
Jda Architects

Environmental Standards Statement

Holehouse Mill, Chisworth

28 April 2023

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1 Executive Summary

This Environmental Standards Statement has been prepared by Watt Energy on behalf of jda Architects to support a planning application for the development of Holehouse Mill, Chisworth. The statement specifically addresses the following High Peak Borough Council approved climate change action plans in addition to planning policies, as stipulated in High Peak Local Plan (July 2016):

- **Policy S 1 Sustainable Development Principles**
- **Policy S 1a Presumption in Favour of Sustainable Development**
- **Policy EQ 1 Climate Change**

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 **an ASHP system and 1.8kWp PV array to each dwelling** that will be implemented to the rear and roof of the properties.

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:

- **66.8%** with SAP 9 carbon factors (current Building Regulations)
- **75.6%** with SAP 10 carbon factors
- **85.3%** with SAP 10.1 carbon factors (proposed improvements to Part L)

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 High Peak Borough 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 High Peak Borough Council 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 **44.8%** reduction in these emissions, over the Part L1A 2013 of the Building Regulations. This surpasses all of High Peak Borough Council's planning targets and therefore allows compliance to be reached.

2 Planning Statement

The following statement relates to the proposed development at Holehouse Mill, Chisworth.

2.1 The Site and Proposed Development

The site is located southeast of the centre of Glossop. The site occupies approximately 1.7 hectares of land. A 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 southeast by Marple Road and Demmings Road to the south and is adjacent to existing residential properties and Chisworth methodist Church. The site is currently occupied by several connected buildings/farmhouses.

The proposal is for a residential-led development consisting of 25 new build houses. These houses will be including a mix three and four bedroom houses (use class C3).



Figure 1: Site Plan

2.2 Relevant Policies and Guidance

2.2.1 Local Planning Policy

2.2.1.1 High Peak Local Plan 2016

Policy S 1 Sustainable Development Principles

Policy S 1

Sustainable Development Principles

The Borough Council will expect that all new development makes a positive contribution towards the sustainability of communities and to protecting, and where possible enhancing, the environment; and mitigating the process of climate change, within the Plan Area.

This will be achieved by:

- Meeting most development needs within or adjacent to existing communities;
- Making effective use of land (including the remediation of contaminated land and reuse of brownfield land), buildings and existing infrastructure;
- Making efficient use of land by ensuring that the density of proposals is appropriate (and informed by the surrounding built environment);
- Taking account of the distinct Peak District character, landscape, townscape, roles and setting of different areas and settlements in the High Peak;
- Protecting and enhancing the natural and historic environment of the High Peak and its surrounding areas including the Peak District National Park;
- Providing for a mix of types and tenures of quality homes to meet the needs and aspirations of existing and future residents in sustainable locations;
- Supporting the local economy and businesses by providing for a range of economic development that provide employment opportunities suitable for local people in sustainable locations, and generally encourage larger developments to incorporate mixed uses where possible so as to reduce the need to travel;
- Minimising the need to travel by promoting development in locations where there is access to a broad range of jobs, services and facilities which are accessible by foot, cycle or public transport with minimal reliance on the private car;
- Minimising the risk of damage to areas of importance for nature conservation and/or landscape value, both directly and indirectly and ensuring that there is suitable mitigation for a net gain in biodiversity and the creation of ecological networks;
- Minimising carbon or energy impacts associated with development according to the principles of the 'energy hierarchy' by minimising the need for energy through the appropriate siting, orientation and design of new buildings; the use of renewable energy sources and ensuring building construction and other forms of development address the challenge of climate change by meeting high environmental standards with particular regard to energy efficiency, water efficiency, use of sustainable materials, encouraging waste reduction, recycling, including where appropriate the local- or on site-sourcing of building materials;
- Further mitigating the impacts of climate change by seeking reductions in greenhouse gas emissions across the High Peak; in particular through supporting the delivery of renewable and low-carbon forms of energy (either via stand-alone installations, or installations integrated within new/existing developments), where this is considered acceptable against all other Development Plan Policies as a whole;

- Requiring that all new development addresses flood risk mitigation/adaptation, ensuring for example that sustainable drainage systems are considered at the outset within proposals (and to comply with legislative requirements);
- Seeking to secure high quality, locally distinctive and inclusive design in all development that can be accessed and used by everyone including disabled people;
- Seeking to secure developments provide a high standard of amenity for all existing and future occupants of land and buildings, ensuring communities have a healthy, safe and attractive living and working environment and the risks from potential hazards are minimised
- Maintaining and where possible enhancing accessibility to a good range of services and facilities, and ensuring existing infrastructure and services have the capacity to support development when required.

In order to enable required development to take place, in some cases mitigation measures will be needed to address the impacts of new development on existing infrastructure and on nearby sensitive areas.

In all cases development should not conflict with the relevant policies in this Local Plan. Development should be designed to be sustainable; seek to enhance the environment; have regard to both its direct and indirect cumulative impact over the longer term; and should provide any necessary mitigating or compensatory measures to address harmful implications.

New development should make effective use of land and buildings and be located in sustainable locations in line with the Settlement Hierarchy in Policy S2.

Policy S 1a Presumption in Favour of Sustainable Development

Policy S 1a

Presumption in Favour of Sustainable Development

When considering development proposals the Council will take a positive approach that reflects the presumption in favour of sustainable development contained in the National Planning Policy Framework. It will always work pro-actively with applicants jointly to find solutions which mean that proposals can be approved wherever possible, and to secure development that improves the economic, social and environmental conditions in the area.

Planning applications that accord with the policies in this Local Plan (and, where relevant, with policies in neighbourhood plans) will be approved without delay, unless material considerations indicate otherwise. Where there are no policies relevant to the application or relevant policies are out of date at the time of making the decision then the Council will grant permission unless material considerations indicate otherwise – taking into account whether:

- Any adverse impacts of granting permission would significantly and demonstrably outweigh the benefits, when assessed against the policies in the National Planning Policy Framework taken as a whole; or
- Specific policies in that Framework indicate that development should be restricted.

Policy EQ 1 Climate Change

Policy EQ 1

Climate Change

The Council will adopt strategies to mitigate and adapt to climate change. In addressing the move to a low carbon future for High Peak, the Council will plan for new development in locations and ways that reduce greenhouse gas emissions and adopt the principles set out in the energy hierarchy.

The Council intends to meet part of its future energy needs through renewable or low carbon energy sources and will therefore encourage and support the provision of renewable and low carbon technologies, including both stand-alone installations, and micro-renewables integrated within new or existing development.

A low carbon future for High Peak will be achieved by:

- Requiring new development to be designed to contribute to achieving national targets to reduce greenhouse gas emissions by using land-form, layout, building orientation, tree planting, massing and landscaping to reduce likely energy consumption and resilience to increased temperatures
- Ensuring that renewable energy installations do not have an adverse impact on the integrity of any European sites, (including by project- level HRA where appropriate), wildlife sites, protected species or habitats, or the landscape and landscape setting of the Peak District National Park
- Supporting opportunities to deliver decentralised energy systems, particularly those which are powered by a renewable or low carbon source
- Supporting connection to an existing decentralised energy supply system where there is capacity to supply the proposed development, or design for a future connection where there are firm proposals for such a system
- Ensuring that renewable / low carbon energy generation developments and associated infrastructure are supported by requiring Design Statements to include an assessment of how any impacts on the environment and heritage assets, including cumulative landscape, noise and visual impacts, can be avoided and/or mitigated through careful consideration of location, scale, design and other measures
- Applications for new build residential development in the Buxton Sub-Area should meet the optional national technical requirement for water efficiency of 110 litres per person per day to minimise the phosphate load to the River Wye via discharges from the Buxton Sewage Treatment Works, unless it can be demonstrated that doing so would adversely impact on a scheme's viability.
- Unless it can be demonstrated that it would not be technically feasible or financially viable, requiring that commercial developments over 1,000m² the Building Research Establishment Environmental Assessment Method (BREEAM) good standard as a minimum
- Promoting energy efficiency and the use of renewable / low carbon energy in new development and through retro-fitting of existing buildings
- Supporting sustainable waste management by provision of space for recycling and composting

- Supporting the use of sustainable design and construction techniques including the use of recycled materials in construction, including where appropriate the local or on-site sourcing of these building materials
- Supporting high water efficiency standards and measures to recycle and minimise water consumption

2.3 National Planning Policy

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

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

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

2.4 Sustainable Design Strategy

2.4.1 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. Incorporate the energy hierarchy.
2. Incorporate renewable and low/zero carbon technologies to reduce carbon emissions.

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 standards designed to exceed Building Regulations compliancy 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 mechanical ventilation with heat recovery systems.

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).

