
Anchorbridge Developments

Environmental Standards Statement

Ref: 21003 – Proposed development at Summerhill, The Greenfinch, Lapwing Lane, Didsbury, Manchester

10 June 2021

Daniel Watt

CIBSE Accreditation Nos:

LCCSIM084077

LCCD084077

LCEA084077

Watt Energy & Consulting Engineers Ltd

40 King Street, Manchester, M2 6BA

t. 0161 43 43 103

w. www.wece.co.uk



Issue Status

Director

Daniel Watt



Energy and Sustainability Consultant

Jack Sewell

First Issue Date	Revision Issue Date	Issue Revision	Issued By
June 10, 2021			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. Flood Risk Zone
 - 2.4.2. Green Blue Infrastructure
 - 2.4.2.1. Sustainable Drainage Systems (SUDs)
 - 2.4.2.2. Biodiversity
 - 2.4.3. Internal Water Efficiency
 - 2.4.4. Waste Management
 - 2.4.4.1. Occupational Waste
 - 2.4.4.2. Construction Waste
 - 2.4.5. Materials
 - 2.4.6. Pollution Control
 - 2.4.7. Health and Wellbeing
 - 2.4.8. Sustainable Transport
3. Feasibility Assessment of Renewable Energy and Low Carbon Technologies
4. Conclusion

Appendices

- A - Energy Demand Assessment Spreadsheet
- 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 Anchorbridge Developments to support a planning application for the development of The Greenfinch. The statement specifically addresses the following Manchester City 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 (2007)
- 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 2017
- 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 **10%** 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 **1.8kWp PV array**, which equates to a **2.7%** renewable energy contribution.



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

- **10.9%** with SAP 9 carbon factors

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 City 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 relating to creating a sustainable development.

In relation to the planning target centred around carbon emissions reduction, the proposed development is achieving a **10.9%** reduction in these emissions, over the Part L1A 2013 of the Building Regulations. This surpasses all of Manchester City Council's planning targets and therefore allows compliance to be reached.



2. Planning Statement

The following statement relates to the proposed development at Summerhill, The Greenfinch, Lapwing Lane, Didsbury, Manchester.

2.1 The Site and Proposed Development

The site is located south of the centre of Manchester, along Lapwing Lane. 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 northwest by Raleigh Close, Lapwing Lane to northeast and Palatine Road to the southeast. The site is almost entirely hardstanding which at present occupies The Greenfinch pub and its associated car parking.

The proposal is for the change of use and conversion of former Greenfinch Public House including selective demolition to provide office accommodation (use class E) and 3 apartments (use class C3), and redevelopment of site to provide 9 dwellings (use class C3) with associated works including landscaping and car parking. Figure 1 below shows the location of the site and surrounding development areas.



Figure 1: Site Plan

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 2007

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 2017

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 2015-25

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

Table 1: Overview of Manchester Planning Documents Carbon Targets



2.2.4 National Planning Policy

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

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

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



2.3 Sustainable Design Strategy

2.3.1 Energy and Carbon Emissions

Building Services Strategy

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

1. Achieve a minimum of 10% CO₂ reduction over the Part L 2013 Target Emission Rate (TER), as per Target 2 (Electricity intense buildings) in Table 12.1 of Policy EN6.
2. Assist in achieving carbon neutrality by 2038

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

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



Fig 2: Energy Hierarchy

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

Meet demands efficiently – Specification of energy efficient decentralised plant, heating, ventilation, lighting and system controls to facilitate efficient operation. For example, each dwelling will include highly efficient gas boilers to provide the main heating and hot water requirements.

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

Additional Renewable Energy Measures

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

Roof-mounted PV panels, are to be provided in this project on suitable roof-top areas of the apartment blocks 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
- 100% operational energy supplied by a renewable energy provider

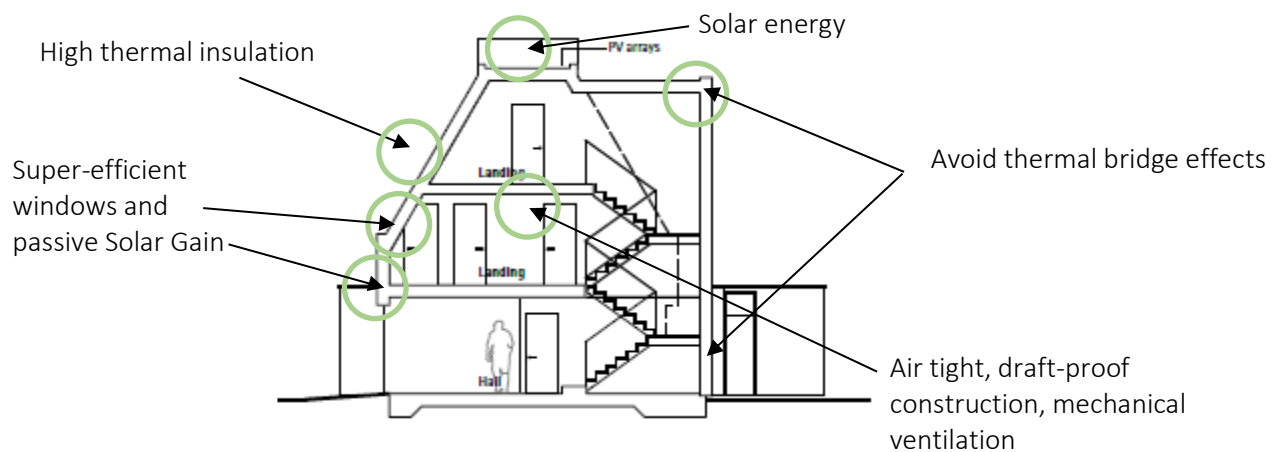


Fig 3. Efficient Design Measure examples

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

Residential Units:

- Ground floor U-values of $0.12 \text{ W/m}^2\text{K}$
- Exposed Floor U-values of $0.12 \text{ W/m}^2\text{K}$
- New External Wall U-values of $0.20 \text{ W/m}^2\text{K}$ (houses)
- Upgraded External Wall U-values of $0.30 \text{ W/m}^2\text{K}$ (flats)
- Flat Ceiling U-values of $0.11 \text{ W/m}^2\text{K}$ and Sloped Ceiling U-values of $0.14 \text{ W/m}^2\text{K}$
- Use of ACD's to minimize Thermal Bridging and ψ Value specifying hi-therm lintels with a PSI of 0.03
- Low Window U-values of $1.4 \text{ W/m}^2\text{K}$
- 100% low energy lighting throughout
- 90% efficient combi and system gas boilers
- Hot water cylinders to all detached and large semi-detached houses
- Air Permeability Rate of $5\text{m}^3/\text{hm}^2$ in all houses

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:

- **1.8kWp Site Wide PV Array (Approx. 6no. 300W Panels) implemented onto the main roof of the converted pub building**

The above LZC contribution has provided a **2.7%** reduction in CO₂ following Energy Efficiency Measures.

- Energy Saving from onsite LZC Technologies = **1538.0 kWh/Yr**
- CO₂ Saving from onsite LZC Technologies = **798.2 kgCO₂/Yr**



2.3.3 Energy and CO₂ Reduction Summary

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

Summary of CO ₂ Emission Reductions	Total CO ₂ emissions (kgCO ₂ /year)
Baseline emissions	32040.6
Improved emissions (after application of energy efficiency measures)	29340.5
Improved emissions (after incorporation of efficient energy supply)	29340.5
Improved emissions (after incorporation of renewable energy technology) % CO ₂ displaced in total	28542.3
% CO ₂ displaced in total	10.9%
% CO ₂ displaced by energy efficiency measures	8.4%
% CO ₂ displaced by efficient supply of energy	0.0%
% CO ₂ displaced by renewable energy	2.7%

Table 2: 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)	138042.1		32040.6	
Proposed scheme after energy efficiency measures and CHP ("Residual" energy demand & emissions)	134349.4	2.7%	29340.5	8.4%
Proposed scheme after on-site renewables	132811.3	1.1%	28542.3	2.7%
Proposed scheme offset for financial contribution or other "allowable solution"	0	0	0	0
Total savings on energy demand and emissions		3.8%		10.9%

Table 3. Total Energy and Carbon Emissions Savings Based on SAP 9.0 Carbon Factors



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

Baseline energy demand

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

Baseline energy demand (kWh pa)	138042.1
Regulated emissions (kg pa)	32040.6

Heating

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

Energy savings from the use of CHP systems (kWh pa)	-
Emission savings from the use of CHP systems (kg pa)	-
Total regulated emissions after CHP savings (kg pa)	32040.6

Energy efficiency

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

Energy savings from energy efficiency measures (kWh pa)	3692.7
Emission savings from energy efficiency measures (kg pa)	2700.0
Total regulated emissions after CHP savings and energy efficiency measures (kg pa) (“residual emissions”)	29340.5

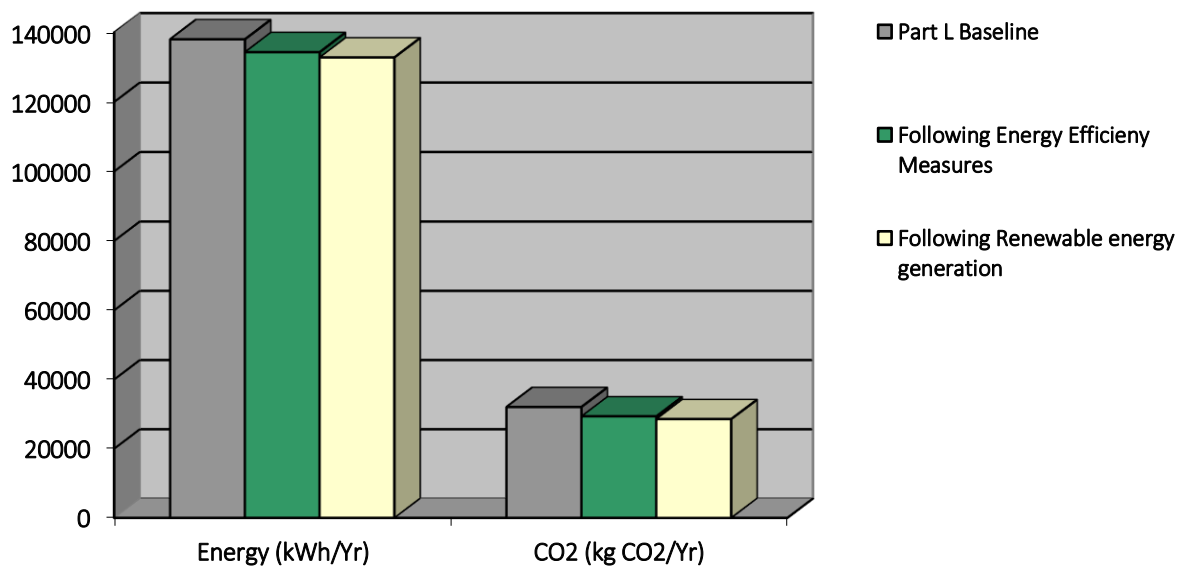


On-site renewables

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)	1538.0
Saving on residual emissions from the use of renewables (kg)	798.2
Saving on residual emissions from the use of renewables (%)	2.7%

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 10.9% 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 10.9% 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 10.9% reduction in carbon emissions over Part L 2013 – exceeding the documents Low Carbon target of 10% over Part L 2013.

Table 4. Summary of MCC and Planning 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 development 12 residential dwellings at The Greenfinch site achieves a total reduction of **10.9%** in carbon emissions over Part L 2013.

