# Dexter Building Design

## Energy and Sustainability Statement

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

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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.

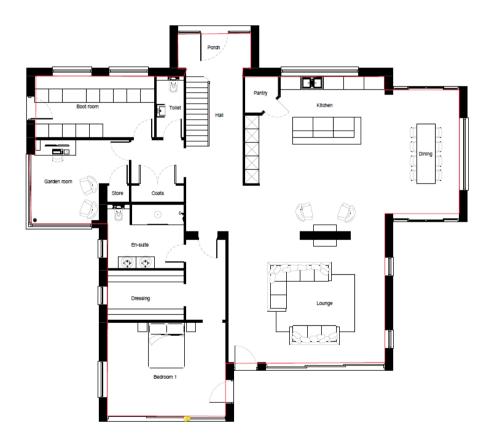


Figure 1: Ground Floor Plan





- 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:

- 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;
- developers are encouraged to incorporate site-wide renewable energy solutions to be delivered in a phased and co-ordinated way with the proposed development;
- 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;



- 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,
- 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:

- 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 500m<sup>2</sup> and 15% for 1000m<sup>2</sup> 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 nonresidential developments over 500m<sup>2</sup> and 'Excellent' over 1000m<sup>2</sup>;
- 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

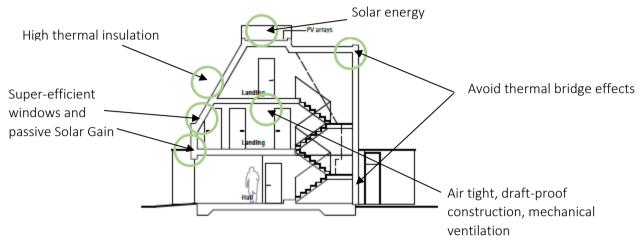
Opportunities for incorporating low and zero carbon technologies (LZCT) have been considered for this development. The viability of several separate technologies was examined in a LZCT study (see section 3) which helped to identify potential opportunities for the inclusion of an ASHP system.



## 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/m<sup>2</sup>K
- External Wall U-values of 0.22 W/m<sup>2</sup>K
- Flat Ceiling U-values of 0.12 W/m<sup>2</sup>K
- Pitched Roof U-values of 0.12 W/m<sup>2</sup>K
- Low Double Glazed Window U-values of 1.3 W/m<sup>2</sup>K
- 100% low energy lighting throughout
- 400L cylinder
- MVHR Pichler LG450
- Air Permeability Rate of 3m<sup>3</sup>/hm<sup>2</sup>



## 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
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• CO2 Saving from onsite LZC Technologies = 2191.3 kgCO2/Yr



## 2.3.3 Energy and CO<sub>2</sub> 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 <sub>2</sub> 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

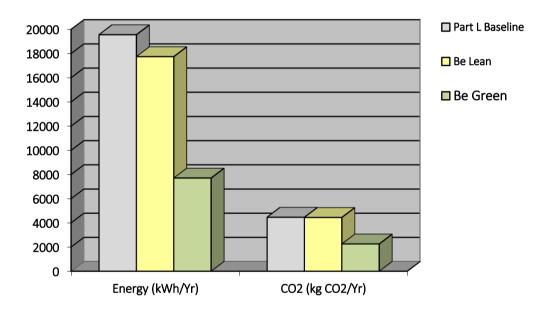


#### On-site renewables

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:





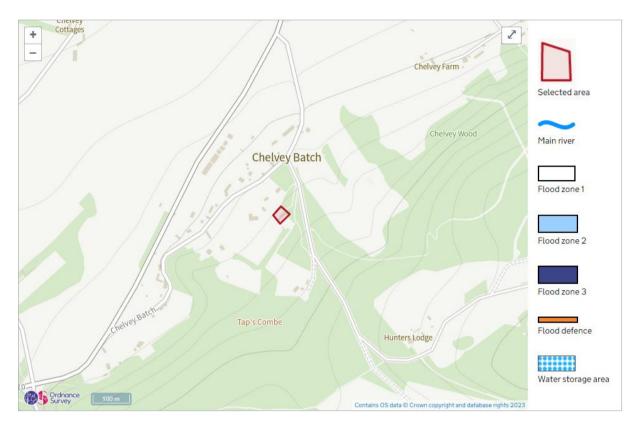
## 2.4 Adaptation to Climate Change

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 I/min	5
Kitchen taps	Flow rate I/min	6
Bath	Capacity to Overflow	170
Shower	Flow rate I/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 triseparator 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)	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)	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)	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