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

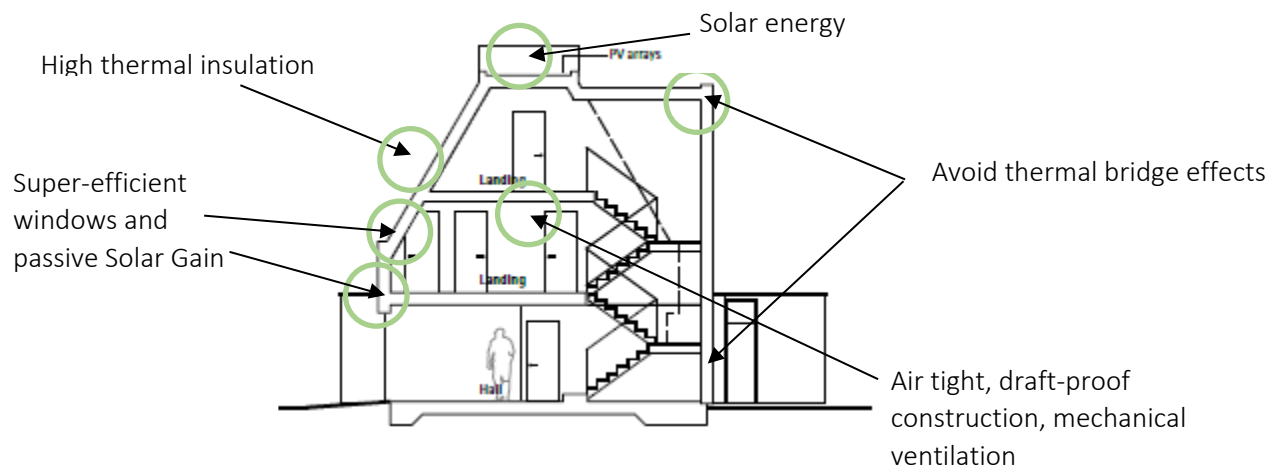


Fig 3. Efficient Design Measure examples

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

Residential Units:

- Ground floor U-values of $0.12 \text{ W/m}^2\text{K}$
- External Wall U-values of $0.18 \text{ W/m}^2\text{K}$
- Flat Ceiling-values of $0.13 \text{ W/m}^2\text{K}$
- Sloped Ceiling U-values of $0.13 \text{ W/m}^2\text{K}$
- Low Double Glazed Window U-values of $1.1 \text{ W/m}^2\text{K}$
- Solid Doors U-values of
- 100% low energy lighting throughout
- 100% efficient electric panel heaters to each flat
- MVHR – Vent Axia Sentinel Kinetic FH to each flat
- Air Permeability Rate of $3\text{m}^3/\text{hm}^2$ in all houses

2.4.2 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:

- Individual ASHP system to each dwelling (Daikin Altherma or similar efficiency)
- 1.8 kWp to each dwelling (45 kWp PV array in total)

The above LZC contribution has provided an **62.9%** reduction in CO₂ following Energy Efficiency Measures.

- Energy Saving from onsite LZC Technologies = **182554.3 kWh/Yr**
- CO₂ Saving from onsite LZC Technologies = **55697.4 kgCO₂/Yr**

2.4.3 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:

	SAP 9.0	SAP 10.0	SAP 10.1
Summary of CO₂ Emission Reductions	Total CO₂ emissions (kgCO₂/year)		
Carbon Factors (Gas / Electric)	0.216 / 0.519	0.210 / 0.233	0.210 / 0.136
Baseline emissions	102775.5	62905.7	61271.3
Improved emissions (after application of energy efficiency measures) - residual emissions	88524.9	52397.0	49116.7
Improved emissions (after incorporation of renewable energy technology) % CO ₂ displaced in total	32827.5	14737.6	8602.2
% CO ₂ displaced in total	68.1%	76.6%	86.0%
% CO ₂ displaced by energy efficiency measures	13.9%	16.7%	19.8%
% CO ₂ displaced by renewable energy	62.9%	71.9%	82.5%

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)	297705.5		102775.5	
Proposed scheme after energy efficiency measures (“Residual” energy demand & emissions)	245805.7	17.4%	88524.9	13.9%
Improved emissions (after incorporation of incorporation of renewable energy)	63251.4	74.3%	32827.5	62.9%
Proposed scheme offset for financial contribution or other “allowable solution”			0	0
Total savings on residual emissions				62.9%

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)	297705.5
Baseline carbon emissions (kg pa)	102775.5

Be Lean stage

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)	51899.8
Emission savings from energy efficiency measures (kg pa)	14250.6
Total regulated emissions after CHP savings and energy efficiency measures (kg pa) (“residual emissions”)	88524.9

Be Clean stage

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.

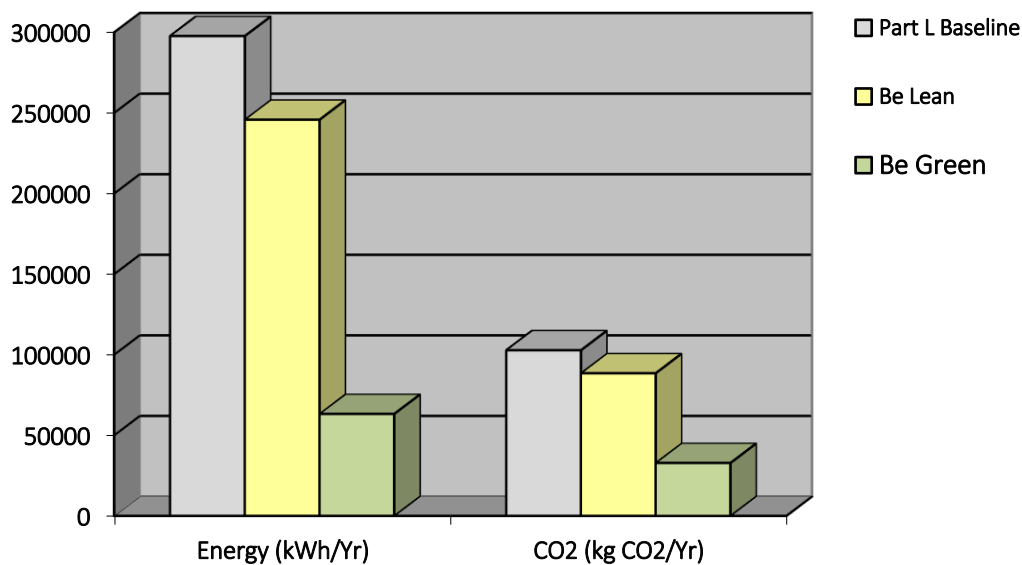
Energy savings from the use of CHP systems (kWh pa)	-
Emission savings from the use of CHP systems (kg pa)	-
Total regulated emissions after CHP savings (kg pa)	88524.9

Be Green stage

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)	182554.3
Saving on residual emissions from the use of renewables (kg)	55697.4
Saving on residual emissions from the use of renewables (%)	62.9%

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



2.5 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 these issues feature regularly within the separate climate change action plans, outlined within section 2.2, as areas that Chisworth is aiming to significantly improve on in order to become a more carbon neutral and clean city.

All 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.

2.5.1 Flood Risk Zone

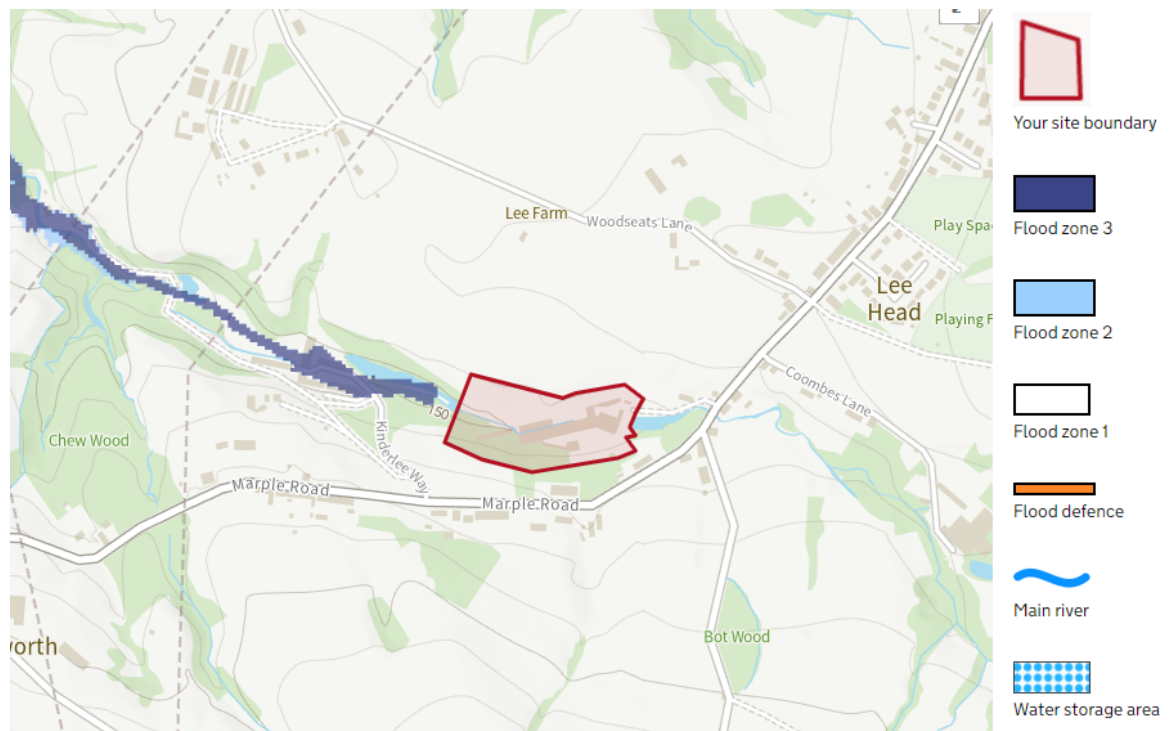


Fig 4: Flood Risk Map

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

2.5.2 Green Blue Infrastructure

2.5.2.1 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 still be ensured 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:

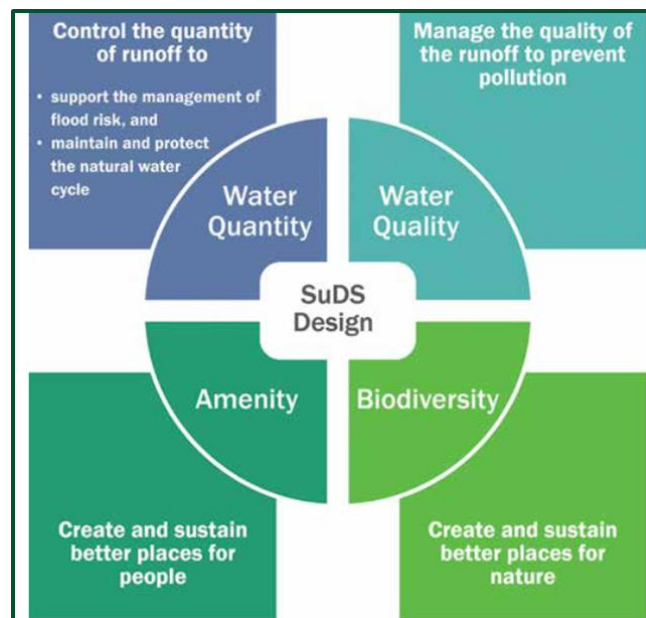


Fig 5. Representation of figure 2.1 of the SUDs Manual

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



2.5.2.2 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.

2.5.3 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.



2.5.4 Waste Management

2.5.4.1 Occupational Waste

High Peak Borough 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.

2.5.4.2 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 HPBC.

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

2.5.5 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, High Peak Borough 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.

2.5.6 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.

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.

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 and are to be proposed at this stage to offset residual carbon emissions and contribute towards achieving an A rated EPC. A 45 kWp PV array is to be proposed at this stage with 1.8 kWp designated to each dwelling.

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 and are to be proposed at this stage to satisfy the heating and hot water demand.

Chosen Renewable Technology



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 Holehouse Mill site against the relevant climate change and sustainability policies and targets, as outlined within: the High Peak Borough Council Local Plan (2016) 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 exceed Building Regulations Part L 2013 standards. Following on from this, efficient MVHR systems were proposed for each dwelling and house, to further reduce the total energy demands whilst simultaneously providing each dwelling with healthy internal environments. This approach demonstrates a holistic low energy design concept, involving very low limiting values and thus led to high-energy performance targets and being defined as a low carbon development.

Furthermore, an LZC feasibility assessment was carried out, with all suitable technologies investigated for their suitability to the site and development. The assessment determined that a Daikin Altherma Heat Pump and 1.8 kWp PV array to each dwelling can be proposed at this stage, which would provide an additional **62.9%** reduction in carbon emissions over the residual emissions: bringing the total carbon reduction to **68.1%**, when using SAP 9.0 carbon factors. However, this reduction rises further to **76.6%** and **86%** when using SAP 10 and 10.1 carbon factors. In addition to this renewable technology provision, the development can also be defined as carbon neutral because it will have net zero carbon emissions. This is to be achieved by obtaining all the energy used on site from a 100% renewable energy electricity supply provider.

The development will also be targeting an **A rated EPC** for each dwelling which is currently being achieved through the adoption of energy efficiency measures, high performance ASHP in the form of a Daikin Altherma and PV array.

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 High Peak Borough Council carbon targets the proposal will include many sustainability measures throughout construction and once completed, which will contribute heavily to the development's sustainability performance and accord with the requirements of the NPPF. The key measures to be included and therefore can be taken from this report include:

- The proposal sits within Flood Risk Zone 1 and therefore has minimal to no risk of flooding.
- A SUDs strategy will be produced to outline all measures to be incorporated that will ensure any additional surface water is collected, treated and removed.

- The development will incorporate green infrastructure in the form of extensive planting involving hedges, trees, sedum/green roofs and ornamental planting that will instil a sense of wellbeing whilst also assisting with offsetting carbon dioxide and balancing local temperatures through evapotranspiration.
- Internal water efficiency will be prioritised by ensuring that efficient water fixtures are proposed so that each dwelling achieves less than 110L per person per day and 'A' rated appliances will be specified where possible.
- Waste minimisation will be targeted from throughout construction and occupational phase. It is targeted that at least 90% of construction waste will be diverted from landfill. Whilst tri-separator refuse shoots will be installed on each floor to promote recycling.
- In addition to targeting Secure by Design accreditation through adoption crime prevention measures, the site layout promotes busy spaces and routes and facilitates natural surveillance. These will therefore reduce the fear of crime and subsequently improving mental health of residents, visitors and workers.
- Prioritising reusing existing materials and locally sourced materials for construction to reduce waste and transportation to landfill in addition and promote a low embodied carbon development.
- When new materials are specified that are not locally attainable then only those that score well on the BRE: The Green Guide to Specification are to be used; to further encourage the use of sustainable materials and reductions in embodied carbon.
- The buildings will have a daylight and sunlight analysis carried out and will aim to achieve high pass rates. Additionally, highly efficient MVHR systems are being proposed to each flat individually to provide a continuous source of fresh air and maintain healthy indoor environments. These will promote healthy housing and subsequently boost physical and mental wellbeing of residents.

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

House Type/Name	Houses	Flats	Flat 3	Flat 4	TOTAL (kWh/yr)		TOTAL (kgCO2/yr)	SAP 10.0	TOTAL (kgCO2/yr)	SAP 10.1	TOTAL (kgCO2/yr)
Frequency	1	1	1	1	4						
BASELINE Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (DER)	7954.49	9444.8	9257.32	8324.11	34980.7	0.216	11711.5	0.210	7346.0	0.210	7346.0
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0.0	0.216	0.0	0.210	0.0	0.136	0.0
Water Fuel Requirement (DER)	2677.23	2686.28	2707.15	2709.9	10780.6	0.216	3609.3	0.210	2263.9	0.210	2263.9
Electricity Pumps Fans Requirement (DER)	75	75	75	75	300.0	0.519	155.7	0.233	69.9	0.136	40.8
Electricity Lighting Requirement (DER)	566.2	611.86	696.87	759.4	2634.3	0.519	1367.2	0.233	613.8	0.136	358.3
TOTAL PER DEVELOPMENT					48695.6		16843.8		10293.6		10008.9
AFTER ENERGY SAVING MEASURES Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (DER)	5817.05	6488.96	6312.82	5373.91	23992.7	0.216	8032.8	0.210	5038.5	0.210	5038.5
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
Water Fuel Requirement (DER)	2701.59	2713.85	2736.86	2742.53	10894.8	0.216	3647.6	0.210	2287.9	0.210	2287.9
Electricity Pumps Fans Requirement (DER)	703.31	756.3	981.89	981.89	3423.4	0.519	1776.7	0.233	797.6	0.136	465.6
Electricity Lighting Requirement (DER)	566.2	611.86	696.87	759.4	2634.3	0.519	1367.2	0.233	613.8	0.136	358.3
TOTAL PER DEVELOPMENT					40945.3		14824.3		8737.8		8150.2
FINAL Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (DER)	1834.94	2048.26	1976.57	1664.66	7524.4	0.519	3905.2	0.233	1753.2	0.136	1023.3
Secondary Main Heating Fuel Requirement (DER)	0	0	0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
Secondary Heating Fuel Requirement (DER)	0	0	0	0	0.0	0.519	0.0	0.233	0.0	0.136	0.0
Water Fuel Requirement (DER)	1031.46	1037	1044.23	1044.23	4156.9	0.519	2157.4	0.233	968.6	0.136	565.3
Electricity Pumps Fans Requirement (DER)	748.31	801.3	1026.89	1026.89	3603.4	0.519	1870.2	0.233	839.6	0.136	490.1
Electricity Lighting Requirement (DER)	566.2	611.86	696.87	759.4	2634.3	0.519	1367.2	0.233	613.8	0.136	358.3
TOTAL PER DEVELOPMENT					17919.1		9300.0		4175.1		2437.0
PV Energy Produced (DER)					0.0	0.519	0.0	0.233	0.0	0.136	0.0
TOTAL PER DEVELOPMENT					17919.1		9300.0		4175.1		2437.0



Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.60
Printed on 28 April 2023 at 10:35:30

Project Information:

Assessed By: Daniel Watt (STRO026464) **Building Type:** Semi-detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 167.21m²

Site Reference : 1225 Holehouse Mill

Plot Reference: Type A - Be Green

Address : 1225 Holehouse Mill, Chisworth, tba

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.