The low carbon classification for The Greenfinch development can be derived from its prioritisation of fabric first carbon reduction through exceeding Building Regulation design 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 Flood Risk Zone

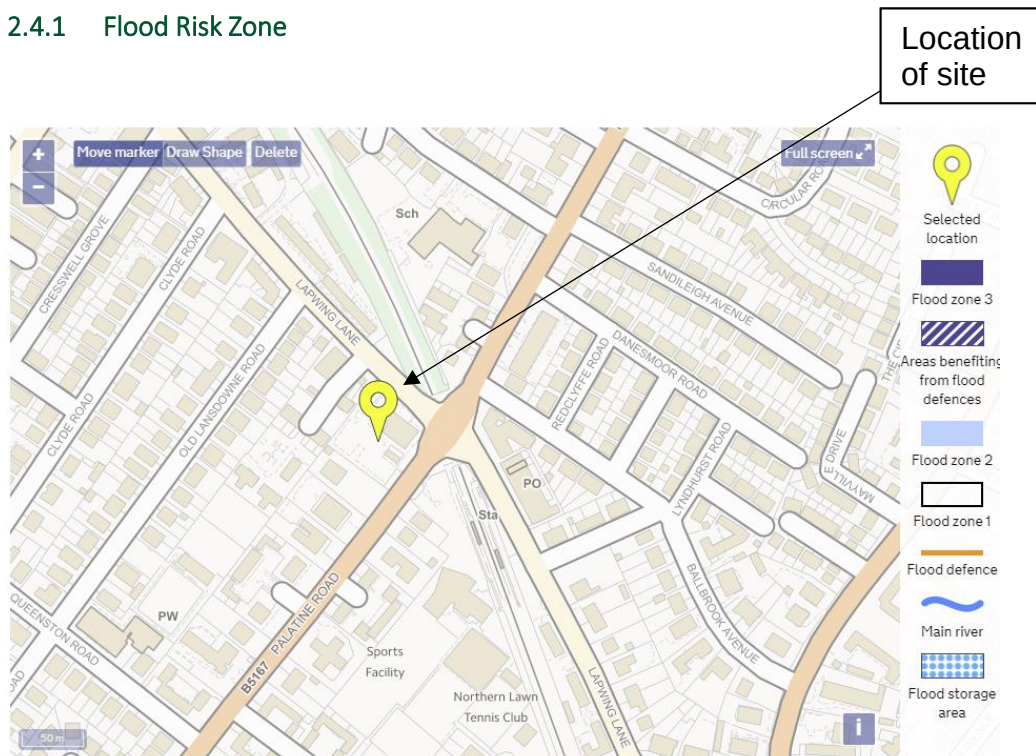


Fig 4: Flood Risk Map

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.

2.4.2 Green Blue Infrastructure

2.4.2.1 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 potentially resulting in new areas of impermeable surfacing. Therefore a drainage strategy assessment should be undertaken, by a suitably qualified professional, to assess the feasibility of introducing on-site SuDs measures, that will reduce surface water run-off and any flood risks associated.

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:

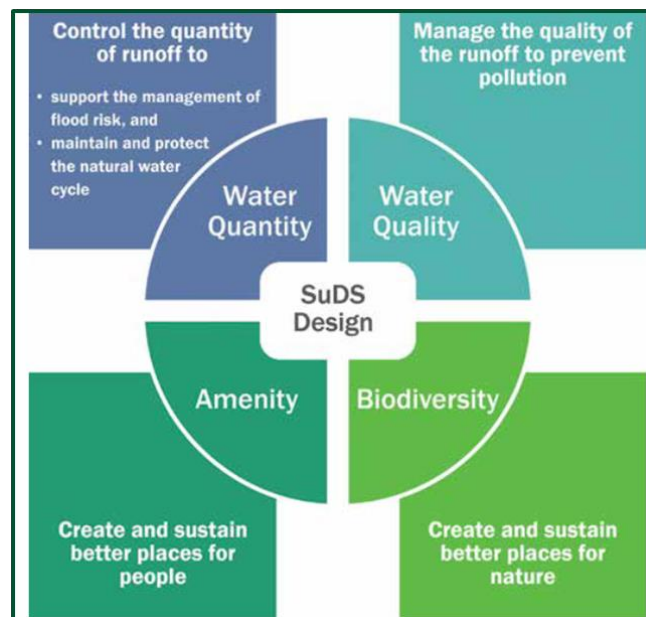


Fig 5. Representation of figure 2.1 of the SUDs Manual

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 5. Outline of types of green/blue infrastructure and associated benefit

2.4.2.2 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.

2.4.3 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 6. 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.



2.4.4 Waste Management

2.4.4.1 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.

All houses will be provided with the required bins to cover all types of waste and recycling that

Manchester City Council also provide a free pick-up service for.

2.4.4.2 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.

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

2.4.5 Materials

The construction of new buildings and building elements has a large environmental impact in terms of both, energy and embodied carbon of new materials. Therefore, Manchester City Council promote the prioritising of environmentally friendly materials, where possible, and encourages the use of recycled building materials. This information should also be incorporated into the SWMP mentioned in the previous subsection (Waste Management) as a means of promoting the re-using and recycling of materials.

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

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



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

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

2.4.6 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.
- 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.

2.4.7 Health & Wellbeing

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

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

- Enhancing the green infrastructure of the site by introducing planting wherever possible, therefore improving the physical and mental wellbeing of residents, visitors, and workers.
- 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.

2.4.8 Sustainable Transport

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

The proposed development acknowledges the benefits associated with these forms of sustainable transport and therefore, sufficient space within each dwelling will be provided to store bicycles. Also provided to each dwelling, will be electric vehicle charging (EVC) ports in order to further satisfy the requirement for promoting sustainable transport alternatives.

Further to providing cycle provision and EVC ports, the site is located within West Didsbury on the crossroads of Lapwing Lane and Palatine Road, which both have multiple bus stops. Also located on the crossroad is the West Didsbury tram stop. This proximity to a number of transports node with such a range of travel possibilities further reduces the reliance on cars and the negative environmental impacts associated.

Transport Links

Further to providing significant cycle provision, the site is located within West Didsbury and therefore has good sustainable transport links:

- **Train:** The closest train station to the site is Burnage Train Station, which is located approximately 1.1 miles east of the site, taking roughly 20 minutes to walk to. This station provides access to central Manchester stations from which other regional and national destinations can be reached.
- **Bus:** The nearest bus stops are located on Lapwing Lane and Palatine Road and are roughly 200ft southeast and 400ft northeast from the site, respectively. These will provide frequent services to Manchester Airport, Chorlton, Newton Heath and Gorton. 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 West Didsbury Tram Stop. This provides an additional means of public transport to locations within central Manchester, Manchester Airport and also further afield to Altrincham, Bury, Eccles, East Didsbury, Rochdale, Ashton-Under-Lyne and Manchester Airport.



Local Amenities

- Fog Lane Park and Fletcher Moss Park are both situated within a 2 miles from site; providing excellent recreational space for residents.
- The site is also only 0.3 miles from Burton Road where a multitude of shops and amenities can be accessed.
- Manchester Metropolitan and Manchester University are both less than 3.5 miles from the proposed development providing good access to higher education via the transport nodes mentioned earlier in this subsection. In addition, there are several schools and colleges within a 15-minute walk from the site, including: West Didsbury Primary School, Cavendish Community Primary School and Lancasterian Primary School.
- Due to its proximity to Didsbury and Central Manchester, the site has good 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 **1.8kWp Site Wide PV Array (Approx. 6no. 300W Panels) implemented onto the main roof area of the apartment block.**

Chosen Renewable Technology



Ground Source Heat pumps

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

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

Renewable Technology Not Viable

Air Source Heat pumps

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

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

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

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

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 and PV.

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 The Greenfinch site against the relevant climate change and sustainability policies and targets, as outlined within: the Manchester City Council Core Strategy (July 2012), Our Manchester Strategy, Manchester: A Certain Future and The Zero Carbon Framework, through the following of the energy hierarchy, the modelling of apartments in the FSAP 2012 software and addressing all aspects of a sustainable development. In addition, the proposal has been assessed against national sustainable design definitions to determine how it can be classified.

As part of this process, the development was designed with a fabric first approach; with U-values, design air permeability and ventilation targets all aspiring to Passive House design standards and therefore significantly exceeding Building Regulations Part L 2013 standards. 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 1.8kWp system can be proposed at this stage, which would equate to 6No panels and would provide an additional 2.7% reduction in carbon emissions over the residual emissions: bringing the total carbon reduction to **10.9%** over Part L 2013 of the Building Regulations

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

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 low risk of flooding.
- 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.
- 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 proximity of the Burnage and Didsbury train and tram stops, respectively, to the proposed site is highly sustainable in terms of transport and local amenities as it is in close proximity to a number of public transport nodes, as well as a multitude of shops and other local amenities.

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 – The Greenfinch, Didsbury

Apartment Type	Flat 1	Flat 2	Top Floor Flat	Detached with External Garage	Detached with Integral Garage NE
Frequency	1	1	1	1	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)
Main Heating Fuel Requirement (DER)	6080.37	3722.42	11288.91	13661.22	14104
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0
Water Fuel Requirement (DER)	2005.5	1721.23	2460.29	2786.3	2773.54
Electricity Pumps Fans Requirement (DER)	75	75	75	75	75
Electricity Lighting Requirement (DER)	359.67	269.91	675.28	706.87	682.1
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)
Main Heating Fuel Requirement (DER)	4831.26	2722.55	9874.22	11999.3	12157.02
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0
Secondary Heating Fuel Requirement (DER)	0	0	0	1864.51	1889.01
Water Fuel Requirement (DER)	1994.36	1711.67	2446.62	2808.9	2796.97
Electricity Pumps Fans Requirement (DER)	75	75	75	75	75
Electricity Lighting Requirement (DER)	294.25	220.57	549.82	706.87	682.1
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)
Main Heating Fuel Requirement (DER)	4831.26	2722.55	9874.22	11999.3	12157.02
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0
Secondary Heating Fuel Requirement (DER)	0	0	0	1864.51	1889.01
Water Fuel Requirement (DER)	1994.36	1711.67	2446.62	2808.9	2796.97
Electricity Pumps Fans Requirement (DER)	75	75	75	75	75
Electricity Lighting Requirement (DER)	294.25	220.57	549.82	706.87	682.1
PV Energy Produced (DER)	-1538.0				
TOTAL PER DEVELOPMENT					



Appendix A – Energy Demand Assessment – The Greenfinch, Didsbury

Detached with Integral Garage NW	Small Semi-Detached E x2	Small Semi-Detached SW x2	Semi-detached x2	TOTAL (kWh/yr)		TOTAL (kgCO2/yr)
1	2	2	2	12		
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)
13861.71	3733.58	3838.09	11564.12	100990.2	0.216	21813.9
0	0	0	0	0.0	0.519	0.0
0	0	0	0	0.0	0.216	0.0
2774.27	2482.49	2480.24	2633.5	29713.6	0.216	6418.1
75	75	75	75	900.0	0.519	467.1
682.1	382.13	382.13	766.91	6438.3	0.519	3341.5
				138042.1		32040.6
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)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
11909.73	3690.39	3789	10516.08	89485.0	0.216	19328.8
0	0	0	0	0.0	0.519	0.0
1850.59	0	0	1634.04	8872.2	0.019	168.6
2797.93	2335.77	2335.77	2632.29	29164.1	0.216	6299.4
75	30	30	30	630.0	0.519	327.0
682.1	382.13	382.13	766.91	6198.1	0.519	3216.8
				134349.4		29340.5
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)
11909.73	3690.39	3789	10516.08	89485.0	0.216	19328.8
0	0	0	0	0.0	0.519	0.0
1850.59	0	0	1634.04	8872.2	0.019	168.6
2797.93	2335.77	2335.77	2632.29	29164.1	0.216	6299.4
75	30	30	30	630.0	0.519	327.0
682.1	382.13	382.13	766.91	6198.1	0.519	3216.8
				-1538.0	0.519	-798.2
				132811.3		28542.3



Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.33
Printed on 08 April 2021 at 12:27:13

Project Information:

Assessed By: Daniel Watt (STRO026464)

Building Type: Detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 288.6m²

Site Reference : Greenfinch PH Development

Plot Reference: Detached with External Garage

Address : Greenfinch PH Development, Didsbury, Manchester

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: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 13.72 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 12.61 kg/m² **OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 56.9 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 48.0 kWh/m² **OK**

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.14 (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 5.00 (design value)
Maximum 10.0 **OK**

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas
Data from manufacturer
Efficiency 90.0 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: Room heaters - wood
Closed room heater
Efficiency 65.0 %
Minimum 65.0 % **OK**

5 Cylinder insulation

Hot water Storage: Measured cylinder loss: 2.27 kWh/day
Permitted by DBSCG: 2.86 kWh/day **OK**

