Dexter Building Design

Energy and Sustainability Statement

The Shingles, Chelvey Batch, Backwell Bristol, BS48 3BZ

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Document Disclaimer

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1 Executive Summary

This Energy and Sustainability Statement has been prepared by Watt Energy on behalf of Dexter Building Design to support a planning application for the development of The Shingles. The statement specifically addresses the following North Somerset Council planning policies, as stipulated in the North Somerset Council's Core Strategy 2017:

- CS1 – Addressing Climate Change and Carbon Reduction
- CS2 – Delivering Sustainable Design and Construction

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.

In relation to the planning documents and policies outlined above, the development is required to achieve a **10%** reduction in primary energy demand over the Part L 2013 Building Regulations baseline, solely through the implementation of renewable and low/zero carbon technologies.

To achieve this 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 achieve and exceed Part L 2013 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 benefit from a **NIBE F2040 ASHP** to satisfy the space heating and hot water demand.

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

- 60.6%

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 North Somerset 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

The development therefore complies with all North Somerset Council's current and future policy requirements relating to creating a sustainable development.

In relation to the planning target centred around carbon emission reduction, the proposed development is achieving a **60.6%** reduction over the baseline energy demand. This surpasses North Somerset Council's planning targets and therefore allows compliance to be reached.

2 Planning Statement

The following statement relates to the proposed development at The Shingles Chelvey Batch, Backwell Bristol, BS48 3BZ.

2.1 The Site and Proposed Development

The site is located south of Nailsea and southwest of Bristol. The site occupies approximately 250 metres 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 north by a single lane from Chelvey Drive. The site is currently occupied by an existing dwelling which is to be demolished.

The proposal is for a residential-led mixed use development consisting of a new two storey house. The dwelling will be a four bedroom four bathroom house. (use class C3). Also provided will be associated ancillary facilities including a refuse/recycling store and bike store.

Figure 1: Ground Floor Plan

2.2 Relevant Policies and Guidance

2.2.1 Local Planning Policy

2.2.1.1 North Somerset Core Strategy

This report is a resultant production in response to North Somerset Council's Core Strategy 2017, and specifically deals with planning policies CS1 and CS2, covering Climate Change and Sustainability.

CS1

Living within environmental limits

CS1: Addressing climate change and carbon reduction

North Somerset Council is committed to reducing carbon emissions and tackling climate change, mitigating further impacts and supporting adaptation to its effects, and to support this, the following principles will guide development:

1) development should demonstrate a commitment to reducing carbon emissions, including reducing energy demand through good design, and utilising renewable energy where feasible and viable in line with standards set out in Policy CS2; and by focusing development in accordance with the settlement strategy set out in the Area Policies;
2) developers are encouraged to incorporate site-wide renewable energy solutions to be delivered in a phased and co-ordinated way with the proposed development;
3) maximise the opportunities for all new homes to contribute to tackling climate change through adherence to emerging national standards such as the Code for Sustainable Homes to ensure they perform well against evolving energy standards, and have a reduced carbon footprint;
4) developments of 10 or more dwellings should demonstrate a commitment to maximising the use of sustainable transport solutions, particularly at Weston-super-Mare. Opportunities for walking, cycling and use of public transport should be maximised through new development and in existing areas emphasising the aim to provide opportunities that encourage and facilitate modal shift towards more sustainable transport modes;
5) a network of multifunctional green infrastructure will be planned for and delivered through new development. They should be located throughout and in adjacent developments and demonstrate a functional relationship to the proposed development and existing area including the potential to relate to the Area of Outstanding Natural Beauty. This would include not only green spaces but also the creation and enhancement of woodland areas;
6) protecting and enhancing biodiversity across North Somerset including species and habitats that are characteristic of the area, in order to support adaptation to climate change. This should be achieved through on and off-site measures to conserve and enhance species and habitats as well as the reduction or preferably elimination of any adverse impacts through sensitive design and layout and construction of developments;
7) the reduction, re-use and recycling of waste with particular emphasis on waste minimisation on development sites and the creation of waste to energy facilities in the Weston villages;
8) the re-use of previously developed land and existing buildings in preference to the loss of green field sites;

9) opportunities for local food production and farming will be encouraged to reduce the district's contribution to food miles,

10) areas will be enhanced to be resilient to the impacts of climate change including flood defence and public realm enhancements including the integration of effective shading through, for example, tree planting; and,

11) developments should demonstrate water efficiency measures to reduce demand on water resources, including through the use of efficient appliances and exploration of the potential for rainwater recycling.

CS2

Living within environmental limits

CS2: Delivering sustainable design and construction

New development both residential (including conversions) and non-residential should demonstrate a commitment to sustainable design and construction, increasing energy efficiency through design, and prioritising the use of sustainable low or zero carbon forms of renewable energy generation in order to increase the sustainability of the building stock across North Somerset.

The greatest potential for energy saving opportunities is likely to be at larger scale developments particularly at the Weston Villages and Weston town centre. In addition these areas are expected to demonstrate exemplar environmental standards contributing to the objectives of Policy CS1, and adding value to the local economy.

When considering proposals for development the council will:

1) require designs that are energy efficient and designed to reduce their energy demands;

2) require the use of on-site renewable energy sources or by linking with/contributing to available local off-site renewable energy sources to meet a minimum of 10% of predicted energy use for residential development proposals involving one to nine dwellings, and 15% for 10 or more dwellings; and 10% for non-residential developments over 500m² and 15% for 1000m² and above;

3) require as a minimum Code for Sustainable Homes Level 3 for all new dwellings from October 2010, Level 4 from 2013, rising to Level 6 by 2016. Higher standards will be encouraged ahead of this trajectory where scheme viability specifically supports this. BREEAM 'Very Good' will be required on all non-residential developments over 500m² and 'Excellent' over 1000m²;

4) require all developments of 10 or more new homes to incorporate 50% constructed to the Lifetime Homes standard up to 2013 and 100% from 2013 onwards.

5) require the application of best practice in Sustainable Drainage Systems to reduce the impact of additional surface water run-off from new development. Such environmental infrastructure should be integrated into the design of the scheme and into landscaping features, and be easily maintained.

In moving towards zero carbon development, applicants will ensure that sustainable principles are established in the new proposals from the outset.

2.2.2 National Planning Policy

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

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

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

2.3 Sustainable Design Strategy

2.3.1 Energy and Carbon Emissions

Building Services Strategy

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

1. Achieve a minimum of 10% energy demand reduction over the Part L 2013 baseline, solely through renewable/ LZC technologies

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

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

Fig 2: Energy Hierarchy

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

Meet demands efficiently – Specification of energy efficient decentralised plant, heating, ventilation, lighting, and system controls to facilitate efficient operation.

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

Additional Renewable Energy Measures

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

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

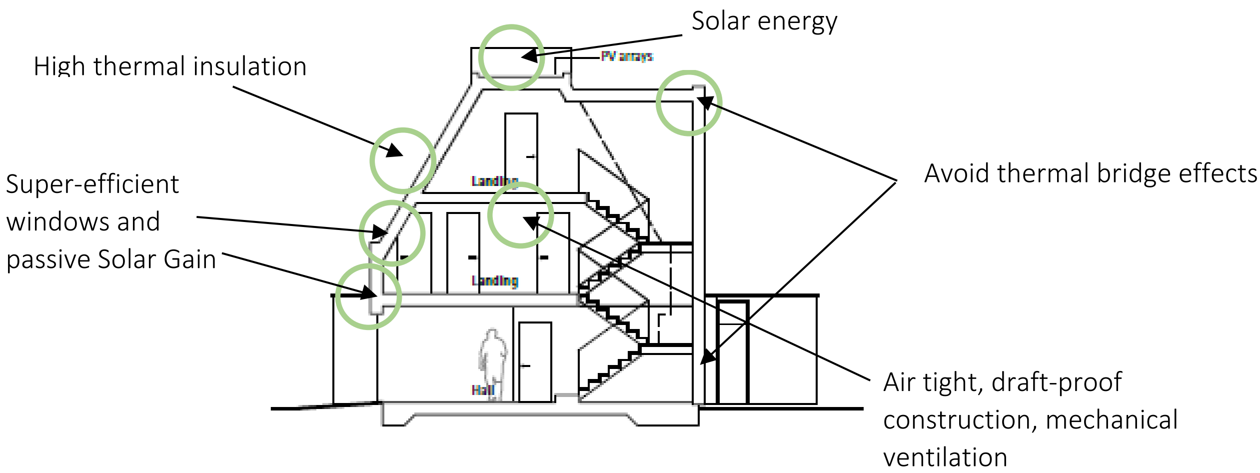


Fig 3. Efficient Design Measure examples

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

Residential Units:

- Ground floor U-values of 0.15 W/m²K
- External Wall U-values of 0.22 W/m²K
- Flat Ceiling U-values of 0.12 W/m²K
- Pitched Roof U-values of 0.12 W/m²K
- Low Double Glazed Window U-values of 1.3 W/m²K
- 100% low energy lighting throughout
- 400L cylinder
- MVHR – Pichler LG450
- Air Permeability Rate of 3m³/hm²

2.3.2 Choice and Impact of Renewable Technology

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

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

- NIBE F2040 16 kW Heat Pump

The above LZC contribution has provided an **56.6%** reduction in energy demand following Energy Efficiency Measures.

- Energy Saving from onsite LZC Technologies = **10039.5 kWh/Yr**
- CO2 Saving from onsite LZC Technologies = **2191.3 kgCO2/Yr**

2.3.3 Energy and CO_2 Reduction Summary

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

Summary of Energy Reductions	**Total energy demand (kgCO2/year)**
Baseline Energy Demand	19557.4
Improved energy demand (after application of energy efficiency measures)	17746.9
Improved energy demand (after incorporation of renewable energy technology) % CO2 displaced in total	7707.4
% Energy displaced in total	60.6%
% Energy displaced by energy efficiency measures	9.3%
% Energy displaced by renewable energy	56.6%

Table 1: Summary of Energy Demand Reductions

	Energy demand (kWh pa)	Energy saving achieved (%)	Regulated CO_2 emissions (kg pa)	Saving achieved on resi dual energy (%)
Building Regulations Part L compliance ("Baseline" energy demand & emissions)	19557.4		4466.2	
Proposed scheme after energy efficiency measures a nd CHP ("Residual" energy demand & emissions)	17746.9	9.3%	4448.5	9.3%
Proposed scheme after on-site renewables	7707.4	60.6%	2257.2	56.6%
Proposed scheme offset for financial contribution or other "allowable solution"			0	0
Total savings on residual energy demand				**56.6%**

Table 2. 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)	19557.4
Regulated emissions (kg pa)	4466.2

Be Lean stage

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

Energy savings from energy efficiency measures (kWh pa)	1810.5
Emission savings from energy efficiency measures (kg pa)	17.7
Total regulated energy demand energy efficiency measures (kg pa) ("residual energy demand")	17746.9

Be Clean stage

The following table demonstrates how the development achieves the reduction in energy demand and carbon dioxide emissions through the implementation of any clean energy systems; such as heat pumps or communal heating.

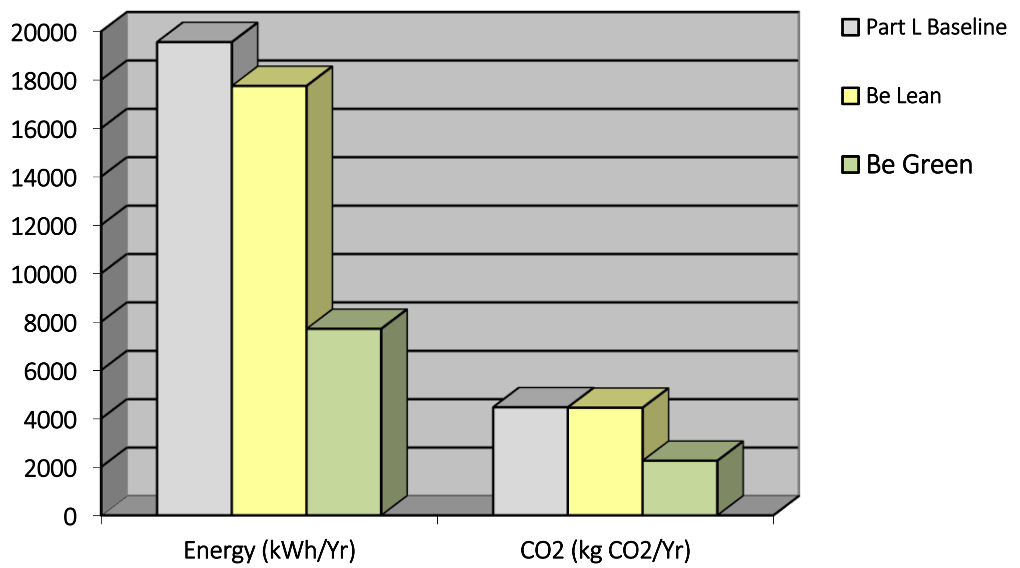
Energy savings from the use of clean energy systems (kWh pa)	-
Emission savings from the use of clean energy systems (kg pa)	-
Total regulated energy demand after clean energy savings (kg pa)	17746.9

On-site renewables

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

Energy saving from the use of renewables (kWh)	10039.5
Saving on emissions from the use of renewables (kg)	2191.3
Saving on energy demand from the use of renewables (%)	56.6%

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



2.4 Adaptation to Climate Change

In addition to the primary building design and fabric, many other issues that will influence creating a Sustainable Development, including flood prevention, material use, waste minimisation and transport.