It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Electricity

Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 23.28 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 7.44 kg/m² **OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 57.0 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 48.1 kWh/m² **OK**

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.09 (max. 2.00)	1.10 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric
Daikin Altherma EDLA08EV3

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: Measured cylinder loss: 2.01 kWh/day
Permitted by DBSCG: 2.56 kWh/day **OK**
Primary pipework insulated: Yes **OK**

Regulations Compliance Report

6 Controls

Space heating controls	Programmer and room thermostat	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

Continuous supply and extract system		
Specific fan power:	0.88	
Maximum	1.5	OK
MVHR efficiency:	84%	
Minimum	70%	OK

9 Summertime temperature

Overheating risk (North West England):	Not significant	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: South	7.36m ²	
Windows facing: North	12m ²	
Windows facing: East	3.2m ²	
Ventilation rate:	8.00	
Blinds/curtains:	Light-coloured curtain or roller blind	
	Closed 100% of daylight hours	

10 Key features

Air permeability	3.0 m ³ /m ² h
Windows U-value	1.1 W/m ² K
Doors U-value	1 W/m ² K
Floors U-value	0.12 W/m ² K
Floors U-value	0.12 W/m ² K
Photovoltaic array	

Predicted Energy Assessment



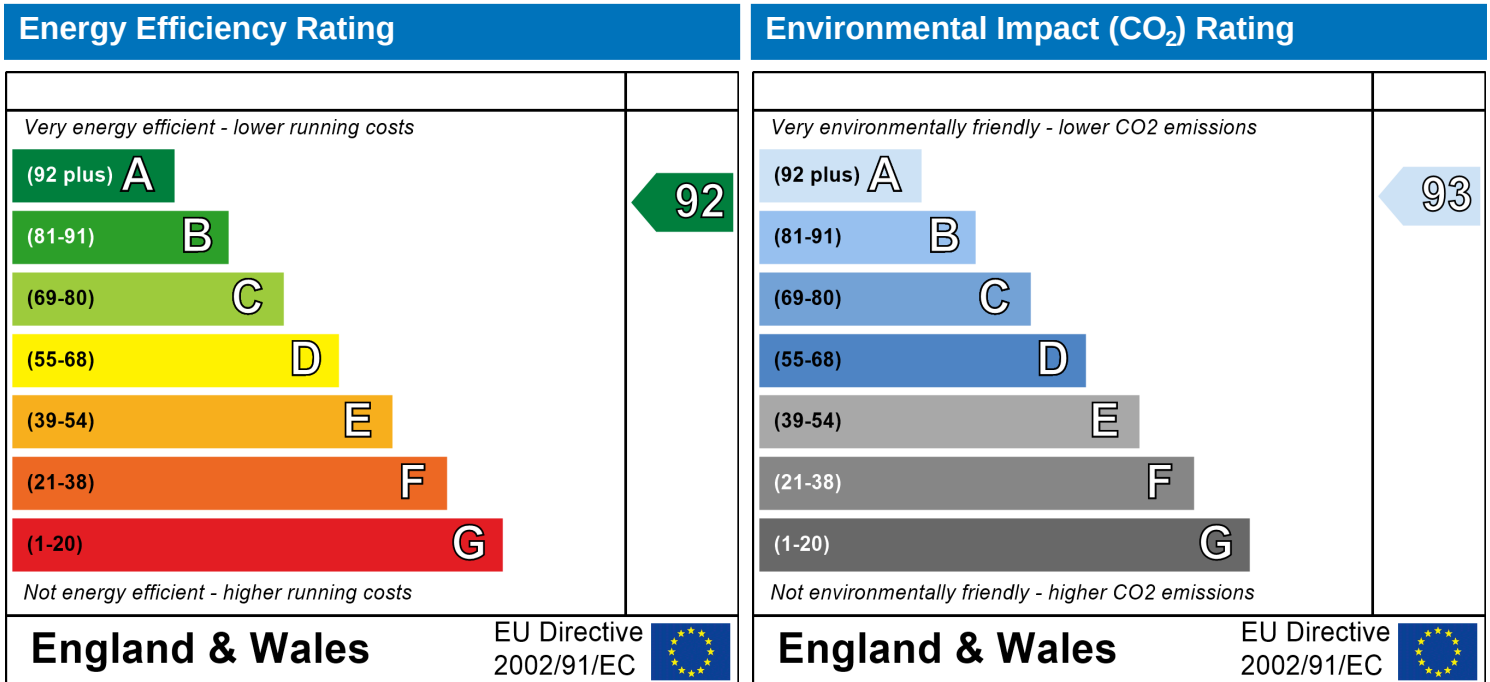
1225 Holehouse Mill
Chisworth
tba

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

Semi-detached House
26 April 2023
Daniel Watt
167.21 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: Type A - Be Green

Address: 1225 Holehouse Mill, Chisworth, tba
 Located in: England
 Region: North West England
 UPRN:
 Date of assessment: 26 April 2023
 Date of certificate: 28 April 2023
 Assessment type: New dwelling design stage
 Transaction type: New dwelling
 Tenure type: Unknown
 Related party disclosure: Employed by the professional dealing with the property transaction
 Thermal Mass Parameter: Indicative Value Medium
 Water use <= 125 litres/person/day: True
 PCDF Version: 512

Property description:

Dwelling type: House
 Detachment: Semi-detached
 Year Completed: 2023
 Floor Location: Floor area: Storey height:
 Floor 0 38.59 m² 2.8 m
 Floor 1 64.31 m² 2.8 m
 Floor 2 64.31 m² 2.8 m
 Living area: 26 m² (fraction 0.155)
 Front of dwelling faces: South

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Half glazed	low-E, En = 0.05, soft coat	Yes	PVC-U
Front	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
Rear	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
Side	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Front Door	16mm or more mm	0.7	0.72	1	2	1
Front	16mm or more	0.7	0.72	1.1	7.36	1
Rear	16mm or more	0.7	0.72	1.1	12	1
Side	16mm or more	0.7	0.72	1.1	3.2	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		Walls	South	0	0
Front		Walls	South	0	0
Rear		Walls	North	0	0
Side		Walls	East	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Walls	166.29	24.56	141.73	0.18	0	False	N/A
Wall to Void	14	0	14	0.18	0	False	N/A
Flat Ceiling	64.31	0	64.31	0.13	0		N/A
Ground	38.59			0.12			N/A
Floor to Void	25.72			0.12			N/A

SAP Input

Internal Elements

Party Elements

Thermal bridges:

Thermal bridges:	User-defined (individual PSI-values) Y-Value = 0.0982			
	Length	Psi-value		
[Approved]	15.5	0.3	E2	Other lintels (including other steel lintels)
[Approved]	11.8	0.04	E3	Sill
[Approved]	32.2	0.05	E4	Jamb
[Approved]	23.45	0.16	E5	Ground floor (normal)
[Approved]	34.41	0.07	E6	Intermediate floor within a dwelling
	15	0.32	E20	Exposed floor (normal)
	6	0.32	E21	Exposed floor (inverted)
[Approved]	8.93	0.06	E10	Eaves (insulation at ceiling level)
[Approved]	14.52	0.24	E12	Gable (insulation at ceiling level)
[Approved]	28	0.09	E16	Corner (normal)
[Approved]	11.2	-0.09	E17	Corner (inverted internal area greater than external area)
[Approved]	16.8	0.06	E18	Party wall between dwellings
	10.46	0.16	P1	Ground floor
	10.46	0.24	P4	Roof (insulation at ceiling level)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery
	Number of wet rooms: Kitchen + 4
	Ductwork: Insulation, rigid
	Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

Main heating system:

Main heating system:	Heat pumps with radiators or underfloor heating
	Electric heat pumps
	Fuel: Electricity
	Info Source: Boiler Database
	Database: (rev 512, product index 106483, SEDBUK 410%):
	Brand name: Daikin Altherma
	Model: EDLA08EV3
	Model qualifier: Underfloor
	(provides DHW all year)
	Systems with radiators
	Central heating pump : 2013 or later
	Design flow temperature: Design flow temperature<=35°C
	Open
	Boiler interlock: Yes
	MCS Installation Certificate

Main heating Control:

Main heating Control:	Programmer and room thermostat
	Control code: 2204

Secondary heating system:

Secondary heating system:	None
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Water heating:

Water heating:	From main heating system
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SAP Input

Water code: 901
Fuel :Electricity
Hot water cylinder
Cylinder volume: 250 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:	Unknown
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	<u>Photovoltaic 1</u> Installed Peak power: 1.8 Tilt of collector: 45° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.60