Regulations Compliance Report

Primary pipework insulated: Yes

OK

6 Controls

Space heating controls TTZC by plumbing and electrical services

OK

Hot water controls: Cylinderstat

OK

Independent timer for DHW

OK

Boiler interlock: Yes

OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings 100.0%

Minimum 75.0%

OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (North West England): Not significant

OK

Based on:

Overshading: More than average

Windows facing: North West 25.5m²

Windows facing: South East 24.4m²

Windows facing: North East 2.7m²

Windows facing: South West 8.1m²

Roof windows facing: North West 1.3m²

Roof windows facing: South East 1.3m²

Roof windows facing: North East 2.6m²

Roof windows facing: South West 2.6m²

Ventilation rate: 8.00

Blinds/curtains: Dark-coloured curtain or roller blind
Closed 100% of daylight hours

10 Key features

Roofs U-value 0.1 W/m²K

Floors U-value 0.12 W/m²K

Secondary heating (wood logs)

Secondary heating fuel wood logs

Predicted Energy Assessment



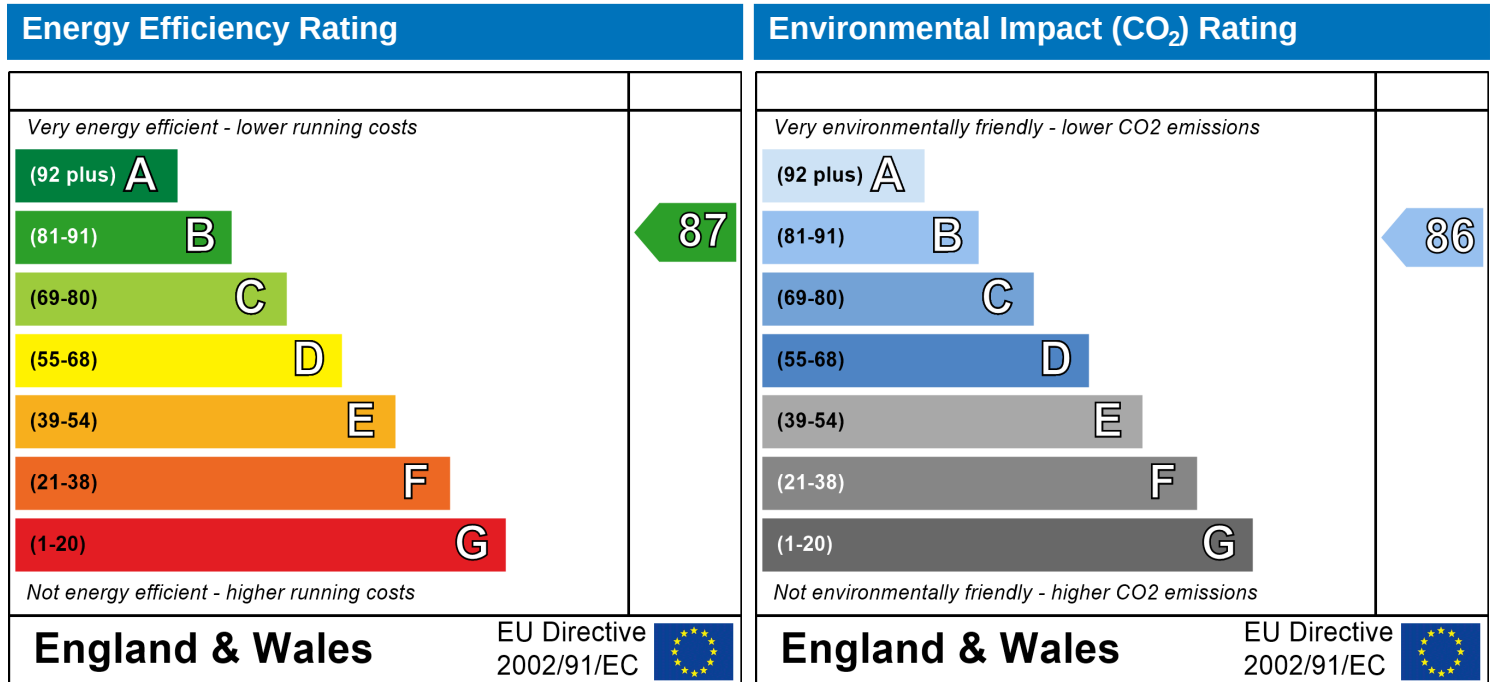
Greenfinch PH Development
Didsbury
Manchester

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

Detached House
07 April 2021
Daniel Watt
288.6 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: Detached with External Garage

Address: Greenfinch PH Development, Didsbury, Manchester
Located in: England
Region: North West England
UPRN: tba
Date of assessment: 07 April 2021
Date of certificate: 08 April 2021
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Owner-occupied
Related party disclosure: Employed by the professional dealing with the property transaction
Thermal Mass Parameter: Indicative Value Medium
Water use <= 125 litres/person/day: True
PCDF Version: 476

Property description:

Dwelling type: House
Detachment: Detached
Year Completed: 2021
Floor Location: **Floor area:** **Storey height:**
 Floor 0 102.8 m² 3 m
 Floor 1 102.6 m² 3.1 m
 Floor 2 83.2 m² 2.5 m
Living area: 45.58 m² (fraction 0.169)
Front of dwelling faces: North West

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front glazing	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
Rear glazing	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
NE glazing	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
SW glazing	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
Front RLs	Manufacturer	Roof Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
Rear RLs	Manufacturer	Roof Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
NE RLs	Manufacturer	Roof Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
SW RLs	Manufacturer	Roof Windows	low-E, En = 0.05, soft coat	Yes	PVC-U

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Front glazing	16mm or more	0.7	0.72	1.4	25.5	1
Rear glazing	16mm or more	0.7	0.72	1.4	24.4	1
NE glazing	16mm or more	0.7	0.72	1.4	2.7	1
SW glazing	16mm or more	0.7	0.72	1.4	8.1	1
Front RLs	16mm or more	0.7	0.72	1.4	1.3	1
Rear RLs	16mm or more	0.7	0.72	1.4	1.3	1
NE RLs	16mm or more	0.7	0.72	1.4	2.6	1
SW RLs	16mm or more	0.7	0.72	1.4	2.6	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front glazing		External walls	North West	0	0
Rear glazing		External walls	South East	0	0
NE glazing		External walls	North East	0	0
SW glazing		External walls	South West	0	0
Front RLs		Sloped Ceiling	North West	0.001	0
Rear RLs		Sloped Ceiling	South East	0.001	0
NE RLs		Sloped Ceiling	North East	0.001	0

SAP Input

SW RLs	Sloped Ceiling	South West	0.001	0
--------	----------------	------------	-------	---

Overshading: More than average

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
External walls	292.214	60.7	231.51	0.2	0	False	N/A
Sloped Ceiling	127.878	7.8	120.08	0.14	0		N/A
Adj flat ceiling over FF	19.4	0	19.4	0.1008	0		N/A
Ground floor	102.8			0.12			N/A

Internal Elements

Party Elements

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0435

	Length	Psi-value		
[Approved]	43	0.16	E5	Ground floor (normal)
[Approved]	86	0.07	E6	Intermediate floor within a dwelling
[Approved]	0	0.06	E10	Eaves (insulation at ceiling level)
[Approved]	31	0.04	E11	Eaves (insulation at rafter level)
[Approved]	0	0.24	E12	Gable (insulation at ceiling level)
[Approved]	19	0.04	E13	Gable (insulation at rafter level)
	35	0.03	E2	Other lintels (including other steel lintels)
[Approved]	30	0.04	E3	Sill
[Approved]	77	0.05	E4	Jamb
[Approved]	50	0.09	E16	Corner (normal)
[Approved]	21	-0.09	E17	Corner (inverted internal area greater than external area)
	5	0	R1	Head
	5	0	R2	Sill
	17	0	R3	Jamb
	23.77	0	R4	Ridge (vaulted ceiling)
	23.77	0	R8	Roof wall (rafter)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	8
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	5

Main heating system:

Boiler systems with radiators or underfloor heating

Gas boilers and oil boilers

Fuel: mains gas

Info Source: Manufacturer Declaration

Manufacturer's data

Efficiency: 90.0% (SEDBUK2009)

Regular condensing with automatic ignition

Fuel Burning Type:

Systems with radiators

Central heating pump : 2013 or later

Design flow temperature: Design flow temperature<=35°C

Room-sealed

SAP Input

Boiler interlock: Yes
Delayed start

Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2110

Secondary heating system:

Secondary heating system: Room heaters
Solid fuel room heaters
Fuel :wood logs
Info Source: SAP Tables
Closed room heater
HETAS Approved

Water heating:

Water heating: From main heating system
Water code: 901
Fuel :mains gas
Hot water cylinder
Cylinder volume: 300 litres
Cylinder insulation: Factory 100 mm
Primary pipework insulation: True
Cylinderstat: True
Cylinder in heated space: True
Solar panel: False

Others:

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

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.33

Property Address: Detached with External Garage

Address : Greenfinch PH Development, Didsbury, Manchester

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	102.8 (1a)	x	3 (2a)	=	308.4 (3a)
First floor	102.6 (1b)	x	3.1 (2b)	=	318.06 (3b)
Second floor	83.2 (1c)	x	2.5 (2c)	=	208 (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	288.6 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	834.46 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 (6a)
Number of open flues	0	+	0	=	0 (6b)
Number of intermittent fans				8 x 10 =	80 (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) =	80	÷ (5) =	0.1 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			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)			0.35 (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			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.27 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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
---------	------	------	------	-----	------	------	------	------	---	------	------	------

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

	0.34	0.34	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31
--	------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

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

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

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

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

(25)m= 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.53 0.54 0.54 0.55 0.55 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			25.5	$x1/[1/(1.4)+0.04] =$	33.81		(27)
Windows Type 2			24.4	$x1/[1/(1.4)+0.04] =$	32.35		(27)
Windows Type 3			2.7	$x1/[1/(1.4)+0.04] =$	3.58		(27)
Windows Type 4			8.1	$x1/[1/(1.4)+0.04] =$	10.74		(27)
Rooflights Type 1			1.3	$x1/[1/(1.4)+0.04] =$	1.82		(27b)
Rooflights Type 2			1.3	$x1/[1/(1.4)+0.04] =$	1.82		(27b)
Rooflights Type 3			2.6	$x1/[1/(1.4)+0.04] =$	3.64		(27b)
Rooflights Type 4			2.6	$x1/[1/(1.4)+0.04] =$	3.64		(27b)
Floor			102.8	x 0.12 =	12.336		(28)
Walls	292.21	60.7	231.51	x 0.2 =	46.3		(29)
Roof Type1	127.88	7.8	120.08	x 0.14 =	16.81		(30)
Roof Type2	19.4	0	19.4	x 0.1 =	1.96		(30)
Total area of elements, m²			542.29				(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) = 168.22 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 26454.14 (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

SAP WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

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

23.61 (36)

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

Total fabric heat loss

(33) + (36) =

191.83 (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
153.77	153.14	152.53	149.66	149.12	146.61	146.61	146.15	147.58	149.12	150.21	151.34

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=

345.6	344.97	344.36	341.49	340.95	338.44	338.44	337.98	339.41	340.95	342.04	343.17
-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

341.48 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=

1.2	1.2	1.19	1.18	1.18	1.17	1.17	1.17	1.18	1.18	1.19	1.19
-----	-----	------	------	------	------	------	------	------	------	------	------

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

1.18 (40)

Number of days in month (Table 1a)

(41)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

3.12

(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

108.23

(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=

119.05	114.73	110.4	106.07	101.74	97.41	97.41	101.74	106.07	110.4	114.73	119.05
--------	--------	-------	--------	--------	-------	-------	--------	--------	-------	--------	--------

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

1298.78 (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=

176.55	154.42	159.34	138.92	133.3	115.02	106.59	122.31	123.77	144.24	157.45	170.98
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------

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

1702.9 (45)

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

(46)m=

26.48	23.16	23.9	20.84	19.99	17.25	15.99	18.35	18.57	21.64	23.62	25.65
-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(46)

Water storage loss:

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

300

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

300

(50)