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

2.4.1 Flood Risk Zone

Fig 4: Flood Risk Map

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

2.4.2 Green Blue Infrastructure

2.4.2.1 Sustainable Drainage Systems (SUDs)

Even though it has been shown that the proposed scheme is located on a site with a low to zero flood risk, 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.

2.4.2.2 Biodiversity

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

2.4.3 Internal Water Efficiency

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

Appliance	Unit of measure	Amount (litres)
WC (Dual flush)	Full flush volume	4
WC (Dual flush)	Part flush volume	2.6
Taps (excluding kitchen)	Flow rate l/min	5
Kitchen taps	Flow rate l/min	6
Bath	Capacity to Overflow	170
Shower	Flow rate l/min	8
Washing Machine	Litres / kg dry load	8.17
Dishwasher	Litres / place setting	1.25

Table 4. Internal Water Efficiency Flow Rates

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

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

2.4.4 Waste Management

2.4.4.1 Occupational Waste

North Somerset Council encourages all new developments to incorporate a waste management strategy into the build at the earliest stage possible.

2.4.4.2 Construction Waste

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

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

2.4.5 Materials

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

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

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

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

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

2.4.6 Pollution Control

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

Additionally, the following measures will be implemented:

- Pollution Prevention Guidance will be adhered to in respects of air (dust) and water (ground and surface) pollution during the demolition and construction phase.
- External light fittings will be controlled through a time switch, or daylight sensor, to prevent operation during daylight hours to limit the impact of artificial lighting for the development's residents and surrounding environment.

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

2.4.7 Health and Wellbeing

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

- Efficient MVHR Units are to be specified to each individual dwelling which will provide a continuous source of fresh, filtered air to maintain a healthy indoor environment.
- Enhancing the green infrastructure of the site by introducing planting wherever possible, therefore improving the physical and mental wellbeing of residents, visitors, and workers.
- Secure by Design accreditation will be sought which will incorporate the adoption of crime prevention measures to further prevent crime and promote a safe environment.

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

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, however the North Somerset planning target of reducing energy demand from the use of renewables is already being satisfied through the use of the NIBE ASHP.

Renewable Technology Not Chosen.

Ground Source Heat pumps

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

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

Renewable Technology Not Viable

Air Source Heat pumps

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

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

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

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

Air Source heat pumps are a good option to provide heating and cooling. A NIBE ASHP is to be proposed at this stage.

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 Shingles site against the relevant climate change and sustainability policies and targets, as outlined within: the North Somerset Council Core Strategy (2017), 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 exceeding Building Regulations Part L 2013 standards. Following on from this, efficient MVHR systems were proposed 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.

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 NIBE ASHP system can be proposed at this stage and would provide an additional 56.6% reduction in energy demand over the baseline: bringing the total energy demand reduction to **60.6%**.

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 North Somerset Council primary energy targets the proposal will include a large number of sustainability measures throughout construction and once completed, which will contribute heavily to the development's sustainability performance and accord with the requirements of the NPPF. The key measures to be included and therefore can be taken from this report include:

- The proposal sits within Flood Risk Zone 1 and therefore has minimal to no risk of flooding.
- A SUDs strategy will be produced to outline all measures to be incorporated that will ensure any additional surface water is collected, treated and removed.
- The development will incorporate green infrastructure in the form of extensive planting 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 provide a continuous source of fresh air and maintain healthy indoor environments. These will promote healthy housing and subsequently boost physical and mental wellbeing of residents.
- The development will also include significant cycle storage provision.

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

House Type	Flat 1	Flat 2	Flat 3	Flat 4	TOTAL (kWh/yr)		TOTAL (kgCO2/yr)
BASELINE Dwelling Emission Rate (DER)	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Carbon Emission Factor**	**Associated Total CO2 (kgCO2/yr)**
Main Heating Fuel Requirement (DER)	15876.9				15876.9	0.216	3429.4
Secondary Main Heating Fuel Requirement (DER)	0				0.0	0.519	0.0
Secondary Heating Fuel Requirement (DER)	0				0.0	0.216	0.0
Water Fuel Requirement (DER)	2882.38				2882.4	0.216	622.6
Electricity Pumps Fans Requirement (DER)	75				75.0	0.519	38.9
Electricity Lighting Requirement (DER)	723.12				723.1	0.519	375.3
TOTAL PER DEVELOPMENT					**19557.4**		**4466.2**
AFTER ENERGY SAVING MEASURES Dwelling Emission Rate (DER)	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Carbon Emission Factor**	**Associated Total CO2 (kgCO2/yr)**
Main Heating Fuel Requirement (DER)	11062.19				11062.2	0.216	2389.4
Secondary Main Heating Fuel Requirement (DER)	0				0.0	0.519	0.0
Secondary Heating Fuel Requirement (DER)	1718.89				1718.9	0.216	371.3
Water Fuel Requirement (DER)	2935.66				2935.7	0.216	634.1
Electricity Pumps Fans Requirement (DER)	1307.06				1307.1	0.519	678.4
Electricity Lighting Requirement (DER)	723.12				723.1	0.519	375.3
TOTAL PER DEVELOPMENT					**17746.9**		**4448.5**
FINAL Dwelling Emission Rate (DER)	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Carbon Emission Factor**	**Associated Total CO2 (kgCO2/yr)**
Main Heating Fuel Requirement (DER)	3400.3				3400.3	0.216	734.5
Secondary Main Heating Fuel Requirement (DER)	0				0.0	0.519	0.0
Secondary Heating Fuel Requirement (DER)	0				0.0	0.216	0.0
Water Fuel Requirement (DER)	2351.92				2351.9	0.216	508.0
Electricity Pumps Fans Requirement (DER)	1232.06				1232.1	0.519	639.4
Electricity Lighting Requirement (DER)	723.12				723.1	0.519	375.3
PV Energy Produced (DER)					0.0	0.519	0.0
TOTAL PER DEVELOPMENT					**7707.4**		**2257.2**

Energy & Consulting Engineers

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.59
Printed on 20 January 2023 at 15:19:10

Project Information:

Assessed By: Daniel Watt (STRO026464) **Building Type:** Detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 301.27m²

Site Reference : Ridgeway Road **Plot Reference:** The Shingles

Address : The Shingles, Chelvey Batch, Backwell, BRISTOL, BS48 3BZ

Client Details:

Name:

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	14.82 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	13.64 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	63.1 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	53.3 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	**OK**
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	**OK**
Roof	0.14 (max. 0.20)	0.14 (max. 0.35)	**OK**
Openings	1.30 (max. 2.00)	1.30 (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:	Boiler systems with radiators or underfloor heating - mains gas	
	Data from manufacturer	
	Efficiency 90.0 % SEDBUK2009	
	Minimum 88.0 %	**OK**
Secondary heating system:	Room heaters - wood	
	Closed room heater	
	Efficiency 65.0 %	
	Minimum 65.0 %	**OK**

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.75 kWh/day	
	Permitted by DBSCG: 3.41 kWh/day	**OK**

Regulations Compliance Report

Primary pipework insulated:	Yes		OK

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock:	Yes	OK

7 Low energy lights

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

8 Mechanical ventilation

Continuous supply and extract system		
Specific fan power:	0.89	
Maximum	1.5	OK
MVHR efficiency:	89%	
Minimum	70%	OK

9 Summertime temperature

Overheating risk (South West England):	Not significant	OK

Based on:

Overshading:	Average or unknown
Windows facing: North West	22.67m²
Windows facing: South East	35.5m²
Windows facing: North East	11.67m²
Windows facing: South West	15.45m²
Ventilation rate:	8.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Air permeablility	3.0 m³/m²h
Secondary heating (wood logs)	
Secondary heating fuel wood logs	

SAP Input

Property Details: The Shingles

Address:	The Shingles, Chelvey Batch, Backwell, BRISTOL, BS48 3BZ
Located in:	England
Region:	South West England
UPRN:	UPRN-000024066096
Date of assessment:	20 January 2023
Date of certificate:	20 January 2023
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Owner-occupied
Related party disclosure:	Employed by the professional dealing with the property transaction
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	510

Property description:

Dwelling type:	House
Detachment:	Detached
Year Completed:	2023

Floor Location:	Floor area:	Storey height:
Floor 0	211.32 m²	2.75 m
Floor 1	89.95 m²	2.55 m

Living area:	32 m² (fraction 0.127)
Front of dwelling faces:	North West

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Solid			Wood
Front	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break
Rear	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break
Right	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break
Left	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
Front Door	mm	0.7	0	1.3	2.64	1
Front	16mm or more	0.8	0.72	1.3	22.67	1
Rear	16mm or more	0.8	0.72	1.3	35.5	1
Right	16mm or more	0.8	0.72	1.3	11.67	1
Left	16mm or more	0.8	0.72	1.3	15.45	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		External Walls	North West	0	0
Front		External Walls	North West	0	0
Rear		External Walls	South East	0	0
Right		External Walls	North East	0	0
Left		External Walls	South West	0	0

Overshading:	Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
External Walls	240.92	87.93	152.99	0.22	0	False	N/A
FLat ceiling	83.52	0	83.52	0.14	0		N/A
Sloped roof	154	0	154	0.14	0		N/A

SAP Input

Ground	211.32	0.15	N/A

Internal Elements
Party Elements

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0896

	Length	Psi-value		
[Approved]	31	0.3	E2	Other lintels (including other steel lintels)
[Approved]	22	0.04	E3	Sill
[Approved]	75	0.05	E4	Jamb
[Approved]	17	0.16	E5	Ground floor (normal)
	7	0.07	E19	Ground floor (inverted)
	15	0.07	E22	Basement floor
[Approved]	53	0.07	E6	Intermediate floor within a dwelling
	66	0.56	E15	Flat roof with parapet
[Approved]	65	0.09	E16	Corner (normal)
[Approved]	32	-0.09	E17	Corner (inverted internal area greater than external area)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 4 Ductwork: Insulation, rigid Approved Installation Scheme: False
Number of chimneys:	1 (main: 0, secondary: 1, other: 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:

Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: Manufacturer Declaration
Manufacturer's data
Efficiency: 90.0% (SEDBUK2009)
Regular condensing with automatic ignition
Fuel Burning Type:
Systems with radiators
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed
Boiler interlock: Yes

Main heating Control:

Main heating Control:

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

Secondary heating system:

Secondary heating system:

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

SAP Input

Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas Hot water cylinder Cylinder volume: 400 litres Cylinder insulation: Factory 100 mm Primary pipework insulation: True Cylinderstat: True Cylinder in heated space: True Solar panel: False

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

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Daniel Watt	**Stroma Number:**	STRO026464
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.59

Property Address: The Shingles

Address : The Shingles, Chelvey Batch, Backwell, BRISTOL, BS48 3BZ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	211.32	(1a)	x	2.75	(2a)	=	581.13	(3a)
First floor	89.95	(1b)	x	2.55	(2b)	=	229.37	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	301.27	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	810.5	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	1	+	0	=	1	x 40 =	40	(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) =	40	÷ (5) =	0.05	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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)	0.2	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.17	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.2

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) = 75.65 (23c)

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

(24a)m=	0.34	0.33	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32	(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=	0.34	0.33	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32	(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			2.64	x	1.3	=	3.432			(26)
Windows Type 1			22.67	x1/[1/(1.3)+ 0.04]		=	28.01			(27)
Windows Type 2			35.5	x1/[1/(1.3)+ 0.04]		=	43.87			(27)
Windows Type 3			11.67	x1/[1/(1.3)+ 0.04]		=	14.42			(27)
Windows Type 4			15.45	x1/[1/(1.3)+ 0.04]		=	19.09			(27)
Floor			211.32	x	0.15	=	31.698			(28)
Walls	240.92	87.93	152.99	x	0.22	=	33.66			(29)
Roof Type1	83.52	0	83.52	x	0.14	=	11.69			(30)
Roof Type2	154	0	154	x	0.14	=	21.56			(30)
Total area of elements, m²			689.76							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 207.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 34562.28 (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 61.83 (36)

SAP WorkSheet: New dwelling design stage

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

Total fabric heat loss (33) + (36) = 269.27 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	90.35	89.22	88.08	82.42	81.28	75.62	75.62	74.49	77.89	81.28	83.55	85.82	(38)

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

(39)m=	359.62	358.48	357.35	351.69	350.55	344.89	344.89	343.75	347.15	350.55	352.82	355.08	

Average = Sum(39)$_{1...12}$ /12= 351.4 (39)

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

(40)m=	1.19	1.19	1.19	1.17	1.16	1.14	1.14	1.14	1.15	1.16	1.17	1.18	

Average = Sum(40)$_{1...12}$ /12= 1.17 (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 3.13 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.62 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	119.48	115.14	110.79	106.45	102.11	97.76	97.76	102.11	106.45	110.79	115.14	119.48	
										Total = Sum(44)$_{1...12}$ =			1303.47 (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=	177.19	154.97	159.92	139.42	133.78	115.44	106.97	122.75	124.22	144.76	158.02	171.6	
										Total = Sum(45)$_{1...12}$ =			1709.06 (45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	26.58	23.25	23.99	20.91	20.07	17.32	16.05	18.41	18.63	21.71	23.7	25.74	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 400 (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) = 400 (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 0.67 (52)