Property Address: Type A - Be Green

Address : 1225 Holehouse Mill, Chisworth, tba

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	38.59 (1a)	x	2.8 (2a)	=	108.05 (3a)
First floor	64.31 (1b)	x	2.8 (2b)	=	180.07 (3b)
Second floor	64.31 (1c)	x	2.8 (2c)	=	180.07 (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	167.21 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	468.19 (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				0 x 10 =	0 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.13 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

71.4 (23c)

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

(24a)m=	0.31	0.3	0.3	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.29	0.29	(24a)
---------	------	-----	-----	------	------	------	------	------	------	------	------	------	-------

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

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

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

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

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

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

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

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

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

(25)m=	0.31	0.3	0.3	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.29	0.29	(25)
--------	------	-----	-----	------	------	------	------	------	------	------	------	------	------

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2	x 1	= 2		(26)
Windows Type 1			7.36	x1/[1/(1.1)+ 0.04] =	7.75		(27)
Windows Type 2			12	x1/[1/(1.1)+ 0.04] =	12.64		(27)
Windows Type 3			3.2	x1/[1/(1.1)+ 0.04] =	3.37		(27)
Floor Type 1			38.59	x 0.12	= 4.6308		(28)
Floor Type 2			25.72	x 0.12	= 3.0864		(28)
Walls Type1	166.29	24.56	141.73	x 0.18	= 25.51		(29)
Walls Type2	14	0	14	x 0.18	= 2.52		(29)
Roof	64.31	0	64.31	x 0.13	= 8.36		(30)
Total area of elements, m²			308.91				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 69.88 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 16096.49 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 30.34 (36)

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

Total fabric heat loss (33) + (36) = 100.22 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	47.21	46.72	46.23	43.76	43.27	40.81	40.81	40.32	41.79	43.27	44.26	45.24	(38)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	147.43	146.93	146.44	143.98	143.49	141.02	141.02	140.53	142.01	143.49	144.47	145.46	
Average = Sum(39) _{1...12} /12=												143.86	(39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	0.88	0.88	0.88	0.86	0.86	0.84	0.84	0.84	0.85	0.86	0.86	0.87	
Average = Sum(40) _{1...12} /12=												0.86	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N 2.96 (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) + 36 104.47 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	114.92	110.74	106.56	102.38	98.2	94.02	94.02	98.2	102.38	106.56	110.74	114.92	
Total = Sum(44) _{1...12} =												1253.66	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	170.42	149.05	153.81	134.09	128.67	111.03	102.88	118.06	119.47	139.23	151.98	165.04	
Total = Sum(45) _{1...12} =												1643.75	(45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	25.56	22.36	23.07	20.11	19.3	16.65	15.43	17.71	17.92	20.88	22.8	24.76	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (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) = 250 (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 0.78 (52)

Temperature factor from Table 2b 0.54 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.09 (54)

Enter (50) or (54) in (55) 1.09 (55)

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Water storage loss calculated for each month

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

(56)m=

33.71	30.45	33.71	32.63	33.71	32.63	33.71	33.71	32.63	33.71	32.63	33.71
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (56)

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

(57)m=

33.71	30.45	33.71	32.63	33.71	32.63	33.71	33.71	32.63	33.71	32.63	33.71
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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=

227.4	200.51	210.78	189.23	185.64	166.17	159.86	175.04	174.61	196.21	207.12	222.02
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 (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=

227.4	200.51	210.78	189.23	185.64	166.17	159.86	175.04	174.61	196.21	207.12	222.02
-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Output from water heater (annual) _{1...12}	2314.59
---	---------

 (64)

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

(65)m=

102.25	90.73	96.72	88.7	88.36	81.03	79.79	84.84	83.83	91.88	94.64	100.46
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 (65)

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

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

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
177.53	177.53	177.53	177.53	177.53	177.53	177.53	177.53	177.53	177.53	177.53	177.53

 (66)

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

(67)m=

80.15	71.19	57.9	43.83	32.76	27.66	29.89	38.85	52.14	66.21	77.28	82.38
-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (67)

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

(68)m=

505.51	510.76	497.54	469.4	433.87	400.49	378.18	372.94	386.16	414.3	449.82	483.21
--------	--------	--------	-------	--------	--------	--------	--------	--------	-------	--------	--------

 (68)

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

(69)m=

55.71	55.71	55.71	55.71	55.71	55.71	55.71	55.71	55.71	55.71	55.71	55.71
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

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

 (70)

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

(71)m=

-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

 (71)

Water heating gains (Table 5)

(72)m=

137.43	135.01	130	123.19	118.77	112.54	107.24	114.03	116.44	123.49	131.45	135.02
--------	--------	-----	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (72)

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

(73)m=

837.98	831.85	800.32	751.31	700.29	655.57	630.2	640.7	669.63	718.88	773.44	815.5
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 (73)

6. Solar gains:

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

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Orientation:	Access Factor Table 6d	Area m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
North	0.9x	12	10.63	0.72	0.7	44.57 (74)
North	0.9x	12	20.32	0.72	0.7	85.17 (74)
North	0.9x	12	34.53	0.72	0.7	144.73 (74)
North	0.9x	12	55.46	0.72	0.7	232.47 (74)
North	0.9x	12	74.72	0.72	0.7	313.15 (74)
North	0.9x	12	79.99	0.72	0.7	335.24 (74)
North	0.9x	12	74.68	0.72	0.7	312.99 (74)
North	0.9x	12	59.25	0.72	0.7	248.32 (74)
North	0.9x	12	41.52	0.72	0.7	174.01 (74)
North	0.9x	12	24.19	0.72	0.7	101.38 (74)
North	0.9x	12	13.12	0.72	0.7	54.98 (74)
North	0.9x	12	8.86	0.72	0.7	37.15 (74)
East	0.9x	3.2	19.64	0.72	0.7	21.95 (76)
East	0.9x	3.2	38.42	0.72	0.7	42.94 (76)
East	0.9x	3.2	63.27	0.72	0.7	70.72 (76)
East	0.9x	3.2	92.28	0.72	0.7	103.14 (76)
East	0.9x	3.2	113.09	0.72	0.7	126.4 (76)
East	0.9x	3.2	115.77	0.72	0.7	129.39 (76)
East	0.9x	3.2	110.22	0.72	0.7	123.19 (76)
East	0.9x	3.2	94.68	0.72	0.7	105.82 (76)
East	0.9x	3.2	73.59	0.72	0.7	82.25 (76)
East	0.9x	3.2	45.59	0.72	0.7	50.95 (76)
East	0.9x	3.2	24.49	0.72	0.7	27.37 (76)
East	0.9x	3.2	16.15	0.72	0.7	18.05 (76)
South	0.9x	7.36	46.75	0.72	0.7	120.18 (78)
South	0.9x	7.36	76.57	0.72	0.7	196.83 (78)
South	0.9x	7.36	97.53	0.72	0.7	250.72 (78)
South	0.9x	7.36	110.23	0.72	0.7	283.37 (78)
South	0.9x	7.36	114.87	0.72	0.7	295.29 (78)
South	0.9x	7.36	110.55	0.72	0.7	284.18 (78)
South	0.9x	7.36	108.01	0.72	0.7	277.66 (78)
South	0.9x	7.36	104.89	0.72	0.7	269.65 (78)
South	0.9x	7.36	101.89	0.72	0.7	261.91 (78)
South	0.9x	7.36	82.59	0.72	0.7	212.3 (78)
South	0.9x	7.36	55.42	0.72	0.7	142.46 (78)
South	0.9x	7.36	40.4	0.72	0.7	103.85 (78)

Solar gains in watts, calculated for each month

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

(83)m= 186.7 324.94 466.17 618.98 734.85 748.81 713.84 623.78 518.17 364.64 224.81 159.05 (83)

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

(84)m= 1024.68 1156.79 1266.49 1370.28 1435.14 1404.39 1344.04 1264.48 1187.79 1083.52 998.24 974.55 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (86)

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	0.94	0.83	0.63	0.46	0.51	0.77	0.96	0.99	1	(86)

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

(87)m=	20.15	20.28	20.48	20.73	20.92	20.99	21	21	20.96	20.73	20.39	20.13	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.56	20.56	20.56	20.57	20.57	20.58	20.58	20.58	20.58	20.57	20.57	20.57	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.81	0.59	0.42	0.46	0.73	0.95	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.75	19.88	20.08	20.33	20.5	20.57	20.58	20.58	20.55	20.34	20	19.73	(90)
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fLA = Living area ÷ (4) = 0.16 (91)

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

(92)m=	19.81	19.94	20.14	20.39	20.57	20.64	20.64	20.64	20.61	20.4	20.06	19.8	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.81	19.94	20.14	20.39	20.57	20.64	20.64	20.64	20.61	20.4	20.06	19.8	(93)
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8. Space heating requirement

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.93	0.81	0.6	0.42	0.47	0.74	0.95	0.99	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	1020.93	1147.18	1239.1	1276.12	1159.02	837.88	568.92	593.99	876.52	1028.51	989.61	971.89	(95)
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Monthly average external temperature from Table 8