# **Regulations Compliance Report**

••	ent L1A, 2013 Edition Jary 2023 at 15:19:10	, England assessed by Stroma FS າ	SAP 2012 program, Ve	rsion: 1.0.5.59	
Project Information	•	5			
Assessed By:	Daniel Watt (STRO	0026464)	Building Type:	Detached House	
Dwelling Details:	(				
NEW DWELLING	DESIGN STAGE		Total Floor Area: 3	301.27m <sup>2</sup>	
Site Reference :	Ridgeway Road		Plot Reference:	The Shingles	
Address :		lvey Batch, Backwell, BRISTOL, E	3S48 3BZ	0	
Client Details:		·			
Name:					
Address :					
This report cover	s items included wi	thin the SAP calculations.			
It is not a comple	te report of regulat	ons compliance.			
1a TER and DER					
	ing system: Mains ga	as			
Fuel factor: 1.00 (r	nains gas) oxide Emission Rate		14.82 kg/m²		
-	Dioxide Emission Rate	. ,	13.64 kg/m <sup>2</sup>		ок
1b TFEE and DF			roto r kg/m		
Target Fabric Ener	rgy Efficiency (TFEE	)	63.1 kWh/m²		
Dwelling Fabric Er	nergy Efficiency (DFE	E)	53.3 kWh/m <sup>2</sup>		
					ОК
2 Fabric U-value	S				
Element		Average	Highest		01/
External v Floor	wall	0.22 (max. 0.30) 0.15 (max. 0.25)	0.22 (max. 0.70)		OK OK
Roof		0.13 (max. 0.23) 0.14 (max. 0.20)	0.15 (max. 0.70) 0.14 (max. 0.35)		OK
Openings	5	1.30 (max. 2.00)	1.30 (max. 3.30)		OK
2a Thermal brid		, , , , , , , , , , , , , , , , , , ,			
		om linear thermal transmittances f	for each junction		
3 Air permeabili	ty				
	pility at 50 pascals		3.00 (design val	lue)	
Maximum			10.0		ОК
4 Heating efficie	ncy				
Main Heatir	ng system:	Boiler systems with radiators or Data from manufacturer Efficiency 90.0 % SEDBUK2009 Minimum 88.0 %	-	ains gas	ок
Secondary	heating system:	Room heaters - wood			
		Closed room heater			
		Efficiency 65.0 %			OK
5 Cylinder insula	ation	Minimum 65.0 %			ОК
Hot water S		Measured cylinder loss: 2.75 kW	Vh/dav		
		Permitted by DBSCG: 3.41 kWh	•		ОК

## **Regulations Compliance Report**

Primary pipework insulated	Yes		OK
Controls			
Space heating controls	TTZC by plumbing and el	ectrical services	OK
Hot water controls:	Cylinderstat		OK
	Independent timer for DH	W	OK
Boiler interlock:	Yes		OK
' Low energy lights			
Percentage of fixed lights w	ith low-energy fittings	100.0%	
Minimum		75.0%	OK
B Mechanical ventilation			
Continuous supply and extr	act system		
Specific fan power:		0.89	
Maximum		1.5	OK
MVHR efficiency:		89%	
Minimum		70%	OK
Summertime temperature			
Overheating risk (South We	st England):	Not significant	OK
ased on:			
Overshading:		Average or unknown	
Windows facing: North Wes	t	22.67m <sup>2</sup>	
Windows facing: South Eas	t	35.5m <sup>2</sup>	
Windows facing: North East	:	11.67m <sup>2</sup>	
Windows facing: South Wes	st	15.45m <sup>2</sup>	
Ventilation rate:		8.00	
Blinds/curtains:		Dark-coloured curtain or roller	blind
		Closed 100% of daylight hours	6

#### 10 Key features

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

## **SAP Input**

Property Details:	The Shingles					
Address:		The Shingles, Chelvey Ba	itch, Backwell, BR	ISTOL, BS48 3B	Z	
Located in:		England				
Region:		South West England				
UPRN:		UPRN-000024066096				
Date of assess	ment:	20 January 2023				
Date of certific	ate:	20 January 2023				
Assessment ty	pe:	New dwelling design stag	je			
Transaction ty	pe:	New dwelling				
Tenure type:		Owner-occupied				
Related party of		Employed by the professi	ional dealing with	the property tra	Insaction	
Thermal Mass		Indicative Value Medium				
	125 litres/person/d					
PCDF Version:		510				
Property descript	ion:					
Dwelling type:		House				
Detachment:		Detached				
Year Completed:		2023				
Floor Location:		Floor area:				
			c	Storey height		
		$111 \ 10 \ m^2$		2.75 m	•	
Floor 0		211.32 m² 89.95 m²		2.75 m 2.55 m		
Floor 1				2.55 111		
Living area: Front of dwelling	faces:	32 m <sup>2</sup> (fraction 0.127) 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 Facto	r: 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	J	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	5:	-				
Туре:	Gross area: Ope	nings: Net area:	U-value:	Ru value:	Curtain	wall: Kappa:
External Element	ts	C C	0.22	0	Falco	
External Walls			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 <u>Internal Elements</u> Party Elements	211.32			0.15		N/A				
Thermal bridges:										
Thermal bridges:		User-defined <b>Length</b>	(individual PSI- Psi-value	values)	Y-Value = 0.0896					
	pproved]	31	0.3	E2	Other lintels (including other steel linter	els)				
	pproved]	22	0.04	E3	Sill					
	.pproved] .pproved]	75 17	0.05 0.16	E4 E5	Jamb Ground floor (normal)					
L/ V	pproved]	7	0.07	E19	Ground floor (inverted)					
		15	0.07	E22	Basement floor					
[A	pproved]	53	0.07	E6	Intermediate floor within a dwelling					
		66	0.56	E15	Flat roof with parapet					
	pproved]	65 32	0.09 -0.09	E16 E17	Corner (normal) Corner (inverted internal area greater	than external area)				
ĮA	pproved]	32	-0.09	EI/	Corner (inverted internal area greater	(nan external area)				
Ventilation:										
Pressure test:		Yes (As desig								
Ventilation:			heat recovery							
		Number of wet rooms: Kitchen + 4 Ductwork: Insulation, rigid								
			tallation Schem	e: False						
Number of chimneys	5:		econdary: 1, oth							
Number of open flue	es:	0								
Number of fans:		0								
Number of passive s		0 2								
Number of sides she Pressure test:	eitereu:	2								
Main heating system:										
Main heating system		Boiler system	s with radiators	or und	erfloor heating					
Main neuting system		Gas boilers ar			g					
		Fuel: mains g	as							
			Manufacturer D	eclarati	on					
		Manufacturer		000)						
		-	.0% (SEDBUK2 ensing with aut		ignition					
		Fuel Burning	-	omatio	.g					
		Systems with	• •							
			ng pump:2013							
		0	emperature: De	esign flo	w temperature >45°C					
		Room-sealed								
Main heating Control:		Boiler interloc	K: Yes							
		Time and tem	noraturo zono	control	by suitable arrangement of plumbin	a and electrical				
Main heating Contro	11.	services	iperature zone	CONTRION	by suitable arrangement of plumbin	y and electrical				
		Control code:	2110							
Secondary heating sy	vstem:									
Secondary heating s	system:	Room heaters	5							
		Solid fuel room								
		Fuel :wood lo								
		Info Source: S Closed room								
		HETAS Appro								

