140.12	140.12	140.12	140.12	140.12	140.12	140.12	140.12	140.12	140.12	140.12	(66)

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

(67)m=	45.96	40.82	33.2	25.13	18.79	15.86	17.14	22.28	29.9	37.97	44.31	47.24	(67)
--------	-------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

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

(68)m=	307.56	310.75	302.71	285.59	263.98	243.66	230.09	226.9	234.94	252.06	273.68	293.99	(68)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

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

(69)m=	51.35	51.35	51.35	51.35	51.35	51.35	51.35	51.35	51.35	51.35	51.35	51.35	(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=	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	90.77	88.7	84.4	78.55	74.75	69.41	64.86	70.69	72.75	78.81	85.64	88.71	(72)
--------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	542.35	538.33	518.36	487.33	455.57	426.99	410.15	417.92	435.65	466.89	501.69	527.99	(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	4.18	x	10.63	x	0.63	x	0.7	=	13.58	(74)
North	0.9x	0.77	x	1.57	x	10.63	x	0.63	x	0.7	=	15.31	(74)
North	0.9x	0.77	x	4.18	x	20.32	x	0.63	x	0.7	=	25.96	(74)
North	0.9x	0.77	x	1.57	x	20.32	x	0.63	x	0.7	=	29.25	(74)
North	0.9x	0.77	x	4.18	x	34.53	x	0.63	x	0.7	=	44.11	(74)

SAP WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.57	x	34.53	x	0.63	x	0.7	=	49.7	(74)
North	0.9x	0.77	x	4.18	x	55.46	x	0.63	x	0.7	=	70.85	(74)
North	0.9x	0.77	x	1.57	x	55.46	x	0.63	x	0.7	=	79.84	(74)
North	0.9x	0.77	x	4.18	x	74.72	x	0.63	x	0.7	=	95.45	(74)
North	0.9x	0.77	x	1.57	x	74.72	x	0.63	x	0.7	=	107.55	(74)
North	0.9x	0.77	x	4.18	x	79.99	x	0.63	x	0.7	=	102.18	(74)
North	0.9x	0.77	x	1.57	x	79.99	x	0.63	x	0.7	=	115.13	(74)
North	0.9x	0.77	x	4.18	x	74.68	x	0.63	x	0.7	=	95.4	(74)
North	0.9x	0.77	x	1.57	x	74.68	x	0.63	x	0.7	=	107.49	(74)
North	0.9x	0.77	x	4.18	x	59.25	x	0.63	x	0.7	=	75.68	(74)
North	0.9x	0.77	x	1.57	x	59.25	x	0.63	x	0.7	=	85.28	(74)
North	0.9x	0.77	x	4.18	x	41.52	x	0.63	x	0.7	=	53.04	(74)
North	0.9x	0.77	x	1.57	x	41.52	x	0.63	x	0.7	=	59.76	(74)
North	0.9x	0.77	x	4.18	x	24.19	x	0.63	x	0.7	=	30.9	(74)
North	0.9x	0.77	x	1.57	x	24.19	x	0.63	x	0.7	=	34.82	(74)
North	0.9x	0.77	x	4.18	x	13.12	x	0.63	x	0.7	=	16.76	(74)
North	0.9x	0.77	x	1.57	x	13.12	x	0.63	x	0.7	=	18.88	(74)
North	0.9x	0.77	x	4.18	x	8.86	x	0.63	x	0.7	=	11.32	(74)
North	0.9x	0.77	x	1.57	x	8.86	x	0.63	x	0.7	=	12.76	(74)
South	0.9x	0.77	x	5.34	x	46.75	x	0.63	x	0.7	=	76.3	(78)
South	0.9x	0.77	x	1.84	x	46.75	x	0.63	x	0.7	=	26.29	(78)
South	0.9x	0.77	x	5.34	x	76.57	x	0.63	x	0.7	=	124.96	(78)
South	0.9x	0.77	x	1.84	x	76.57	x	0.63	x	0.7	=	43.06	(78)
South	0.9x	0.77	x	5.34	x	97.53	x	0.63	x	0.7	=	159.17	(78)
South	0.9x	0.77	x	1.84	x	97.53	x	0.63	x	0.7	=	54.85	(78)
South	0.9x	0.77	x	5.34	x	110.23	x	0.63	x	0.7	=	179.9	(78)
South	0.9x	0.77	x	1.84	x	110.23	x	0.63	x	0.7	=	61.99	(78)
South	0.9x	0.77	x	5.34	x	114.87	x	0.63	x	0.7	=	187.47	(78)
South	0.9x	0.77	x	1.84	x	114.87	x	0.63	x	0.7	=	64.6	(78)
South	0.9x	0.77	x	5.34	x	110.55	x	0.63	x	0.7	=	180.41	(78)
South	0.9x	0.77	x	1.84	x	110.55	x	0.63	x	0.7	=	62.16	(78)
South	0.9x	0.77	x	5.34	x	108.01	x	0.63	x	0.7	=	176.27	(78)
South	0.9x	0.77	x	1.84	x	108.01	x	0.63	x	0.7	=	60.74	(78)
South	0.9x	0.77	x	5.34	x	104.89	x	0.63	x	0.7	=	171.19	(78)
South	0.9x	0.77	x	1.84	x	104.89	x	0.63	x	0.7	=	58.99	(78)
South	0.9x	0.77	x	5.34	x	101.89	x	0.63	x	0.7	=	166.27	(78)
South	0.9x	0.77	x	1.84	x	101.89	x	0.63	x	0.7	=	57.29	(78)
South	0.9x	0.77	x	5.34	x	82.59	x	0.63	x	0.7	=	134.78	(78)
South	0.9x	0.77	x	1.84	x	82.59	x	0.63	x	0.7	=	46.44	(78)
South	0.9x	0.77	x	5.34	x	55.42	x	0.63	x	0.7	=	90.44	(78)
South	0.9x	0.77	x	1.84	x	55.42	x	0.63	x	0.7	=	31.16	(78)

SAP WorkSheet: New dwelling design stage

South	0.9x	0.77	x	5.34	x	40.4	x	0.63	x	0.7	=	65.93	(78)
South	0.9x	0.77	x	1.84	x	40.4	x	0.63	x	0.7	=	22.72	(78)

Solar gains in watts, calculated for each month

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

(83)m=	131.48	223.22	307.83	392.58	455.06	459.89	439.9	391.14	336.36	246.94	157.24	112.73	(83)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

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

(84)m=	673.83	761.55	826.2	879.91	910.63	886.87	850.05	809.06	772.02	713.83	658.93	640.72	(84)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.94	0.86	0.72	0.55	0.38	0.27	0.3	0.48	0.75	0.93	0.98	(86)

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

(87)m=	20.62	20.75	20.88	20.97	21	21	21	21	21	20.97	20.8	20.59	(87)
--------	-------	-------	-------	-------	----	----	----	----	----	-------	------	-------	------

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

(88)m=	20.29	20.29	20.3	20.31	20.31	20.33	20.33	20.33	20.32	20.31	20.31	20.3	(88)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(89)m=	0.96	0.92	0.84	0.69	0.51	0.34	0.23	0.26	0.43	0.71	0.91	0.97	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	19.8	19.99	20.16	20.28	20.31	20.33	20.33	20.33	20.32	20.28	20.07	19.77	(90)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.41 (91)

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

(92)m=	20.14	20.3	20.45	20.56	20.59	20.6	20.6	20.6	20.6	20.56	20.37	20.11	(92)
--------	-------	------	-------	-------	-------	------	------	------	------	-------	-------	-------	------

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

(93)m=	20.14	20.3	20.45	20.56	20.59	20.6	20.6	20.6	20.6	20.56	20.37	20.11	(93)
--------	-------	------	-------	-------	-------	------	------	------	------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.96	0.92	0.85	0.7	0.53	0.36	0.25	0.27	0.45	0.73	0.92	0.97	(94)
--------	------	------	------	-----	------	------	------	------	------	------	------	------	------

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

(95)m=	647.79	702.28	699.23	615.87	478.5	317.74	211.9	221.65	346.46	519.95	603.5	621.02	(95)
--------	--------	--------	--------	--------	-------	--------	-------	--------	--------	--------	-------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	884.02	856.17	772.71	633.07	480.62	317.84	211.9	221.66	346.97	538.53	723.25	874.07	(97)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

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

(98)m=	175.75	103.42	54.67	12.38	1.58	0	0	0	0	13.83	86.22	188.27	(98)
--------	--------	--------	-------	-------	------	---	---	---	---	-------	-------	--------	------

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 636.11 (99)

Space heating requirement in kWh/m²/year

8.62 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

SAP WorkSheet: New dwelling design stage

Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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

Space heating requirement (calculated above)

175.75	103.42	54.67	12.38	1.58	0	0	0	0	13.83	86.22	188.27
--------	--------	-------	-------	------	---	---	---	---	-------	-------	--------

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

(211)

175.75	103.42	54.67	12.38	1.58	0	0	0	0	13.83	86.22	188.27
--------	--------	-------	-------	------	---	---	---	---	-------	-------	--------

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

636.11 (211)

Space heating fuel (secondary), kWh/month

= {[[(98)m × (201)] } × 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)

169.89	149.26	155.63	137.95	134.05	118.15	111.93	124.95	125.4	143.12	153.3	165.28
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	-------	--------

Efficiency of water heater

100 (216)

(217)m=

100	100	100	100	100	100	100	100	100	100	100	100
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=

169.89	149.26	155.63	137.95	134.05	118.15	111.93	124.95	125.4	143.12	153.3	165.28
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	-------	--------

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

1688.92 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

636.11

Water heating fuel used

1688.92

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

175.64 (230a)

Total electricity for the above, kWh/year

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

175.64 (231)

Electricity for lighting

324.67 (232)

Electricity generated by PVs

-172.72 (233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) ×	13.19 × 0.01 =	83.9 (240)
Space heating - main system 2	(213) ×	0 × 0.01 =	0 (241)
Space heating - secondary	(215) ×	13.19 × 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)