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

(97)m=	2286.81	2210.24	1997.91	1654.8	1272.42	851.2	570.18	596.37	924.71	1405.76	1872.14	2268.47	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	941.82	714.38	564.55	272.65	84.37	0	0	0	0	280.67	635.42	964.66	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												4458.51	(98)

Space heating requirement in kWh/m²/year

26.66 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

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

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

Efficiency of main space heating system 1 410.46 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	941.82	714.38	564.55	272.65	84.37	0	0	0	0	280.67	635.42	964.66	
(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$	229.46	174.04	137.54	66.43	20.55	0	0	0	0	68.38	154.81	235.02	(211)
Total (kWh/year) = Sum(211) _{1..5,10...12} =													1086.23 (211)
Space heating fuel (secondary), kWh/month = $\{[(98)m \times (201)]\} \times 100 \div (208)$	0	0	0	0	0	0	0	0	0	0	0	0	
(215)m =													0 (215)
Total (kWh/year) = Sum(215) _{1..5,10...12} =													
Water heating													
Output from water heater (calculated above)	227.4	200.51	210.78	189.23	185.64	166.17	159.86	175.04	174.61	196.21	207.12	222.02	
Efficiency of water heater													167.1 (216)
(217)m =	167.1	167.1	167.1	167.1	167.1	167.1	167.1	167.1	167.1	167.1	167.1	167.1	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m	136.08	120	126.14	113.24	111.1	99.44	95.67	104.75	104.49	117.42	123.95	132.87	
(219)m =													1385.15 (219)
Total = Sum(219a) _{1..12} =													
Annual totals													
													kWh/year
Space heating fuel used, main system 1													1086.23
Water heating fuel used													1385.15
Electricity for pumps, fans and electric keep-hot													
mechanical ventilation - balanced, extract or positive input from outside													628.31 (230a)
Total electricity for the above, kWh/year													628.31 (231)
Electricity for lighting													566.2 (232)
Electricity generated by PVs													-1538.02 (233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													2127.87 (338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	13.19 x 0.01 =	143.27 (240)
Space heating - main system 2	(213) x	0 x 0.01 =	0 (241)
Space heating - secondary	(215) x	13.19 x 0.01 =	0 (242)
Water heating cost (other fuel)	(219)	13.19 x 0.01 =	182.7 (247)
Pumps, fans and electric keep-hot	(231)	13.19 x 0.01 =	82.87 (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 =	74.68 (250)
Additional standing charges (Table 12)			0 (251)
	one of (233) to (235) x	13.19 x 0.01 =	-202.87 (252)

SAP WorkSheet: New dwelling design stage

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost $(245) \dots (247) + (250) \dots (254) =$ 280.67 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12) 0.42 (256)

Energy cost factor (ECF) $[(255) \times (256)] \div [(4) + 45.0] =$ 0.56 (257)

SAP rating (Section 12) 92.25 (258)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	563.76	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	718.89	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1282.65	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	326.09	(267)
Electricity for lighting	(232) x	0.519	=	293.86	(268)
Energy saving/generation technologies Item 1		0.519	=	-798.23	(269)
Total CO2, kg/year		sum of (265) ... (271) =		1104.37	(272)
CO2 emissions per m²		(272) ÷ (4) =		6.6	(273)
El rating (section 14)				93	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	3.07	=	3334.74	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	4252.41	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7587.15	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	1928.91	(267)
Electricity for lighting	(232) x	0	=	1738.24	(268)
Energy saving/generation technologies Item 1		3.07	=	-4721.73	(269)
'Total Primary Energy		sum of (265) ... (271) =		6532.57	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		39.07	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.60

Property Address: Type A - Be Green

Address : 1225 Holehouse Mill, Chisworth, tba

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	38.59 (1a)	x	2.8 (2a)	=	108.05 (3a)
First floor	64.31 (1b)	x	2.8 (2b)	=	180.07 (3b)
Second floor	64.31 (1c)	x	2.8 (2c)	=	180.07 (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	167.21 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	468.19 (5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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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
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

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

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

71.4 (23c)

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

(24a)m=	0.31	0.3	0.3	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.29	0.29	(24a)
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b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
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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)
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d) If natural ventilation or whole house positive input ventilation from loft

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

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

(25)m=	0.31	0.3	0.3	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.29	0.29	(25)
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3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2	x 1	= 2		(26)
Windows Type 1			7.36	x1/[1/(1.1)+ 0.04] =	7.75		(27)
Windows Type 2			12	x1/[1/(1.1)+ 0.04] =	12.64		(27)
Windows Type 3			3.2	x1/[1/(1.1)+ 0.04] =	3.37		(27)
Floor Type 1			38.59	x 0.12	= 4.6308		(28)
Floor Type 2			25.72	x 0.12	= 3.0864		(28)
Walls Type1	166.29	24.56	141.73	x 0.18	= 25.51		(29)
Walls Type2	14	0	14	x 0.18	= 2.52		(29)
Roof	64.31	0	64.31	x 0.13	= 8.36		(30)
Total area of elements, m²			308.91				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 69.88 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 16096.49 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 30.34 (36)

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

Total fabric heat loss (33) + (36) = 100.22 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	47.21	46.72	46.23	43.76	43.27	40.81	40.81	40.32	41.79	43.27	44.26	45.24	(38)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	147.43	146.93	146.44	143.98	143.49	141.02	141.02	140.53	142.01	143.49	144.47	145.46	
Average = Sum(39) _{1...12} /12=												143.86	(39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	0.88	0.88	0.88	0.86	0.86	0.84	0.84	0.84	0.85	0.86	0.86	0.87	
Average = Sum(40) _{1...12} /12=												0.86	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N 2.96 (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) + 36 104.47 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	114.92	110.74	106.56	102.38	98.2	94.02	94.02	98.2	102.38	106.56	110.74	114.92	
Total = Sum(44) _{1...12} =												1253.66	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	170.42	149.05	153.81	134.09	128.67	111.03	102.88	118.06	119.47	139.23	151.98	165.04	
Total = Sum(45) _{1...12} =												1643.75	(45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	25.56	22.36	23.07	20.11	19.3	16.65	15.43	17.71	17.92	20.88	22.8	24.76	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (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) = 250 (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 0.78 (52)

Temperature factor from Table 2b 0.54 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.09 (54)

Enter (50) or (54) in (55) 1.09 (55)

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Water storage loss calculated for each month

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

(56)m=	33.71	30.45	33.71	32.63	33.71	32.63	33.71	33.71	32.63	33.71	32.63	33.71	(56)
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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	33.71	30.45	33.71	32.63	33.71	32.63	33.71	33.71	32.63	33.71	32.63	33.71	(57)
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Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	227.4	200.51	210.78	189.23	185.64	166.17	159.86	175.04	174.61	196.21	207.12	222.02	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	227.4	200.51	210.78	189.23	185.64	166.17	159.86	175.04	174.61	196.21	207.12	222.02	
Output from water heater (annual) _{1...12}												2314.59	(64)

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

(65)m=	102.25	90.73	96.72	88.7	88.36	81.03	79.79	84.84	83.83	91.88	94.64	100.46	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	147.94	147.94	147.94	147.94	147.94	147.94	147.94	147.94	147.94	147.94	147.94	147.94	(66)

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

(67)m=	32.06	28.48	23.16	17.53	13.11	11.06	11.96	15.54	20.86	26.48	30.91	32.95	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	338.69	342.21	333.35	314.5	290.7	268.33	253.38	249.87	258.72	277.58	301.38	323.75	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.79	37.79	37.79	37.79	37.79	37.79	37.79	37.79	37.79	37.79	37.79	37.79	(69)
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Pumps and fans gains (Table 5a)

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

(71)m=	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	(71)
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Water heating gains (Table 5)

(72)m=	137.43	135.01	130	123.19	118.77	112.54	107.24	114.03	116.44	123.49	131.45	135.02	(72)
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Total internal gains =

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

(73)m=	575.56	573.08	553.89	522.6	489.95	459.31	439.96	446.82	463.4	494.93	531.12	559.11	(73)
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6. Solar gains:

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

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Orientation:	Access Factor Table 6d	Area m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
North	0.9x	12	10.63	0.72	0.7	44.57 (74)
North	0.9x	12	20.32	0.72	0.7	85.17 (74)
North	0.9x	12	34.53	0.72	0.7	144.73 (74)
North	0.9x	12	55.46	0.72	0.7	232.47 (74)
North	0.9x	12	74.72	0.72	0.7	313.15 (74)
North	0.9x	12	79.99	0.72	0.7	335.24 (74)
North	0.9x	12	74.68	0.72	0.7	312.99 (74)
North	0.9x	12	59.25	0.72	0.7	248.32 (74)
North	0.9x	12	41.52	0.72	0.7	174.01 (74)
North	0.9x	12	24.19	0.72	0.7	101.38 (74)
North	0.9x	12	13.12	0.72	0.7	54.98 (74)
North	0.9x	12	8.86	0.72	0.7	37.15 (74)
East	0.9x	3.2	19.64	0.72	0.7	21.95 (76)
East	0.9x	3.2	38.42	0.72	0.7	42.94 (76)
East	0.9x	3.2	63.27	0.72	0.7	70.72 (76)
East	0.9x	3.2	92.28	0.72	0.7	103.14 (76)
East	0.9x	3.2	113.09	0.72	0.7	126.4 (76)
East	0.9x	3.2	115.77	0.72	0.7	129.39 (76)
East	0.9x	3.2	110.22	0.72	0.7	123.19 (76)
East	0.9x	3.2	94.68	0.72	0.7	105.82 (76)
East	0.9x	3.2	73.59	0.72	0.7	82.25 (76)
East	0.9x	3.2	45.59	0.72	0.7	50.95 (76)
East	0.9x	3.2	24.49	0.72	0.7	27.37 (76)
East	0.9x	3.2	16.15	0.72	0.7	18.05 (76)
South	0.9x	7.36	46.75	0.72	0.7	120.18 (78)
South	0.9x	7.36	76.57	0.72	0.7	196.83 (78)
South	0.9x	7.36	97.53	0.72	0.7	250.72 (78)
South	0.9x	7.36	110.23	0.72	0.7	283.37 (78)
South	0.9x	7.36	114.87	0.72	0.7	295.29 (78)
South	0.9x	7.36	110.55	0.72	0.7	284.18 (78)
South	0.9x	7.36	108.01	0.72	0.7	277.66 (78)
South	0.9x	7.36	104.89	0.72	0.7	269.65 (78)
South	0.9x	7.36	101.89	0.72	0.7	261.91 (78)
South	0.9x	7.36	82.59	0.72	0.7	212.3 (78)
South	0.9x	7.36	55.42	0.72	0.7	142.46 (78)
South	0.9x	7.36	40.4	0.72	0.7	103.85 (78)

Solar gains in watts, calculated for each month

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

(83)m= 186.7 324.94 466.17 618.98 734.85 748.81 713.84 623.78 518.17 364.64 224.81 159.05 (83)

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

(84)m= 762.26 898.02 1020.06 1141.58 1224.8 1208.12 1153.8 1070.6 981.57 859.57 755.93 718.16 (84)

DER WorkSheet: New dwelling design stage

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.9	0.71	0.53	0.59	0.87	0.99	1	1	(86)

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

(87)m=	20	20.13	20.35	20.62	20.86	20.98	21	20.99	20.92	20.62	20.25	19.98	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.56	20.56	20.56	20.57	20.57	20.58	20.58	20.58	20.58	20.57	20.57	20.57	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.88	0.68	0.48	0.54	0.84	0.98	1	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.6	19.73	19.95	20.23	20.46	20.56	20.58	20.58	20.52	20.22	19.86	19.58	(90)
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fLA = Living area ÷ (4) = 0.16 (91)

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

(92)m=	19.66	19.79	20.01	20.29	20.52	20.63	20.64	20.64	20.58	20.29	19.92	19.65	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.66	19.79	20.01	20.29	20.52	20.63	20.64	20.64	20.58	20.29	19.92	19.65	(93)
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8. Space heating requirement

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.97	0.88	0.68	0.49	0.55	0.84	0.98	1	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	761.7	896.03	1012.31	1104.57	1075.94	822.25	567.04	590.15	820.8	843.94	754.43	717.8	(95)
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Monthly average external temperature from Table 8

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

(97)m=	2264.23	2188.31	1978.09	1639.78	1265.44	849.97	570.03	596.07	920.08	1389.84	1851.7	2246.6	(97)
--------	---------	---------	---------	---------	---------	--------	--------	--------	--------	---------	--------	--------	------

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

(98)m=	1117.88	868.41	718.54	385.36	140.98	0	0	0	0	406.15	790.04	1137.43	(98)
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 5564.78 (98)

Space heating requirement in kWh/m²/year

33.28 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

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

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

Efficiency of main space heating system 1 410.46 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	1117.88	868.41	718.54	385.36	140.98	0	0	0	0	406.15	790.04	1137.43	
(211)m = {[[(98)m x (204)] } x 100 ÷ (206) (211)													
	272.35	211.57	175.06	93.88	34.35	0	0	0	0	98.95	192.48	277.11	
Total (kWh/year) =Sum(211) _{1..5,10...12} =													1355.75 (211)
Space heating fuel (secondary), kWh/month													
= {[[(98)m x (201)] } x 100 ÷ (208)													
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total (kWh/year) =Sum(215) _{1..5,10...12} =													0 (215)
Water heating													
Output from water heater (calculated above)													
	227.4	200.51	210.78	189.23	185.64	166.17	159.86	175.04	174.61	196.21	207.12	222.02	
Efficiency of water heater													167.1 (216)
(217)m=	167.1	167.1	167.1	167.1	167.1	167.1	167.1	167.1	167.1	167.1	167.1	167.1	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	136.08	120	126.14	113.24	111.1	99.44	95.67	104.75	104.49	117.42	123.95	132.87	
Total = Sum(219a) _{1..12} =													1385.15 (219)
Annual totals													
													kWh/year
Space heating fuel used, main system 1													1355.75
Water heating fuel used													1385.15
Electricity for pumps, fans and electric keep-hot													
mechanical ventilation - balanced, extract or positive input from outside													628.31 (230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =												628.31 (231)
Electricity for lighting													566.2 (232)
Electricity generated by PVs													-1538.02 (233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													2397.39 (338)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519	= 703.64 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 718.89 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1422.53 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 326.09 (267)
Electricity for lighting	(232) x	0.519	= 293.86 (268)
Energy saving/generation technologies			
Item 1		0.519	= -798.23 (269)
Total CO2, kg/year	sum of (265)...(271) =		1244.25 (272)

DER WorkSheet: New dwelling design stage

Dwelling CO2 Emission Rate

$(272) \div (4) =$

7.44

(273)

EI rating (section 14)

92

(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Daniel Watt **Stroma Number:** STRO026464
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.60

Property Address: Type A - Be Green

Address : 1225 Holehouse Mill, Chisworth, tba

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	38.59 (1a)	x	2.8 (2a)	=	108.05 (3a)
First floor	64.31 (1b)	x	2.8 (2b)	=	180.07 (3b)
Second floor	64.31 (1c)	x	2.8 (2c)	=	180.07 (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	167.21 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	468.19 (5)

2. Ventilation rate:

	main heating	+	secondary heating	+	other	=	total		m ³ per hour
Number of chimneys	0		0		0	=	0	x 40 =	0 (6a)
Number of open flues	0		0		0	=	0	x 20 =	0 (6b)
Number of intermittent fans							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) =	0.09 (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)			0.34 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.29 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

	0.36	0.36	0.35	0.31	0.31	0.27	0.27	0.26	0.29	0.31	0.32	0.34
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × 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= 0.57 0.56 0.56 0.55 0.55 0.54 0.54 0.53 0.54 0.55 0.55 0.56 (24d)

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

(25)m= 0.57 0.56 0.56 0.55 0.55 0.54 0.54 0.53 0.54 0.55 0.55 0.56 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2	x 1.2	= 2.4		(26)
Windows Type 1			7.36	x1/[1/(1.4)+0.04]	= 9.76		(27)
Windows Type 2			12	x1/[1/(1.4)+0.04]	= 15.91		(27)
Windows Type 3			3.2	x1/[1/(1.4)+0.04]	= 4.24		(27)
Floor Type 1			38.59	x 0.13	= 5.0167		(28)
Floor Type 2			25.72	x 0.13	= 3.3436		(28)
Walls Type1	166.29	24.56	141.73	x 0.18	= 25.51		(29)
Walls Type2	14	0	14	x 0.18	= 2.52		(29)
Roof	64.31	0	64.31	x 0.13	= 8.36		(30)
Total area of elements, m²			308.91				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 77.06 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 16096.49 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 19.47 (36)

TER WorkSheet: New dwelling design stage

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

Total fabric heat loss (33) + (36) = 96.53 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	87.46	87.06	86.67	84.85	84.51	82.92	82.92	82.62	83.53	84.51	85.2	85.92	(38)

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

(39)m=	183.99	183.59	183.2	181.38	181.04	179.45	179.45	179.15	180.06	181.04	181.73	182.45	
Average = Sum(39) _{1...12} /12=												181.38	(39)

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

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

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N 2.96 (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) + 36 104.47 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	114.92	110.74	106.56	102.38	98.2	94.02	94.02	98.2	102.38	106.56	110.74	114.92	
Total = Sum(44) _{1...12} =												1253.66	(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=	170.42	149.05	153.81	134.09	128.67	111.03	102.88	118.06	119.47	139.23	151.98	165.04	
Total = Sum(45) _{1...12} =												1643.75	(45)

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

(46)m=	25.56	22.36	23.07	20.11	19.3	16.65	15.43	17.71	17.92	20.88	22.8	24.76	(46)
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Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.89 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.02 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 1.02 (55)