## **SAP Input**

Wat	tor	hoa	tino
vva		пеа	ung

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

## SAP WorkSheet: New dwelling design stage

				User [	Details:						
Assessor Name:	Daniel Wa	tt			Strom	a Num	ber:		STRO	026464	
Software Name:	Stroma FS	AP 201	2		Softwa	are Vei	Versio	ion: 1.0.5.59			
			P	roperty	Address	: The Sh	ingles				
Address :	The Shingle	es, Chelv	vey Batch	n, Back	well, BRI	STOL, E	3S48 3B2	Z			
1. Overall dwelling dimer	isions:										
				Are	a(m²)		Av. Hei	ght(m)	-	Volume(m <sup>3</sup> )	_
Ground floor				2	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	e)+(1n	) 3	801.27	(4)					
Dwelling volume						(3a)+(3b)	)+(3c)+(3d	)+(3e)+	.(3n) =	810.5	(5)
2. Ventilation rate:											
	main heating		econdar leating	у	other		total			m <sup>3</sup> per hou	r
Number of chimneys	0	+	1	+	0	=	1	X 4	40 =	40	(6a)
Number of open flues	0	_ + _	0	<u> </u> + [	0		0	x 2	20 =	0	(6b)
Number of intermittent far	s					Γ	0	x ′	10 =	0	(7a)
Number of passive vents						Γ	0	x	10 =	0	(7b)
Number of flueless gas fir	es					Г	0	x 4	40 =	0	(7c)
									Air ch	anges per ho	ur
Infiltration due to chimney							40		÷ (5) =	0.05	(8)
If a pressurisation test has be			ed, proceed	d to (17),	otherwise of	continue fr	om (9) to (	16)			
Number of storeys in the Additional infiltration	e uwennig (na	>)						[(0).	-1]x0.1 =	0	(9) (10)
Structural infiltration: 0.2	25 for steel o	r timber t	frame or	0 35 fc	r masoni	v constr	uction	[(3)	110.1 -	0	(10)
if both types of wall are pre						•	dottori			0	
deducting areas of opening											_
If suspended wooden flo			ed) or 0.	1 (seal	ed), else	enter 0				0	(12)
If no draught lobby, ente										0	(13)
Percentage of windows	and doors dr	aught st	ripped		0.05 10.0		0.01			0	(14)
Window infiltration					0.25 - [0.2			(45)		0	(15)
Infiltration rate	50						2) + (13) +			0	(16)
Air permeability value, o						•	etre of e	nvelope	area	3	(17)
If based on air permeabilit Air permeability value applies							is being us	od		0.2	(18)
Number of sides sheltered		on test nas	s been don		gree an pe	ineability	is being us	seu		2	(19)
Shelter factor	•				(20) = 1 -	[0.075 x (1	9)] =			0.85	(20)
Infiltration rate incorporation	ng shelter fac	tor			(21) = (18	) x (20) =				0.17	(21)
Infiltration rate modified for	r monthly wir	nd speed	ł								
Jan Feb I	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spe	ed from Tabl	e 7									
(22)m= 5.1 5	4.9 4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		