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

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

0.01

(51)

If community heating see section 4.3

Volume factor from Table 2a

0.74

(52)

Temperature factor from Table 2b

0.54

(53)

SAP WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year

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

1.23

(54)

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

1.23

(55)

Water storage loss calculated for each month

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

(56)m=

38.07	34.39	38.07	36.84	38.07	36.84	38.07	38.07	36.84	38.07	36.84	38.07
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(56)

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

(57)m=

38.07	34.39	38.07	36.84	38.07	36.84	38.07	38.07	36.84	38.07	36.84	38.07
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(59)

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

(61)m=

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

(61)

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

(62)m=

237.89	209.81	220.68	198.27	194.63	174.38	167.92	183.64	183.12	205.58	216.81	232.32
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(62)

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

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

(63)m=

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

(63)

Output from water heater

(64)m=

237.89	209.81	220.68	198.27	194.63	174.38	167.92	183.64	183.12	205.58	216.81	232.32
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

2425.04

(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=

107.77	95.66	102.05	93.67	93.39	85.73	84.51	89.73	88.64	97.03	99.84	105.92
--------	-------	--------	-------	-------	-------	-------	-------	-------	-------	-------	--------

(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
187.03	187.03	187.03	187.03	187.03	187.03	187.03	187.03	187.03	187.03	187.03	187.03

(66)

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

(67)m=

100.06	88.88	72.28	54.72	40.9	34.53	37.31	48.5	65.1	82.66	96.47	102.85
--------	-------	-------	-------	------	-------	-------	------	------	-------	-------	--------

(67)

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

(68)m=

670.1	677.05	659.53	622.23	575.14	530.88	501.31	494.36	511.88	549.19	596.28	640.53
-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(68)

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

(69)m=

56.82	56.82	56.82	56.82	56.82	56.82	56.82	56.82	56.82	56.82	56.82	56.82
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(69)

Pumps and fans gains (Table 5a)

(70)m=

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

(70)

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

(71)m=

-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

(71)

Water heating gains (Table 5)

(72)m=

144.85	142.35	137.16	130.1	125.52	119.07	113.58	120.61	123.11	130.41	138.66	142.36
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

(72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=

1037.18	1030.44	991.13	929.21	863.72	806.64	774.37	785.63	822.25	884.42	953.57	1007.9
---------	---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(73)

6. Solar gains:

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

SAP WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	2.7	x	11.28	x	0.72	x	0.7	=	10.64	(75)
Northeast 0.9x	0.77	x	2.7	x	22.97	x	0.72	x	0.7	=	21.66	(75)
Northeast 0.9x	0.77	x	2.7	x	41.38	x	0.72	x	0.7	=	39.02	(75)
Northeast 0.9x	0.77	x	2.7	x	67.96	x	0.72	x	0.7	=	64.08	(75)
Northeast 0.9x	0.77	x	2.7	x	91.35	x	0.72	x	0.7	=	86.14	(75)
Northeast 0.9x	0.77	x	2.7	x	97.38	x	0.72	x	0.7	=	91.84	(75)
Northeast 0.9x	0.77	x	2.7	x	91.1	x	0.72	x	0.7	=	85.91	(75)
Northeast 0.9x	0.77	x	2.7	x	72.63	x	0.72	x	0.7	=	68.49	(75)
Northeast 0.9x	0.77	x	2.7	x	50.42	x	0.72	x	0.7	=	47.55	(75)
Northeast 0.9x	0.77	x	2.7	x	28.07	x	0.72	x	0.7	=	26.47	(75)
Northeast 0.9x	0.77	x	2.7	x	14.2	x	0.72	x	0.7	=	13.39	(75)
Northeast 0.9x	0.77	x	2.7	x	9.21	x	0.72	x	0.7	=	8.69	(75)
Southeast 0.9x	0.77	x	24.4	x	36.79	x	0.72	x	0.7	=	313.57	(77)
Southeast 0.9x	0.77	x	24.4	x	62.67	x	0.72	x	0.7	=	534.12	(77)
Southeast 0.9x	0.77	x	24.4	x	85.75	x	0.72	x	0.7	=	730.8	(77)
Southeast 0.9x	0.77	x	24.4	x	106.25	x	0.72	x	0.7	=	905.5	(77)
Southeast 0.9x	0.77	x	24.4	x	119.01	x	0.72	x	0.7	=	1014.24	(77)
Southeast 0.9x	0.77	x	24.4	x	118.15	x	0.72	x	0.7	=	1006.9	(77)
Southeast 0.9x	0.77	x	24.4	x	113.91	x	0.72	x	0.7	=	970.76	(77)
Southeast 0.9x	0.77	x	24.4	x	104.39	x	0.72	x	0.7	=	889.64	(77)
Southeast 0.9x	0.77	x	24.4	x	92.85	x	0.72	x	0.7	=	791.31	(77)
Southeast 0.9x	0.77	x	24.4	x	69.27	x	0.72	x	0.7	=	590.31	(77)
Southeast 0.9x	0.77	x	24.4	x	44.07	x	0.72	x	0.7	=	375.58	(77)
Southeast 0.9x	0.77	x	24.4	x	31.49	x	0.72	x	0.7	=	268.35	(77)
Southwest 0.9x	0.77	x	8.1	x	36.79		0.72	x	0.7	=	104.09	(79)
Southwest 0.9x	0.77	x	8.1	x	62.67		0.72	x	0.7	=	177.31	(79)
Southwest 0.9x	0.77	x	8.1	x	85.75		0.72	x	0.7	=	242.6	(79)
Southwest 0.9x	0.77	x	8.1	x	106.25		0.72	x	0.7	=	300.6	(79)
Southwest 0.9x	0.77	x	8.1	x	119.01		0.72	x	0.7	=	336.69	(79)
Southwest 0.9x	0.77	x	8.1	x	118.15		0.72	x	0.7	=	334.26	(79)
Southwest 0.9x	0.77	x	8.1	x	113.91		0.72	x	0.7	=	322.26	(79)
Southwest 0.9x	0.77	x	8.1	x	104.39		0.72	x	0.7	=	295.33	(79)
Southwest 0.9x	0.77	x	8.1	x	92.85		0.72	x	0.7	=	262.69	(79)
Southwest 0.9x	0.77	x	8.1	x	69.27		0.72	x	0.7	=	195.97	(79)
Southwest 0.9x	0.77	x	8.1	x	44.07		0.72	x	0.7	=	124.68	(79)
Southwest 0.9x	0.77	x	8.1	x	31.49		0.72	x	0.7	=	89.08	(79)
Northwest 0.9x	0.77	x	25.5	x	11.28	x	0.72	x	0.7	=	100.49	(81)
Northwest 0.9x	0.77	x	25.5	x	22.97	x	0.72	x	0.7	=	204.55	(81)
Northwest 0.9x	0.77	x	25.5	x	41.38	x	0.72	x	0.7	=	368.54	(81)

SAP WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	25.5	x	67.96	x	0.72	x	0.7	=	605.24	(81)
Northwest 0.9x	0.77	x	25.5	x	91.35	x	0.72	x	0.7	=	813.57	(81)
Northwest 0.9x	0.77	x	25.5	x	97.38	x	0.72	x	0.7	=	867.35	(81)
Northwest 0.9x	0.77	x	25.5	x	91.1	x	0.72	x	0.7	=	811.39	(81)
Northwest 0.9x	0.77	x	25.5	x	72.63	x	0.72	x	0.7	=	646.85	(81)
Northwest 0.9x	0.77	x	25.5	x	50.42	x	0.72	x	0.7	=	449.07	(81)
Northwest 0.9x	0.77	x	25.5	x	28.07	x	0.72	x	0.7	=	249.98	(81)
Northwest 0.9x	0.77	x	25.5	x	14.2	x	0.72	x	0.7	=	126.44	(81)
Northwest 0.9x	0.77	x	25.5	x	9.21	x	0.72	x	0.7	=	82.07	(81)
Rooflights 0.9x	1	x	1.3	x	15.92	x	0.72	x	0.7	=	9.39	(82)
Rooflights 0.9x	1	x	1.3	x	37.03	x	0.72	x	0.7	=	21.84	(82)
Rooflights 0.9x	1	x	2.6	x	15.92	x	0.72	x	0.7	=	18.77	(82)
Rooflights 0.9x	1	x	2.6	x	40.5	x	0.72	x	0.7	=	47.77	(82)
Rooflights 0.9x	1	x	1.3	x	32.51	x	0.72	x	0.7	=	19.17	(82)
Rooflights 0.9x	1	x	1.3	x	70.28	x	0.72	x	0.7	=	41.44	(82)
Rooflights 0.9x	1	x	2.6	x	32.51	x	0.72	x	0.7	=	38.34	(82)
Rooflights 0.9x	1	x	2.6	x	73.74	x	0.72	x	0.7	=	86.97	(82)
Rooflights 0.9x	1	x	1.3	x	59.5	x	0.72	x	0.7	=	35.09	(82)
Rooflights 0.9x	1	x	1.3	x	111.87	x	0.72	x	0.7	=	65.97	(82)
Rooflights 0.9x	1	x	2.6	x	59.5	x	0.72	x	0.7	=	70.17	(82)
Rooflights 0.9x	1	x	2.6	x	111.06	x	0.72	x	0.7	=	130.97	(82)
Rooflights 0.9x	1	x	1.3	x	100.03	x	0.72	x	0.7	=	58.99	(82)
Rooflights 0.9x	1	x	1.3	x	159.33	x	0.72	x	0.7	=	93.95	(82)
Rooflights 0.9x	1	x	2.6	x	100.03	x	0.72	x	0.7	=	117.98	(82)
Rooflights 0.9x	1	x	2.6	x	150.59	x	0.72	x	0.7	=	177.6	(82)
Rooflights 0.9x	1	x	1.3	x	136.88	x	0.72	x	0.7	=	80.71	(82)
Rooflights 0.9x	1	x	1.3	x	193.3	x	0.72	x	0.7	=	113.98	(82)
Rooflights 0.9x	1	x	2.6	x	136.88	x	0.72	x	0.7	=	161.43	(82)
Rooflights 0.9x	1	x	2.6	x	177.61	x	0.72	x	0.7	=	209.46	(82)
Rooflights 0.9x	1	x	1.3	x	147.03	x	0.72	x	0.7	=	86.7	(82)
Rooflights 0.9x	1	x	1.3	x	197.35	x	0.72	x	0.7	=	116.37	(82)
Rooflights 0.9x	1	x	2.6	x	147.03	x	0.72	x	0.7	=	173.4	(82)
Rooflights 0.9x	1	x	2.6	x	179.47	x	0.72	x	0.7	=	211.66	(82)
Rooflights 0.9x	1	x	1.3	x	137.1	x	0.72	x	0.7	=	80.85	(82)
Rooflights 0.9x	1	x	1.3	x	188.08	x	0.72	x	0.7	=	110.9	(82)
Rooflights 0.9x	1	x	2.6	x	137.1	x	0.72	x	0.7	=	161.69	(82)
Rooflights 0.9x	1	x	2.6	x	171.77	x	0.72	x	0.7	=	202.58	(82)
Rooflights 0.9x	1	x	1.3	x	107.76	x	0.72	x	0.7	=	63.55	(82)
Rooflights 0.9x	1	x	1.3	x	162.62	x	0.72	x	0.7	=	95.89	(82)
Rooflights 0.9x	1	x	2.6	x	107.76	x	0.72	x	0.7	=	127.09	(82)
Rooflights 0.9x	1	x	2.6	x	151.65	x	0.72	x	0.7	=	178.86	(82)