SAP WorkSheet: New dwelling design stage

High-rate cost	(219) x (243) x	13.19	x 0.01 =	222.77	(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 =	23.17	(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 =	42.82	(250)
Additional standing charges (Table 12)				0	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-22.78	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)...(254) =			349.88	(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] =	1.24	(257)
SAP rating (Section 12)		82.75	(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	=	330.14	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	876.55	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1206.69	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	91.16	(267)
Electricity for lighting	(232) x	0.519	=	168.51	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-89.64	(269)
Total CO2, kg/year		sum of (265)...(271) =		1376.71	(272)
CO2 emissions per m²		(272) ÷ (4) =		18.65	(273)
EI 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	=	1952.86	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	5185	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7137.86	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	539.22	(267)
Electricity for lighting	(232) x	0	=	996.75	(268)

SAP WorkSheet: New dwelling design stage

Energy saving/generation technologies
Item 1

3.07

=

-530.26

(269)

'Total Primary Energy

sum of (265)...(271) =

8143.57

(272)

Primary energy kWh/m²/year

(272) ÷ (4) =

110.3

(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.26

Property Address: 2B-AP-T2-EndTce-South-2ndF-9thF x8

Address : 2B-AP-T2-EndTce-South-2ndF-9thF, Ellesmere Street, MANCHESTER, M15

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	73.83 (1a) x	2.6 (2a) =	191.96 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.83 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	191.96 (5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30 ÷ (5) =	0.16 (8)
<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)		0.41 (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		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38 (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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TER WorkSheet: New dwelling design stage

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

0.48	0.47	0.46	0.41	0.4	0.36	0.36	0.35	0.38	0.4	0.42	0.44
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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= 0.61 0.61 0.61 0.59 0.58 0.56 0.56 0.56 0.57 0.58 0.59 0.6 (24d)

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.34	$x1/[1/(1.4)+0.04] =$	7.08		(27)
Windows Type 2			1.84	$x1/[1/(1.4)+0.04] =$	2.44		(27)
Windows Type 3			4.18	$x1/[1/(1.4)+0.04] =$	5.54		(27)
Windows Type 4			1.57	$x1/[1/(1.4)+0.04] =$	2.08		(27)
Walls	62.4	16.07	46.33	x 0.18 =	8.34		(29)
Total area of elements, m²			62.4				(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) = 29.64 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 648.62 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.27 (36)

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

Total fabric heat loss (33) + (36) = 35.92 (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=	38.95	38.66	38.39	37.09	36.84	35.71	35.71	35.5	36.15	36.84	37.33	37.85

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

(39)m= 74.86 74.58 74.3 73 72.76 71.63 71.63 71.42 72.06 72.76 73.25 73.77
Average = Sum(39)_{1...12} /12= 73 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	1.01	1.01	1.01	0.99	0.99	0.97	0.97	0.97	0.98	0.99	0.99	1		
Average = Sum(40) _{1...12} /12=													0.99	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.34

(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

89.67

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	98.63	95.05	91.46	87.87	84.29	80.7	80.7	84.29	87.87	91.46	95.05	98.63		
Total = Sum(44) _{1...12} =													1075.99	(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=	146.27	127.93	132.01	115.09	110.43	95.29	88.3	101.33	102.54	119.5	130.44	141.65		
Total = Sum(45) _{1...12} =													1410.79	(45)

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

(46)m=	21.94	19.19	19.8	17.26	16.56	14.29	13.25	15.2	15.38	17.93	19.57	21.25		(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)
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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=	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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TER WorkSheet: New dwelling design stage

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=	192.86	170.01	178.61	160.18	157.03	140.39	134.9	147.92	147.63	166.1	175.54	188.25	(62)
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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=	192.86	170.01	178.61	160.18	157.03	140.39	134.9	147.92	147.63	166.1	175.54	188.25	
Output from water heater (annual) _{1...12}												1959.41	(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=	85.91	76.2	81.17	74.34	73.99	67.76	66.64	70.97	70.17	77.01	79.45	84.38	(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=	116.77	116.77	116.77	116.77	116.77	116.77	116.77	116.77	116.77	116.77	116.77	116.77	(66)

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

(67)m=	18.38	16.33	13.28	10.05	7.52	6.34	6.86	8.91	11.96	15.19	17.72	18.9	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	206.07	208.2	202.82	191.34	176.86	163.25	154.16	152.02	157.41	168.88	183.36	196.97	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.68	34.68	34.68	34.68	34.68	34.68	34.68	34.68	34.68	34.68	34.68	34.68	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

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

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

(71)m=	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	-93.42	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	115.47	113.4	109.1	103.25	99.45	94.11	89.57	95.39	97.46	103.51	110.34	113.41	(72)
--------	--------	-------	-------	--------	-------	-------	-------	-------	-------	--------	--------	--------	------

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

(73)m=	400.95	398.96	386.23	365.68	344.86	324.74	311.61	317.35	327.86	348.61	372.46	390.31	(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	4.18	x	10.63	x	0.63	x	0.7	=	13.58	(74)
North	0.9x	0.77	x	1.57	x	10.63	x	0.63	x	0.7	=	15.31	(74)
North	0.9x	0.77	x	4.18	x	20.32	x	0.63	x	0.7	=	25.96	(74)
North	0.9x	0.77	x	1.57	x	20.32	x	0.63	x	0.7	=	29.25	(74)
North	0.9x	0.77	x	4.18	x	34.53	x	0.63	x	0.7	=	44.11	(74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.57	x	34.53	x	0.63	x	0.7	=	49.7	(74)
North	0.9x	0.77	x	4.18	x	55.46	x	0.63	x	0.7	=	70.85	(74)
North	0.9x	0.77	x	1.57	x	55.46	x	0.63	x	0.7	=	79.84	(74)
North	0.9x	0.77	x	4.18	x	74.72	x	0.63	x	0.7	=	95.45	(74)
North	0.9x	0.77	x	1.57	x	74.72	x	0.63	x	0.7	=	107.55	(74)
North	0.9x	0.77	x	4.18	x	79.99	x	0.63	x	0.7	=	102.18	(74)
North	0.9x	0.77	x	1.57	x	79.99	x	0.63	x	0.7	=	115.13	(74)
North	0.9x	0.77	x	4.18	x	74.68	x	0.63	x	0.7	=	95.4	(74)
North	0.9x	0.77	x	1.57	x	74.68	x	0.63	x	0.7	=	107.49	(74)
North	0.9x	0.77	x	4.18	x	59.25	x	0.63	x	0.7	=	75.68	(74)
North	0.9x	0.77	x	1.57	x	59.25	x	0.63	x	0.7	=	85.28	(74)
North	0.9x	0.77	x	4.18	x	41.52	x	0.63	x	0.7	=	53.04	(74)
North	0.9x	0.77	x	1.57	x	41.52	x	0.63	x	0.7	=	59.76	(74)
North	0.9x	0.77	x	4.18	x	24.19	x	0.63	x	0.7	=	30.9	(74)
North	0.9x	0.77	x	1.57	x	24.19	x	0.63	x	0.7	=	34.82	(74)
North	0.9x	0.77	x	4.18	x	13.12	x	0.63	x	0.7	=	16.76	(74)
North	0.9x	0.77	x	1.57	x	13.12	x	0.63	x	0.7	=	18.88	(74)
North	0.9x	0.77	x	4.18	x	8.86	x	0.63	x	0.7	=	11.32	(74)
North	0.9x	0.77	x	1.57	x	8.86	x	0.63	x	0.7	=	12.76	(74)
South	0.9x	0.77	x	5.34	x	46.75	x	0.63	x	0.7	=	76.3	(78)
South	0.9x	0.77	x	1.84	x	46.75	x	0.63	x	0.7	=	26.29	(78)
South	0.9x	0.77	x	5.34	x	76.57	x	0.63	x	0.7	=	124.96	(78)
South	0.9x	0.77	x	1.84	x	76.57	x	0.63	x	0.7	=	43.06	(78)
South	0.9x	0.77	x	5.34	x	97.53	x	0.63	x	0.7	=	159.17	(78)
South	0.9x	0.77	x	1.84	x	97.53	x	0.63	x	0.7	=	54.85	(78)
South	0.9x	0.77	x	5.34	x	110.23	x	0.63	x	0.7	=	179.9	(78)
South	0.9x	0.77	x	1.84	x	110.23	x	0.63	x	0.7	=	61.99	(78)
South	0.9x	0.77	x	5.34	x	114.87	x	0.63	x	0.7	=	187.47	(78)
South	0.9x	0.77	x	1.84	x	114.87	x	0.63	x	0.7	=	64.6	(78)
South	0.9x	0.77	x	5.34	x	110.55	x	0.63	x	0.7	=	180.41	(78)
South	0.9x	0.77	x	1.84	x	110.55	x	0.63	x	0.7	=	62.16	(78)
South	0.9x	0.77	x	5.34	x	108.01	x	0.63	x	0.7	=	176.27	(78)
South	0.9x	0.77	x	1.84	x	108.01	x	0.63	x	0.7	=	60.74	(78)
South	0.9x	0.77	x	5.34	x	104.89	x	0.63	x	0.7	=	171.19	(78)
South	0.9x	0.77	x	1.84	x	104.89	x	0.63	x	0.7	=	58.99	(78)
South	0.9x	0.77	x	5.34	x	101.89	x	0.63	x	0.7	=	166.27	(78)
South	0.9x	0.77	x	1.84	x	101.89	x	0.63	x	0.7	=	57.29	(78)
South	0.9x	0.77	x	5.34	x	82.59	x	0.63	x	0.7	=	134.78	(78)
South	0.9x	0.77	x	1.84	x	82.59	x	0.63	x	0.7	=	46.44	(78)
South	0.9x	0.77	x	5.34	x	55.42	x	0.63	x	0.7	=	90.44	(78)
South	0.9x	0.77	x	1.84	x	55.42	x	0.63	x	0.7	=	31.16	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	5.34	x	40.4	x	0.63	x	0.7	=	65.93	(78)
South	0.9x	0.77	x	1.84	x	40.4	x	0.63	x	0.7	=	22.72	(78)

Solar gains in watts, calculated for each month

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

(83)m=	131.48	223.22	307.83	392.58	455.06	459.89	439.9	391.14	336.36	246.94	157.24	112.73	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	532.43	622.19	694.06	758.26	799.92	784.63	751.51	708.49	664.22	595.55	529.7	503.04	(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)
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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	0.91	0.77	0.57	0.42	0.46	0.71	0.93	0.99	1	(86)