## SAP WorkSheet: New dwelling design stage

Wind F	-actor (2	2a)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		
Adjuste	ed infiltra	ation rate	e (allowi	ng for sł	nelter an	d wind s	peed) =	(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		
	ate effec		-	rate for t	he appli	cable ca	se		-					
	echanica aust air he			andix NL (2	2h) _ (22	$\rightarrow$ $\sim$ $Emy(c$	auction (N		nuico (22h	) - (220)			0.5	(23a)
	anced with	• •	0 11		, (	, (		<i>,, ,</i>	<b>`</b>	) = (23a)			0.5	(23b)
			-	-	-						001-)	1 (00 c)	75.65	(23c)
,	i	0.33	0.33	0.31	0.3	at recove		HR) (24a	a)m = (22)	2D)m + (. 0.3	23D) × [ 0.31	1 – (23c) 0.32	÷100]	(24a)
(24a)m=												0.32		(24a)
,	balance		anical ve			neat rec			m = (22)	$\frac{1}{0} + m(a)$	<i>,</i>		l	(24b)
(24b)m=		Ţ		-	-		-	_		0	0	0		(240)
,	whole ho if (22b)m				•					5 v (23h				
(24c)m=	r í í	0	0		0 = (201)		0	$\frac{0}{0} = \frac{221}{2}$	0	0	0	0		(24c)
	natural \	Ţ	Ţ	Ŧ	-	-	-		-	•				~ /
,	if (22b)m				•					0.5]				
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effe	ctive air	change	rate - en	iter (24a	) or (24	o) or (24	c) or (24	d) in boy	(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)
2 40	at losses	and be	at loce r	aramat	or:			•						
ELEN		Gros		Openin		Net Ar	ea	U-valı	IP	AXU		k-value	Δ Δ	Xk
		area		m	-	A ,r		W/m2		(W/I	≺)	kJ/m²·ł		/K
Doors						2.64	x	10		3.432				(26)
Window							^	1.3						
	ws Type	1				22.67	<b>-</b>	1.3 /[1/( 1.3 )+	!	28.01				(27)
Window	ws Type ws Type						×1,		0.04] =					(27) (27)
		2				22.67	x1,	/[1/( 1.3 )+	0.04] = [ 0.04] = [	28.01				
Windov	ws Type	2 3				22.67 35.5	x1, x1, x1, x1,	/[1/( 1.3 )+ /[1/( 1.3 )+	0.04] = [ 0.04] = [ 0.04] = [	28.01 43.87				(27)
Windov	ws Type ws Type	2 3				22.67 35.5 11.67 15.45	x1) x1) x1) x1) x1)	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+	0.04] = [ 0.04] = [ 0.04] = [	28.01 43.87 14.42 19.09			-, [	(27) (27) (27)
Windov Windov Floor	ws Type ws Type	2 3 4	92	87.9	3	22.67 35.5 11.67 15.45 211.3	x 1, x 1, x 1, x 1, x 1, x 1, x 2, x	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 	0.04] = [ 0.04] = [ 0.04] = [ 0.04] = [ 0.04] = [	28.01 43.87 14.42 19.09 31.698			]	(27) (27) (27) (28)
Windov Windov Floor Walls	ws Type ws Type ws Type	2 3 4 		87.9	3	22.67 35.5 11.67 15.45 211.3 152.9	x 1/ x 1/ x 1/ x 1/ x 1/ x 1/ x 2 x 2 y x	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22	$\begin{array}{c} 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ \\ \end{array}$	28.01 43.87 14.42 19.09 31.698 33.66				(27) (27) (27) (28) (29)
Windov Windov Floor Walls Roof 1	ws Type ws Type ws Type Type1	2 3 4 240.9 83.5	2	0	3	22.67 35.5 11.67 15.45 211.3 152.9 83.52	x 11, x 11, x 11, x 11, x 11, x 11, x 11, 2 x x 2 x 2 x	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22 0.14	$\begin{array}{c} 0.04] = \\ 0.04] = \\ \\ 0.04] = \\ \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	28.01 43.87 14.42 19.09 31.698 33.66 11.69				(27) (27) (27) (28) (28) (29) (30)
Windov Windov Floor Walls Roof 1 Roof 1	ws Type ws Type ws Type Type1 Type2	2 3 4 240.1 83.5 154	2 	-	3	22.67 35.5 11.67 15.45 211.3 152.9 83.52 154	x 1/ x 1/ x 1/ x 1/ x 1/ z x 1/ z x 1/ z x 9 x 2 x 2 x 2 x x x 2 x	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22	$\begin{array}{c} 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ \\ \end{array}$	28.01 43.87 14.42 19.09 31.698 33.66				(27) (27) (27) (28) (28) (29) (30) (30)
Windov Windov Floor Walls Roof 1 Roof 1 Total a	ws Type ws Type ws Type Type1 Type2 area of el	2 3 4 240.3 83.5 154	2 1 , m²	0		22.67 35.5 11.67 15.45 211.3 152.9 83.52 154 689.7	x 1/ x 1/ x 1/ x 1/ x 1/ 2 x 9 x 2 x 9 x 2 x 6	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22 0.14 0.14	$\begin{array}{c} 0.04] = \\ 0.04] = \\ \\ 0.04] = \\ \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56		paragraph		(27) (27) (27) (28) (28) (29) (30)
Windov Windov Floor Walls Roof 1 Roof 1 Total a	ws Type ws Type ws Type Type1 Type2 area of el	2 3 4 240.3 83.5 154 lements roof winder	, m <sup>2</sup>	0 0	ndow U-va	22.67 35.5 11.67 15.45 211.3 152.9 83.52 154 689.7 alue calcul	x 1/ x 1/ x 1/ x 1/ x 1/ 2 x 9 x 2 x 9 x 2 x 6	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22 0.14 0.14	$\begin{array}{c} 0.04] = \\ 0.04] = \\ \\ 0.04] = \\ \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56		paragraph		(27) (27) (27) (28) (28) (29) (30) (30)
Windov Floor Walls Roof 1 Roof 1 Total a * for win ** includ	ws Type ws Type ws Type Type1 Type2 area of el dows and	2 3 4 240.9 83.5 154 lements roof winde s on both	, m <sup>2</sup> , m <sup>2</sup> sides of in	0 0 ffective wi	ndow U-va	22.67 35.5 11.67 15.45 211.3 152.9 83.52 154 689.7 alue calcul	x 1/ x 1/ x 1/ x 1/ x 1/ 2 x 9 x 2 x 2 x 2 x 4 6 ated using	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22 0.14 0.14	$\begin{array}{c} 0.04] = \\ 0.04] = \\ \\ 0.04] = \\ \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56		paragraph	3.2	(27) (27) (27) (28) (28) (29) (30) (30)
Windov Floor Floor Walls Roof 1 Roof 1 Total a * for win ** includ Fabric	ws Type ws Type ws Type Type1 Type2 area of el dows and le the area	2 3 4 240.1 83.5 154 lements roof winde s on both s, W/K =	, m <sup>2</sup> , m <sup>2</sup> ows, use e sides of in = S (A x	0 0 ffective wi	ndow U-va	22.67 35.5 11.67 15.45 211.3 152.9 83.52 154 689.7 alue calcul	x 1/ x 1/ x 1/ x 1/ x 1/ 2 x 9 x 2 x 2 x 2 x 4 6 ated using	$ \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[0.15]{0.22}}{0.12} \frac{[0.14]{0.14}}{0.14} $	$\begin{array}{c} 0.04] = \\ 0.04] = \\ \\ 0.04] = \\ \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56	s given in			(27) (27) (27) (28) (29) (30) (30) (31)
Windov Floor Floor Walls Roof T Roof T Total a * for win ** includ Fabric Heat ca	ws Type ws Type ws Type Type1 Type2 area of el dows and le the area heat los	2 3 4 240.3 83.5 154 lements roof winde s on both s, W/K = Cm = S(	, m <sup>2</sup> , sides of in = S (A x A x k)	ffective winternal wall	ndow U-va	22.67 35.5 11.67 15.45 211.3 152.9 83.52 154 689.7 alue calculations	x 1/ x 1/ x 1/ x 1/ x 1/ 2 x 1/ 2 x 9 x 2 x 9 x 2 x 2 x 6 ated using	$ \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[0.15]{0.22}}{0.12} \frac{[0.14]{0.14}}{0.14} $	$\begin{array}{c} 0.04] = \\ 0.04] = \\ \\ 0.04] = \\ \\ 0.04] = \\ \\ \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56 re)+0.04] a	s given in		207.44	(27) (27) (27) (28) (29) (30) (30) (31) (33)
Windov Floor Floor Walls Roof T Roof T Total a * for win ** includ Fabric Heat c Therma For desig	ws Type ws Type ws Type Type1 Type2 area of el dows and le the area heat los apacity (	2 3 4 240.9 83.5 154 lements roof winde s on both s, W/K = Cm = S(parame ments wh	, m <sup>2</sup> , m <sup>2</sup> sides of in = S (A x A x k ) ter (TMF ere the det	ffective winternal wall U)	ndow U-va Is and par	22.67 35.5 11.67 15.45 211.3 152.9 83.52 83.52 154 689.7 alue calcul titions	x 1/ x 1/ x 1/ x 1/ x 1/ 2 x 9 x 2 x 9 x 2 x 6 ated using	/[1/(1.3)+]/[1/(1.3)+]/[1/(1.3)+]/[1/(1.3)+]/[1/(1.3)+]0.15]0.2200.140000000000000000000000000000000	$\begin{array}{c} 0.04] = \\ 0.04] = \\ \\ 0.04] = \\ \\ 0.04] = \\ \\ \\ \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56 re)+0.04] a .(30) + (32	2) + (32a).	(32e) =	207.44 34562.28	(27) (27) (27) (28) (29) (30) (30) (31) (31) (33) (33) (34)