SAP WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	1.3	x	73.17	x	0.72	x	0.7	=	43.15	(82)
Rooflights 0.9x	1	x	1.3	x	128.66	x	0.72	x	0.7	=	75.87	(82)
Rooflights 0.9x	1	x	2.6	x	73.17	x	0.72	x	0.7	=	86.29	(82)
Rooflights 0.9x	1	x	2.6	x	125.02	x	0.72	x	0.7	=	147.45	(82)
Rooflights 0.9x	1	x	1.3	x	39.91	x	0.72	x	0.7	=	23.53	(82)
Rooflights 0.9x	1	x	1.3	x	82.24	x	0.72	x	0.7	=	48.5	(82)
Rooflights 0.9x	1	x	2.6	x	39.91	x	0.72	x	0.7	=	47.07	(82)
Rooflights 0.9x	1	x	2.6	x	84.48	x	0.72	x	0.7	=	99.63	(82)
Rooflights 0.9x	1	x	1.3	x	20.03	x	0.72	x	0.7	=	11.81	(82)
Rooflights 0.9x	1	x	1.3	x	45.75	x	0.72	x	0.7	=	26.98	(82)
Rooflights 0.9x	1	x	2.6	x	20.03	x	0.72	x	0.7	=	23.62	(82)
Rooflights 0.9x	1	x	2.6	x	49.44	x	0.72	x	0.7	=	58.3	(82)
Rooflights 0.9x	1	x	1.3	x	13.01	x	0.72	x	0.7	=	7.67	(82)
Rooflights 0.9x	1	x	1.3	x	30.74	x	0.72	x	0.7	=	18.13	(82)
Rooflights 0.9x	1	x	2.6	x	13.01	x	0.72	x	0.7	=	15.34	(82)
Rooflights 0.9x	1	x	2.6	x	34.03	x	0.72	x	0.7	=	40.13	(82)

Solar gains in watts, calculated for each month

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

(83)m=	626.55	1123.56	1683.17	2323.94	2816.23	2888.48	2746.35	2365.69	1903.37	1281.46	760.81	529.45	(83)
--------	--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	--------	--------	------

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

(84)m=	1663.73	2154	2674.3	3253.15	3679.95	3695.12	3520.72	3151.33	2725.62	2165.88	1714.38	1537.36	(84)
--------	---------	------	--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.91	0.76	0.57	0.42	0.49	0.76	0.96	1	1	(86)

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

(87)m=	19.67	19.9	20.23	20.62	20.88	20.98	21	20.99	20.91	20.53	20.01	19.63	(87)
--------	-------	------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	------

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

(88)m=	19.92	19.92	19.93	19.93	19.93	19.94	19.94	19.94	19.94	19.93	19.93	19.93	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	0.99	0.97	0.89	0.7	0.48	0.32	0.38	0.68	0.95	0.99	1	(89)
--------	---	------	------	------	-----	------	------	------	------	------	------	---	------

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

(90)m=	18.16	18.48	18.97	19.51	19.83	19.93	19.94	19.94	19.88	19.4	18.66	18.1	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------	------

fLA = Living area ÷ (4) =

0.16 (91)

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

(92)m=	18.4	18.71	19.17	19.69	20	20.09	20.11	20.11	20.04	19.58	18.87	18.34	(92)
--------	------	-------	-------	-------	----	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.25	18.56	19.02	19.54	19.85	19.94	19.96	19.96	19.89	19.43	18.72	18.19	(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=	1	0.99	0.96	0.87	0.7	0.48	0.32	0.38	0.67	0.94	0.99	1	(94)
--------	---	------	------	------	-----	------	------	------	------	------	------	---	------

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

(95)m=	1657.56	2127.94	2569.07	2840.82	2567.09	1781.55	1133.38	1195.69	1837.98	2025.43	1698.54	1533.38	(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=	4819.38	4711.33	4309.81	3633	2777.64	1808.88	1136.25	1201.99	1965.36	3009.37	3975.9	4801.94	(97)
--------	---------	---------	---------	------	---------	---------	---------	---------	---------	---------	--------	---------	------

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

(98)m=	2352.39	1736.04	1295.11	570.37	156.65	0	0	0	0	732.05	1639.69	2431.81	(98)
--------	---------	---------	---------	--------	--------	---	---	---	---	--------	---------	---------	------

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

10914.12	(98)
----------	------

Space heating requirement in kWh/m²/year

37.82	(99)
-------	------

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

Space heating:

Fraction of space heat from secondary/supplementary system

0.1	(201)
-----	-------

Fraction of space heat from main system(s) (202) = 1 – (201) =

0.9	(202)
-----	-------

Fraction of total heating from main system 1 (204) = (202) x [1 – (203)] =

0.9	(204)
-----	-------

Efficiency of main space heating system 1

90.9	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

65	(208)
----	-------

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

Space heating requirement (calculated above)

2352.39	1736.04	1295.11	570.37	156.65	0	0	0	0	732.05	1639.69	2431.81
---------	---------	---------	--------	--------	---	---	---	---	--------	---------	---------

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

2329.1	1718.85	1282.29	564.72	155.1	0	0	0	0	724.8	1623.46	2407.73
--------	---------	---------	--------	-------	---	---	---	---	-------	---------	---------

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

10806.05	(211)
----------	-------

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	361.91	267.08	199.25	87.75	24.1	0	0	0	0	112.62	252.26	374.12	(215)
---------	--------	--------	--------	-------	------	---	---	---	---	--------	--------	--------	-------

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

1679.09	(215)
---------	-------

Water heating

Output from water heater (calculated above)

237.89	209.81	220.68	198.27	194.63	174.38	167.92	183.64	183.12	205.58	216.81	232.32
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.8	(216)
------	-------

(217)m=

89.77	89.57	89.13	87.84	84.76	80.8	80.8	80.8	80.8	88.28	89.47	89.82
-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	265.01	234.23	247.6	225.72	229.63	215.81	207.82	227.28	226.64	232.88	242.33	258.64	(219)
---------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

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

2813.59	(219)
---------	-------

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

10806.05

Space heating fuel used, secondary

1679.09

Water heating fuel used

2813.59

SAP WorkSheet: New dwelling design stage

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

706.87

(232)

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

16161.41

(238)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	3.48	x 0.01 = 376.05 (240)
Space heating - main system 2	(213) x	0	x 0.01 = 0 (241)
Space heating - secondary	(215) x	4.23	x 0.01 = 71.03 (242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 = 97.91 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 = 9.89 (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 = 93.24 (250)
Additional standing charges (Table 12)			120 (251)
Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)...(254) =		768.12 (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] =	0.97 (257)
SAP rating (Section 12)		86.51 (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	0.216	= 2334.11 (261)
Space heating (secondary)	(215) x	0.019	= 31.9 (263)
Water heating	(219) x	0.216	= 607.74 (264)
Space and water heating	(261) + (262) + (263) + (264) =		2973.75 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 38.93 (267)
Electricity for lighting	(232) x	0.519	= 366.86 (268)
Total CO2, kg/year	sum of (265)...(271) =		3379.53 (272)
CO2 emissions per m²	(272) ÷ (4) =		11.71 (273)
El rating (section 14)			86 (274)

13a. Primary Energy

SAP WorkSheet: New dwelling design stage

	Energy kWh/year	Primary factor		P. Energy kWh/year
Space heating (main system 1)	(211) x	1.22	=	13183.39 (261)
Space heating (secondary)	(215) x	1.04	=	1746.26 (263)
Energy for water heating	(219) x	1.22	=	3432.58 (264)
Space and water heating	(261) + (262) + (263) + (264) =			18362.23 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25 (267)
Electricity for lighting	(232) x	0	=	2170.08 (268)
'Total Primary Energy	sum of (265)...(271) =			20762.56 (272)
Primary energy kWh/m²/year	(272) ÷ (4) =			71.94 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.33

Property Address: Detached with External Garage

Address : Greenfinch PH Development, Didsbury, Manchester

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	102.8 (1a)	x	3 (2a)	=	308.4 (3a)
First floor	102.6 (1b)	x	3.1 (2b)	=	318.06 (3b)
Second floor	83.2 (1c)	x	2.5 (2c)	=	208 (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	288.6 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	834.46 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 (6a)
Number of open flues	0	+	0	=	0 (6b)
Number of intermittent fans				8	x 10 = 80 (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) =	80	÷ (5) =	0.1 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			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)			0.35 (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			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.27 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.34	0.34	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31
--	------	------	------	------	------	------	------	------	------	------	-----	------

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=	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55
---------	------	------	------	------	------	------	------	------	------	------	------	------

(24d)

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

(25)m=	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55
--------	------	------	------	------	------	------	------	------	------	------	------	------

(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			25.5	$x1/[1/(1.4)+0.04] =$	33.81		(27)
Windows Type 2			24.4	$x1/[1/(1.4)+0.04] =$	32.35		(27)
Windows Type 3			2.7	$x1/[1/(1.4)+0.04] =$	3.58		(27)
Windows Type 4			8.1	$x1/[1/(1.4)+0.04] =$	10.74		(27)
Rooflights Type 1			1.3	$x1/[1/(1.4)+0.04] =$	1.82		(27b)
Rooflights Type 2			1.3	$x1/[1/(1.4)+0.04] =$	1.82		(27b)
Rooflights Type 3			2.6	$x1/[1/(1.4)+0.04] =$	3.64		(27b)
Rooflights Type 4			2.6	$x1/[1/(1.4)+0.04] =$	3.64		(27b)
Floor			102.8	x 0.12 =	12.336		(28)
Walls	292.21	60.7	231.51	x 0.2 =	46.3		(29)
Roof Type1	127.88	7.8	120.08	x 0.14 =	16.81		(30)
Roof Type2	19.4	0	19.4	x 0.1 =	1.96		(30)
Total area of elements, m²			542.29				(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) =

168.22 (33)

Heat capacity Cm = S(A x k)

((28)...(30) + (32) + (32a)...(32e) =

26454.14 (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

DER WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

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

23.61 (36)

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

Total fabric heat loss

(33) + (36) =

191.83 (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
153.77	153.14	152.53	149.66	149.12	146.61	146.61	146.15	147.58	149.12	150.21	151.34

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=

345.6	344.97	344.36	341.49	340.95	338.44	338.44	337.98	339.41	340.95	342.04	343.17
-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

341.48 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=

1.2	1.2	1.19	1.18	1.18	1.17	1.17	1.17	1.18	1.18	1.19	1.19
-----	-----	------	------	------	------	------	------	------	------	------	------

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

1.18 (40)

Number of days in month (Table 1a)

(41)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

3.12 (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

108.23 (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=

119.05	114.73	110.4	106.07	101.74	97.41	97.41	101.74	106.07	110.4	114.73	119.05
--------	--------	-------	--------	--------	-------	-------	--------	--------	-------	--------	--------

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

1298.78 (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=

176.55	154.42	159.34	138.92	133.3	115.02	106.59	122.31	123.77	144.24	157.45	170.98
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------

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

1702.9 (45)

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

(46)m=

26.48	23.16	23.9	20.84	19.99	17.25	15.99	18.35	18.57	21.64	23.62	25.65
-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(46)

Water storage loss:

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

300 (47)

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

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

Water storage loss:

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

0 (48)

Temperature factor from Table 2b

0 (49)

Energy lost from water storage, kWh/year

(48) x (49) =

300 (50)

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

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

0.01 (51)

If community heating see section 4.3

Volume factor from Table 2a

0.74 (52)

Temperature factor from Table 2b

0.54 (53)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year

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

1.23
1.23

(54)

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

(55)

Water storage loss calculated for each month

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

(56)m=	38.07	34.39	38.07	36.84	38.07	36.84	38.07	38.07	36.84	38.07	36.84	38.07
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(56)

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

(57)m=	38.07	34.39	38.07	36.84	38.07	36.84	38.07	38.07	36.84	38.07	36.84	38.07
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(59)

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

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

(61)

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

(62)m=	237.89	209.81	220.68	198.27	194.63	174.38	167.92	183.64	183.12	205.58	216.81	232.32
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(63)

Output from water heater

(64)m=	237.89	209.81	220.68	198.27	194.63	174.38	167.92	183.64	183.12	205.58	216.81	232.32
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

2425.04

(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=	107.77	95.66	102.05	93.67	93.39	85.73	84.51	89.73	88.64	97.03	99.84	105.92
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------	-------	-------	--------

(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=	155.86	155.86	155.86	155.86	155.86	155.86	155.86	155.86	155.86	155.86	155.86	155.86

(66)

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

(67)m=	40.03	35.55	28.91	21.89	16.36	13.81	14.93	19.4	26.04	33.06	38.59	41.14
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------

(67)

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

(68)m=	448.97	453.63	441.89	416.89	385.34	355.69	335.88	331.22	342.96	367.95	399.5	429.16
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