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

(87)m=	20.06	20.23	20.47	20.74	20.92	20.99	21	21	20.96	20.74	20.35	20.03	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.07	20.07	20.08	20.09	20.1	20.11	20.11	20.11	20.1	20.1	20.09	20.08	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.88	0.72	0.5	0.33	0.37	0.63	0.91	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=	18.83	19.08	19.42	19.81	20.02	20.1	20.11	20.11	20.08	19.8	19.26	18.8	(90)
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fLA = Living area ÷ (4) =

(91)

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

(92)m=	19.33	19.55	19.85	20.19	20.39	20.46	20.47	20.47	20.44	20.18	19.71	19.3	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.33	19.55	19.85	20.19	20.39	20.46	20.47	20.47	20.44	20.18	19.71	19.3	(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	0.96	0.88	0.74	0.53	0.37	0.41	0.66	0.91	0.98	0.99	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	528.04	610.35	662.88	669.79	588.53	414.57	276.7	289.78	438.72	541.33	519.78	499.89	(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=	1125.14	1092.71	991.8	824.05	632.28	419.94	277.26	290.77	456.78	697.34	923.52	1114.04	(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=	444.24	324.14	244.72	111.07	32.55	0	0	0	0	116.08	290.7	456.92	
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = (98)

Space heating requirement in kWh/m²/year

(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

(201)

TER WorkSheet: New dwelling design stage

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	
Space heating requirement (calculated above)													
444.24	324.14	244.72	111.07	32.55	0	0	0	0	116.08	290.7	456.92		
(211)m = {[[(98)m x (204)] } x 100 ÷ (206)													(211)
475.13	346.68	261.73	118.79	34.82	0	0	0	0	124.15	310.91	488.69		
Total (kWh/year) =Sum(211) _{1..5,10...12} =												2160.88	(211)

Space heating fuel (secondary), kWh/month													
= {[[(98)m x (201)] } x 100 ÷ (208)													
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total (kWh/year) =Sum(215) _{1..5,10....12} =												0	(215)

Water heating

Output from water heater (calculated above)													
192.86	170.01	178.61	160.18	157.03	140.39	134.9	147.92	147.63	166.1	175.54	188.25		
Efficiency of water heater												79.8	(216)
(217)m=	86.97	86.51	85.65	83.86	81.45	79.8	79.8	79.8	79.8	83.88	86.15	87.09	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	221.76	196.53	208.52	191.01	192.78	175.92	169.05	185.37	185	198.02	203.75	216.15	
Total = Sum(219a) _{1...12} =												2343.85	(219)

Annual totals

Space heating fuel used, main system 1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					</
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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	=	466.75 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	506.27 (264)
Space and water heating	(261) + (262) + (263) + (264) =			973.02 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93 (267)
Electricity for lighting	(232) x	0.519	=	168.51 (268)

TER WorkSheet: New dwelling design stage

Total CO2, kg/year

sum of (265)...(271) =

1180.45

(272)

TER =

23.24

(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.26
Printed on 11 September 2020 at 15:19:09

Project Information:

Assessed By: Daniel Watt (STRO026464)

Building Type: End-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 71.26m²

Site Reference : Phoenix Works

Plot Reference: 2B-TH-T1-MidTce-South x7

Address : 2B-TH-T1-MidTce-South, Ellesmere Street, MANCHESTER, M15

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) 24.84 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 23.41 kg/m² **OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 44.4 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 36.9 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: 1.27 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: South	11.57m ²	
Windows facing: North	5.02m ²	
Ventilation rate:	4.00	

10 Key features

Air permeability	3.0 m ³ /m ² h
Photovoltaic array	

Predicted Energy Assessment



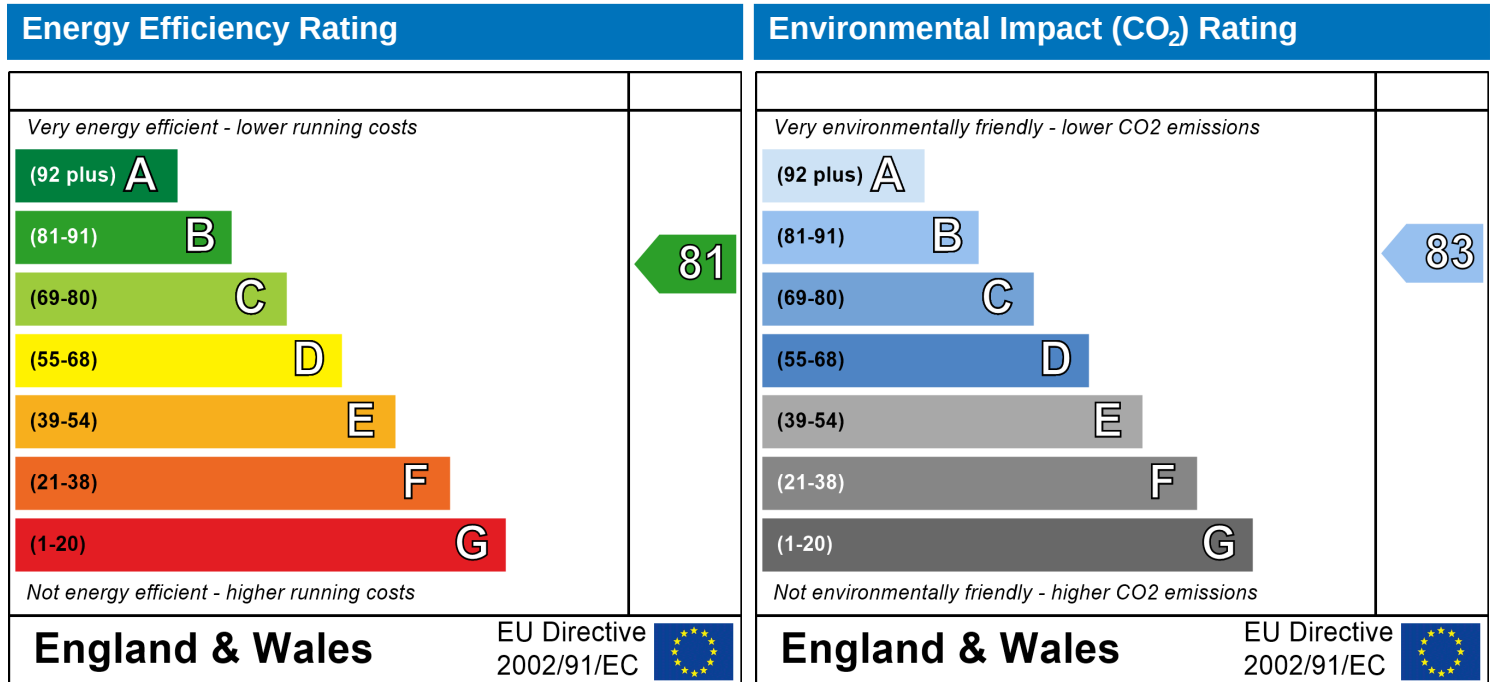
2B-TH-T1-MidTce-South
Ellesmere Street
MANCHESTER
M15

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

End-terrace House
02 September 2020
Daniel Watt
71.26 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: 2B-TH-T1-MidTce-South x7

Address: 2B-TH-T1-MidTce-South, Ellesmere Street, MANCHESTER, M15
Located in: England
Region: North West England
UPRN:
Date of assessment: 02 September 2020
Date of certificate: 11 September 2020
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: 465

Property description:

Dwelling type: House
Detachment: End-terrace
Year Completed: 2020
Floor Location: Floor area: Storey height:
 Floor 0 27.3 m² 2.75 m
 Floor 1 43.96 m² 3 m
Living area: 29.7 m² (fraction 0.417)
Front of dwelling faces: South

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Double-storey N window	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
Living area window	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Double-storey N window	16mm or more	0.7	0.63	1.4	11.57	1
Living area window	16mm or more	0.7	0.63	1.4	5.02	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Double-storey N window		External walls	South	2.475	4.675
Living area window		External walls	North	2.05	2.45

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	32.3	16.59	15.71	0.2	0	False	N/A
Adj walls to stores/parking	0.45	0	10.45	0.2	0.25	False	N/A
Ground floor	27.3			0.15			N/A
Exposed floor	16.66			0.15			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0961

Length	Psi-value
4.525	0.03

 E2 Other lintels (including other steel lintels)

SAP Input

[Approved]	2.05	0.04	E3	Sill
[Approved]	14.25	0.05	E4	Jamb
[Approved]	7.6	0.16	E5	Ground floor (normal)
[Approved]	3.8	0.07	E6	Intermediate floor within a dwelling
[Approved]	7.6	0.07	E7	Party floor between dwellings (in blocks of flats)
[Approved]	0	0.09	E16	Corner (normal)
[Approved]	22.5	0.06	E18	Party wall between dwellings
	3.8	0.32	E20	Exposed floor (normal)
	3.8	0.32	E21	Exposed floor (inverted)
	14.58	0	P1	Ground floor
	14.58	0	P2	Intermediate floor within a dwelling
	24.6	0	P3	Intermediate floor between dwellings (in blocks of flats)
	10.02	0.16	P7	Exposed floor (normal)

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, 1.27kWh/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
Low energy lights:	100%

SAP Input

Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	<u>Photovoltaic 1</u> Installed Peak power: 0.2 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: 1.0.4.26

Property Address: 2B-TH-T1-MidTce-South x7

Address : 2B-TH-T1-MidTce-South, Ellesmere Street, MANCHESTER, M15

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	27.3	(1a) x	2.75	(2a) =	75.07
First floor	43.96	(1b) x	3	(2b) =	131.88
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.26	(4)			
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			206.95
					(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0
Number of open flues	0	+	0	+	0	=	0	x 20 =	0
Number of intermittent fans							0	x 10 =	0
Number of passive vents							0	x 10 =	0
Number of flueless gas fires							0	x 40 =	0

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			0	(11)
<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>				
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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SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

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

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

74.8 (23c)

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

(24a)m= 0.29 0.29 0.28 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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