			are not kn	own (36) =	= 0.05 x (3	1)								_
Total fa	abric he	at loss							(33) +	(36) =			269.27	(37)
Ventila	tion hea	at loss ca	alculated	monthly	Y		r		(38)m	= 0.33 × (	25)m x (5)		I	
	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 tr	ansfer o	coefficier	nt, W/K						(39)m	= (37) + (3	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		
Heat lo	ss para	ımeter (H	HLP), W	/m²K						Average = = (39)m ÷	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	12 /12=	351.4	(39)
(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		
Numbe	er of day	/s in moi	nth (Tab	le 1a)			-		,	Average =	Sum(40) <sub>1.</sub>	12 /12=	1.17	(40)
	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. Wa	ter heat	ting enei	rav reau	irement:								kWh/ye	ear:	
Assum if TF.	ed occu	ipancy, l 9, N = 1	N		(-0.0003	49 x (TF	FA -13.9	)2)] + 0.(	)013 x ( <sup>-</sup>	ΓFA -13.		13		(42)
Reduce	the annua	al average	hot water	usage by a	5% if the a	welling is	designed t	(25 x N) to achieve		se target o		3.62		(43)
not more	e that 125	litres per j	person pei	r day (all w	ater use, I	not and co	ld)						1	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot wate	er usage i	n litres per	day for ea	ach month	Vd,m = fa	ctor from T	Table 1c x	(43)					I	
(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		<b>-</b>
Energy o	content of	hot water	used - cal	culated mo	onthly $= 4$ .	190 x Vd,r	m x nm x D	)Tm / 3600		Total = Su hth (see Ta	· · ·		1303.47	(44)
(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		
lf instant	aneous w	vater heatii	ng at point	t of use (no	hot water	storage),	enter 0 in	boxes (46,		Total = Su	m(45) <sub>112</sub> =	-	1709.06	(45)
(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)
	storage											-		
-		. ,		• •			-	within sa	ime ves	sel		400		(47)
Otherw Water	vise if no storage	o stored loss:	hot wate	ink in dw er (this in oss facto	icludes i	nstantar	neous co	(47) ombi boil	ers) ente	er '0' in (		0	l	(48)
						vvii (r.vvi	i/uay).					0		(48)
		actor fro						(40) (40)				0		(49)
b) If m	anufact	urer's de	eclared of	, kWh/ye cylinder l om Tabl	oss fact		known:	(48) x (49)	=			00		(50) (51)
		leating s					.,				0.	<b>U</b> 1	l	()
		from Ta									0.	67		(52)
Tempe	rature f	actor fro	m Table	2b							0.	54		(53)
•••		m water (54) in (5	-	e, kWh/y€	ear			(47) x (51)	x (52) x (	53) =		49 49		(54) (55)