(68)

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

(69)m=	38.59	38.59	38.59	38.59	38.59	38.59	38.59	38.59	38.59	38.59	38.59	38.59
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(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=	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

(71)

Water heating gains (Table 5)

(72)m=	144.85	142.35	137.16	130.1	125.52	119.07	113.58	120.61	123.11	130.41	138.66	142.36
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

(72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=	706.6	704.28	680.71	641.64	599.98	561.33	537.15	543.99	564.86	604.19	649.51	685.41
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	2.7	x	11.28	x	0.72	x	0.7	=	10.64	(75)
Northeast 0.9x	0.77	x	2.7	x	22.97	x	0.72	x	0.7	=	21.66	(75)
Northeast 0.9x	0.77	x	2.7	x	41.38	x	0.72	x	0.7	=	39.02	(75)
Northeast 0.9x	0.77	x	2.7	x	67.96	x	0.72	x	0.7	=	64.08	(75)
Northeast 0.9x	0.77	x	2.7	x	91.35	x	0.72	x	0.7	=	86.14	(75)
Northeast 0.9x	0.77	x	2.7	x	97.38	x	0.72	x	0.7	=	91.84	(75)
Northeast 0.9x	0.77	x	2.7	x	91.1	x	0.72	x	0.7	=	85.91	(75)
Northeast 0.9x	0.77	x	2.7	x	72.63	x	0.72	x	0.7	=	68.49	(75)
Northeast 0.9x	0.77	x	2.7	x	50.42	x	0.72	x	0.7	=	47.55	(75)
Northeast 0.9x	0.77	x	2.7	x	28.07	x	0.72	x	0.7	=	26.47	(75)
Northeast 0.9x	0.77	x	2.7	x	14.2	x	0.72	x	0.7	=	13.39	(75)
Northeast 0.9x	0.77	x	2.7	x	9.21	x	0.72	x	0.7	=	8.69	(75)
Southeast 0.9x	0.77	x	24.4	x	36.79	x	0.72	x	0.7	=	313.57	(77)
Southeast 0.9x	0.77	x	24.4	x	62.67	x	0.72	x	0.7	=	534.12	(77)
Southeast 0.9x	0.77	x	24.4	x	85.75	x	0.72	x	0.7	=	730.8	(77)
Southeast 0.9x	0.77	x	24.4	x	106.25	x	0.72	x	0.7	=	905.5	(77)
Southeast 0.9x	0.77	x	24.4	x	119.01	x	0.72	x	0.7	=	1014.24	(77)
Southeast 0.9x	0.77	x	24.4	x	118.15	x	0.72	x	0.7	=	1006.9	(77)
Southeast 0.9x	0.77	x	24.4	x	113.91	x	0.72	x	0.7	=	970.76	(77)
Southeast 0.9x	0.77	x	24.4	x	104.39	x	0.72	x	0.7	=	889.64	(77)
Southeast 0.9x	0.77	x	24.4	x	92.85	x	0.72	x	0.7	=	791.31	(77)
Southeast 0.9x	0.77	x	24.4	x	69.27	x	0.72	x	0.7	=	590.31	(77)
Southeast 0.9x	0.77	x	24.4	x	44.07	x	0.72	x	0.7	=	375.58	(77)
Southeast 0.9x	0.77	x	24.4	x	31.49	x	0.72	x	0.7	=	268.35	(77)
Southwest 0.9x	0.77	x	8.1	x	36.79		0.72	x	0.7	=	104.09	(79)
Southwest 0.9x	0.77	x	8.1	x	62.67		0.72	x	0.7	=	177.31	(79)
Southwest 0.9x	0.77	x	8.1	x	85.75		0.72	x	0.7	=	242.6	(79)
Southwest 0.9x	0.77	x	8.1	x	106.25		0.72	x	0.7	=	300.6	(79)
Southwest 0.9x	0.77	x	8.1	x	119.01		0.72	x	0.7	=	336.69	(79)
Southwest 0.9x	0.77	x	8.1	x	118.15		0.72	x	0.7	=	334.26	(79)
Southwest 0.9x	0.77	x	8.1	x	113.91		0.72	x	0.7	=	322.26	(79)
Southwest 0.9x	0.77	x	8.1	x	104.39		0.72	x	0.7	=	295.33	(79)
Southwest 0.9x	0.77	x	8.1	x	92.85		0.72	x	0.7	=	262.69	(79)
Southwest 0.9x	0.77	x	8.1	x	69.27		0.72	x	0.7	=	195.97	(79)
Southwest 0.9x	0.77	x	8.1	x	44.07		0.72	x	0.7	=	124.68	(79)
Southwest 0.9x	0.77	x	8.1	x	31.49		0.72	x	0.7	=	89.08	(79)
Northwest 0.9x	0.77	x	25.5	x	11.28	x	0.72	x	0.7	=	100.49	(81)
Northwest 0.9x	0.77	x	25.5	x	22.97	x	0.72	x	0.7	=	204.55	(81)
Northwest 0.9x	0.77	x	25.5	x	41.38	x	0.72	x	0.7	=	368.54	(81)

DER WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	25.5	x	67.96	x	0.72	x	0.7	=	605.24	(81)
Northwest 0.9x	0.77	x	25.5	x	91.35	x	0.72	x	0.7	=	813.57	(81)
Northwest 0.9x	0.77	x	25.5	x	97.38	x	0.72	x	0.7	=	867.35	(81)
Northwest 0.9x	0.77	x	25.5	x	91.1	x	0.72	x	0.7	=	811.39	(81)
Northwest 0.9x	0.77	x	25.5	x	72.63	x	0.72	x	0.7	=	646.85	(81)
Northwest 0.9x	0.77	x	25.5	x	50.42	x	0.72	x	0.7	=	449.07	(81)
Northwest 0.9x	0.77	x	25.5	x	28.07	x	0.72	x	0.7	=	249.98	(81)
Northwest 0.9x	0.77	x	25.5	x	14.2	x	0.72	x	0.7	=	126.44	(81)
Northwest 0.9x	0.77	x	25.5	x	9.21	x	0.72	x	0.7	=	82.07	(81)
Rooflights 0.9x	1	x	1.3	x	15.92	x	0.72	x	0.7	=	9.39	(82)
Rooflights 0.9x	1	x	1.3	x	37.03	x	0.72	x	0.7	=	21.84	(82)
Rooflights 0.9x	1	x	2.6	x	15.92	x	0.72	x	0.7	=	18.77	(82)
Rooflights 0.9x	1	x	2.6	x	40.5	x	0.72	x	0.7	=	47.77	(82)
Rooflights 0.9x	1	x	1.3	x	32.51	x	0.72	x	0.7	=	19.17	(82)
Rooflights 0.9x	1	x	1.3	x	70.28	x	0.72	x	0.7	=	41.44	(82)
Rooflights 0.9x	1	x	2.6	x	32.51	x	0.72	x	0.7	=	38.34	(82)
Rooflights 0.9x	1	x	2.6	x	73.74	x	0.72	x	0.7	=	86.97	(82)
Rooflights 0.9x	1	x	1.3	x	59.5	x	0.72	x	0.7	=	35.09	(82)
Rooflights 0.9x	1	x	1.3	x	111.87	x	0.72	x	0.7	=	65.97	(82)
Rooflights 0.9x	1	x	2.6	x	59.5	x	0.72	x	0.7	=	70.17	(82)
Rooflights 0.9x	1	x	2.6	x	111.06	x	0.72	x	0.7	=	130.97	(82)
Rooflights 0.9x	1	x	1.3	x	100.03	x	0.72	x	0.7	=	58.99	(82)
Rooflights 0.9x	1	x	1.3	x	159.33	x	0.72	x	0.7	=	93.95	(82)
Rooflights 0.9x	1	x	2.6	x	100.03	x	0.72	x	0.7	=	117.98	(82)
Rooflights 0.9x	1	x	2.6	x	150.59	x	0.72	x	0.7	=	177.6	(82)
Rooflights 0.9x	1	x	1.3	x	136.88	x	0.72	x	0.7	=	80.71	(82)
Rooflights 0.9x	1	x	1.3	x	193.3	x	0.72	x	0.7	=	113.98	(82)
Rooflights 0.9x	1	x	2.6	x	136.88	x	0.72	x	0.7	=	161.43	(82)
Rooflights 0.9x	1	x	2.6	x	177.61	x	0.72	x	0.7	=	209.46	(82)
Rooflights 0.9x	1	x	1.3	x	147.03	x	0.72	x	0.7	=	86.7	(82)
Rooflights 0.9x	1	x	1.3	x	197.35	x	0.72	x	0.7	=	116.37	(82)
Rooflights 0.9x	1	x	2.6	x	147.03	x	0.72	x	0.7	=	173.4	(82)
Rooflights 0.9x	1	x	2.6	x	179.47	x	0.72	x	0.7	=	211.66	(82)
Rooflights 0.9x	1	x	1.3	x	137.1	x	0.72	x	0.7	=	80.85	(82)
Rooflights 0.9x	1	x	1.3	x	188.08	x	0.72	x	0.7	=	110.9	(82)
Rooflights 0.9x	1	x	2.6	x	137.1	x	0.72	x	0.7	=	161.69	(82)
Rooflights 0.9x	1	x	2.6	x	171.77	x	0.72	x	0.7	=	202.58	(82)
Rooflights 0.9x	1	x	1.3	x	107.76	x	0.72	x	0.7	=	63.55	(82)
Rooflights 0.9x	1	x	1.3	x	162.62	x	0.72	x	0.7	=	95.89	(82)
Rooflights 0.9x	1	x	2.6	x	107.76	x	0.72	x	0.7	=	127.09	(82)
Rooflights 0.9x	1	x	2.6	x	151.65	x	0.72	x	0.7	=	178.86	(82)

DER WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	1.3	x	73.17	x	0.72	x	0.7	=	43.15	(82)
Rooflights 0.9x	1	x	1.3	x	128.66	x	0.72	x	0.7	=	75.87	(82)
Rooflights 0.9x	1	x	2.6	x	73.17	x	0.72	x	0.7	=	86.29	(82)
Rooflights 0.9x	1	x	2.6	x	125.02	x	0.72	x	0.7	=	147.45	(82)
Rooflights 0.9x	1	x	1.3	x	39.91	x	0.72	x	0.7	=	23.53	(82)
Rooflights 0.9x	1	x	1.3	x	82.24	x	0.72	x	0.7	=	48.5	(82)
Rooflights 0.9x	1	x	2.6	x	39.91	x	0.72	x	0.7	=	47.07	(82)
Rooflights 0.9x	1	x	2.6	x	84.48	x	0.72	x	0.7	=	99.63	(82)
Rooflights 0.9x	1	x	1.3	x	20.03	x	0.72	x	0.7	=	11.81	(82)
Rooflights 0.9x	1	x	1.3	x	45.75	x	0.72	x	0.7	=	26.98	(82)
Rooflights 0.9x	1	x	2.6	x	20.03	x	0.72	x	0.7	=	23.62	(82)
Rooflights 0.9x	1	x	2.6	x	49.44	x	0.72	x	0.7	=	58.3	(82)
Rooflights 0.9x	1	x	1.3	x	13.01	x	0.72	x	0.7	=	7.67	(82)
Rooflights 0.9x	1	x	1.3	x	30.74	x	0.72	x	0.7	=	18.13	(82)
Rooflights 0.9x	1	x	2.6	x	13.01	x	0.72	x	0.7	=	15.34	(82)
Rooflights 0.9x	1	x	2.6	x	34.03	x	0.72	x	0.7	=	40.13	(82)

Solar gains in watts, calculated for each month

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

(83)m=	626.55	1123.56	1683.17	2323.94	2816.23	2888.48	2746.35	2365.69	1903.37	1281.46	760.81	529.45	(83)
--------	--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	--------	--------	------

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

(84)m=	1333.15	1827.84	2363.88	2965.58	3416.21	3449.8	3283.49	2909.68	2468.23	1885.65	1410.32	1214.87	(84)
--------	---------	---------	---------	---------	---------	--------	---------	---------	---------	---------	---------	---------	------

7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.94	0.8	0.6	0.45	0.52	0.81	0.98	1	1	(86)