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

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

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

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

(25)m= 0.29 0.29 0.28 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			11.57	$x1/[1/(1.4)+0.04] =$	15.34		(27)
Windows Type 2			5.02	$x1/[1/(1.4)+0.04] =$	6.66		(27)
Floor Type 1			27.3	x 0.15	4.095		(28)
Floor Type 2			16.66	x 0.15	2.499		(28)
Walls Type1	32.3	16.59	15.71	x 0.2	3.14		(29)
Walls Type2	10.45	0	10.45	x 0.19	1.99		(29)
Total area of elements, m²			86.71				(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) = 33.72 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4618.74 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.33 (36)

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

Total fabric heat loss (33) + (36) = 42.05 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	19.71	19.49	19.27	18.18	17.97	16.88	16.88	16.66	17.31	17.97	18.4	18.84

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

(39)m= 61.76 61.54 61.32 60.23 60.02 58.93 58.93 58.71 59.36 60.02 60.45 60.89 (39)

SAP WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	0.87	0.86	0.86	0.85	0.84	0.83	0.83	0.82	0.83	0.84	0.85	0.85		
	Average = Sum(40) _{1...12} /12=												0.84	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.28

(42)

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

if TFA ≤ 13.9, N = 1

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

88.26

(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=	97.09	93.56	90.03	86.5	82.97	79.44	79.44	82.97	86.5	90.03	93.56	97.09		
	Total = Sum(44) _{1...12} =												1059.15	(44)

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

(45)m=	143.98	125.93	129.94	113.29	108.7	93.8	86.92	99.74	100.94	117.63	128.4	139.44		
	Total = Sum(45) _{1...12} =												1388.72	(45)

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

(46)m=	21.6	18.89	19.49	16.99	16.31	14.07	13.04	14.96	15.14	17.64	19.26	20.92		(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):

1.27

(48)

Temperature factor from Table 2b

0.6

(49)

Energy lost from water storage, kWh/year

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

0.76

(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)

0.76

(55)

Water storage loss calculated for each month

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

(56)m=	23.62	21.34	23.62	22.86	23.62	22.86	23.62	23.62	22.86	23.62	22.86	23.62		(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=	23.62	21.34	23.62	22.86	23.62	22.86	23.62	23.62	22.86	23.62	22.86	23.62		(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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SAP WorkSheet: New dwelling design stage

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=	167.6	147.26	153.57	136.15	132.33	116.66	110.54	123.37	123.8	141.25	151.26	163.06	(62)
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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=	167.6	147.26	153.57	136.15	132.33	116.66	110.54	123.37	123.8	141.25	151.26	163.06	
Output from water heater (annual) _{1...12}												1666.85	(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=	66.77	58.94	62.1	55.96	55.04	49.48	47.8	52.06	51.85	58.01	60.98	65.26	(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=	136.58	136.58	136.58	136.58	136.58	136.58	136.58	136.58	136.58	136.58	136.58	136.58	(66)

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

(67)m=	44.62	39.63	32.23	24.4	18.24	15.4	16.64	21.63	29.03	36.86	43.02	45.86	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	298.84	301.94	294.12	277.49	256.49	236.75	223.56	220.46	228.28	244.91	265.91	285.65	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	50.93	50.93	50.93	50.93	50.93	50.93	50.93	50.93	50.93	50.93	50.93	50.93	(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=	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	89.75	87.71	83.47	77.72	73.98	68.72	64.25	69.98	72.01	77.97	84.7	87.72	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

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

(73)m=	529.67	525.74	506.29	476.07	445.17	417.33	400.91	408.53	425.78	456.21	490.09	515.69	(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	5.02	x	10.63	x	0.63	x	0.7	=	16.31	(74)
North	0.9x	0.77	x	5.02	x	20.32	x	0.63	x	0.7	=	31.18	(74)
North	0.9x	0.77	x	5.02	x	34.53	x	0.63	x	0.7	=	52.98	(74)
North	0.9x	0.77	x	5.02	x	55.46	x	0.63	x	0.7	=	85.09	(74)
North	0.9x	0.77	x	5.02	x	74.72	x	0.63	x	0.7	=	114.63	(74)

SAP WorkSheet: New dwelling design stage

North	0.9x	0.77	x	5.02	x	79.99	x	0.63	x	0.7	=	122.71	(74)
North	0.9x	0.77	x	5.02	x	74.68	x	0.63	x	0.7	=	114.57	(74)
North	0.9x	0.77	x	5.02	x	59.25	x	0.63	x	0.7	=	90.89	(74)
North	0.9x	0.77	x	5.02	x	41.52	x	0.63	x	0.7	=	63.69	(74)
North	0.9x	0.77	x	5.02	x	24.19	x	0.63	x	0.7	=	37.11	(74)
North	0.9x	0.77	x	5.02	x	13.12	x	0.63	x	0.7	=	20.12	(74)
North	0.9x	0.77	x	5.02	x	8.86	x	0.63	x	0.7	=	13.6	(74)
South	0.9x	0.77	x	11.57	x	46.75	x	0.63	x	0.7	=	165.31	(78)
South	0.9x	0.77	x	11.57	x	76.57	x	0.63	x	0.7	=	270.74	(78)
South	0.9x	0.77	x	11.57	x	97.53	x	0.63	x	0.7	=	344.87	(78)
South	0.9x	0.77	x	11.57	x	110.23	x	0.63	x	0.7	=	389.78	(78)
South	0.9x	0.77	x	11.57	x	114.87	x	0.63	x	0.7	=	406.18	(78)
South	0.9x	0.77	x	11.57	x	110.55	x	0.63	x	0.7	=	390.89	(78)
South	0.9x	0.77	x	11.57	x	108.01	x	0.63	x	0.7	=	381.92	(78)
South	0.9x	0.77	x	11.57	x	104.89	x	0.63	x	0.7	=	370.9	(78)
South	0.9x	0.77	x	11.57	x	101.89	x	0.63	x	0.7	=	360.26	(78)
South	0.9x	0.77	x	11.57	x	82.59	x	0.63	x	0.7	=	292.02	(78)
South	0.9x	0.77	x	11.57	x	55.42	x	0.63	x	0.7	=	195.95	(78)
South	0.9x	0.77	x	11.57	x	40.4	x	0.63	x	0.7	=	142.85	(78)

Solar gains in watts, calculated for each month

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

(83)m=	181.63	301.92	397.85	474.87	520.8	513.6	496.49	461.8	423.96	329.13	216.08	156.45	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	711.29	827.65	904.14	950.94	965.97	930.93	897.4	870.33	849.74	785.33	706.17	672.14	(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)
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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=	0.97	0.93	0.86	0.73	0.57	0.4	0.29	0.31	0.48	0.75	0.93	0.98	(86)

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

(87)m=	20.52	20.69	20.84	20.95	20.99	21	21	21	21	20.95	20.74	20.49	(87)
--------	-------	-------	-------	-------	-------	----	----	----	----	-------	-------	-------	------

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

(88)m=	20.2	20.2	20.2	20.21	20.22	20.23	20.23	20.23	20.22	20.22	20.21	20.21	(88)
--------	------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.96	0.91	0.83	0.69	0.53	0.36	0.24	0.26	0.43	0.71	0.91	0.97	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	19.59	19.82	20.02	20.16	20.21	20.23	20.23	20.23	20.22	20.17	19.91	19.55	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.42 (91)

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

(92)m=	19.98	20.18	20.36	20.49	20.53	20.55	20.55	20.55	20.55	20.5	20.25	19.94	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

SAP WorkSheet: New dwelling design stage

(93)m=	19.98	20.18	20.36	20.49	20.53	20.55	20.55	20.55	20.55	20.5	20.25	19.94	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.96	0.91	0.84	0.7	0.54	0.38	0.26	0.28	0.45	0.72	0.91	0.97	(94)
--------	------	------	------	-----	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	681.5	755.42	756.24	670.39	525.31	350.29	232.79	243.75	381.52	567.01	643.66	649.94	(95)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	968.27	940.52	850.06	698.25	530.22	350.64	232.82	243.79	382.65	593.89	795.21	958.35	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	213.35	124.39	69.8	20.06	3.65	0	0	0	0	19.99	109.12	229.45	
--------	--------	--------	------	-------	------	---	---	---	---	-------	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 789.82 (98)

Space heating requirement in $kWh/m^2/year$

11.08 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

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

1 (202)

Fraction of total heating from main system 1

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

1 (204)

Efficiency of main space heating system 1

100 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

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

Space heating requirement (calculated above)

213.35	124.39	69.8	20.06	3.65	0	0	0	0	19.99	109.12	229.45
--------	--------	------	-------	------	---	---	---	---	-------	--------	--------

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

213.35	124.39	69.8	20.06	3.65	0	0	0	0	19.99	109.12	229.45
--------	--------	------	-------	------	---	---	---	---	-------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 789.82 (211)

Space heating fuel (secondary), $kWh/month$

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

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

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

Water heating

Output from water heater (calculated above)

167.6	147.26	153.57	136.15	132.33	116.66	110.54	123.37	123.8	141.25	151.26	163.06
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Efficiency of water heater

100 (216)

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

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	167.6	147.26	153.57	136.15	132.33	116.66	110.54	123.37	123.8	141.25	151.26	163.06
---------	-------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

Total = $Sum(219a)_{1..12} =$ 1666.85 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

789.82

SAP WorkSheet: New dwelling design stage

Water heating fuel used		1666.85	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside		189.36	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	189.36	(231)
Electricity for lighting		315.23	(232)
Electricity generated by PVs		-172.72	(233)

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 =	104.18 (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 =	219.86 (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 =	24.98 (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 =	41.58 (250)
Additional standing charges (Table 12)				0 (251)
	one of (233) to (235) x	13.19	x 0.01 =	-22.78 (252)
Appendix Q items: repeat lines (253) and (254) as needed				
Total energy cost	(245)...(247) + (250)...(254) =			367.81 (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] =	1.33	(257)
SAP rating (Section 12)		81.46	(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	=	409.92 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.519	=	865.09 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1275.01 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	98.28 (267)