Water	storage	loss cal	culated	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 cylind	er contain	s dedicate	d solar sto	orage, (57)	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	lix 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)
Prima	ry circuit	loss (ar	nual) fr	om Table	e 3				•	•		0		(58)
	•	•	,			59)m = (	(58) ÷ 36	65 × (41)	m				I	
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	er heati	ng and a	cylinde	r thermo	ostat)			
(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)
Comb	i loss ca	lculated	for each	month	(61)m =	(60) ÷ 36	65 × (41	)m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat req	uired for	water h	eating ca	alculated	for eacl	h 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 D	HW input	calculated	using App	endix G o	r Appendix	H (negativ	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)	•	
(add a	dditiona	l lines if	FGHRS	and/or \	NWHRS	applies	, see Ap	pendix (	G)		-	-		
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Outpu	t from w	ater hea	ter										_	
(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		_
								Outp	out from w	ater heate	r (annual)₁	12	2525.96	(64)
Heat g	gains fro	m water	heating	, kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 0.8 x	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)
inclu	ude (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	vater is f	rom com	munity h	leating	
5. In	ternal ga	ains (see	e Table S	5 and 5a	):									
Metab	olic gair	is (Table	e 5), Wat	tts	_								_	
	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)
Lightir	ng gains	(calcula	ted in A	ppendix	L, equat	ion L9 oi	r L9a), a	lso 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)
Applia	nces ga	ins (calc	ulated ir	n Appeno	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 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)
Cookii	ng gains	(calcula	ated in A	ppendix	L, equat	tion L15	or L15a)	), also se	e 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)
Pump	s and fa	ns gains	(Table	5a)				-	-	-	-		•	
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losse	s e.g. ev	vaporatio	n (nega	tive valu	es) (Tab	le 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 (1	able 5)		•			•	•	•			1	
(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	1 + (68)m -	+ (69)m +	(70)m + (7	(1)m + (72)	m	1	
(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	1	(73)
	lar gains	•	•	•	•	•				•	•	•		

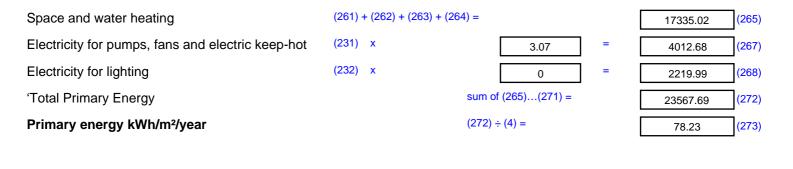
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Facto Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	11.67	x	11.28	×	0.72	x	0.8	=	52.56	(75)
Northeast 0.9x	0.77	x	11.67	x	22.97	×	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	×	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	×	0.72	x	0.8	=	338.32	(75)
Northeast 0.9x	0.77	x	11.67	x	50.42	×	0.72	x	0.8	=	234.87	(75)
Northeast 0.9x	0.77	x	11.67	×	28.07	×	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	×	85.75	×	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	×	0.72	x	0.8	=	1686.44	(77)
Southeast 0.9x	0.77	x	35.5	×	118.15	×	0.72	x	0.8	=	1674.24	(77)
Southeast 0.9x	0.77	x	35.5	×	113.91	×	0.72	x	0.8	=	1614.15	(77)
Southeast 0.9x	0.77	x	35.5	×	104.39	×	0.72	x	0.8	=	1479.26	(77)
Southeast 0.9x	0.77	x	35.5	x	92.85	×	0.72	x	0.8	=	1315.75	(77)
Southeast 0.9x	0.77	x	35.5	×	69.27	×	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		x	35.5	x	31.49	x	0.72	x	0.8	=	446.2	(77)
Southwest <sub>0.9x</sub>		x	15.45	x	36.79		0.72	x	0.8	=	226.91	(79)
Southwest0.9x		x	15.45	x	62.67		0.72	x	0.8	=	386.52	(79)
Southwest <sub>0.9x</sub>	0.77	x	15.45	x	85.75		0.72	x	0.8	=	528.85	(79)
Southwest0.9x	0.77	x	15.45	x	106.25		0.72	x	0.8	=	655.27	(79)
Southwest0.9x		x	15.45	x	119.01		0.72	x	0.8	=	733.96	(79)
Southwest0.9x		x	15.45	×	118.15		0.72	x	0.8	=	728.65	(79)
Southwest0.9x		x	15.45	x	113.91		0.72	x	0.8	=	702.49	(79)
Southwest0.9x		x	15.45	x	104.39		0.72	x	0.8	=	643.79	(79)
Southwest0.9x	-	x	15.45	x	92.85		0.72	x	0.8	=	572.63	(79)
Southwest0.9x	0.77	x	15.45	x	69.27		0.72	x	0.8	=	427.18	(79)
Southwest0.9x		x	15.45	×	44.07		0.72	x	0.8	=	271.79	(79)
Southwest <sub>0.9x</sub>		x	15.45	×	31.49		0.72	x	0.8	=	194.19	(79)
Northwest 0.9x	_	x	22.67	×	11.28	×	0.72	x	0.8	=	102.1	(81)
Northwest 0.9x	_	x	22.67	×	22.97	×	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)