Temperature factor from Table 2b 0.54 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.49 (54)

Enter (50) or (54) in (55) 1.49 (55)

SAP WorkSheet: New dwelling design stage

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

(56)m=	46.12	41.66	46.12	44.63	46.12	44.63	46.12	46.12	44.63	46.12	44.63	46.12	(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=	46.12	41.66	46.12	44.63	46.12	44.63	46.12	46.12	44.63	46.12	44.63	46.12	(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=	246.57	217.64	229.3	206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98	(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=	246.57	217.64	229.3	206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98

Output from water heater (annual)$_{1...12}$ 2525.96 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	114.42	101.66	108.68	100.07	99.99	92.1	91.07	96.32	95.02	103.64	106.26	112.56	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	(66)

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

(67)m=	102.37	90.92	73.94	55.98	41.84	35.33	38.17	49.62	66.6	84.56	98.69	105.21	(67)

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

(68)m=	685.51	692.62	674.7	636.54	588.36	543.09	512.84	505.73	523.66	561.82	609.99	655.26	(68)

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

(69)m=	56.94	56.94	56.94	56.94	56.94	56.94	56.94	56.94	56.94	56.94	56.94	56.94	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	(71)

Water heating gains (Table 5)

(72)m=	153.79	151.28	146.07	138.99	134.39	127.91	122.41	129.46	131.97	139.3	147.58	151.29	(72)

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

(73)m=	1064.27	1057.43	1017.32	954.11	887.21	828.94	796.03	807.42	844.83	908.28	978.87	1034.37	(73)

6. Solar gains:

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

SAP WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	11.67	x	11.28	x	0.72	x	0.8	=	52.56	(75)
Northeast	0.9x	0.77	x	11.67	x	22.97	x	0.72	x	0.8	=	106.99	(75)
Northeast	0.9x	0.77	x	11.67	x	41.38	x	0.72	x	0.8	=	192.75	(75)
Northeast	0.9x	0.77	x	11.67	x	67.96	x	0.72	x	0.8	=	316.56	(75)
Northeast	0.9x	0.77	x	11.67	x	91.35	x	0.72	x	0.8	=	425.52	(75)
Northeast	0.9x	0.77	x	11.67	x	97.38	x	0.72	x	0.8	=	453.65	(75)
Northeast	0.9x	0.77	x	11.67	x	91.1	x	0.72	x	0.8	=	424.38	(75)
Northeast	0.9x	0.77	x	11.67	x	72.63	x	0.72	x	0.8	=	338.32	(75)
Northeast	0.9x	0.77	x	11.67	x	50.42	x	0.72	x	0.8	=	234.87	(75)
Northeast	0.9x	0.77	x	11.67	x	28.07	x	0.72	x	0.8	=	130.75	(75)
Northeast	0.9x	0.77	x	11.67	x	14.2	x	0.72	x	0.8	=	66.13	(75)
Northeast	0.9x	0.77	x	11.67	x	9.21	x	0.72	x	0.8	=	42.92	(75)
Southeast	0.9x	0.77	x	35.5	x	36.79	x	0.72	x	0.8	=	521.39	(77)
Southeast	0.9x	0.77	x	35.5	x	62.67	x	0.72	x	0.8	=	888.11	(77)
Southeast	0.9x	0.77	x	35.5	x	85.75	x	0.72	x	0.8	=	1215.15	(77)
Southeast	0.9x	0.77	x	35.5	x	106.25	x	0.72	x	0.8	=	1505.63	(77)
Southeast	0.9x	0.77	x	35.5	x	119.01	x	0.72	x	0.8	=	1686.44	(77)
Southeast	0.9x	0.77	x	35.5	x	118.15	x	0.72	x	0.8	=	1674.24	(77)
Southeast	0.9x	0.77	x	35.5	x	113.91	x	0.72	x	0.8	=	1614.15	(77)
Southeast	0.9x	0.77	x	35.5	x	104.39	x	0.72	x	0.8	=	1479.26	(77)
Southeast	0.9x	0.77	x	35.5	x	92.85	x	0.72	x	0.8	=	1315.75	(77)
Southeast	0.9x	0.77	x	35.5	x	69.27	x	0.72	x	0.8	=	981.55	(77)
Southeast	0.9x	0.77	x	35.5	x	44.07	x	0.72	x	0.8	=	624.5	(77)
Southeast	0.9x	0.77	x	35.5	x	31.49	x	0.72	x	0.8	=	446.2	(77)
Southwest	0.9x	0.77	x	15.45	x	36.79		0.72	x	0.8	=	226.91	(79)
Southwest	0.9x	0.77	x	15.45	x	62.67		0.72	x	0.8	=	386.52	(79)
Southwest	0.9x	0.77	x	15.45	x	85.75		0.72	x	0.8	=	528.85	(79)
Southwest	0.9x	0.77	x	15.45	x	106.25		0.72	x	0.8	=	655.27	(79)
Southwest	0.9x	0.77	x	15.45	x	119.01		0.72	x	0.8	=	733.96	(79)
Southwest	0.9x	0.77	x	15.45	x	118.15		0.72	x	0.8	=	728.65	(79)
Southwest	0.9x	0.77	x	15.45	x	113.91		0.72	x	0.8	=	702.49	(79)
Southwest	0.9x	0.77	x	15.45	x	104.39		0.72	x	0.8	=	643.79	(79)
Southwest	0.9x	0.77	x	15.45	x	92.85		0.72	x	0.8	=	572.63	(79)
Southwest	0.9x	0.77	x	15.45	x	69.27		0.72	x	0.8	=	427.18	(79)
Southwest	0.9x	0.77	x	15.45	x	44.07		0.72	x	0.8	=	271.79	(79)
Southwest	0.9x	0.77	x	15.45	x	31.49		0.72	x	0.8	=	194.19	(79)
Northwest	0.9x	0.77	x	22.67	x	11.28	x	0.72	x	0.8	=	102.1	(81)
Northwest	0.9x	0.77	x	22.67	x	22.97	x	0.72	x	0.8	=	207.83	(81)
Northwest	0.9x	0.77	x	22.67	x	41.38	x	0.72	x	0.8	=	374.44	(81)

Northwest	0.9x	0.77	x	22.67	x	67.96	x	0.72	x	0.8	=	614.94	(81)
Northwest	0.9x	0.77	x	22.67	x	91.35	x	0.72	x	0.8	=	826.6	(81)
Northwest	0.9x	0.77	x	22.67	x	97.38	x	0.72	x	0.8	=	881.25	(81)
Northwest	0.9x	0.77	x	22.67	x	91.1	x	0.72	x	0.8	=	824.39	(81)
Northwest	0.9x	0.77	x	22.67	x	72.63	x	0.72	x	0.8	=	657.21	(81)
Northwest	0.9x	0.77	x	22.67	x	50.42	x	0.72	x	0.8	=	456.26	(81)
Northwest	0.9x	0.77	x	22.67	x	28.07	x	0.72	x	0.8	=	253.98	(81)
Northwest	0.9x	0.77	x	22.67	x	14.2	x	0.72	x	0.8	=	128.47	(81)
Northwest	0.9x	0.77	x	22.67	x	9.21	x	0.72	x	0.8	=	83.38	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	902.96	1589.44	2311.2	3092.4	3672.51	3737.78	3565.4	3118.58	2579.52	1793.47	1090.89	766.69	(83)

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

(84)m=	1967.23	2646.88	3328.52	4046.51	4559.72	4566.72	4361.44	3926	3424.35	2701.75	2069.76	1801.07	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.96	0.85	0.67	0.48	0.35	0.4	0.66	0.93	0.99	1	(86)

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

(87)m=	19.75	20.02	20.38	20.75	20.94	20.99	21	21	20.96	20.65	20.11	19.71	(87)

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

(88)m=	19.93	19.93	19.93	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.94	19.94	(88)

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

(89)m=	1	0.98	0.94	0.81	0.61	0.4	0.27	0.31	0.58	0.9	0.99	1	(89)

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

(90)m=	18.27	18.67	19.18	19.68	19.9	19.96	19.96	19.97	19.93	19.57	18.81	18.21	(90)

fLA = Living area ÷ (4) = 0.11 (91)

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

(92)m=	18.42	18.81	19.3	19.79	20.01	20.07	20.07	20.08	20.04	19.68	18.95	18.37	(92)

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

(93)m=	18.42	18.81	19.3	19.79	20.01	20.07	20.07	20.08	20.04	19.68	18.95	18.37	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.93	0.81	0.61	0.41	0.27	0.32	0.58	0.89	0.98	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1955.4	2589.43	3103.57	3272.78	2790.71	1873.23	1196.79	1260.82	1994.14	2412.77	2037.16	1793.74	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	5079.52	4986.78	4575.78	3830.82	2911.84	1886.09	1198.08	1263.59	2061.64	3183.46	4181.32	5032.79	(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=	2324.34	1611.02	1095.33	401.79	90.12	0	0	0	0	573.39	1543.79	2409.85

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 10049.63 (98)

Space heating requirement in kWh/m²/year 33.36 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.9 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	2324.34	1611.02	1095.33	401.79	90.12	0	0	0	0	573.39	1543.79	2409.85		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	2301.33	1595.07	1084.48	397.81	89.23	0	0	0	0	567.72	1528.51	2385.99		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													9950.13	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	357.59	247.85	168.51	61.81	13.86	0	0	0	0	88.21	237.51	370.75		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													1546.1	(215)
Water heating														
Output from water heater (calculated above)	246.57	217.64	229.3	206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98		
Efficiency of water heater													80.8	(216)
(217)m=	89.72	89.44	88.81	86.95	83.45	80.8	80.8	80.8	80.8	87.69	89.34	89.78		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	274.83	243.33	258.21	237.57	243.46	225.97	218.26	237.79	236.83	244.22	252.02	268.42		
Total = Sum(219a)$_{1...12}$ =													2940.92	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		9950.13	
Space heating fuel used, secondary		1546.1	
Water heating fuel used		2940.92	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	1232.06		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		1307.06	(231)
Electricity for lighting		723.12	(232)

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Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =				16467.33	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	346.26	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	4.23	x 0.01 =	65.4	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	102.34	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	172.4	(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 =	95.38	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			901.79	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.09	(257)
SAP rating (Section 12)		84.74	(258)

12a. CO_2 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	=	2149.23	(261)
Space heating (secondary)	(215) x	0.019	=	29.38	(263)
Water heating	(219) x	0.216	=	635.24	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2813.84	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	678.36	(267)
Electricity for lighting	(232) x	0.519	=	375.3	(268)
Total CO2, kg/year		sum of (265)…(271) =		3867.51	(272)
CO2 emissions per m²		(272) ÷ (4) =		12.84	(273)
EI rating (section 14)				85	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.22	=	12139.16	(261)
Space heating (secondary)	(215) x	1.04	=	1607.94	(263)
Energy for water heating	(219) x	1.22	=	3587.92	(264)

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Space and water heating	(261) + (262) + (263) + (264) =			17335.02	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	4012.68	(267)
Electricity for lighting	(232) x	0	=	2219.99	(268)
'Total Primary Energy		sum of (265)…(271) =		23567.69	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		78.23	(273)

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User Details:

Assessor Name:	Daniel Watt	**Stroma Number:**	STRO026464
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.59

Property Address: The Shingles

Address : The Shingles, Chelvey Batch, Backwell, BRISTOL, BS48 3BZ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	211.32	(1a)	x	2.75	(2a)	=	581.13	(3a)
First floor	89.95	(1b)	x	2.55	(2b)	=	229.37	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	301.27	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	810.5	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	1	+	0	=	1	x 40 =	40	(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) =	40	÷ (5) =	0.05	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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)	0.2	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.17	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.2

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) = 75.65 (23c)

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

(24a)m=	0.34	0.33	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32	(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=	0.34	0.33	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32	(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			2.64	x	1.3	=	3.432			(26)
Windows Type 1			22.67	x1/[1/(1.3)+ 0.04]		=	28.01			(27)
Windows Type 2			35.5	x1/[1/(1.3)+ 0.04]		=	43.87			(27)
Windows Type 3			11.67	x1/[1/(1.3)+ 0.04]		=	14.42			(27)
Windows Type 4			15.45	x1/[1/(1.3)+ 0.04]		=	19.09			(27)
Floor			211.32	x	0.15	=	31.698			(28)
Walls	240.92	87.93	152.99	x	0.22	=	33.66			(29)
Roof Type1	83.52	0	83.52	x	0.14	=	11.69			(30)
Roof Type2	154	0	154	x	0.14	=	21.56			(30)
Total area of elements, m²			689.76							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 207.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 34562.28 (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 61.83 (36)

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

Total fabric heat loss	(33) + (36) =	269.27	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	90.35	89.22	88.08	82.42	81.28	75.62	75.62	74.49	77.89	81.28	83.55	85.82	(38)

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

(39)m=	359.62	358.48	357.35	351.69	350.55	344.89	344.89	343.75	347.15	350.55	352.82	355.08	

Average = $Sum(39)_{1...12}$ /12= 351.4 (39)

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

(40)m=	1.19	1.19	1.19	1.17	1.16	1.14	1.14	1.14	1.15	1.16	1.17	1.18	

Average = $Sum(40)_{1...12}$ /12= 1.17 (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	3.13	(42)