TER WorkSheet: New dwelling design stage

Water storage loss calculated for each month

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

(56)m=	31.64	28.58	31.64	30.62	31.64	30.62	31.64	31.64	30.62	31.64	30.62	31.64	(56)
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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=	31.64	28.58	31.64	30.62	31.64	30.62	31.64	31.64	30.62	31.64	30.62	31.64	(57)
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Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	225.33	198.65	208.72	187.23	183.57	164.16	157.79	172.97	172.61	194.14	205.12	219.95	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	225.33	198.65	208.72	187.23	183.57	164.16	157.79	172.97	172.61	194.14	205.12	219.95	
Output from water heater (annual) _{1...12}												2290.23	(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=	100.59	89.23	95.07	87.09	86.71	79.43	78.13	83.18	82.23	90.22	93.04	98.8	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	147.94	147.94	147.94	147.94	147.94	147.94	147.94	147.94	147.94	147.94	147.94	147.94	(66)

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

(67)m=	32.06	28.48	23.16	17.53	13.11	11.06	11.96	15.54	20.86	26.48	30.91	32.95	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	338.69	342.21	333.35	314.5	290.7	268.33	253.38	249.87	258.72	277.58	301.38	323.75	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.79	37.79	37.79	37.79	37.79	37.79	37.79	37.79	37.79	37.79	37.79	37.79	(69)
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Pumps and fans gains (Table 5a)

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

(71)m=	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	-118.35	(71)
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Water heating gains (Table 5)

(72)m=	135.2	132.79	127.78	120.96	116.54	110.31	105.02	111.8	114.21	121.26	129.23	132.8	(72)
--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------	------

Total internal gains =

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

(73)m=	576.34	573.86	554.67	523.38	490.73	460.09	440.74	447.59	464.18	495.71	531.9	559.88	(73)
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6. Solar gains:

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

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)	
North	0.9x	0.77	x	12	x	10.63	x	0.63	x	0.7	=	39 (74)
North	0.9x	0.77	x	12	x	20.32	x	0.63	x	0.7	=	74.52 (74)
North	0.9x	0.77	x	12	x	34.53	x	0.63	x	0.7	=	126.63 (74)
North	0.9x	0.77	x	12	x	55.46	x	0.63	x	0.7	=	203.41 (74)
North	0.9x	0.77	x	12	x	74.72	x	0.63	x	0.7	=	274.01 (74)
North	0.9x	0.77	x	12	x	79.99	x	0.63	x	0.7	=	293.33 (74)
North	0.9x	0.77	x	12	x	74.68	x	0.63	x	0.7	=	273.87 (74)
North	0.9x	0.77	x	12	x	59.25	x	0.63	x	0.7	=	217.28 (74)
North	0.9x	0.77	x	12	x	41.52	x	0.63	x	0.7	=	152.26 (74)
North	0.9x	0.77	x	12	x	24.19	x	0.63	x	0.7	=	88.71 (74)
North	0.9x	0.77	x	12	x	13.12	x	0.63	x	0.7	=	48.11 (74)
North	0.9x	0.77	x	12	x	8.86	x	0.63	x	0.7	=	32.51 (74)
East	0.9x	0.77	x	3.2	x	19.64	x	0.63	x	0.7	=	19.21 (76)
East	0.9x	0.77	x	3.2	x	38.42	x	0.63	x	0.7	=	37.57 (76)
East	0.9x	0.77	x	3.2	x	63.27	x	0.63	x	0.7	=	61.88 (76)
East	0.9x	0.77	x	3.2	x	92.28	x	0.63	x	0.7	=	90.25 (76)
East	0.9x	0.77	x	3.2	x	113.09	x	0.63	x	0.7	=	110.6 (76)
East	0.9x	0.77	x	3.2	x	115.77	x	0.63	x	0.7	=	113.22 (76)
East	0.9x	0.77	x	3.2	x	110.22	x	0.63	x	0.7	=	107.79 (76)
East	0.9x	0.77	x	3.2	x	94.68	x	0.63	x	0.7	=	92.59 (76)
East	0.9x	0.77	x	3.2	x	73.59	x	0.63	x	0.7	=	71.97 (76)
East	0.9x	0.77	x	3.2	x	45.59	x	0.63	x	0.7	=	44.58 (76)
East	0.9x	0.77	x	3.2	x	24.49	x	0.63	x	0.7	=	23.95 (76)
East	0.9x	0.77	x	3.2	x	16.15	x	0.63	x	0.7	=	15.8 (76)
South	0.9x	0.77	x	7.36	x	46.75	x	0.63	x	0.7	=	105.16 (78)
South	0.9x	0.77	x	7.36	x	76.57	x	0.63	x	0.7	=	172.22 (78)
South	0.9x	0.77	x	7.36	x	97.53	x	0.63	x	0.7	=	219.38 (78)
South	0.9x	0.77	x	7.36	x	110.23	x	0.63	x	0.7	=	247.95 (78)
South	0.9x	0.77	x	7.36	x	114.87	x	0.63	x	0.7	=	258.38 (78)
South	0.9x	0.77	x	7.36	x	110.55	x	0.63	x	0.7	=	248.66 (78)
South	0.9x	0.77	x	7.36	x	108.01	x	0.63	x	0.7	=	242.95 (78)
South	0.9x	0.77	x	7.36	x	104.89	x	0.63	x	0.7	=	235.94 (78)
South	0.9x	0.77	x	7.36	x	101.89	x	0.63	x	0.7	=	229.17 (78)
South	0.9x	0.77	x	7.36	x	82.59	x	0.63	x	0.7	=	185.76 (78)
South	0.9x	0.77	x	7.36	x	55.42	x	0.63	x	0.7	=	124.65 (78)
South	0.9x	0.77	x	7.36	x	40.4	x	0.63	x	0.7	=	90.87 (78)

Solar gains in watts, calculated for each month

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

(83)m= 163.36 284.32 407.9 541.61 642.99 655.21 624.61 545.81 453.4 319.06 196.71 139.17 (83)

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

(84)m= 739.7 858.18 962.57 1064.98 1133.72 1115.3 1065.35 993.4 917.57 814.77 728.61 699.06 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.85	0.7	0.75	0.94	0.99	1	1	(86)

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

(87)m=	19.68	19.81	20.04	20.35	20.66	20.89	20.97	20.96	20.78	20.39	19.98	19.66	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

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

(89)m=	1	1	1	0.98	0.93	0.78	0.56	0.63	0.9	0.99	1	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.22	18.41	18.75	19.21	19.64	19.94	20.01	20	19.82	19.27	18.66	18.19	(90)
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fLA = Living area ÷ (4) = 0.16 (91)

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

(92)m=	18.44	18.63	18.95	19.38	19.8	20.08	20.16	20.15	19.97	19.44	18.87	18.42	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.44	18.63	18.95	19.38	19.8	20.08	20.16	20.15	19.97	19.44	18.87	18.42	(93)
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8. Space heating requirement

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.98	0.93	0.78	0.58	0.65	0.89	0.99	1	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	738.95	856.12	956.4	1042.29	1051.13	875.1	621.29	642.41	820.45	803.25	726.94	698.53	(95)
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Monthly average external temperature from Table 8

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

(97)m=	2602.21	2520.49	2280.13	1901.72	1466.51	984.08	638.88	672.11	1056.49	1600.59	2138.68	2594.18	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	1386.27	1118.45	984.86	618.79	309.04	0	0	0	0	593.22	1016.45	1410.36	(98)
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 7437.45 (98)

Space heating requirement in kWh/m²/year

44.48 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

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

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

Efficiency of main space heating system 1 93.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	1386.27	1118.45	984.86	618.79	309.04	0	0	0	0	593.22	1016.45	1410.36	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1482.64	1196.21	1053.32	661.81	330.53	0	0	0	0	634.46	1087.12	1508.41	(211)
Total (kWh/year) = Sum(211) _{1..5,10...12} =													7954.49 (211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)	0	0	0	0	0	0	0	0	0	0	0	0	
(215)m =	0	0	0	0	0	0	0	0	0	0	0	0	(215)
Total (kWh/year) = Sum(215) _{1..5,10...12} =													0 (215)
Water heating													
Output from water heater (calculated above)	225.33	198.65	208.72	187.23	183.57	164.16	157.79	172.97	172.61	194.14	205.12	219.95	
Efficiency of water heater													79.8 (216)
(217)m =	88.83	88.71	88.43	87.77	86.19	79.8	79.8	79.8	79.8	87.6	88.51	88.89	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m	253.65	223.94	236.03	213.33	212.98	205.72	197.73	216.75	216.3	221.61	231.75	247.44	
(219)m =													2677.23 (219)
Total = Sum(219a) _{1..12} =													2677.23 (219)
Annual totals													
Space heating fuel used, main system 1													7954.49
Water heating fuel used													2677.23
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													566.2 (232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													11272.92 (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	= 1718.17 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.216	= 578.28 (264)
Space and water heating	(261) + (262) + (263) + (264) =		2296.45 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 38.93 (267)
Electricity for lighting	(232) x	0.519	= 293.86 (268)
Total CO2, kg/year	sum of (265)...(271) =		2629.24 (272)
TER =			23.28 (273)

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