					r						r				_
Northwest 0.9x	•	×	22.	67	×	6	7.96	×		0.72		0.8	=	614.94	(81)
Northwest 0.9x		x	22.	67	×	9	1.35	×		0.72	x	0.8	=	826.6	(81)
Northwest 0.9x	0.77	x	22.	67	×	9	7.38	x		0.72	x	0.8	=	881.25	(81)
Northwest 0.9x	0.77	x	22.	67	×	ç	91.1	×		0.72	x	0.8	=	824.39	(81)
Northwest 0.9x	0.77	x	22.	67	x [	7	2.63	x		0.72	×	0.8	=	657.21	(81)
Northwest 0.9x	0.77	x	22.	67	x [	5	0.42	x		0.72	×	0.8	=	456.26	(81)
Northwest 0.9x	0.77	x	22.	67	x [	2	8.07	x		0.72	_ x [	0.8	=	253.98	(81)
Northwest 0.9x	0.77	x	22.	67	x [	1	4.2	x		0.72	×	0.8	=	128.47	(81)
Northwest 0.9x	0.77	x	22.	67	x [	ç	9.21	x		0.72	x	0.8	=	83.38	(81)
								_							
Solar gains ir	n watts, cal	culated	for eac	h month	l			(83)m	= Su	ım(74)m .	(82)m				
															(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)															(84)
7. Mean internal temperature (heating season)															
7. Mean internal temperature (heating season)         Temperature during heating periods in the living area from Table 9, Th1 (°C)       21 (85)															
Temperature during heating periods in the living area from Table 9, Th1 (°C)21Utilisation factor for gains for living area, h1,m (see Table 9a)															
Jan					T`			Αι	Ja	Sep	Oct	Nov	Dec	1	
														(86)	
Moon intorn		turo in l	iving or	00 T1 /f				L 7 in Tr				1			
Mean intern (87)m= 19.75	<u> </u>	20.38	20.75	20.94	-	w Sie 0.99	21	21	-	20.96	20.65	20.11	19.71	1	(87)
					1						20.00	20.11	10.71		(01)
Temperature	<u> </u>	i			-				-	. ,				7	(00)
(88)m= 19.93	19.93	19.93	19.95	19.95	19	9.96	19.96	19.9	97	19.96	19.95	19.94	19.94		(88)
Utilisation fa	ctor for ga	ins for r	est of d	welling,	h2,	m (se	e Table	9a)			-			_	
(89)m= 1	0.98	0.94	0.81	0.61	(	0.4	0.27	0.3	1	0.58	0.9	0.99	1		(89)
Mean intern	al tempera	ture in t	he rest	of dwell	ing	T2 (fc	ollow ste	ps 3	to 7	in Tabl	e 9c)				
(90)m= 18.27	18.67	19.18	19.68	19.9		9.96	19.96	19.9		19.93	, 19.57	18.81	18.21	7	(90)
	-11									f	iLA = Livi	ng area ÷ (4	4) =	0.11	(91)
Mean intern	al tompora	turo (fo	r tho wh	olo dwo	lling		Λ 🗸 Τ1	. (1	fl /	Λ) <del>ν</del> Τ2					
(92)m= 18.42	<u> </u>	19.3	19.79	20.01	<b>—</b>	) = IL 0.07	20.07	20.0	- T	20.04	19.68	18.95	18.37	7	(92)
Apply adjust												10.00	10.07		(/
(93)m= 18.42		19.3	19.79	20.01	-	0.07	20.07	20.0		20.04	19.68	18.95	18.37	1	(93)
8. Space he		I			<u> </u>	<u> </u>							I		
Set Ti to the			nperatu	re obtair	ned	at ste	ep 11 of	Table	e 9b	. so tha	t Ti.m=	(76)m an	d re-cal	culate	
the utilisatio					.00	aron	ур 11 <b>0</b> 1	rabit	0 0 0	,		(10)111 a11		ounate	
Jan	Feb	Mar	Apr	May	,	Jun	Jul	Αι	Jg	Sep	Oct	Nov	Dec		
Utilisation fa	ctor for ga	ins, hm												-	
(94)m= 0.99	0.98	0.93	0.81	0.61	0	).41	0.27	0.3	2	0.58	0.89	0.98	1		(94)
Useful gains		<u> </u>	<i>,</i> .	<u> </u>										-	
<mark>(95)m=</mark> 1955.4						73.23	1196.79	1260	.82	1994.14	2412.77	2037.16	1793.74	Ļ	(95)
Monthly ave	rage exter	nal tem	perature	e from T	able	e 8						1		-	
(96)m= 4.3	4.9	6.5	8.9	11.7	1	4.6	16.6	16.4	4	14.1	10.6	7.1	4.2		(96)
Heat loss ra					-		- ,	- `	ŕ	. ,	Ē			-	
<mark>(97)m=</mark> 5079.5	2 4986.78	4575.78	3830.82	2911.84	18	86.09	1198.08	1263	5.59	2061.64	3183.46	6 4181.32	5032.79	<u>'</u>	(97)