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

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.62	(43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	119.48	115.14	110.79	106.45	102.11	97.76	97.76	102.11	106.45	110.79	115.14	119.48

Total = $Sum(44)_{1...12}$ = 1303.47 (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=	177.19	154.97	159.92	139.42	133.78	115.44	106.97	122.75	124.22	144.76	158.02	171.6

Total = $Sum(45)_{1...12}$ = 1709.06 (45)

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

(46)m=	26.58	23.25	23.99	20.91	20.07	17.32	16.05	18.41	18.63	21.71	23.7	25.74	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		400	(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) =	400	(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		0.67	(52)
Temperature factor from Table 2b		0.54	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.49	(54)
Enter (50) or (54) in (55)		1.49	(55)

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

(56)m=	46.12	41.66	46.12	44.63	46.12	44.63	46.12	46.12	44.63	46.12	44.63	46.12	(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=	46.12	41.66	46.12	44.63	46.12	44.63	46.12	46.12	44.63	46.12	44.63	46.12	(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=	246.57	217.64	229.3	206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98	(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=	246.57	217.64	229.3	206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98

Output from water heater (annual)1…12 2525.96 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	114.42	101.66	108.68	100.07	99.99	92.1	91.07	96.32	95.02	103.64	106.26	112.56	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	(66)

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

(67)m=	40.95	36.37	29.58	22.39	16.74	14.13	15.27	19.85	26.64	33.82	39.48	42.08	(67)

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

(68)m=	459.29	464.06	452.05	426.48	394.2	363.87	343.6	338.84	350.85	376.42	408.69	439.03	(68)

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

(69)m=	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	(71)

Water heating gains (Table 5)

(72)m=	153.79	151.28	146.07	138.99	134.39	127.91	122.41	129.46	131.97	139.3	147.58	151.29	(72)

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

(73)m=	727.03	724.71	700.7	660.86	618.34	578.92	554.29	561.15	582.46	622.54	668.75	705.41	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	11.67	x	11.28	x	0.72	x	0.8	=	52.56	(75)
Northeast	0.9x	0.77	x	11.67	x	22.97	x	0.72	x	0.8	=	106.99	(75)
Northeast	0.9x	0.77	x	11.67	x	41.38	x	0.72	x	0.8	=	192.75	(75)
Northeast	0.9x	0.77	x	11.67	x	67.96	x	0.72	x	0.8	=	316.56	(75)
Northeast	0.9x	0.77	x	11.67	x	91.35	x	0.72	x	0.8	=	425.52	(75)
Northeast	0.9x	0.77	x	11.67	x	97.38	x	0.72	x	0.8	=	453.65	(75)
Northeast	0.9x	0.77	x	11.67	x	91.1	x	0.72	x	0.8	=	424.38	(75)
Northeast	0.9x	0.77	x	11.67	x	72.63	x	0.72	x	0.8	=	338.32	(75)
Northeast	0.9x	0.77	x	11.67	x	50.42	x	0.72	x	0.8	=	234.87	(75)
Northeast	0.9x	0.77	x	11.67	x	28.07	x	0.72	x	0.8	=	130.75	(75)
Northeast	0.9x	0.77	x	11.67	x	14.2	x	0.72	x	0.8	=	66.13	(75)
Northeast	0.9x	0.77	x	11.67	x	9.21	x	0.72	x	0.8	=	42.92	(75)
Southeast	0.9x	0.77	x	35.5	x	36.79	x	0.72	x	0.8	=	521.39	(77)
Southeast	0.9x	0.77	x	35.5	x	62.67	x	0.72	x	0.8	=	888.11	(77)
Southeast	0.9x	0.77	x	35.5	x	85.75	x	0.72	x	0.8	=	1215.15	(77)
Southeast	0.9x	0.77	x	35.5	x	106.25	x	0.72	x	0.8	=	1505.63	(77)
Southeast	0.9x	0.77	x	35.5	x	119.01	x	0.72	x	0.8	=	1686.44	(77)
Southeast	0.9x	0.77	x	35.5	x	118.15	x	0.72	x	0.8	=	1674.24	(77)
Southeast	0.9x	0.77	x	35.5	x	113.91	x	0.72	x	0.8	=	1614.15	(77)
Southeast	0.9x	0.77	x	35.5	x	104.39	x	0.72	x	0.8	=	1479.26	(77)
Southeast	0.9x	0.77	x	35.5	x	92.85	x	0.72	x	0.8	=	1315.75	(77)
Southeast	0.9x	0.77	x	35.5	x	69.27	x	0.72	x	0.8	=	981.55	(77)
Southeast	0.9x	0.77	x	35.5	x	44.07	x	0.72	x	0.8	=	624.5	(77)
Southeast	0.9x	0.77	x	35.5	x	31.49	x	0.72	x	0.8	=	446.2	(77)
Southwest	0.9x	0.77	x	15.45	x	36.79		0.72	x	0.8	=	226.91	(79)
Southwest	0.9x	0.77	x	15.45	x	62.67		0.72	x	0.8	=	386.52	(79)
Southwest	0.9x	0.77	x	15.45	x	85.75		0.72	x	0.8	=	528.85	(79)
Southwest	0.9x	0.77	x	15.45	x	106.25		0.72	x	0.8	=	655.27	(79)
Southwest	0.9x	0.77	x	15.45	x	119.01		0.72	x	0.8	=	733.96	(79)
Southwest	0.9x	0.77	x	15.45	x	118.15		0.72	x	0.8	=	728.65	(79)
Southwest	0.9x	0.77	x	15.45	x	113.91		0.72	x	0.8	=	702.49	(79)
Southwest	0.9x	0.77	x	15.45	x	104.39		0.72	x	0.8	=	643.79	(79)
Southwest	0.9x	0.77	x	15.45	x	92.85		0.72	x	0.8	=	572.63	(79)
Southwest	0.9x	0.77	x	15.45	x	69.27		0.72	x	0.8	=	427.18	(79)
Southwest	0.9x	0.77	x	15.45	x	44.07		0.72	x	0.8	=	271.79	(79)
Southwest	0.9x	0.77	x	15.45	x	31.49		0.72	x	0.8	=	194.19	(79)
Northwest	0.9x	0.77	x	22.67	x	11.28	x	0.72	x	0.8	=	102.1	(81)
Northwest	0.9x	0.77	x	22.67	x	22.97	x	0.72	x	0.8	=	207.83	(81)
Northwest	0.9x	0.77	x	22.67	x	41.38	x	0.72	x	0.8	=	374.44	(81)

Northwest 0.9x	0.77	x	22.67	x	67.96	x	0.72	x	0.8	=	614.94	(81)
Northwest 0.9x	0.77	x	22.67	x	91.35	x	0.72	x	0.8	=	826.6	(81)
Northwest 0.9x	0.77	x	22.67	x	97.38	x	0.72	x	0.8	=	881.25	(81)
Northwest 0.9x	0.77	x	22.67	x	91.1	x	0.72	x	0.8	=	824.39	(81)
Northwest 0.9x	0.77	x	22.67	x	72.63	x	0.72	x	0.8	=	657.21	(81)
Northwest 0.9x	0.77	x	22.67	x	50.42	x	0.72	x	0.8	=	456.26	(81)
Northwest 0.9x	0.77	x	22.67	x	28.07	x	0.72	x	0.8	=	253.98	(81)
Northwest 0.9x	0.77	x	22.67	x	14.2	x	0.72	x	0.8	=	128.47	(81)
Northwest 0.9x	0.77	x	22.67	x	9.21	x	0.72	x	0.8	=	83.38	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	902.96	1589.44	2311.2	3092.4	3672.51	3737.78	3565.4	3118.58	2579.52	1793.47	1090.89	766.69	(83)

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

(84)m=	1629.99	2314.16	3011.9	3753.27	4290.85	4316.7	4119.69	3679.73	3161.98	2416.01	1759.64	1472.1	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.88	0.7	0.5	0.37	0.43	0.7	0.95	1	1	(86)

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

(87)m=	19.65	19.93	20.3	20.7	20.92	20.99	21	21	20.94	20.58	20.02	19.61	(87)

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

(88)m=	19.93	19.93	19.93	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.94	19.94	(88)

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

(89)m=	1	0.99	0.96	0.85	0.64	0.43	0.28	0.33	0.62	0.93	0.99	1	(89)

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

(90)m=	18.12	18.53	19.06	19.62	19.88	19.96	19.96	19.97	19.92	19.48	18.68	18.07	(90)

fLA = Living area ÷ (4) = 0.11 (91)

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

(92)m=	18.28	18.67	19.2	19.74	19.99	20.07	20.07	20.08	20.03	19.6	18.82	18.23	(92)

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

(93)m=	18.28	18.67	19.2	19.74	19.99	20.07	20.07	20.08	20.03	19.6	18.82	18.23	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.95	0.84	0.64	0.43	0.29	0.34	0.62	0.92	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1625.46	2283.6	2862.79	3148.07	2757.67	1869.16	1196.34	1259.72	1967.95	2227.9	1744.87	1469.55	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	5027.19	4937.77	4536.92	3811.79	2907.22	1885.54	1198.02	1263.45	2058.04	3154.35	4135.27	4981.99	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(98)m=	2530.88	1783.6	1245.56	477.88	111.27	0	0	0	0	689.28	1721.09	2613.26

Total per year (kWh/year) = Sum(98)1...5,9...12 = 11172.81 (98)

Space heating requirement in kWh/m²/year 37.09 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0.1	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	0.9	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	0.9	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		65	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	2530.88	1783.6	1245.56	477.88	111.27	0	0	0	0	689.28	1721.09	2613.26	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	2505.83	1765.94	1233.22	473.15	110.16	0	0	0	0	682.46	1704.05	2587.38	(211)

Total (kWh/year) =Sum(211)1...5,10....12= 11062.19 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(215)m=	389.37	274.4	191.62	73.52	17.12	0	0	0	0	106.04	264.78	402.04

Total (kWh/year) =Sum(215)1...5,10....12= 1718.89 (215)

Water heating

Output from water heater (calculated above)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	246.57	217.64	229.3	206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98

Efficiency of water heater 80.8 (216)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(217)m=	89.8	89.56	89.01	87.36	83.88	80.8	80.8	80.8	80.8	88.07	89.48	89.86	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(219)m=	274.57	243	257.61	236.46	242.21	225.97	218.26	237.79	236.83	243.14	251.64	268.19

Total = Sum(219a)1...12 = 2935.66 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			11062.19	
Space heating fuel used, secondary			1718.89	
Water heating fuel used			2935.66	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		1232.06		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		1307.06	(231)
Electricity for lighting			723.12	(232)

DER WorkSheet: New dwelling design stage

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =				17746.93	(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	=	2389.43	(261)
Space heating (secondary)	(215) x	0.019	=	32.66	(263)
Water heating	(219) x	0.216	=	634.1	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3056.19	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	678.36	(267)
Electricity for lighting	(232) x	0.519	=	375.3	(268)
Total CO2, kg/year		sum of (265)…(271) =		4109.86	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.64	(273)
EI rating (section 14)				84	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Daniel Watt	**Stroma Number:**	STRO026464
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.59

Property Address: The Shingles

Address : The Shingles, Chelvey Batch, Backwell, BRISTOL, BS48 3BZ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	211.32	(1a)	x	2.75	(2a)	=	581.13	(3a)
First floor	89.95	(1b)	x	2.55	(2b)	=	229.37	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	301.27	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	810.5	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	1	+	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) =	0.05	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.3	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.25	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.32	0.32	0.31	0.28	0.27	0.24	0.24	0.24	0.25	0.27	0.29	0.3

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.64	x	1	=	2.64			(26)
Windows Type 1			19.32	x1/[1/(1.4)+ 0.04]		=	25.61			(27)
Windows Type 2			30.25	x1/[1/(1.4)+ 0.04]		=	40.1			(27)
Windows Type 3			9.94	x1/[1/(1.4)+ 0.04]		=	13.18			(27)
Windows Type 4			13.17	x1/[1/(1.4)+ 0.04]		=	17.46			(27)
Floor			211.32	x	0.13	=	27.4716			(28)
Walls	240.92	75.32	165.6	x	0.18	=	29.81			(29)
Roof Type1	83.52	0	83.52	x	0.13	=	10.86			(30)
Roof Type2	154	0	154	x	0.13	=	20.02			(30)
Total area of elements, m²			689.76							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 187.15 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 35318.88 (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 50.59 (36)

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

Total fabric heat loss (33) + (36) = 237.74 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	147.81	147.26	146.73	144.21	143.74	141.55	141.55	141.14	142.39	143.74	144.69	145.69	(38)

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

(39)m=	385.55	385.01	384.47	381.95	381.48	379.29	379.29	378.88	380.13	381.48	382.43	383.43	

Average = Sum(39)$_{1...12}$ /12= 381.95 (39)

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

(40)m=	1.28	1.28	1.28	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.27	1.27	

Average = Sum(40)$_{1...12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.13 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.62 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	119.48	115.14	110.79	106.45	102.11	97.76	97.76	102.11	106.45	110.79	115.14	119.48	

Total = Sum(44)$_{1...12}$ = 1303.47 (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=	177.19	154.97	159.92	139.42	133.78	115.44	106.97	122.75	124.22	144.76	158.02	171.6	

Total = Sum(45)$_{1...12}$ = 1709.06 (45)