SAP WorkSheet: New dwelling design stage

Electricity for lighting	(232) x	0.519	=	163.61	(268)
Energy saving/generation technologies Item 1		0.519	=	-89.64	(269)
Total CO ₂ , kg/year	sum of (265)...(271) =			1447.25	(272)
CO₂ emissions per m²	(272) ÷ (4) =			20.31	(273)
El rating (section 14)				83	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2424.74	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	5117.21	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7541.96	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	581.35	(267)
Electricity for lighting	(232) x	0	=	967.76	(268)
Energy saving/generation technologies Item 1		3.07	=	-530.26	(269)
'Total Primary Energy	sum of (265)...(271) =			8560.8	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			120.13	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.26

Property Address: 2B-TH-T1-MidTce-South x7

Address : 2B-TH-T1-MidTce-South, Ellesmere Street, MANCHESTER, M15

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	27.3	(1a) x	2.75	(2a) =	75.07 (3a)
First floor	43.96	(1b) x	3	(2b) =	131.88 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.26	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	206.95 (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				3	30 (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) =	30	÷ (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			0 (11)
<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>			
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) =		0.34 (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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TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.39
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

(24a)m=

0	0	0	0	0	0	0	0	0	0	0	0	0
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(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	0
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(24b)

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

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

(24c)m=

0	0	0	0	0	0	0	0	0	0	0	0	0
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(24c)

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

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

(24d)m=

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

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

(25)m=

0.59	0.59	0.58	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	0.58
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(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			11.57	x1/[1/(1.4)+0.04] =	15.34		(27)
Windows Type 2			5.02	x1/[1/(1.4)+0.04] =	6.66		(27)
Floor Type 1			27.3	x 0.13 =	3.549		(28)
Floor Type 2			16.66	x 0.13 =	2.1658		(28)
Walls Type1	32.3	16.59	15.71	x 0.18 =	2.83		(29)
Walls Type2	10.45	0	10.45	x 0.18 =	1.88		(29)
Total area of elements, m²			86.71				(31)

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

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

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

32.42 (33)

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

4618.74 (34)

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

250 (35)

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

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

9.34 (36)

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

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

41.76 (37)

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

(38)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	40.4	40.16	39.92	38.8	38.6	37.62	37.62	37.44	38	38.6	39.02	39.46

(38)

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

(39)m=	82.16	81.92	81.68	80.56	80.35	79.38	79.38	79.2	79.75	80.35	80.78	81.22
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TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	1.15	1.15	1.15	1.13	1.13	1.11	1.11	1.11	1.12	1.13	1.13	1.14		
Average = Sum(40) _{1...12} /12=													1.13	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.28

(42)

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

if TFA ≤ 13.9, N = 1

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

88.26

(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=	97.09	93.56	90.03	86.5	82.97	79.44	79.44	82.97	86.5	90.03	93.56	97.09		
Total = Sum(44) _{1...12} =													1059.15	(44)

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

(45)m=	143.98	125.93	129.94	113.29	108.7	93.8	86.92	99.74	100.94	117.63	128.4	139.44		
Total = Sum(45) _{1..12} =													1388.72	(45)

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

(46)m=	21.6	18.89	19.49	16.99	16.31	14.07	13.04	14.96	15.14	17.64	19.26	20.92		(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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TER WorkSheet: New dwelling design stage

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=	190.57	168.01	176.54	158.38	155.3	138.89	133.52	146.34	146.03	164.23	173.49	186.03	(62)
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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=	190.57	168.01	176.54	158.38	155.3	138.89	133.52	146.34	146.03	164.23	173.49	186.03	
Output from water heater (annual) _{1...12}												1937.33	(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=	85.15	75.54	80.48	73.74	73.42	67.26	66.18	70.44	69.63	76.39	78.77	83.64	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	113.82	113.82	113.82	113.82	113.82	113.82	113.82	113.82	113.82	113.82	113.82	113.82	(66)

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

(67)m=	17.85	15.85	12.89	9.76	7.3	6.16	6.66	8.65	11.61	14.74	17.21	18.35	(67)
--------	-------	-------	-------	------	-----	------	------	------	-------	-------	-------	-------	------

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

(68)m=	200.22	202.3	197.06	185.92	171.85	158.62	149.79	147.71	152.95	164.09	178.16	191.39	(68)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	34.38	34.38	34.38	34.38	34.38	34.38	34.38	34.38	34.38	34.38	34.38	34.38	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

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

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

(71)m=	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	-91.05	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	114.45	112.41	108.18	102.42	98.68	93.42	88.95	94.68	96.71	102.67	109.4	112.42	(72)
--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	-------	--------	------

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

(73)m=	392.66	390.71	378.28	358.24	337.97	318.35	305.54	311.19	321.42	341.65	364.92	382.29	(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	5.02	x	10.63	x	0.63	x	0.7	=	16.31	(74)
North	0.9x	0.77	x	5.02	x	20.32	x	0.63	x	0.7	=	31.18	(74)
North	0.9x	0.77	x	5.02	x	34.53	x	0.63	x	0.7	=	52.98	(74)
North	0.9x	0.77	x	5.02	x	55.46	x	0.63	x	0.7	=	85.09	(74)
North	0.9x	0.77	x	5.02	x	74.72	x	0.63	x	0.7	=	114.63	(74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	5.02	x	79.99	x	0.63	x	0.7	=	122.71	(74)
North	0.9x	0.77	x	5.02	x	74.68	x	0.63	x	0.7	=	114.57	(74)
North	0.9x	0.77	x	5.02	x	59.25	x	0.63	x	0.7	=	90.89	(74)
North	0.9x	0.77	x	5.02	x	41.52	x	0.63	x	0.7	=	63.69	(74)
North	0.9x	0.77	x	5.02	x	24.19	x	0.63	x	0.7	=	37.11	(74)
North	0.9x	0.77	x	5.02	x	13.12	x	0.63	x	0.7	=	20.12	(74)
North	0.9x	0.77	x	5.02	x	8.86	x	0.63	x	0.7	=	13.6	(74)
South	0.9x	0.77	x	11.57	x	46.75	x	0.63	x	0.7	=	165.31	(78)
South	0.9x	0.77	x	11.57	x	76.57	x	0.63	x	0.7	=	270.74	(78)
South	0.9x	0.77	x	11.57	x	97.53	x	0.63	x	0.7	=	344.87	(78)
South	0.9x	0.77	x	11.57	x	110.23	x	0.63	x	0.7	=	389.78	(78)
South	0.9x	0.77	x	11.57	x	114.87	x	0.63	x	0.7	=	406.18	(78)
South	0.9x	0.77	x	11.57	x	110.55	x	0.63	x	0.7	=	390.89	(78)
South	0.9x	0.77	x	11.57	x	108.01	x	0.63	x	0.7	=	381.92	(78)
South	0.9x	0.77	x	11.57	x	104.89	x	0.63	x	0.7	=	370.9	(78)
South	0.9x	0.77	x	11.57	x	101.89	x	0.63	x	0.7	=	360.26	(78)
South	0.9x	0.77	x	11.57	x	82.59	x	0.63	x	0.7	=	292.02	(78)
South	0.9x	0.77	x	11.57	x	55.42	x	0.63	x	0.7	=	195.95	(78)
South	0.9x	0.77	x	11.57	x	40.4	x	0.63	x	0.7	=	142.85	(78)

Solar gains in watts, calculated for each month

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

(83)m=

181.63	301.92	397.85	474.87	520.8	513.6	496.49	461.8	423.96	329.13	216.08	156.45
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 (83)

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

(84)m=

574.29	692.62	776.12	833.12	858.77	831.95	802.03	772.98	745.37	670.78	580.99	538.74
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (84)

7. Mean internal temperature (heating season)

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

21

 (85)

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

(86)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.99	0.98	0.96	0.89	0.77	0.59	0.43	0.47	0.69	0.91	0.98	0.99

 (86)

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

(87)m=

19.94	20.16	20.42	20.7	20.89	20.98	21	20.99	20.95	20.7	20.27	19.91
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 (87)

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

(88)m=

19.96	19.96	19.96	19.98	19.98	19.99	19.99	19.99	19.99	19.98	19.97	19.97
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (88)

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

(89)m=

0.99	0.98	0.94	0.86	0.71	0.51	0.33	0.37	0.61	0.88	0.98	0.99
------	------	------	------	------	------	------	------	------	------	------	------

 (89)

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

(90)m=

18.57	18.88	19.25	19.64	19.88	19.98	19.99	19.99	19.95	19.66	19.06	18.53
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (90)

fLA = Living area ÷ (4) =

0.42

 (91)

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

(92)m=

19.14	19.41	19.74	20.08	20.3	20.39	20.41	20.41	20.37	20.1	19.56	19.1
-------	-------	-------	-------	------	-------	-------	-------	-------	------	-------	------

 (92)

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

TER WorkSheet: New dwelling design stage

(93)m=	19.14	19.41	19.74	20.08	20.3	20.39	20.41	20.41	20.37	20.1	19.56	19.1	(93)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	------	-------	------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.99	0.97	0.94	0.87	0.73	0.54	0.38	0.41	0.64	0.89	0.97	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	567.26	672.74	728.49	722.09	630.46	449.97	301.08	315.57	476.81	593.69	565.43	533.73	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	1219.64	1188.97	1081.21	900.73	691.04	459.91	302.31	317.47	499.97	763.12	1006.78	1210.26	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(98)m=	485.37	346.91	262.42	128.62	45.07	0	0	0	0	126.06	317.77	503.34	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												2215.55	(98)

Space heating requirement in $kWh/m^2/year$

31.09	(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) × [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
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

485.37	346.91	262.42	128.62	45.07	0	0	0	0	126.06	317.77	503.34
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

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

519.11	371.02	280.67	137.56	48.2	0	0	0	0	134.82	339.87	538.33
--------	--------	--------	--------	------	---	---	---	---	--------	--------	--------

Total (kWh/year) = Sum(211)_{1...5,10...12} = 2369.58 (211)

Space heating fuel (secondary), $kWh/month$

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

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

Water heating

Output from water heater (calculated above)

190.57	168.01	176.54	158.38	155.3	138.89	133.52	146.34	146.03	164.23	173.49	186.03
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Efficiency of water heater 79.8 (216)

(217)m= (217)

87.2	86.71	85.87	84.26	81.98	79.8	79.8	79.8	79.8	84.12	86.41	87.34
------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	218.54	193.77	205.59	187.96	189.43	174.05	167.31	183.38	182.99	195.23	200.78	213	
Total = Sum(219a) _{1...12} =												2312.04	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year	kWh/year
	2369.58