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

(87)m=	19.57	19.8	20.14	20.56	20.86	20.97	20.99	20.99	20.89	20.45	19.92	19.53	(87)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.92	19.92	19.93	19.93	19.93	19.94	19.94	19.94	19.94	19.93	19.93	19.93	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	0.98	0.91	0.74	0.51	0.34	0.41	0.73	0.97	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(90)m=	18	18.33	18.84	19.43	19.8	19.92	19.94	19.94	19.85	19.29	18.52	17.95	(90)
--------	----	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.16

(91)

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

(92)m=	18.25	18.57	19.04	19.61	19.97	20.09	20.11	20.1	20.02	19.47	18.74	18.2	(92)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------	------

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

(93)m=	18.1	18.42	18.89	19.46	19.82	19.94	19.96	19.95	19.87	19.32	18.59	18.05	(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
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.97	0.9	0.73	0.51	0.34	0.41	0.72	0.96	1	1	(94)
--------	---	------	------	-----	------	------	------	------	------	------	---	---	------

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

(95)m=	1331.2	1816.21	2302.95	2671.48	2506.28	1771.47	1132.13	1192.62	1784.8	1807.01	1404.38	1213.73	(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, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	4768.49	4662.34	4267.3	3606.06	2768.43	1807.37	1136.04	1201.49	1957.23	2974.48	3930.12	4752.45	(97)
--------	---------	---------	--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

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

(98)m=	2557.34	1912.6	1461.48	672.9	195.04	0	0	0	0	868.59	1818.53	2632.81	(98)
--------	---------	--------	---------	-------	--------	---	---	---	---	--------	---------	---------	------

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

12119.3

Space heating requirement in kWh/m²/year

41.99

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

Space heating:

Fraction of space heat from secondary/supplementary system 0.1 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 0.9 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 0.9 (204)

Efficiency of main space heating system 1 90.9 (206)

Efficiency of secondary/supplementary heating system, % 65 (208)

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

Space heating requirement (calculated above)

2557.34	1912.6	1461.48	672.9	195.04	0	0	0	0	868.59	1818.53	2632.81
---------	--------	---------	-------	--------	---	---	---	---	--------	---------	---------

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

2532.02	1893.66	1447.01	666.23	193.11	0	0	0	0	859.99	1800.52	2606.74
---------	---------	---------	--------	--------	---	---	---	---	--------	---------	---------

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

11999.3

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	393.44	294.25	224.84	103.52	30.01	0	0	0	0	133.63	279.77	405.05	(215)
---------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	-------

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

1864.51

Water heating

Output from water heater (calculated above)

237.89	209.81	220.68	198.27	194.63	174.38	167.92	183.64	183.12	205.58	216.81	232.32
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater 80.8 (216)

(217)m=	89.85	89.68	89.3	88.18	85.29	80.8	80.8	80.8	80.8	88.59	89.59	89.9	(217)
---------	-------	-------	------	-------	-------	------	------	------	------	-------	-------	------	-------

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	264.77	233.95	247.13	224.85	228.18	215.81	207.82	227.28	226.64	232.04	242	258.43	(219)
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	-------

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

2808.9

Annual totals

kWh/year **kWh/year**

Space heating fuel used, main system 1 11999.3

Space heating fuel used, secondary 1864.51

Water heating fuel used 2808.9

DER WorkSheet: New dwelling design stage

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

706.87

(232)

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

17535.37

(338)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x		0.216	=	2591.85 (261)
Space heating (secondary)	(215) x		0.019	=	35.43 (263)
Water heating	(219) x		0.216	=	606.72 (264)
Space and water heating	(261) + (262) + (263) + (264) =				3234 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93 (267)
Electricity for lighting	(232) x		0.519	=	366.86 (268)
Total CO2, kg/year				sum of (265)...(271) =	3639.79 (272)
Dwelling CO2 Emission Rate				(272) ÷ (4) =	12.61 (273)
El rating (section 14)					85 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.33

Property Address: Detached with External Garage

Address : Greenfinch PH Development, Didsbury, Manchester

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	102.8 (1a)	x	3 (2a)	=	308.4 (3a)
First floor	102.6 (1b)	x	3.1 (2b)	=	318.06 (3b)
Second floor	83.2 (1c)	x	2.5 (2c)	=	208 (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	288.6 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	834.46 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 (6a)
Number of open flues	0	+	0	=	0 (6b)
Number of intermittent fans				4 x 10 =	40 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.05 (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)			0.3 (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			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.23 (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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

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
---------	------	------	------	-----	------	------	------	------	---	------	------	------

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

	0.29	0.29	0.28	0.25	0.25	0.22	0.22	0.21	0.23	0.25	0.26	0.27
--	------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 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 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 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= 0.54 0.54 0.54 0.53 0.53 0.52 0.52 0.52 0.53 0.53 0.53 0.54 (24d)

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

(25)m= 0.54 0.54 0.54 0.53 0.53 0.52 0.52 0.52 0.53 0.53 0.53 0.54 (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			25.5	$x1/[1/(1.4)+0.04] =$	33.81		(27)
Windows Type 2			24.4	$x1/[1/(1.4)+0.04] =$	32.35		(27)
Windows Type 3			2.7	$x1/[1/(1.4)+0.04] =$	3.58		(27)
Windows Type 4			8.1	$x1/[1/(1.4)+0.04] =$	10.74		(27)
Rooflights Type 1			1.3	$x1/[1/(1.7)+0.04] =$	2.21		(27b)
Rooflights Type 2			1.3	$x1/[1/(1.7)+0.04] =$	2.21		(27b)
Rooflights Type 3			2.6	$x1/[1/(1.7)+0.04] =$	4.42		(27b)
Rooflights Type 4			2.6	$x1/[1/(1.7)+0.04] =$	4.42		(27b)
Floor			102.8	x 0.13 =	13.364		(28)
Walls	292.21	60.7	231.51	x 0.18 =	41.67		(29)
Roof Type1	127.88	7.8	120.08	x 0.13 =	15.61		(30)
Roof Type2	19.4	0	19.4	x 0.13 =	2.52		(30)
Total area of elements, m²			542.29				(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) = 166.06 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 26454.14 (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

TER WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

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

24.74 (36)

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

Total fabric heat loss

(33) + (36) =

190.8 (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
149.62	149.16	148.7	146.57	146.17	144.31	144.31	143.97	145.03	146.17	146.98	147.82

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=

340.41	339.95	339.5	337.36	336.96	335.11	335.11	334.76	335.82	336.96	337.77	338.62
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

337.36 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=

1.18	1.18	1.18	1.17	1.17	1.16	1.16	1.16	1.16	1.17	1.17	1.17
------	------	------	------	------	------	------	------	------	------	------	------

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

1.17 (40)

Number of days in month (Table 1a)

(41)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

3.12 (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

108.23 (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=

119.05	114.73	110.4	106.07	101.74	97.41	97.41	101.74	106.07	110.4	114.73	119.05
--------	--------	-------	--------	--------	-------	-------	--------	--------	-------	--------	--------

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

1298.78 (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=

176.55	154.42	159.34	138.92	133.3	115.02	106.59	122.31	123.77	144.24	157.45	170.98
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------

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

1702.9 (45)

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

(46)m=

26.48	23.16	23.9	20.84	19.99	17.25	15.99	18.35	18.57	21.64	23.62	25.65
-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(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):

2.11 (48)

Temperature factor from Table 2b

0.54 (49)

Energy lost from water storage, kWh/year

(48) x (49) =

1.14 (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)

TER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year

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

0
1.14

(54)

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

(55)

Water storage loss calculated for each month

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

(56)m=	35.37	31.94	35.37	34.23	35.37	34.23	35.37	35.37	34.23	35.37	34.23	35.37
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(56)

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

(57)m=	35.37	31.94	35.37	34.23	35.37	34.23	35.37	35.37	34.23	35.37	34.23	35.37
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(59)

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

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

(61)

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

(62)m=	235.18	207.37	217.97	195.66	191.93	171.76	165.22	180.94	180.51	202.87	214.19	229.61
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(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=	235.18	207.37	217.97	195.66	191.93	171.76	165.22	180.94	180.51	202.87	214.19	229.61
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

2393.21

(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=	105.61	93.71	99.88	91.58	91.22	83.64	82.34	87.57	86.54	94.86	97.74	103.76
--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--------

(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=	155.86	155.86	155.86	155.86	155.86	155.86	155.86	155.86	155.86	155.86	155.86	155.86

(66)

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

(67)m=	40.03	35.55	28.91	21.89	16.36	13.81	14.93	19.4	26.04	33.06	38.59	41.14
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------

(67)

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

(68)m=	448.97	453.63	441.89	416.89	385.34	355.69	335.88	331.22	342.96	367.95	399.5	429.16
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

(68)

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

(69)m=	38.59	38.59	38.59	38.59	38.59	38.59	38.59	38.59	38.59	38.59	38.59	38.59
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(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=	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68	-124.68
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

(71)

Water heating gains (Table 5)

(72)m=	141.95	139.45	134.25	127.2	122.61	116.16	110.68	117.7	120.2	127.51	135.75	139.46
--------	--------	--------	--------	-------	--------	--------	--------	-------	-------	--------	--------	--------

(72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=	703.69	701.38	677.81	638.73	597.07	558.42	534.24	541.08	561.96	601.28	646.61	682.51
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(73)

6. Solar gains:

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

TER WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	2.7	x	11.28	x	0.63	x	0.7	=	9.31	(75)
Northeast 0.9x	0.77	x	2.7	x	22.97	x	0.63	x	0.7	=	18.95	(75)
Northeast 0.9x	0.77	x	2.7	x	41.38	x	0.63	x	0.7	=	34.14	(75)
Northeast 0.9x	0.77	x	2.7	x	67.96	x	0.63	x	0.7	=	56.07	(75)
Northeast 0.9x	0.77	x	2.7	x	91.35	x	0.63	x	0.7	=	75.37	(75)
Northeast 0.9x	0.77	x	2.7	x	97.38	x	0.63	x	0.7	=	80.36	(75)
Northeast 0.9x	0.77	x	2.7	x	91.1	x	0.63	x	0.7	=	75.17	(75)
Northeast 0.9x	0.77	x	2.7	x	72.63	x	0.63	x	0.7	=	59.93	(75)
Northeast 0.9x	0.77	x	2.7	x	50.42	x	0.63	x	0.7	=	41.6	(75)
Northeast 0.9x	0.77	x	2.7	x	28.07	x	0.63	x	0.7	=	23.16	(75)
Northeast 0.9x	0.77	x	2.7	x	14.2	x	0.63	x	0.7	=	11.71	(75)
Northeast 0.9x	0.77	x	2.7	x	9.21	x	0.63	x	0.7	=	7.6	(75)
Southeast 0.9x	0.77	x	24.4	x	36.79	x	0.63	x	0.7	=	274.37	(77)
Southeast 0.9x	0.77	x	24.4	x	62.67	x	0.63	x	0.7	=	467.35	(77)
Southeast 0.9x	0.77	x	24.4	x	85.75	x	0.63	x	0.7	=	639.45	(77)
Southeast 0.9x	0.77	x	24.4	x	106.25	x	0.63	x	0.7	=	792.31	(77)
Southeast 0.9x	0.77	x	24.4	x	119.01	x	0.63	x	0.7	=	887.46	(77)
Southeast 0.9x	0.77	x	24.4	x	118.15	x	0.63	x	0.7	=	881.04	(77)
Southeast 0.9x	0.77	x	24.4	x	113.91	x	0.63	x	0.7	=	849.42	(77)
Southeast 0.9x	0.77	x	24.4	x	104.39	x	0.63	x	0.7	=	778.43	(77)
Southeast 0.9x	0.77	x	24.4	x	92.85	x	0.63	x	0.7	=	692.39	(77)
Southeast 0.9x	0.77	x	24.4	x	69.27	x	0.63	x	0.7	=	516.53	(77)
Southeast 0.9x	0.77	x	24.4	x	44.07	x	0.63	x	0.7	=	328.63	(77)
Southeast 0.9x	0.77	x	24.4	x	31.49	x	0.63	x	0.7	=	234.8	(77)
Southwest 0.9x	0.77	x	8.1	x	36.79		0.63	x	0.7	=	91.08	(79)
Southwest 0.9x	0.77	x	8.1	x	62.67		0.63	x	0.7	=	155.15	(79)
Southwest 0.9x	0.77	x	8.1	x	85.75		0.63	x	0.7	=	212.28	(79)
Southwest 0.9x	0.77	x	8.1	x	106.25		0.63	x	0.7	=	263.02	(79)
Southwest 0.9x	0.77	x	8.1	x	119.01		0.63	x	0.7	=	294.61	(79)
Southwest 0.9x	0.77	x	8.1	x	118.15		0.63	x	0.7	=	292.48	(79)
Southwest 0.9x	0.77	x	8.1	x	113.91		0.63	x	0.7	=	281.98	(79)
Southwest 0.9x	0.77	x	8.1	x	104.39		0.63	x	0.7	=	258.41	(79)
Southwest 0.9x	0.77	x	8.1	x	92.85		0.63	x	0.7	=	229.85	(79)
Southwest 0.9x	0.77	x	8.1	x	69.27		0.63	x	0.7	=	171.47	(79)
Southwest 0.9x	0.77	x	8.1	x	44.07		0.63	x	0.7	=	109.1	(79)
Southwest 0.9x	0.77	x	8.1	x	31.49		0.63	x	0.7	=	77.95	(79)
Northwest 0.9x	0.77	x	25.5	x	11.28	x	0.63	x	0.7	=	87.93	(81)
Northwest 0.9x	0.77	x	25.5	x	22.97	x	0.63	x	0.7	=	178.98	(81)
Northwest 0.9x	0.77	x	25.5	x	41.38	x	0.63	x	0.7	=	322.47	(81)