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

(46)m=	26.58	23.25	23.99	20.91	20.07	17.32	16.05	18.41	18.63	21.71	23.7	25.74	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.52 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.36 (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) 1.36 (55)

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

(56)m=	42.24	38.15	42.24	40.88	42.24	40.88	42.24	42.24	40.88	42.24	40.88	42.24	(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=	42.24	38.15	42.24	40.88	42.24	40.88	42.24	42.24	40.88	42.24	40.88	42.24	(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=	242.7	214.14	225.42	202.81	199.28	178.83	172.48	188.26	187.61	210.27	221.41	237.11	(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=	242.7	214.14	225.42	202.81	199.28	178.83	172.48	188.26	187.61	210.27	221.41	237.11

Output from water heater (annual)$_{1...12}$ 2480.31 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	111.32	98.86	105.58	97.07	96.88	89.1	87.97	93.22	92.02	100.54	103.26	109.46	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	(66)

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

(67)m=	40.95	36.37	29.58	22.39	16.74	14.13	15.27	19.85	26.64	33.82	39.48	42.08	(67)

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

(68)m=	459.29	464.06	452.05	426.48	394.2	363.87	343.6	338.84	350.85	376.42	408.69	439.03	(68)

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

(69)m=	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	(71)

Water heating gains (Table 5)

(72)m=	149.62	147.11	141.9	134.82	130.22	123.75	118.24	125.29	127.8	135.13	143.41	147.12	(72)

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

(73)m=	722.87	720.54	696.53	656.69	614.17	574.75	550.12	556.98	578.29	618.38	664.58	701.24	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	9.94	x	11.28	x	0.63	x	0.7	=	34.28	(75)
Northeast	0.9x	0.77	x	9.94	x	22.97	x	0.63	x	0.7	=	69.77	(75)
Northeast	0.9x	0.77	x	9.94	x	41.38	x	0.63	x	0.7	=	125.7	(75)
Northeast	0.9x	0.77	x	9.94	x	67.96	x	0.63	x	0.7	=	206.44	(75)
Northeast	0.9x	0.77	x	9.94	x	91.35	x	0.63	x	0.7	=	277.49	(75)
Northeast	0.9x	0.77	x	9.94	x	97.38	x	0.63	x	0.7	=	295.83	(75)
Northeast	0.9x	0.77	x	9.94	x	91.1	x	0.63	x	0.7	=	276.75	(75)
Northeast	0.9x	0.77	x	9.94	x	72.63	x	0.63	x	0.7	=	220.63	(75)
Northeast	0.9x	0.77	x	9.94	x	50.42	x	0.63	x	0.7	=	153.17	(75)
Northeast	0.9x	0.77	x	9.94	x	28.07	x	0.63	x	0.7	=	85.26	(75)
Northeast	0.9x	0.77	x	9.94	x	14.2	x	0.63	x	0.7	=	43.13	(75)
Northeast	0.9x	0.77	x	9.94	x	9.21	x	0.63	x	0.7	=	27.99	(75)
Southeast	0.9x	0.77	x	30.25	x	36.79	x	0.63	x	0.7	=	340.15	(77)
Southeast	0.9x	0.77	x	30.25	x	62.67	x	0.63	x	0.7	=	579.4	(77)
Southeast	0.9x	0.77	x	30.25	x	85.75	x	0.63	x	0.7	=	792.77	(77)
Southeast	0.9x	0.77	x	30.25	x	106.25	x	0.63	x	0.7	=	982.27	(77)
Southeast	0.9x	0.77	x	30.25	x	119.01	x	0.63	x	0.7	=	1100.23	(77)
Southeast	0.9x	0.77	x	30.25	x	118.15	x	0.63	x	0.7	=	1092.27	(77)
Southeast	0.9x	0.77	x	30.25	x	113.91	x	0.63	x	0.7	=	1053.07	(77)
Southeast	0.9x	0.77	x	30.25	x	104.39	x	0.63	x	0.7	=	965.07	(77)
Southeast	0.9x	0.77	x	30.25	x	92.85	x	0.63	x	0.7	=	858.4	(77)
Southeast	0.9x	0.77	x	30.25	x	69.27	x	0.63	x	0.7	=	640.36	(77)
Southeast	0.9x	0.77	x	30.25	x	44.07	x	0.63	x	0.7	=	407.42	(77)
Southeast	0.9x	0.77	x	30.25	x	31.49	x	0.63	x	0.7	=	291.1	(77)
Southwest	0.9x	0.77	x	13.17	x	36.79		0.63	x	0.7	=	148.09	(79)
Southwest	0.9x	0.77	x	13.17	x	62.67		0.63	x	0.7	=	252.26	(79)
Southwest	0.9x	0.77	x	13.17	x	85.75		0.63	x	0.7	=	345.15	(79)
Southwest	0.9x	0.77	x	13.17	x	106.25		0.63	x	0.7	=	427.65	(79)
Southwest	0.9x	0.77	x	13.17	x	119.01		0.63	x	0.7	=	479.01	(79)
Southwest	0.9x	0.77	x	13.17	x	118.15		0.63	x	0.7	=	475.54	(79)
Southwest	0.9x	0.77	x	13.17	x	113.91		0.63	x	0.7	=	458.48	(79)
Southwest	0.9x	0.77	x	13.17	x	104.39		0.63	x	0.7	=	420.16	(79)
Southwest	0.9x	0.77	x	13.17	x	92.85		0.63	x	0.7	=	373.72	(79)
Southwest	0.9x	0.77	x	13.17	x	69.27		0.63	x	0.7	=	278.8	(79)
Southwest	0.9x	0.77	x	13.17	x	44.07		0.63	x	0.7	=	177.38	(79)
Southwest	0.9x	0.77	x	13.17	x	31.49		0.63	x	0.7	=	126.74	(79)
Northwest	0.9x	0.77	x	19.32	x	11.28	x	0.63	x	0.7	=	66.62	(81)
Northwest	0.9x	0.77	x	19.32	x	22.97	x	0.63	x	0.7	=	135.61	(81)
Northwest	0.9x	0.77	x	19.32	x	41.38	x	0.63	x	0.7	=	244.32	(81)

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Northwest 0.9x	0.77	x	19.32	x	67.96	x	0.63	x	0.7	=	401.24	(81)
Northwest 0.9x	0.77	x	19.32	x	91.35	x	0.63	x	0.7	=	539.35	(81)
Northwest 0.9x	0.77	x	19.32	x	97.38	x	0.63	x	0.7	=	575	(81)
Northwest 0.9x	0.77	x	19.32	x	91.1	x	0.63	x	0.7	=	537.9	(81)
Northwest 0.9x	0.77	x	19.32	x	72.63	x	0.63	x	0.7	=	428.82	(81)
Northwest 0.9x	0.77	x	19.32	x	50.42	x	0.63	x	0.7	=	297.71	(81)
Northwest 0.9x	0.77	x	19.32	x	28.07	x	0.63	x	0.7	=	165.72	(81)
Northwest 0.9x	0.77	x	19.32	x	14.2	x	0.63	x	0.7	=	83.82	(81)
Northwest 0.9x	0.77	x	19.32	x	9.21	x	0.63	x	0.7	=	54.4	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	589.14	1037.03	1507.93	2017.61	2396.07	2438.65	2326.19	2034.68	1682.99	1170.14	711.75	500.23	(83)

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

(84)m=	1312	1757.58	2204.46	2674.3	3010.24	3013.4	2876.31	2591.66	2261.28	1788.52	1376.34	1201.47	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.88	0.72	0.56	0.63	0.88	0.99	1	1	(86)

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

(87)m=	19.44	19.65	19.97	20.38	20.73	20.93	20.98	20.97	20.81	20.33	19.8	19.4	(87)

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

(88)m=	19.86	19.86	19.86	19.87	19.87	19.87	19.87	19.87	19.87	19.87	19.86	19.86	(88)

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

(89)m=	1	1	0.99	0.95	0.84	0.63	0.43	0.5	0.81	0.98	1	1	(89)

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

(90)m=	17.77	18.07	18.54	19.13	19.6	19.82	19.87	19.86	19.71	19.07	18.3	17.72	(90)

fLA = Living area ÷ (4) = 0.11 (91)

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

(92)m=	17.94	18.24	18.69	19.26	19.72	19.94	19.99	19.98	19.83	19.2	18.46	17.9	(92)

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

(93)m=	17.94	18.24	18.69	19.26	19.72	19.94	19.99	19.98	19.83	19.2	18.46	17.9	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.98	0.94	0.83	0.63	0.44	0.51	0.81	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1310.39	1749.42	2168.37	2517.19	2498.05	1910.04	1267.51	1324.19	1826.11	1738.72	1371.82	1200.48	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	5260.41	5135.15	4687.19	3958.35	3059.77	2025.82	1284.03	1356.19	2176.72	3281.91	4343.15	5251.32	(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=	2938.81	2275.21	1874.01	1037.64	417.91	0	0	0	0	1148.14	2139.35	3013.82

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 14844.9 (98)

Space heating requirement in kWh/m²/year 49.27 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	2938.81	2275.21	1874.01	1037.64	417.91	0	0	0	0	1148.14	2139.35	3013.82		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	3143.12	2433.38	2004.29	1109.77	446.97	0	0	0	0	1227.95	2288.08	3223.34		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													15876.9	(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)	242.7	214.14	225.42	202.81	199.28	178.83	172.48	188.26	187.61	210.27	221.41	237.11		
Efficiency of water heater													79.8	(216)
(217)m=	89.58	89.47	89.22	88.56	86.74	79.8	79.8	79.8	79.8	88.66	89.38	89.62		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	270.92	239.35	252.67	229.01	229.73	224.1	216.14	235.91	235.1	237.16	247.73	264.56		
Total = Sum(219a)$_{1...12}$ =													2882.38	(219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			15876.9	
Water heating fuel used			2882.38	
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			723.12	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			19557.4	(338)

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

TER WorkSheet: New dwelling design stage

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	3429.41	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	622.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4052	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	375.3	(268)
Total CO2, kg/year			sum of (265)…(271) =		4466.23	(272)

TER =	14.82	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.59
Printed on 20 January 2023 at 15:19:10

Project Information:

Assessed By:	Daniel Watt (STRO026464)	**Building Type:**	Detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE		Total Floor Area: 301.27m²	
Site Reference :	Ridgeway Road	**Plot Reference:**	The Shingles- Be Green
Address :	The Shingles, Chelvey Batch, Backwell, BRISTOL, BS48 3BZ		

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)	22.22 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	13.28 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	63.1 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	53.3 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	**OK**
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	**OK**
Roof	0.14 (max. 0.20)	0.14 (max. 0.35)	**OK**
Openings	1.30 (max. 2.00)	1.30 (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 NIBE F2040-16	
Secondary heating system:	Room heaters - wood Closed room heater Efficiency 65.0 % Minimum 65.0 %	**OK**

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 2.75 kWh/day Permitted by DBSCG: 3.41 kWh/day	**OK**

Regulations Compliance Report

Primary pipework insulated:	Yes		OK

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock:	Yes	OK

7 Low energy lights

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

8 Mechanical ventilation

Continuous supply and extract system		
Specific fan power:	0.89	
Maximum	1.5	OK
MVHR efficiency:	89%	
Minimum	70%	OK

9 Summertime temperature

Overheating risk (South West England):	Not significant	OK

Based on:

Overshading:	Average or unknown
Windows facing: North West	22.67m²
Windows facing: South East	35.5m²
Windows facing: North East	11.67m²
Windows facing: South West	15.45m²
Ventilation rate:	8.00
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours

10 Key features

Air permeablility	3.0 m³/m²h
Secondary heating (wood logs)	
Secondary heating fuel wood logs	

SAP Input

Property Details: The Shingles- Be Green

Address:	The Shingles, Chelvey Batch, Backwell, BRISTOL, BS48 3BZ
Located in:	England
Region:	South West England
UPRN:	UPRN-000024066096
Date of assessment:	20 January 2023
Date of certificate:	20 January 2023
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Owner-occupied
Related party disclosure:	Employed by the professional dealing with the property transaction
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	510

Property description:

Dwelling type:	House
Detachment:	Detached
Year Completed:	2023

Floor Location:	Floor area:	Storey height:
Floor 0	211.32 m²	2.75 m
Floor 1	89.95 m²	2.55 m

Living area:	32 m² (fraction 0.127)
Front of dwelling faces:	North West

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Solid			Wood
Front	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break
Rear	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break
Right	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break
Left	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
Front Door	mm	0.7	0	1.3	2.64	1
Front	16mm or more	0.8	0.72	1.3	22.67	1
Rear	16mm or more	0.8	0.72	1.3	35.5	1
Right	16mm or more	0.8	0.72	1.3	11.67	1
Left	16mm or more	0.8	0.72	1.3	15.45	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		External Walls	North West	0	0
Front		External Walls	North West	0	0
Rear		External Walls	South East	0	0
Right		External Walls	North East	0	0
Left		External Walls	South West	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
External Walls	240.92	87.93	152.99	0.22	0	False	N/A
FLat ceiling	83.52	0	83.52	0.14	0		N/A
Sloped roof	154	0	154	0.14	0		N/A