TER WorkSheet: New dwelling design stage

Water heating fuel used			2312.04	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75	(231)
Electricity for lighting			315.23	(232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	511.83	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	499.4	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1011.23	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	163.61	(268)
Total CO2, kg/year		sum of (265)...(271) =			1213.76	(272)

TER = 24.84 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.26
Printed on 11 September 2020 at 15:16:56

Project Information:

Assessed By: Daniel Watt (STRO026464)

Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 87.78m²

Site Reference : Phoenix Works

Plot Reference: 2B-PH-T1-MidTce-South x3

Address : 2B-PH-T1-MidTce-South, Ellesmere Street, MANCHESTER, M15

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) 26.42 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 26.06 kg/m² **OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 54.5 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 44.0 kWh/m² **OK**

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Floor	(no floor)		
Roof	0.15 (max. 0.20)	0.15 (max. 0.35)	OK
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: 1.45 kWh/day
Permitted by DBSCG: 2.10 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:	0.71	
Maximum	1.5	OK
MVHR efficiency:	86%	
Minimum	70%	OK

9 Summertime temperature

Overheating risk (North West England):	Not significant	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: South	19.92m ²	
Windows facing: North	8.67m ²	
Windows facing: North	5.28m ²	
Ventilation rate:	4.00	

10 Key features

Air permeability	3.0 m ³ /m ² h	
Photovoltaic array		

Predicted Energy Assessment



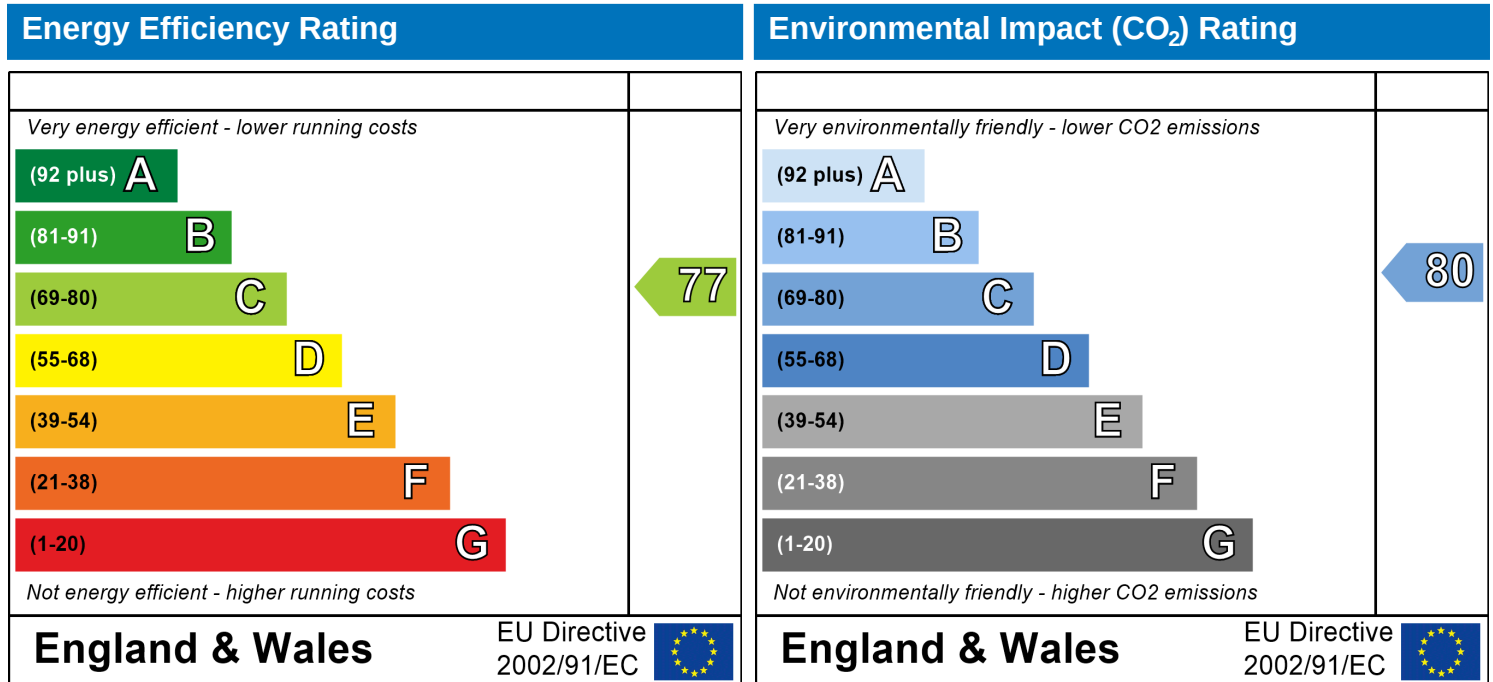
2B-PH-T1-MidTce-South
Ellesmere Street
MANCHESTER
M15

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

Top floor Flat
02 September 2020
Daniel Watt
87.78 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: 2B-PH-T1-MidTce-South x3

Address: 2B-PH-T1-MidTce-South, Ellesmere Street, MANCHESTER, M15
Located in: England
Region: North West England
UPRN:
Date of assessment: 02 September 2020
Date of certificate: 11 September 2020
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: 465

Property description:

Dwelling type: Flat
Detachment:
Year Completed: 2020
Floor Location: **Floor area:** **Storey height:**
 Floor 0 48.59 m² 3.17 m
 Floor 1 39.19 m² 2.95 m
Living area: 30.1 m² (fraction 0.408)
Front of dwelling faces: North

Opening types:

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

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
North glazing	16mm or more	0.7	0.63	1.4	4.98	4
South glazing (large)	16mm or more	0.7	0.63	1.4	8.67	1
South glazing (small)	16mm or more	0.7	0.63	1.4	1.32	4

Name:	Type-Name:	Location:	Orient:	Width:	Height:
North glazing		External walls	South	1.952	2.55
South glazing (large)		External walls	North	1.64	5.2875
South glazing (small)		External walls	North	0.615	2.15

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	87.69	33.87	53.82	0.2	0	False	N/A
Flat roof	48.59	0	48.59	0.15	0		N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0498

Length	Psi-value
11.908	0.03

 E2 Other lintels (including other steel lintels)

SAP Input

[Approved]	11.908	0.04	E3	Sill
[Approved]	48.175	0.05	E4	Jamb
[Approved]	15.8	0.07	E7	Party floor between dwellings (in blocks of flats)
[Approved]	0	0.09	E16	Corner (normal)
[Approved]	22.2	0.06	E18	Party wall between dwellings
	15.8	0	E15	Flat roof with parapet
[Approved]	15.8	0.07	E6	Intermediate floor within a dwelling
	12.3	0	P3	Intermediate floor between dwellings (in blocks of flats)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery
	Number of wet rooms: Kitchen + 3
	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: 180 litres
	Cylinder insulation: Measured loss, 1.45kWh/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
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	<u>Photovoltaic 1</u>
	Installed Peak power: 0.2

SAP Input

Tilt of collector: 30°
Overshading: None or very little
Collector Orientation: South
No

Assess Zero Carbon Home:

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.26

Property Address: 2B-PH-T1-MidTce-South x3

Address : 2B-PH-T1-MidTce-South, Ellesmere Street, MANCHESTER, M15

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	48.59 (1a) x	3.17 (2a) =	154.03 (3a)
First floor	39.19 (1b) x	2.95 (2b) =	115.61 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	87.78 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	269.64 (5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0 (8)
<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		0 (11)
<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>		
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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SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

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

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

73.1 (23c)

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

(24a)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(24a)
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b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

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

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(25)
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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			4.98	$x1/[1/(1.4)+0.04] =$	6.6		(27)
Windows Type 2			8.67	$x1/[1/(1.4)+0.04] =$	11.49		(27)
Windows Type 3			1.32	$x1/[1/(1.4)+0.04] =$	1.75		(27)
Walls	87.69	33.87	53.82	x 0.2	10.76		(29)
Roof	48.59	0	48.59	x 0.15	7.29		(30)
Total area of elements, m²			136.28				(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) = 62.96 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 1190.79 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.79 (36)

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

Total fabric heat loss (33) + (36) = 69.74 (37)

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

(38)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(38)
	26.43	26.15	25.87	24.45	24.16	22.75	22.75	22.46	23.31	24.16	24.73	25.3	

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

(39)m=	96.18	95.89	95.61	94.19	93.91	92.49	92.49	92.2	93.06	93.91	94.47	95.04	Average = Sum(39) _{1...12} /12= 94.12 (39)
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SAP WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	1.1	1.09	1.09	1.07	1.07	1.05	1.05	1.05	1.06	1.07	1.08	1.08		
Average = Sum(40) _{1...12} /12=													1.07	(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

2.59

(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

95.81

(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=	105.39	101.56	97.73	93.89	90.06	86.23	86.23	90.06	93.89	97.73	101.56	105.39		
Total = Sum(44) _{1...12} =													1149.72	(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=	156.29	136.69	141.06	122.98	118	101.82	94.35	108.27	109.57	127.69	139.38	151.36		
Total = Sum(45) _{1...12} =													1507.46	(45)

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

(46)m=	23.44	20.5	21.16	18.45	17.7	15.27	14.15	16.24	16.43	19.15	20.91	22.7		(46)
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Water storage loss:

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

180

(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):

1.45

(48)

Temperature factor from Table 2b

0.6

(49)

Energy lost from water storage, kWh/year

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

0.87

(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)

0.87

(55)

Water storage loss calculated for each month

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

(56)m=	26.97	24.36	26.97	26.1	26.97	26.1	26.97	26.97	26.1	26.97	26.1	26.97		(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=	26.97	24.36	26.97	26.1	26.97	26.1	26.97	26.97	26.1	26.97	26.1	26.97		(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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SAP WorkSheet: New dwelling design stage

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=	183.26	161.05	168.03	149.08	144.97	127.92	121.32	135.24	135.67	154.66	165.48	178.33	(62)
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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=	183.26	161.05	168.03	149.08	144.97	127.92	121.32	135.24	135.67	154.66	165.48	178.33	
Output from water heater (annual) _{1...12}												1825.01	(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=	73.54	64.94	68.48	61.77	60.81	54.74	52.95	57.58	57.31	64.03	67.22	71.9	(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=	155.65	155.65	155.65	155.65	155.65	155.65	155.65	155.65	155.65	155.65	155.65	155.65	(66)