TER WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	25.5	x	67.96	x	0.63	x	0.7	=	529.59	(81)
Northwest 0.9x	0.77	x	25.5	x	91.35	x	0.63	x	0.7	=	711.87	(81)
Northwest 0.9x	0.77	x	25.5	x	97.38	x	0.63	x	0.7	=	758.93	(81)
Northwest 0.9x	0.77	x	25.5	x	91.1	x	0.63	x	0.7	=	709.96	(81)
Northwest 0.9x	0.77	x	25.5	x	72.63	x	0.63	x	0.7	=	565.99	(81)
Northwest 0.9x	0.77	x	25.5	x	50.42	x	0.63	x	0.7	=	392.93	(81)
Northwest 0.9x	0.77	x	25.5	x	28.07	x	0.63	x	0.7	=	218.73	(81)
Northwest 0.9x	0.77	x	25.5	x	14.2	x	0.63	x	0.7	=	110.64	(81)
Northwest 0.9x	0.77	x	25.5	x	9.21	x	0.63	x	0.7	=	71.81	(81)
Rooflights 0.9x	1	x	1.3	x	15.92	x	0.63	x	0.7	=	8.21	(82)
Rooflights 0.9x	1	x	1.3	x	37.03	x	0.63	x	0.7	=	19.11	(82)
Rooflights 0.9x	1	x	2.6	x	15.92	x	0.63	x	0.7	=	16.42	(82)
Rooflights 0.9x	1	x	2.6	x	40.5	x	0.63	x	0.7	=	41.8	(82)
Rooflights 0.9x	1	x	1.3	x	32.51	x	0.63	x	0.7	=	16.77	(82)
Rooflights 0.9x	1	x	1.3	x	70.28	x	0.63	x	0.7	=	36.26	(82)
Rooflights 0.9x	1	x	2.6	x	32.51	x	0.63	x	0.7	=	33.55	(82)
Rooflights 0.9x	1	x	2.6	x	73.74	x	0.63	x	0.7	=	76.1	(82)
Rooflights 0.9x	1	x	1.3	x	59.5	x	0.63	x	0.7	=	30.7	(82)
Rooflights 0.9x	1	x	1.3	x	111.87	x	0.63	x	0.7	=	57.72	(82)
Rooflights 0.9x	1	x	2.6	x	59.5	x	0.63	x	0.7	=	61.4	(82)
Rooflights 0.9x	1	x	2.6	x	111.06	x	0.63	x	0.7	=	114.6	(82)
Rooflights 0.9x	1	x	1.3	x	100.03	x	0.63	x	0.7	=	51.61	(82)
Rooflights 0.9x	1	x	1.3	x	159.33	x	0.63	x	0.7	=	82.21	(82)
Rooflights 0.9x	1	x	2.6	x	100.03	x	0.63	x	0.7	=	103.23	(82)
Rooflights 0.9x	1	x	2.6	x	150.59	x	0.63	x	0.7	=	155.4	(82)
Rooflights 0.9x	1	x	1.3	x	136.88	x	0.63	x	0.7	=	70.63	(82)
Rooflights 0.9x	1	x	1.3	x	193.3	x	0.63	x	0.7	=	99.74	(82)
Rooflights 0.9x	1	x	2.6	x	136.88	x	0.63	x	0.7	=	141.25	(82)
Rooflights 0.9x	1	x	2.6	x	177.61	x	0.63	x	0.7	=	183.28	(82)
Rooflights 0.9x	1	x	1.3	x	147.03	x	0.63	x	0.7	=	75.86	(82)
Rooflights 0.9x	1	x	1.3	x	197.35	x	0.63	x	0.7	=	101.82	(82)
Rooflights 0.9x	1	x	2.6	x	147.03	x	0.63	x	0.7	=	151.73	(82)
Rooflights 0.9x	1	x	2.6	x	179.47	x	0.63	x	0.7	=	185.2	(82)
Rooflights 0.9x	1	x	1.3	x	137.1	x	0.63	x	0.7	=	70.74	(82)
Rooflights 0.9x	1	x	1.3	x	188.08	x	0.63	x	0.7	=	97.04	(82)
Rooflights 0.9x	1	x	2.6	x	137.1	x	0.63	x	0.7	=	141.48	(82)
Rooflights 0.9x	1	x	2.6	x	171.77	x	0.63	x	0.7	=	177.26	(82)
Rooflights 0.9x	1	x	1.3	x	107.76	x	0.63	x	0.7	=	55.6	(82)
Rooflights 0.9x	1	x	1.3	x	162.62	x	0.63	x	0.7	=	83.9	(82)
Rooflights 0.9x	1	x	2.6	x	107.76	x	0.63	x	0.7	=	111.21	(82)
Rooflights 0.9x	1	x	2.6	x	151.65	x	0.63	x	0.7	=	156.5	(82)

TER WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	1.3	x	73.17	x	0.63	x	0.7	=	37.75	(82)
Rooflights 0.9x	1	x	1.3	x	128.66	x	0.63	x	0.7	=	66.39	(82)
Rooflights 0.9x	1	x	2.6	x	73.17	x	0.63	x	0.7	=	75.51	(82)
Rooflights 0.9x	1	x	2.6	x	125.02	x	0.63	x	0.7	=	129.02	(82)
Rooflights 0.9x	1	x	1.3	x	39.91	x	0.63	x	0.7	=	20.59	(82)
Rooflights 0.9x	1	x	1.3	x	82.24	x	0.63	x	0.7	=	42.44	(82)
Rooflights 0.9x	1	x	2.6	x	39.91	x	0.63	x	0.7	=	41.19	(82)
Rooflights 0.9x	1	x	2.6	x	84.48	x	0.63	x	0.7	=	87.18	(82)
Rooflights 0.9x	1	x	1.3	x	20.03	x	0.63	x	0.7	=	10.33	(82)
Rooflights 0.9x	1	x	1.3	x	45.75	x	0.63	x	0.7	=	23.61	(82)
Rooflights 0.9x	1	x	2.6	x	20.03	x	0.63	x	0.7	=	20.67	(82)
Rooflights 0.9x	1	x	2.6	x	49.44	x	0.63	x	0.7	=	51.02	(82)
Rooflights 0.9x	1	x	1.3	x	13.01	x	0.63	x	0.7	=	6.71	(82)
Rooflights 0.9x	1	x	1.3	x	30.74	x	0.63	x	0.7	=	15.86	(82)
Rooflights 0.9x	1	x	2.6	x	13.01	x	0.63	x	0.7	=	13.42	(82)
Rooflights 0.9x	1	x	2.6	x	34.03	x	0.63	x	0.7	=	35.12	(82)

Solar gains in watts, calculated for each month

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

(83)m=	548.23	983.11	1472.77	2033.45	2464.2	2527.42	2403.05	2069.98	1665.45	1121.28	665.71	463.27	(83)
--------	--------	--------	---------	---------	--------	---------	---------	---------	---------	---------	--------	--------	------

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

(84)m=	1251.93	1684.49	2150.58	2672.18	3061.27	3085.84	2937.29	2611.06	2227.4	1722.56	1312.31	1145.78	(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)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	1	1	0.99	0.95	0.84	0.66	0.49	0.57	0.85	0.98	1	1	

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

(87)m=	19.56	19.77	20.1	20.5	20.82	20.96	20.99	20.98	20.86	20.41	19.9	19.53	(87)
--------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	------	-------	------

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

(88)m=	19.94	19.94	19.94	19.94	19.95	19.95	19.95	19.95	19.95	19.95	19.94	19.94	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	0.99	0.94	0.79	0.56	0.38	0.45	0.78	0.98	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(90)m=	18.01	18.31	18.78	19.36	19.77	19.93	19.95	19.95	19.84	19.25	18.51	17.96	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.16

(91)

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

(92)m=	18.25	18.54	18.99	19.54	19.94	20.09	20.11	20.11	20	19.43	18.73	18.2	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	------	------

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

(93)m=	18.25	18.54	18.99	19.54	19.94	20.09	20.11	20.11	20	19.43	18.73	18.2	(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=	1	1	0.98	0.93	0.79	0.58	0.4	0.47	0.78	0.97	1	1	(94)
--------	---	---	------	------	------	------	-----	------	------	------	---	---	------

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

(95)m=	1250.63	1677.19	2112.74	2481.59	2416.15	1780.68	1169.92	1225.84	1738.43	1672.63	1308.48	1145.01	(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=	4749.57	4637.26	4240.01	3590.94	2776.39	1839.67	1177.33	1241.99	1981.1	2976.42	3927.05	4741.83	(97)
--------	---------	---------	---------	---------	---------	---------	---------	---------	--------	---------	---------	---------	------

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

(98)m=	2603.21	1989.17	1582.69	798.73	268.02	0	0	0	0	970.02	1885.37	2676.04	(98)
--------	---------	---------	---------	--------	--------	---	---	---	---	--------	---------	---------	------

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

12773.24

Space heating requirement in kWh/m²/year

44.26

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

Space heating:

Fraction of space heat from secondary/supplementary system

0

Fraction of space heat from main system(s) (202) = 1 – (201) =

1

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] =

1

Efficiency of main space heating system 1

93.5

Efficiency of secondary/supplementary heating system, %

0

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

Space heating requirement (calculated above)

2603.21	1989.17	1582.69	798.73	268.02	0	0	0	0	970.02	1885.37	2676.04
---------	---------	---------	--------	--------	---	---	---	---	--------	---------	---------

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

2784.19	2127.45	1692.72	854.25	286.65	0	0	0	0	1037.45	2016.44	2862.07
---------	---------	---------	--------	--------	---	---	---	---	---------	---------	---------

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

13661.22

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	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

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

0

Water heating

Output from water heater (calculated above)

235.18	207.37	217.97	195.66	191.93	171.76	165.22	180.94	180.51	202.87	214.19	229.61
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

79.8

(217)m=

89.51	89.37	89.05	88.17	85.7	79.8	79.8	79.8	79.8	88.45	89.28	89.55
-------	-------	-------	-------	------	------	------	------	------	-------	-------	-------

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	262.76	232.04	244.76	221.9	223.94	215.24	207.04	226.74	226.2	229.37	239.91	256.4	(219)
---------	--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	-------	-------

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

2786.3

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

13661.22

Water heating fuel used

2786.3

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		706.87	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		17309.19	(338)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	2950.82	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	601.84	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3552.66	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	366.86	(268)
Total CO2, kg/year		sum of (265)...(271) =		3958.45	(272)
TER =				13.72	(273)