SAP Input

Ground	211.32	0.15	N/A

Internal Elements
Party Elements

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0896

	Length	**Psi-value**		
[Approved]	31	0.3	E2	Other lintels (including other steel lintels)
[Approved]	22	0.04	E3	Sill
[Approved]	75	0.05	E4	Jamb
[Approved]	17	0.16	E5	Ground floor (normal)
	7	0.07	E19	Ground floor (inverted)
	15	0.07	E22	Basement floor
[Approved]	53	0.07	E6	Intermediate floor within a dwelling
	66	0.56	E15	Flat roof with parapet
[Approved]	65	0.09	E16	Corner (normal)
[Approved]	32	-0.09	E17	Corner (inverted internal area greater than external area)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 4 Ductwork: Insulation, rigid Approved Installation Scheme: False
Number of chimneys:	1 (main: 0, secondary: 1, other: 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 510, product index 102043, SEDBUK 386%):
Brand name: NIBE
Model: F2040-16
Model qualifier: Underfloor
(provides DHW all year)
Underfloor heating, pipes in screed above insulation
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Room-sealed
Boiler interlock: Yes
MCS Installation Certificate

Main heating Control:

Main heating Control:

Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2207

Secondary heating system:

Secondary heating system:

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

SAP Input

Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :Electricity Hot water cylinder Cylinder volume: 400 litres Cylinder insulation: Factory 100 mm Primary pipework insulation: True Cylinderstat: True Cylinder in heated space: True Solar panel: False

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

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Daniel Watt	**Stroma Number:**	STRO026464
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.59

Property Address: The Shingles- Be Green

Address : The Shingles, Chelvey Batch, Backwell, BRISTOL, BS48 3BZ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	211.32	(1a)	x	2.75	(2a)	=	581.13	(3a)
First floor	89.95	(1b)	x	2.55	(2b)	=	229.37	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	301.27	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	810.5	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	1	+	0	=	1	x 40 =	40	(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) =	40	÷ (5) =	0.05	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

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)	0.2	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.17	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.2

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) = 75.65 (23c)

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

(24a)m=	0.34	0.33	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32	(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=	0.34	0.33	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32	(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			2.64	x	1.3	=	3.432			(26)
Windows Type 1			22.67	x1/[1/(1.3)+ 0.04]		=	28.01			(27)
Windows Type 2			35.5	x1/[1/(1.3)+ 0.04]		=	43.87			(27)
Windows Type 3			11.67	x1/[1/(1.3)+ 0.04]		=	14.42			(27)
Windows Type 4			15.45	x1/[1/(1.3)+ 0.04]		=	19.09			(27)
Floor			211.32	x	0.15	=	31.698			(28)
Walls	240.92	87.93	152.99	x	0.22	=	33.66			(29)
Roof Type1	83.52	0	83.52	x	0.14	=	11.69			(30)
Roof Type2	154	0	154	x	0.14	=	21.56			(30)
Total area of elements, m²			689.76							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 207.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 34562.28 (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 61.83 (36)

SAP WorkSheet: New dwelling design stage

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

Total fabric heat loss (33) + (36) = 269.27 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	90.35	89.22	88.08	82.42	81.28	75.62	75.62	74.49	77.89	81.28	83.55	85.82	(38)

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

(39)m=	359.62	358.48	357.35	351.69	350.55	344.89	344.89	343.75	347.15	350.55	352.82	355.08	

Average = $Sum(39)_{1...12}$ /12= 351.4 (39)

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

(40)m=	1.19	1.19	1.19	1.17	1.16	1.14	1.14	1.14	1.15	1.16	1.17	1.18	

Average = $Sum(40)_{1...12}$ /12= 1.17 (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 3.13 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.62 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	119.48	115.14	110.79	106.45	102.11	97.76	97.76	102.11	106.45	110.79	115.14	119.48	

Total = $Sum(44)_{1...12}$ = 1303.47 (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=	177.19	154.97	159.92	139.42	133.78	115.44	106.97	122.75	124.22	144.76	158.02	171.6	

Total = $Sum(45)_{1...12}$ = 1709.06 (45)

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

(46)m=	26.58	23.25	23.99	20.91	20.07	17.32	16.05	18.41	18.63	21.71	23.7	25.74	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 400 (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) = 400 (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 0.67 (52)

Temperature factor from Table 2b 0.54 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.49 (54)

Enter (50) or (54) in (55) 1.49 (55)

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

(56)m=	46.12	41.66	46.12	44.63	46.12	44.63	46.12	46.12	44.63	46.12	44.63	46.12	(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=	46.12	41.66	46.12	44.63	46.12	44.63	46.12	46.12	44.63	46.12	44.63	46.12	(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=	246.57	217.64	229.3	206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98	(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=	246.57	217.64	229.3	206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98

Output from water heater (annual)$_{1...12}$ | 2525.96 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	114.42	101.66	108.68	100.07	99.99	92.1	91.07	96.32	95.02	103.64	106.26	112.56	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	188.01	(66)

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

(67)m=	102.37	90.92	73.94	55.98	41.84	35.33	38.17	49.62	66.6	84.56	98.69	105.21	(67)

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

(68)m=	685.51	692.62	674.7	636.54	588.36	543.09	512.84	505.73	523.66	561.82	609.99	655.26	(68)

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

(69)m=	56.94	56.94	56.94	56.94	56.94	56.94	56.94	56.94	56.94	56.94	56.94	56.94	(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=	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	(71)

Water heating gains (Table 5)

(72)m=	153.79	151.28	146.07	138.99	134.39	127.91	122.41	129.46	131.97	139.3	147.58	151.29	(72)

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

(73)m=	1061.27	1054.43	1014.32	951.11	884.21	825.94	793.03	804.42	841.83	905.28	975.87	1031.37	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	11.67	x	11.28	x	0.72	x	0.8	=	52.56	(75)
Northeast 0.9x	0.77	x	11.67	x	22.97	x	0.72	x	0.8	=	106.99	(75)
Northeast 0.9x	0.77	x	11.67	x	41.38	x	0.72	x	0.8	=	192.75	(75)
Northeast 0.9x	0.77	x	11.67	x	67.96	x	0.72	x	0.8	=	316.56	(75)
Northeast 0.9x	0.77	x	11.67	x	91.35	x	0.72	x	0.8	=	425.52	(75)
Northeast 0.9x	0.77	x	11.67	x	97.38	x	0.72	x	0.8	=	453.65	(75)
Northeast 0.9x	0.77	x	11.67	x	91.1	x	0.72	x	0.8	=	424.38	(75)
Northeast 0.9x	0.77	x	11.67	x	72.63	x	0.72	x	0.8	=	338.32	(75)
Northeast 0.9x	0.77	x	11.67	x	50.42	x	0.72	x	0.8	=	234.87	(75)
Northeast 0.9x	0.77	x	11.67	x	28.07	x	0.72	x	0.8	=	130.75	(75)
Northeast 0.9x	0.77	x	11.67	x	14.2	x	0.72	x	0.8	=	66.13	(75)
Northeast 0.9x	0.77	x	11.67	x	9.21	x	0.72	x	0.8	=	42.92	(75)
Southeast 0.9x	0.77	x	35.5	x	36.79	x	0.72	x	0.8	=	521.39	(77)
Southeast 0.9x	0.77	x	35.5	x	62.67	x	0.72	x	0.8	=	888.11	(77)
Southeast 0.9x	0.77	x	35.5	x	85.75	x	0.72	x	0.8	=	1215.15	(77)
Southeast 0.9x	0.77	x	35.5	x	106.25	x	0.72	x	0.8	=	1505.63	(77)
Southeast 0.9x	0.77	x	35.5	x	119.01	x	0.72	x	0.8	=	1686.44	(77)
Southeast 0.9x	0.77	x	35.5	x	118.15	x	0.72	x	0.8	=	1674.24	(77)
Southeast 0.9x	0.77	x	35.5	x	113.91	x	0.72	x	0.8	=	1614.15	(77)
Southeast 0.9x	0.77	x	35.5	x	104.39	x	0.72	x	0.8	=	1479.26	(77)
Southeast 0.9x	0.77	x	35.5	x	92.85	x	0.72	x	0.8	=	1315.75	(77)
Southeast 0.9x	0.77	x	35.5	x	69.27	x	0.72	x	0.8	=	981.55	(77)
Southeast 0.9x	0.77	x	35.5	x	44.07	x	0.72	x	0.8	=	624.5	(77)
Southeast 0.9x	0.77	x	35.5	x	31.49	x	0.72	x	0.8	=	446.2	(77)
Southwest 0.9x	0.77	x	15.45	x	36.79		0.72	x	0.8	=	226.91	(79)
Southwest 0.9x	0.77	x	15.45	x	62.67		0.72	x	0.8	=	386.52	(79)
Southwest 0.9x	0.77	x	15.45	x	85.75		0.72	x	0.8	=	528.85	(79)
Southwest 0.9x	0.77	x	15.45	x	106.25		0.72	x	0.8	=	655.27	(79)
Southwest 0.9x	0.77	x	15.45	x	119.01		0.72	x	0.8	=	733.96	(79)
Southwest 0.9x	0.77	x	15.45	x	118.15		0.72	x	0.8	=	728.65	(79)
Southwest 0.9x	0.77	x	15.45	x	113.91		0.72	x	0.8	=	702.49	(79)
Southwest 0.9x	0.77	x	15.45	x	104.39		0.72	x	0.8	=	643.79	(79)
Southwest 0.9x	0.77	x	15.45	x	92.85		0.72	x	0.8	=	572.63	(79)
Southwest 0.9x	0.77	x	15.45	x	69.27		0.72	x	0.8	=	427.18	(79)
Southwest 0.9x	0.77	x	15.45	x	44.07		0.72	x	0.8	=	271.79	(79)
Southwest 0.9x	0.77	x	15.45	x	31.49		0.72	x	0.8	=	194.19	(79)
Northwest 0.9x	0.77	x	22.67	x	11.28	x	0.72	x	0.8	=	102.1	(81)
Northwest 0.9x	0.77	x	22.67	x	22.97	x	0.72	x	0.8	=	207.83	(81)
Northwest 0.9x	0.77	x	22.67	x	41.38	x	0.72	x	0.8	=	374.44	(81)

Northwest	0.9x	0.77	x	22.67	x	67.96	x	0.72	x	0.8	=	614.94	(81)
Northwest	0.9x	0.77	x	22.67	x	91.35	x	0.72	x	0.8	=	826.6	(81)
Northwest	0.9x	0.77	x	22.67	x	97.38	x	0.72	x	0.8	=	881.25	(81)
Northwest	0.9x	0.77	x	22.67	x	91.1	x	0.72	x	0.8	=	824.39	(81)
Northwest	0.9x	0.77	x	22.67	x	72.63	x	0.72	x	0.8	=	657.21	(81)
Northwest	0.9x	0.77	x	22.67	x	50.42	x	0.72	x	0.8	=	456.26	(81)
Northwest	0.9x	0.77	x	22.67	x	28.07	x	0.72	x	0.8	=	253.98	(81)
Northwest	0.9x	0.77	x	22.67	x	14.2	x	0.72	x	0.8	=	128.47	(81)
Northwest	0.9x	0.77	x	22.67	x	9.21	x	0.72	x	0.8	=	83.38	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	902.96	1589.44	2311.2	3092.4	3672.51	3737.78	3565.4	3118.58	2579.52	1793.47	1090.89	766.69	(83)

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

(84)m=	1964.23	2643.88	3325.52	4043.51	4556.72	4563.72	4358.44	3923	3421.35	2698.75	2066.76	1798.07	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.96	0.85	0.67	0.48	0.35	0.4	0.66	0.93	0.99	1	(86)

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

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

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

(88)m=	19.93	19.93	19.93	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.94	19.94	(88)

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

(89)m=	1	0.98	0.94	0.82	0.61	0.4	0.27	0.31	0.58	0.9	0.99	1	(89)

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

(90)m=	19.93	19.93	19.93	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.94	19.94	(90)

fLA = Living area ÷ (4) = 0.11 (91)

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

(92)m=	20.04	20.04	20.04	20.06	20.06	20.07	20.07	20.08	20.07	20.06	20.06	20.05	(92)

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

(93)m=	20.04	20.04	20.04	20.06	20.06	20.07	20.07	20.08	20.07	20.06	20.06	20.05	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.98	0.94	0.82	0.62	0.41	0.27	0.32	0.59	0.91	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1956.88	2603.07	3140.05	3314.35	2805.76	1875.09	1196.99	1261.24	2002.76	2444.46	2044.35	1793.64	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	5660.09	5428.13	4840.18	3924.15	2930.91	1888.06	1198.28	1264.03	2072.15	3316.52	4570.91	5628.1	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(98)m=	2755.19	1898.44	1264.89	439.06	93.12	0	0	0	0	648.81	1819.12	2852.84

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 11771.47 (98)

Space heating requirement in kWh/m²/year 39.07 (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		385.96	(206)
Efficiency of secondary/supplementary heating system, %		65	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	2755.19	1898.44	1264.89	439.06	93.12	0	0	0	0	648.81	1819.12	2852.84	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	713.84	491.87	327.72	113.76	24.13	0	0	0	0	168.1	471.32	739.14	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3049.88 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)	246.57	217.64	229.3	206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98	
Efficiency of water heater												107.4	(216)
(217)m=	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	229.58	202.64	213.5	192.33	189.16	170	164.2	178.89	178.18	199.39	209.65	224.38