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

(67)m=	52.36	46.51	37.82	28.63	21.4	18.07	19.53	25.38	34.06	43.25	50.48	53.82	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	350.65	354.29	345.12	325.6	300.96	277.8	262.33	258.69	267.86	287.38	312.02	335.18	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	53.16	53.16	53.16	53.16	53.16	53.16	53.16	53.16	53.16	53.16	53.16	53.16	(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=	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	(71)
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Water heating gains (Table 5)

(72)m=	98.85	96.63	92.04	85.79	81.73	76.02	71.17	77.39	79.6	86.07	93.37	96.64	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	606.9	602.47	580.02	545.06	509.13	476.93	458.06	466.5	486.56	521.74	560.91	590.68	(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	8.67	x	10.63	x	0.63	x	0.7	=	28.17	(74)
North	0.9x	0.77	x	1.32	x	10.63	x	0.63	x	0.7	=	17.16	(74)
North	0.9x	0.77	x	8.67	x	20.32	x	0.63	x	0.7	=	53.84	(74)
North	0.9x	0.77	x	1.32	x	20.32	x	0.63	x	0.7	=	32.79	(74)
North	0.9x	0.77	x	8.67	x	34.53	x	0.63	x	0.7	=	91.49	(74)

SAP WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.32	x	34.53	x	0.63	x	0.7	=	55.72	(74)
North	0.9x	0.77	x	8.67	x	55.46	x	0.63	x	0.7	=	146.96	(74)
North	0.9x	0.77	x	1.32	x	55.46	x	0.63	x	0.7	=	89.5	(74)
North	0.9x	0.77	x	8.67	x	74.72	x	0.63	x	0.7	=	197.97	(74)
North	0.9x	0.77	x	1.32	x	74.72	x	0.63	x	0.7	=	120.56	(74)
North	0.9x	0.77	x	8.67	x	79.99	x	0.63	x	0.7	=	211.93	(74)
North	0.9x	0.77	x	1.32	x	79.99	x	0.63	x	0.7	=	129.07	(74)
North	0.9x	0.77	x	8.67	x	74.68	x	0.63	x	0.7	=	197.87	(74)
North	0.9x	0.77	x	1.32	x	74.68	x	0.63	x	0.7	=	120.5	(74)
North	0.9x	0.77	x	8.67	x	59.25	x	0.63	x	0.7	=	156.98	(74)
North	0.9x	0.77	x	1.32	x	59.25	x	0.63	x	0.7	=	95.6	(74)
North	0.9x	0.77	x	8.67	x	41.52	x	0.63	x	0.7	=	110	(74)
North	0.9x	0.77	x	1.32	x	41.52	x	0.63	x	0.7	=	66.99	(74)
North	0.9x	0.77	x	8.67	x	24.19	x	0.63	x	0.7	=	64.09	(74)
North	0.9x	0.77	x	1.32	x	24.19	x	0.63	x	0.7	=	39.03	(74)
North	0.9x	0.77	x	8.67	x	13.12	x	0.63	x	0.7	=	34.76	(74)
North	0.9x	0.77	x	1.32	x	13.12	x	0.63	x	0.7	=	21.17	(74)
North	0.9x	0.77	x	8.67	x	8.86	x	0.63	x	0.7	=	23.49	(74)
North	0.9x	0.77	x	1.32	x	8.86	x	0.63	x	0.7	=	14.3	(74)
South	0.9x	0.77	x	4.98	x	46.75	x	0.63	x	0.7	=	284.62	(78)
South	0.9x	0.77	x	4.98	x	76.57	x	0.63	x	0.7	=	466.13	(78)
South	0.9x	0.77	x	4.98	x	97.53	x	0.63	x	0.7	=	593.77	(78)
South	0.9x	0.77	x	4.98	x	110.23	x	0.63	x	0.7	=	671.09	(78)
South	0.9x	0.77	x	4.98	x	114.87	x	0.63	x	0.7	=	699.31	(78)
South	0.9x	0.77	x	4.98	x	110.55	x	0.63	x	0.7	=	672.99	(78)
South	0.9x	0.77	x	4.98	x	108.01	x	0.63	x	0.7	=	657.56	(78)
South	0.9x	0.77	x	4.98	x	104.89	x	0.63	x	0.7	=	638.58	(78)
South	0.9x	0.77	x	4.98	x	101.89	x	0.63	x	0.7	=	620.26	(78)
South	0.9x	0.77	x	4.98	x	82.59	x	0.63	x	0.7	=	502.77	(78)
South	0.9x	0.77	x	4.98	x	55.42	x	0.63	x	0.7	=	337.37	(78)
South	0.9x	0.77	x	4.98	x	40.4	x	0.63	x	0.7	=	245.94	(78)

Solar gains in watts, calculated for each month

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

(83)m= 329.95 552.76 740.98 907.55 1017.85 1014 975.92 891.16 797.26 605.89 393.29 283.73 (83)

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

(84)m= 936.85 1155.23 1321 1452.61 1526.98 1490.93 1433.98 1357.66 1283.82 1127.63 954.2 874.41 (84)

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	0.97	0.93	0.86	0.73	0.56	0.4	0.28	0.31	0.49	0.78	0.94	0.98

(86)

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

(87)m= 20.25 20.5 20.73 20.91 20.98 21 21 21 20.99 20.89 20.55 20.2 (87)

SAP WorkSheet: New dwelling design stage

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

(88)m=	20	20.01	20.01	20.02	20.03	20.04	20.04	20.04	20.03	20.03	20.02	20.01	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.92	0.83	0.68	0.5	0.34	0.22	0.25	0.43	0.73	0.92	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=	19.05	19.39	19.7	19.93	20.01	20.04	20.04	20.04	20.03	19.92	19.48	18.98	(90)
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fLA = Living area ÷ (4) =	0.34	(91)
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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.46	19.77	20.05	20.26	20.34	20.37	20.37	20.37	20.36	20.25	19.85	19.4	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.46	19.77	20.05	20.26	20.34	20.37	20.37	20.37	20.36	20.25	19.85	19.4	(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
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.96	0.91	0.83	0.69	0.52	0.36	0.24	0.27	0.45	0.74	0.92	0.97	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	901.39	1055.67	1098.84	1005.36	798.1	532	348.39	365.82	577.78	832.21	879.26	848.9	(95)
--------	--------	---------	---------	---------	-------	-----	--------	--------	--------	--------	--------	-------	------

Monthly average external temperature from Table 8

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

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

(97)m=	1458.04	1426.05	1295.83	1070.41	811.44	533.34	348.52	366.04	582.38	906.38	1204.47	1444.64	(97)
--------	---------	---------	---------	---------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(98)m=	414.14	248.89	146.56	46.84	9.93	0	0	0	0	55.18	234.15	443.23	(98)
--------	--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------	------

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	1598.92	(98)
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Space heating requirement in kWh/m²/year

18.22	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

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

1	(202)
---	-------

Fraction of total heating from main system 1

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

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

Efficiency of main space heating system 1

100	(206)
-----	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

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

kWh/year

Space heating requirement (calculated above)

414.14	248.89	146.56	46.84	9.93	0	0	0	0	55.18	234.15	443.23
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

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

414.14	248.89	146.56	46.84	9.93	0	0	0	0	55.18	234.15	443.23
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

Total (kWh/year) =Sum(211) _{1...5,10...12} =	1598.92	(211)
---	---------	-------

Space heating fuel (secondary), kWh/month

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

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

SAP WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

183.26	161.05	168.03	149.08	144.97	127.92	121.32	135.24	135.67	154.66	165.48	178.33
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

100 (216)

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

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

183.26	161.05	168.03	149.08	144.97	127.92	121.32	135.24	135.67	154.66	165.48	178.33
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} = 1825.01 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1598.92

Water heating fuel used

1825.01

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

291.95 (230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 291.95 (231)

Electricity for lighting

369.89 (232)

Electricity generated by PVs

-172.72 (233)

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 =	210.9 (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 =	240.72 (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 =	38.51 (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 =	48.79 (250)
Additional standing charges (Table 12)			0 (251)
	one of (233) to (235) x	13.19 x 0.01 =	-22.78 (252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)...(254) = 516.13 (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] = 1.63 (257)

SAP rating (Section 12) 77.23 (258)

SAP WorkSheet: New dwelling design stage

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	=	829.84 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.519	=	947.18 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1777.02 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	151.52 (267)
Electricity for lighting	(232) x	0.519	=	191.97 (268)
Energy saving/generation technologies Item 1		0.519	=	-89.64 (269)
Total CO2, kg/year		sum of (265)...(271) =		2030.87 (272)
CO2 emissions per m²		(272) ÷ (4) =		23.14 (273)
El rating (section 14)				80 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year
Space heating (main system 1)	(211) x	3.07	=	4908.69 (261)
Space heating (secondary)	(215) x	3.07	=	0 (263)
Energy for water heating	(219) x	3.07	=	5602.79 (264)
Space and water heating	(261) + (262) + (263) + (264) =			10511.48 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	896.3 (267)
Electricity for lighting	(232) x	0	=	1135.55 (268)
Energy saving/generation technologies Item 1		3.07	=	-530.26 (269)
'Total Primary Energy		sum of (265)...(271) =		12013.06 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =		136.85 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.26

Property Address: 2B-PH-T1-MidTce-South x3

Address : 2B-PH-T1-MidTce-South, Ellesmere Street, MANCHESTER, M15

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	48.59 (1a)	x	3.17 (2a)	=	154.03 (3a)
First floor	39.19 (1b)	x	2.95 (2b)	=	115.61 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	87.78 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	269.64 (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				3	30 (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) =	30	÷ (5) =	0.11 (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			0 (11)
<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>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.36 (18)
<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) =		0.31 (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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TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.39	0.38	0.38	0.34	0.33	0.29	0.29	0.28	0.31	0.33	0.35	0.36
--	------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