Total = Sum(219a)$_{1...12}$ = 2351.92 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3049.88	
Water heating fuel used			2351.92	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		1232.06		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		1232.06	(231)
Electricity for lighting			723.12	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			7356.98	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)	**Fuel Cost** £/year

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Space heating - main system 1	(211) x	13.19	x 0.01 =	402.28	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	4.23	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	310.22	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	162.51	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	95.38	(250)
Additional standing charges (Table 12)				0	(251)

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

Total energy cost	(245)...(247) + (250)...(254) =	970.39	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.18	(257)
SAP rating (Section 12)		83.58	(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	=	1582.89	(261)
Space heating (secondary)	(215) x	0.019	=	0	(263)
Water heating	(219) x	0.519	=	1220.64	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2803.53	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	639.44	(267)
Electricity for lighting	(232) x	0.519	=	375.3	(268)
Total CO2, kg/year		sum of (265)…(271) =		3818.27	(272)
CO2 emissions per m²		(272) ÷ (4) =		12.67	(273)
EI rating (section 14)				85	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	9363.14	(261)
Space heating (secondary)	(215) x	1.04	=	0	(263)
Energy for water heating	(219) x	3.07	=	7220.38	(264)
Space and water heating	(261) + (262) + (263) + (264) =			16583.52	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	3782.43	(267)
Electricity for lighting	(232) x	0	=	2219.99	(268)
'Total Primary Energy		sum of (265)…(271) =		22585.93	(272)

Primary energy kWh/m²/year	(272) ÷ (4) =	74.97	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Daniel Watt	**Stroma Number:**	STRO026464
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.59

Property Address: The Shingles- Be Green

Address : The Shingles, Chelvey Batch, Backwell, BRISTOL, BS48 3BZ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	211.32	(1a)	x	2.75	(2a)	=	581.13	(3a)
First floor	89.95	(1b)	x	2.55	(2b)	=	229.37	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	301.27	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	810.5	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	1	+	0	=	1	x 40 =	40	(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) =	40	÷ (5) =	0.05	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)
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			
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)	0.2	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
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) =	0.17	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.22	0.21	0.21	0.19	0.18	0.16	0.16	0.16	0.17	0.18	0.19	0.2

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) = 75.65 (23c)

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

(24a)m=	0.34	0.33	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32	(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=	0.34	0.33	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32	(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			2.64	x	1.3	=	3.432			(26)
Windows Type 1			22.67	x1/[1/(1.3)+ 0.04]		=	28.01			(27)
Windows Type 2			35.5	x1/[1/(1.3)+ 0.04]		=	43.87			(27)
Windows Type 3			11.67	x1/[1/(1.3)+ 0.04]		=	14.42			(27)
Windows Type 4			15.45	x1/[1/(1.3)+ 0.04]		=	19.09			(27)
Floor			211.32	x	0.15	=	31.698			(28)
Walls	240.92	87.93	152.99	x	0.22	=	33.66			(29)
Roof Type1	83.52	0	83.52	x	0.14	=	11.69			(30)
Roof Type2	154	0	154	x	0.14	=	21.56			(30)
Total area of elements, m²			689.76							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 207.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 34562.28 (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 61.83 (36)

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

Total fabric heat loss	(33) + (36) =	269.27	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	90.35	89.22	88.08	82.42	81.28	75.62	75.62	74.49	77.89	81.28	83.55	85.82	(38)

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

(39)m=	359.62	358.48	357.35	351.69	350.55	344.89	344.89	343.75	347.15	350.55	352.82	355.08	

Average = Sum(39)$_{1...12}$ /12= 351.4 (39)

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

(40)m=	1.19	1.19	1.19	1.17	1.16	1.14	1.14	1.14	1.15	1.16	1.17	1.18	

Average = Sum(40)$_{1...12}$ /12= 1.17 (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 — 3.13 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 108.62 (43)

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

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

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

(44)m=	119.48	115.14	110.79	106.45	102.11	97.76	97.76	102.11	106.45	110.79	115.14	119.48

Total = Sum(44)$_{1...12}$ = 1303.47 (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=	177.19	154.97	159.92	139.42	133.78	115.44	106.97	122.75	124.22	144.76	158.02	171.6

Total = Sum(45)$_{1...12}$ = 1709.06 (45)

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

(46)m=	26.58	23.25	23.99	20.91	20.07	17.32	16.05	18.41	18.63	21.71	23.7	25.74	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		400	(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) =	400	(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		0.67	(52)
Temperature factor from Table 2b		0.54	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.49	(54)
Enter (50) or (54) in (55)		1.49	(55)

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

(56)m=	46.12	41.66	46.12	44.63	46.12	44.63	46.12	46.12	44.63	46.12	44.63	46.12	(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=	46.12	41.66	46.12	44.63	46.12	44.63	46.12	46.12	44.63	46.12	44.63	46.12	(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=	246.57	217.64	229.3	206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98	(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=	246.57	217.64	229.3	206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98

Output from water heater (annual)$_{1…12}$ | 2525.96 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	114.42	101.66	108.68	100.07	99.99	92.1	91.07	96.32	95.02	103.64	106.26	112.56	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	(66)

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

(67)m=	40.95	36.37	29.58	22.39	16.74	14.13	15.27	19.85	26.64	33.82	39.48	42.08	(67)

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

(68)m=	459.29	464.06	452.05	426.48	394.2	363.87	343.6	338.84	350.85	376.42	408.69	439.03	(68)

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

(69)m=	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	(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=	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	(71)

Water heating gains (Table 5)

(72)m=	153.79	151.28	146.07	138.99	134.39	127.91	122.41	129.46	131.97	139.3	147.58	151.29	(72)

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

(73)m=	724.03	721.71	697.7	657.86	615.34	575.92	551.29	558.15	579.46	619.54	665.75	702.41	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	11.67	x	11.28	x	0.72	x	0.8	=	52.56	(75)
Northeast	0.9x	0.77	x	11.67	x	22.97	x	0.72	x	0.8	=	106.99	(75)
Northeast	0.9x	0.77	x	11.67	x	41.38	x	0.72	x	0.8	=	192.75	(75)
Northeast	0.9x	0.77	x	11.67	x	67.96	x	0.72	x	0.8	=	316.56	(75)
Northeast	0.9x	0.77	x	11.67	x	91.35	x	0.72	x	0.8	=	425.52	(75)
Northeast	0.9x	0.77	x	11.67	x	97.38	x	0.72	x	0.8	=	453.65	(75)
Northeast	0.9x	0.77	x	11.67	x	91.1	x	0.72	x	0.8	=	424.38	(75)
Northeast	0.9x	0.77	x	11.67	x	72.63	x	0.72	x	0.8	=	338.32	(75)
Northeast	0.9x	0.77	x	11.67	x	50.42	x	0.72	x	0.8	=	234.87	(75)
Northeast	0.9x	0.77	x	11.67	x	28.07	x	0.72	x	0.8	=	130.75	(75)
Northeast	0.9x	0.77	x	11.67	x	14.2	x	0.72	x	0.8	=	66.13	(75)
Northeast	0.9x	0.77	x	11.67	x	9.21	x	0.72	x	0.8	=	42.92	(75)
Southeast	0.9x	0.77	x	35.5	x	36.79	x	0.72	x	0.8	=	521.39	(77)
Southeast	0.9x	0.77	x	35.5	x	62.67	x	0.72	x	0.8	=	888.11	(77)
Southeast	0.9x	0.77	x	35.5	x	85.75	x	0.72	x	0.8	=	1215.15	(77)
Southeast	0.9x	0.77	x	35.5	x	106.25	x	0.72	x	0.8	=	1505.63	(77)
Southeast	0.9x	0.77	x	35.5	x	119.01	x	0.72	x	0.8	=	1686.44	(77)
Southeast	0.9x	0.77	x	35.5	x	118.15	x	0.72	x	0.8	=	1674.24	(77)
Southeast	0.9x	0.77	x	35.5	x	113.91	x	0.72	x	0.8	=	1614.15	(77)
Southeast	0.9x	0.77	x	35.5	x	104.39	x	0.72	x	0.8	=	1479.26	(77)
Southeast	0.9x	0.77	x	35.5	x	92.85	x	0.72	x	0.8	=	1315.75	(77)
Southeast	0.9x	0.77	x	35.5	x	69.27	x	0.72	x	0.8	=	981.55	(77)
Southeast	0.9x	0.77	x	35.5	x	44.07	x	0.72	x	0.8	=	624.5	(77)
Southeast	0.9x	0.77	x	35.5	x	31.49	x	0.72	x	0.8	=	446.2	(77)
Southwest	0.9x	0.77	x	15.45	x	36.79		0.72	x	0.8	=	226.91	(79)
Southwest	0.9x	0.77	x	15.45	x	62.67		0.72	x	0.8	=	386.52	(79)
Southwest	0.9x	0.77	x	15.45	x	85.75		0.72	x	0.8	=	528.85	(79)
Southwest	0.9x	0.77	x	15.45	x	106.25		0.72	x	0.8	=	655.27	(79)
Southwest	0.9x	0.77	x	15.45	x	119.01		0.72	x	0.8	=	733.96	(79)
Southwest	0.9x	0.77	x	15.45	x	118.15		0.72	x	0.8	=	728.65	(79)
Southwest	0.9x	0.77	x	15.45	x	113.91		0.72	x	0.8	=	702.49	(79)
Southwest	0.9x	0.77	x	15.45	x	104.39		0.72	x	0.8	=	643.79	(79)
Southwest	0.9x	0.77	x	15.45	x	92.85		0.72	x	0.8	=	572.63	(79)
Southwest	0.9x	0.77	x	15.45	x	69.27		0.72	x	0.8	=	427.18	(79)
Southwest	0.9x	0.77	x	15.45	x	44.07		0.72	x	0.8	=	271.79	(79)
Southwest	0.9x	0.77	x	15.45	x	31.49		0.72	x	0.8	=	194.19	(79)
Northwest	0.9x	0.77	x	22.67	x	11.28	x	0.72	x	0.8	=	102.1	(81)
Northwest	0.9x	0.77	x	22.67	x	22.97	x	0.72	x	0.8	=	207.83	(81)
Northwest	0.9x	0.77	x	22.67	x	41.38	x	0.72	x	0.8	=	374.44	(81)

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Northwest	0.9x	0.77	x	22.67	x	67.96	x	0.72	x	0.8	=	614.94	(81)
Northwest	0.9x	0.77	x	22.67	x	91.35	x	0.72	x	0.8	=	826.6	(81)
Northwest	0.9x	0.77	x	22.67	x	97.38	x	0.72	x	0.8	=	881.25	(81)
Northwest	0.9x	0.77	x	22.67	x	91.1	x	0.72	x	0.8	=	824.39	(81)
Northwest	0.9x	0.77	x	22.67	x	72.63	x	0.72	x	0.8	=	657.21	(81)
Northwest	0.9x	0.77	x	22.67	x	50.42	x	0.72	x	0.8	=	456.26	(81)
Northwest	0.9x	0.77	x	22.67	x	28.07	x	0.72	x	0.8	=	253.98	(81)
Northwest	0.9x	0.77	x	22.67	x	14.2	x	0.72	x	0.8	=	128.47	(81)
Northwest	0.9x	0.77	x	22.67	x	9.21	x	0.72	x	0.8	=	83.38	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	902.96	1589.44	2311.2	3092.4	3672.51	3737.78	3565.4	3118.58	2579.52	1793.47	1090.89	766.69	(83)

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

(84)m=	1626.99	2311.16	3008.9	3750.27	4287.85	4313.7	4116.69	3676.73	3158.98	2413.01	1756.64	1469.1	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.88	0.7	0.5	0.37	0.43	0.7	0.95	1	1	(86)

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

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

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

(88)m=	19.93	19.93	19.93	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.94	19.94	(88)

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

(89)m=	1	0.99	0.96	0.85	0.64	0.43	0.28	0.33	0.62	0.93	0.99	1	(89)

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

(90)m=	19.93	19.93	19.93	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.94	19.94	(90)

fLA = Living area ÷ (4) = 0.11 (91)

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

(92)m=	20.04	20.04	20.04	20.06	20.06	20.07	20.07	20.08	20.07	20.06	20.06	20.05	(92)

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

(93)m=	20.04	20.04	20.04	20.06	20.06	20.07	20.07	20.08	20.07	20.06	20.06	20.05	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.96	0.85	0.65	0.43	0.29	0.34	0.63	0.93	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1624.34	2290.64	2891.11	3190.22	2775.4	1871.5	1196.6	1260.28	1978.84	2254.39	1747.13	1467.65	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	5660.09	5428.13	4840.18	3924.15	2930.91	1888.06	1198.28	1264.03	2072.15	3316.52	4570.91	5628.1	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(98)m=	3002.6	2108.4	1450.11	528.43	115.7	0	0	0	0	790.23	2033.12	3095.37

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 13123.96 (98)

Space heating requirement in kWh/m²/year 43.56 (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 1 385.96 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	3002.6	2108.4	1450.11	528.43	115.7	0	0	0	0	790.23	2033.12	3095.37	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	777.95	546.27	375.71	136.91	29.98	0	0	0	0	204.74	526.76	801.98	(211)

Total (kWh/year) = $Sum(211)_{1...5,10...12}$ = 3400.3 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Output from water heater (calculated above)	246.57	217.64	229.3	206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98