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

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

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

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

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

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

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

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

(24d)m=	0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.57	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.57	(25)
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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			3.23	$x1/[1/(1.4)+0.04] =$	4.28		(27)
Windows Type 2			5.62	$x1/[1/(1.4)+0.04] =$	7.45		(27)
Windows Type 3			0.86	$x1/[1/(1.4)+0.04] =$	1.14		(27)
Walls	87.69	21.98	65.71	x 0.18 =	11.83		(29)
Roof	48.59	0	48.59	x 0.13 =	6.32		(30)
Total area of elements, m²			136.28				(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) = 47.28 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 1357.25 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 14.89 (36)

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

Total fabric heat loss (33) + (36) = 62.17 (37)

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

(38)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(38)
	51.31	51.05	50.79	49.57	49.34	48.28	48.28	48.08	48.69	49.34	49.8	50.28	

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

(39)m=	113.48	113.22	112.96	111.74	111.51	110.45	110.45	110.25	110.86	111.51	111.97	112.45	
	Average = Sum(39) _{1...12} /12= 111.74												(39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	1.29	1.29	1.29	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28		
Average = Sum(40) _{1...12} /12=													1.27	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.59

(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

95.81

(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=	105.39	101.56	97.73	93.89	90.06	86.23	86.23	90.06	93.89	97.73	101.56	105.39		
Total = Sum(44) _{1...12} =													1149.72	(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=	156.29	136.69	141.06	122.98	118	101.82	94.35	108.27	109.57	127.69	139.38	151.36		
Total = Sum(45) _{1...12} =													1507.46	(45)

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

(46)m=	23.44	20.5	21.16	18.45	17.7	15.27	14.15	16.24	16.43	19.15	20.91	22.7		(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):

1.55

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

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

0.84

(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)

0.84

(55)

Water storage loss calculated for each month

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

(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(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=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98		(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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TER WorkSheet: New dwelling design stage

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=	205.53	181.17	190.3	170.63	167.24	149.48	143.6	157.52	157.22	176.93	187.04	200.6	(62)
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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=	205.53	181.17	190.3	170.63	167.24	149.48	143.6	157.52	157.22	176.93	187.04	200.6	
Output from water heater (annual) _{1...12}												2087.25	(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=	91.36	81.03	86.3	79.01	78.63	71.98	70.77	75.39	74.55	81.85	84.47	89.72	(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=	129.7	129.7	129.7	129.7	129.7	129.7	129.7	129.7	129.7	129.7	129.7	129.7	(66)

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

(67)m=	20.94	18.6	15.13	11.45	8.56	7.23	7.81	10.15	13.63	17.3	20.19	21.53	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	234.93	237.37	231.23	218.15	201.64	186.12	175.76	173.32	179.46	192.54	209.05	224.57	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	35.97	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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=	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	-103.76	(71)
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Water heating gains (Table 5)

(72)m=	122.8	120.58	115.99	109.74	105.68	99.97	95.12	101.34	103.55	110.01	117.32	120.59	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	443.59	441.47	427.26	404.25	380.8	358.24	343.6	349.72	361.55	384.77	411.47	431.6	(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	5.62	x	10.63	x	0.63	x	0.7	=	18.26	(74)
North	0.9x	0.77	x	0.86	x	10.63	x	0.63	x	0.7	=	11.18	(74)
North	0.9x	0.77	x	5.62	x	20.32	x	0.63	x	0.7	=	34.9	(74)
North	0.9x	0.77	x	0.86	x	20.32	x	0.63	x	0.7	=	21.36	(74)
North	0.9x	0.77	x	5.62	x	34.53	x	0.63	x	0.7	=	59.31	(74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	0.86	x	34.53	x	0.63	x	0.7	=	36.3	(74)
North	0.9x	0.77	x	5.62	x	55.46	x	0.63	x	0.7	=	95.26	(74)
North	0.9x	0.77	x	0.86	x	55.46	x	0.63	x	0.7	=	58.31	(74)
North	0.9x	0.77	x	5.62	x	74.72	x	0.63	x	0.7	=	128.33	(74)
North	0.9x	0.77	x	0.86	x	74.72	x	0.63	x	0.7	=	78.55	(74)
North	0.9x	0.77	x	5.62	x	79.99	x	0.63	x	0.7	=	137.38	(74)
North	0.9x	0.77	x	0.86	x	79.99	x	0.63	x	0.7	=	84.09	(74)
North	0.9x	0.77	x	5.62	x	74.68	x	0.63	x	0.7	=	128.26	(74)
North	0.9x	0.77	x	0.86	x	74.68	x	0.63	x	0.7	=	78.51	(74)
North	0.9x	0.77	x	5.62	x	59.25	x	0.63	x	0.7	=	101.76	(74)
North	0.9x	0.77	x	0.86	x	59.25	x	0.63	x	0.7	=	62.29	(74)
North	0.9x	0.77	x	5.62	x	41.52	x	0.63	x	0.7	=	71.31	(74)
North	0.9x	0.77	x	0.86	x	41.52	x	0.63	x	0.7	=	43.65	(74)
North	0.9x	0.77	x	5.62	x	24.19	x	0.63	x	0.7	=	41.55	(74)
North	0.9x	0.77	x	0.86	x	24.19	x	0.63	x	0.7	=	25.43	(74)
North	0.9x	0.77	x	5.62	x	13.12	x	0.63	x	0.7	=	22.53	(74)
North	0.9x	0.77	x	0.86	x	13.12	x	0.63	x	0.7	=	13.79	(74)
North	0.9x	0.77	x	5.62	x	8.86	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	0.86	x	8.86	x	0.63	x	0.7	=	9.32	(74)
South	0.9x	0.77	x	3.23	x	46.75	x	0.63	x	0.7	=	184.6	(78)
South	0.9x	0.77	x	3.23	x	76.57	x	0.63	x	0.7	=	302.33	(78)
South	0.9x	0.77	x	3.23	x	97.53	x	0.63	x	0.7	=	385.11	(78)
South	0.9x	0.77	x	3.23	x	110.23	x	0.63	x	0.7	=	435.26	(78)
South	0.9x	0.77	x	3.23	x	114.87	x	0.63	x	0.7	=	453.57	(78)
South	0.9x	0.77	x	3.23	x	110.55	x	0.63	x	0.7	=	436.5	(78)
South	0.9x	0.77	x	3.23	x	108.01	x	0.63	x	0.7	=	426.49	(78)
South	0.9x	0.77	x	3.23	x	104.89	x	0.63	x	0.7	=	414.18	(78)
South	0.9x	0.77	x	3.23	x	101.89	x	0.63	x	0.7	=	402.3	(78)
South	0.9x	0.77	x	3.23	x	82.59	x	0.63	x	0.7	=	326.09	(78)
South	0.9x	0.77	x	3.23	x	55.42	x	0.63	x	0.7	=	218.82	(78)
South	0.9x	0.77	x	3.23	x	40.4	x	0.63	x	0.7	=	159.51	(78)

Solar gains in watts, calculated for each month

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

(83)m= 214.04 358.6 480.72 588.84 660.45 657.97 633.26 578.22 517.25 393.07 255.14 184.06 (83)

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

(84)m= 657.63 800.07 907.98 993.09 1041.24 1016.2 976.85 927.94 878.8 777.84 666.61 615.66 (84)

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	0.99	0.99	0.97	0.92	0.82	0.65	0.49	0.53	0.76	0.94	0.99	1

(86)

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

(87)m= 19.71 19.92 20.21 20.54 20.81 20.95 20.99 20.99 20.9 20.55 20.06 19.67 (87)

TER WorkSheet: New dwelling design stage

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

(88)m=	19.85	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.86	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.9	0.76	0.55	0.37	0.41	0.67	0.92	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.15	18.46	18.88	19.35	19.69	19.84	19.87	19.87	19.8	19.37	18.68	18.1	(90)
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fLA = Living area ÷ (4) =	0.34	(91)
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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.68	18.96	19.33	19.76	20.07	20.22	20.25	20.25	20.18	19.78	19.15	18.64	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.68	18.96	19.33	19.76	20.07	20.22	20.25	20.25	20.18	19.78	19.15	18.64	(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	0.89	0.78	0.59	0.41	0.45	0.7	0.91	0.98	0.99	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	651.49	782.79	865.4	887.88	807.15	595.49	399.8	418.75	615.1	711.58	653.47	611.28	(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=	1632.22	1592.28	1449.63	1213.4	933.56	621.19	403.61	424.73	673.5	1023.48	1349.38	1623.41	(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=	729.66	543.98	434.67	234.38	94.05	0	0	0	0	232.05	501.05	753.03	(98)
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Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	3522.87	(98)
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Space heating requirement in kWh/m²/year

40.13	(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)
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Fraction of space heat from main system(s)

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

1	(202)
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Fraction of total heating from main system 1

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

1	(204)
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Efficiency of main space heating system 1

93.5	(206)
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Efficiency of secondary/supplementary heating system, %

0	(208)
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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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kWh/year

Space heating requirement (calculated above)

729.66	543.98	434.67	234.38	94.05	0	0	0	0	232.05	501.05	753.03
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(211)m = {[(98)m x (204)] } x 100 ÷ (206)	(211)
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780.39	581.8	464.89	250.67	100.59	0	0	0	0	248.19	535.88	805.37
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Total (kWh/year) =Sum(211) _{1...5,10...12} =	3767.77	(211)
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Space heating fuel (secondary), kWh/month

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

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
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Total (kWh/year) =Sum(215) _{1...5,10...12} =	0	(215)
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TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

205.53	181.17	190.3	170.63	167.24	149.48	143.6	157.52	157.22	176.93	187.04	200.6
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Efficiency of water heater

79.8 (216)

(217)m= 87.91 87.57 86.95 85.66 83.35 79.8 79.8 79.8 79.8 85.54 87.32 88.02 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

233.8	206.9	218.86	199.19	200.66	187.32	179.95	197.39	197.02	206.84	214.2	227.91
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Total = Sum(219a)_{1...12} =

2470.03 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

3767.77

Water heating fuel used

2470.03

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

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

75

(231)

Electricity for lighting

369.89

(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	= 813.84 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 533.53 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1347.37 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 38.93 (267)
Electricity for lighting	(232) x	0.519	= 191.97 (268)
Total CO2, kg/year		sum of (265)...(271) =	1578.26 (272)

TER =

26.42 (273)