Efficiency of water heater 107.4 (216)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(217)m=	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(219)m=	229.58	202.64	213.5	192.33	189.16	170	164.2	178.89	178.18	199.39	209.65	224.38

Total = $Sum(219a)_{1...12}$ = 2351.92 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3400.3	
Water heating fuel used		2351.92	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	1232.06		(230a)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		1232.06	(231)
Electricity for lighting		723.12	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		7707.4	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

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Space heating (main system 1)	(211) x		0.519	=	1764.75	(261)
Space heating (secondary)	(215) x		0.019	=	0	(263)
Water heating	(219) x		0.519	=	1220.64	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2985.4	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	639.44	(267)
Electricity for lighting	(232) x		0.519	=	375.3	(268)
Total CO_2, kg/year		sum of (265)…(271) =			4000.14	(272)
Dwelling CO_2 Emission Rate		(272) ÷ (4) =			13.28	(273)
EI rating (section 14)					85	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Daniel Watt	**Stroma Number:**	STRO026464
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.59

Property Address: The Shingles- Be Green

Address : The Shingles, Chelvey Batch, Backwell, BRISTOL, BS48 3BZ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	211.32	(1a)	x	2.75	(2a)	=	581.13	(3a)
First floor	89.95	(1b)	x	2.55	(2b)	=	229.37	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	301.27	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	810.5	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	1	+	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) =	0.05	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

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)

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.3	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.25	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.32	0.32	0.31	0.28	0.27	0.24	0.24	0.24	0.25	0.27	0.29	0.3

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.64	x	1	=	2.64			(26)
Windows Type 1			19.32		x1/[1/(1.4)+ 0.04]	=	25.61			(27)
Windows Type 2			30.25		x1/[1/(1.4)+ 0.04]	=	40.1			(27)
Windows Type 3			9.94		x1/[1/(1.4)+ 0.04]	=	13.18			(27)
Windows Type 4			13.17		x1/[1/(1.4)+ 0.04]	=	17.46			(27)
Floor			211.32	x	0.13	=	27.4716			(28)
Walls	240.92	75.32	165.6	x	0.18	=	29.81			(29)
Roof Type1	83.52	0	83.52	x	0.13	=	10.86			(30)
Roof Type2	154	0	154	x	0.13	=	20.02			(30)
Total area of elements, m²			689.76							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 187.15 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 35318.88 (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 50.59 (36)

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

Total fabric heat loss (33) + (36) = 237.74 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	147.81	147.26	146.73	144.21	143.74	141.55	141.55	141.14	142.39	143.74	144.69	145.69	(38)

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

(39)m=	385.55	385.01	384.47	381.95	381.48	379.29	379.29	378.88	380.13	381.48	382.43	383.43	

Average = $Sum(39)_{1...12}$ /12= 381.95 (39)

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

(40)m=	1.28	1.28	1.28	1.27	1.27	1.26	1.26	1.26	1.26	1.27	1.27	1.27	

Average = $Sum(40)_{1...12}$ /12= 1.27 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.13 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.62 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	119.48	115.14	110.79	106.45	102.11	97.76	97.76	102.11	106.45	110.79	115.14	119.48

Total = $Sum(44)_{1...12}$ = 1303.47 (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=	177.19	154.97	159.92	139.42	133.78	115.44	106.97	122.75	124.22	144.76	158.02	171.6

Total = $Sum(45)_{1...12}$ = 1709.06 (45)

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

(46)m=	26.58	23.25	23.99	20.91	20.07	17.32	16.05	18.41	18.63	21.71	23.7	25.74	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.52 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.36 (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) 1.36 (55)

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

(56)m=	42.24	38.15	42.24	40.88	42.24	40.88	42.24	42.24	40.88	42.24	40.88	42.24	(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=	42.24	38.15	42.24	40.88	42.24	40.88	42.24	42.24	40.88	42.24	40.88	42.24	(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=	242.7	214.14	225.42	202.81	199.28	178.83	172.48	188.26	187.61	210.27	221.41	237.11	(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=	242.7	214.14	225.42	202.81	199.28	178.83	172.48	188.26	187.61	210.27	221.41	237.11

Output from water heater (annual)1…12 | 2480.31 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	111.32	98.86	105.58	97.07	96.88	89.1	87.97	93.22	92.02	100.54	103.26	109.46	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	156.68	(66)

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

(67)m=	40.95	36.37	29.58	22.39	16.74	14.13	15.27	19.85	26.64	33.82	39.48	42.08	(67)

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

(68)m=	459.29	464.06	452.05	426.48	394.2	363.87	343.6	338.84	350.85	376.42	408.69	439.03	(68)

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

(69)m=	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	38.67	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	-125.34	(71)

Water heating gains (Table 5)

(72)m=	149.62	147.11	141.9	134.82	130.22	123.75	118.24	125.29	127.8	135.13	143.41	147.12	(72)

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

(73)m=	722.87	720.54	696.53	656.69	614.17	574.75	550.12	556.98	578.29	618.38	664.58	701.24	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	9.94	x	11.28	x	0.63	x	0.7	=	34.28	(75)
Northeast	0.9x	0.77	x	9.94	x	22.97	x	0.63	x	0.7	=	69.77	(75)
Northeast	0.9x	0.77	x	9.94	x	41.38	x	0.63	x	0.7	=	125.7	(75)
Northeast	0.9x	0.77	x	9.94	x	67.96	x	0.63	x	0.7	=	206.44	(75)
Northeast	0.9x	0.77	x	9.94	x	91.35	x	0.63	x	0.7	=	277.49	(75)
Northeast	0.9x	0.77	x	9.94	x	97.38	x	0.63	x	0.7	=	295.83	(75)
Northeast	0.9x	0.77	x	9.94	x	91.1	x	0.63	x	0.7	=	276.75	(75)
Northeast	0.9x	0.77	x	9.94	x	72.63	x	0.63	x	0.7	=	220.63	(75)
Northeast	0.9x	0.77	x	9.94	x	50.42	x	0.63	x	0.7	=	153.17	(75)
Northeast	0.9x	0.77	x	9.94	x	28.07	x	0.63	x	0.7	=	85.26	(75)
Northeast	0.9x	0.77	x	9.94	x	14.2	x	0.63	x	0.7	=	43.13	(75)
Northeast	0.9x	0.77	x	9.94	x	9.21	x	0.63	x	0.7	=	27.99	(75)
Southeast	0.9x	0.77	x	30.25	x	36.79	x	0.63	x	0.7	=	340.15	(77)
Southeast	0.9x	0.77	x	30.25	x	62.67	x	0.63	x	0.7	=	579.4	(77)
Southeast	0.9x	0.77	x	30.25	x	85.75	x	0.63	x	0.7	=	792.77	(77)
Southeast	0.9x	0.77	x	30.25	x	106.25	x	0.63	x	0.7	=	982.27	(77)
Southeast	0.9x	0.77	x	30.25	x	119.01	x	0.63	x	0.7	=	1100.23	(77)
Southeast	0.9x	0.77	x	30.25	x	118.15	x	0.63	x	0.7	=	1092.27	(77)
Southeast	0.9x	0.77	x	30.25	x	113.91	x	0.63	x	0.7	=	1053.07	(77)
Southeast	0.9x	0.77	x	30.25	x	104.39	x	0.63	x	0.7	=	965.07	(77)
Southeast	0.9x	0.77	x	30.25	x	92.85	x	0.63	x	0.7	=	858.4	(77)
Southeast	0.9x	0.77	x	30.25	x	69.27	x	0.63	x	0.7	=	640.36	(77)
Southeast	0.9x	0.77	x	30.25	x	44.07	x	0.63	x	0.7	=	407.42	(77)
Southeast	0.9x	0.77	x	30.25	x	31.49	x	0.63	x	0.7	=	291.1	(77)
Southwest	0.9x	0.77	x	13.17	x	36.79		0.63	x	0.7	=	148.09	(79)
Southwest	0.9x	0.77	x	13.17	x	62.67		0.63	x	0.7	=	252.26	(79)
Southwest	0.9x	0.77	x	13.17	x	85.75		0.63	x	0.7	=	345.15	(79)
Southwest	0.9x	0.77	x	13.17	x	106.25		0.63	x	0.7	=	427.65	(79)
Southwest	0.9x	0.77	x	13.17	x	119.01		0.63	x	0.7	=	479.01	(79)
Southwest	0.9x	0.77	x	13.17	x	118.15		0.63	x	0.7	=	475.54	(79)
Southwest	0.9x	0.77	x	13.17	x	113.91		0.63	x	0.7	=	458.48	(79)
Southwest	0.9x	0.77	x	13.17	x	104.39		0.63	x	0.7	=	420.16	(79)
Southwest	0.9x	0.77	x	13.17	x	92.85		0.63	x	0.7	=	373.72	(79)
Southwest	0.9x	0.77	x	13.17	x	69.27		0.63	x	0.7	=	278.8	(79)
Southwest	0.9x	0.77	x	13.17	x	44.07		0.63	x	0.7	=	177.38	(79)
Southwest	0.9x	0.77	x	13.17	x	31.49		0.63	x	0.7	=	126.74	(79)
Northwest	0.9x	0.77	x	19.32	x	11.28	x	0.63	x	0.7	=	66.62	(81)
Northwest	0.9x	0.77	x	19.32	x	22.97	x	0.63	x	0.7	=	135.61	(81)
Northwest	0.9x	0.77	x	19.32	x	41.38	x	0.63	x	0.7	=	244.32	(81)

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Northwest 0.9x	0.77	x	19.32	x	67.96	x	0.63	x	0.7	=	401.24	(81)
Northwest 0.9x	0.77	x	19.32	x	91.35	x	0.63	x	0.7	=	539.35	(81)
Northwest 0.9x	0.77	x	19.32	x	97.38	x	0.63	x	0.7	=	575	(81)
Northwest 0.9x	0.77	x	19.32	x	91.1	x	0.63	x	0.7	=	537.9	(81)
Northwest 0.9x	0.77	x	19.32	x	72.63	x	0.63	x	0.7	=	428.82	(81)
Northwest 0.9x	0.77	x	19.32	x	50.42	x	0.63	x	0.7	=	297.71	(81)
Northwest 0.9x	0.77	x	19.32	x	28.07	x	0.63	x	0.7	=	165.72	(81)
Northwest 0.9x	0.77	x	19.32	x	14.2	x	0.63	x	0.7	=	83.82	(81)
Northwest 0.9x	0.77	x	19.32	x	9.21	x	0.63	x	0.7	=	54.4	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	589.14	1037.03	1507.93	2017.61	2396.07	2438.65	2326.19	2034.68	1682.99	1170.14	711.75	500.23	(83)

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

(84)m=	1312	1757.58	2204.46	2674.3	3010.24	3013.4	2876.31	2591.66	2261.28	1788.52	1376.34	1201.47	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.88	0.72	0.56	0.63	0.88	0.99	1	1	(86)

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

(87)m=	19.44	19.65	19.97	20.38	20.73	20.93	20.98	20.97	20.81	20.33	19.8	19.4	(87)

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

(88)m=	19.86	19.86	19.86	19.87	19.87	19.87	19.87	19.87	19.87	19.87	19.86	19.86	(88)

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

(89)m=	1	1	0.99	0.95	0.84	0.63	0.43	0.5	0.81	0.98	1	1	(89)

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

(90)m=	17.77	18.07	18.54	19.13	19.6	19.82	19.87	19.86	19.71	19.07	18.3	17.72	(90)

fLA = Living area ÷ (4) = 0.11 (91)

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

(92)m=	17.94	18.24	18.69	19.26	19.72	19.94	19.99	19.98	19.83	19.2	18.46	17.9	(92)

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

(93)m=	17.94	18.24	18.69	19.26	19.72	19.94	19.99	19.98	19.83	19.2	18.46	17.9	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.98	0.94	0.83	0.63	0.44	0.51	0.81	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1310.39	1749.42	2168.37	2517.19	2498.05	1910.04	1267.51	1324.19	1826.11	1738.72	1371.82	1200.48	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	5260.41	5135.15	4687.19	3958.35	3059.77	2025.82	1284.03	1356.19	2176.72	3281.91	4343.15	5251.32	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(98)m=	2938.81	2275.21	1874.01	1037.64	417.91	0	0	0	0	1148.14	2139.35	3013.82

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 14844.9 (98)

Space heating requirement in kWh/m²/year 49.27 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	2938.81	2275.21	1874.01	1037.64	417.91	0	0	0	0	1148.14	2139.35	3013.82	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	3143.12	2433.38	2004.29	1109.77	446.97	0	0	0	0	1227.95	2288.08	3223.34	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 15876.9 (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Output from water heater (calculated above)	242.7	214.14	225.42	202.81	199.28	178.83	172.48	188.26	187.61	210.27	221.41	237.11

Efficiency of water heater 79.8 (216)

(217)m=	89.58	89.47	89.22	88.56	86.74	79.8	79.8	79.8	79.8	88.66	89.38	89.62

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	270.92	239.35	252.67	229.01	229.73	224.1	216.14	235.91	235.1	237.16	247.73	264.56

Total = Sum(219a)$_{1...12}$ = 2882.38 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			15876.9	
Water heating fuel used			2882.38	
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			723.12	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			19557.4	(338)

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

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	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	3429.41	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	622.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4052	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	375.3	(268)
Total CO2, kg/year			sum of (265)…(271) =		4466.23	(272)

TER = 22.22 (273)