Spac	e heatin	g require	ement fo	r each n	honth, k	Wh/mon	th = 0.02	24 x [(97)	)m – (95	)m] x (4	1)m			
(98)m=	2324.34	1611.02	1095.33	401.79	90.12	0	0	0	0	573.39	1543.79	2409.85		_
								Tota	l per year	(kWh/year	<sup>.</sup> ) = Sum(9	8)15,912 =	10049.63	(98)
Spac	e heatin	g require	ement in	kWh/m²	/year							[	33.36	(99)
9a. En	ergy rec	luiremer	nts – Ind	ividual h	eating s	ystems i	ncluding	ı micro-C	CHP)					
•	e heatir	•	_	_								r		٦
				econdar		mentary	•						0.1	(201)
	-			nain syst				(202) = 1 -		(222)]			0.9	(202)
			-	main sys				(204) = (2	02) × [1 –	(203)] =			0.9	(204)
	-			ing syste									90.9	(206)
Efficie	ency of s	seconda	ry/suppl	ementar	y heatin	g systen	n, %						65	(208)
-	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Spac	r	g require 1611.02	· · ·	alculate	d above 90.12	)	0	0	0	573.39	1543.79	2409.85		
(0.4.4)						0	0	0	0	573.39	1543.79	2409.85		(5.1.1)
(211)n		)m x (20 1595.07		00 ÷ (20 397.81	89.23	0	0	0	0	567.72	1528.51	2385.99		(211)
	2001.00	1000.07	1004.40	007.01	00.20	0	0	_	l (kWh/yea				9950.13	(211)
Spac	e heatin	a fuel (s	econdar	y), kWh/	month						· 1			], ,
•		)1)]}x1		• •										
(215)m=	357.59	247.85	168.51	61.81	13.86	0	0	0	0	88.21	237.51	370.75		
								Tota	l (kWh/yea	ar) =Sum(2	2 <b>15)</b> <sub>15,1012</sub>	=	1546.1	(215)
	heating	•												
Output	t from w 246.57	ater hea 217.64	ter (calc 229.3	ulated a	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98		
Efficie		ater hea		200.00	200.10	102.00	110.00	102.10	101.00	211.10	220.10	2 10.00	80.8	(216)
(217)m=	<u> </u>	89.44	88.81	86.95	83.45	80.8	80.8	80.8	80.8	87.69	89.34	89.78		(217)
		heating,	kWh/m	onth										
(219)n	<u>1 = (64)</u>	<u>m x 100</u>	) ÷ (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		٦
A	al totals							TULA	I = Sum(2		Mbhioon		2940.92	(219)
		fuel use	ed, main	system	1					ĸ	Wh/year	]	<b>kWh/year</b> 9950.13	1
•	-	fuel use		•								L [	1546.1	1
-	-	fuel use		lidary								l ſ		J
	-											l	2940.92	
		•		electric	•									
mech	anical v	entilatio	n - balar	iced, ext	ract or p	ositive i	nput fror	n outside	Ð			1232.06		(230a)
centra	al heatir	ig pump										30		(230c)
boiler	<sup>r</sup> with a f	an-assis	ted flue									45		(230e)
Total e	electricity	/ for the	above, l	kWh/yea	r			sum	of (230a).	(230g) =		[	1307.06	(231)
Electri	city for li	ghting										Ī	723.12	(232)
												L		_

Total delivered energy for all uses (211)	(221) + (231) + (232)(237b) =	=	16467.33 (338)
10a. Fuel costs - individual heating syste	ms:		
	<b>Fuel</b> kWh/year	Fuel Price (Table 12)	<b>Fuel Cost</b> £/year
Space heating - main system 1	(211) x	3.48 × 0.01 =	346.26 (240)
Space heating - main system 2	(213) x	0 × 0.01 =	0 (241)
Space heating - secondary	(215) x	4.23 × 0.01 =	65.4 (242)
Water heating cost (other fuel)	(219)	3.48 × 0.01 =	102.34 (247)
Pumps, fans and electric keep-hot	(231)	13.19 × 0.01 =	172.4 (249)
(if off-peak tariff, list each of (230a) to (230 Energy for lighting	)g) separately as applicable ar (232)	ad apply fuel price according to $13.19   x   0.01 =$	
Additional standing charges (Table 12)			120 (251)
Appendix Q items: repeat lines (253) and (253) <b>Total energy cost</b> (2	(254) as needed 245)(247) + (250)(254) =		901.79 (255)
11a. SAP rating - individual heating syste	ems		
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)
40- 000 emissions light table the effect			
12a. CO2 emissions – Individual heating	systems including micro-CHP		
12a. CO2 emissions – Individual neating	Energy kWh/year	<b>Emission factor</b> kg CO2/kWh	<b>Emissions</b> kg CO2/year
Space heating (main system 1)	Energy		
	<b>Energy</b> kWh/year	kg CO2/kWh	kg CO2/year
Space heating (main system 1)	Energy kWh/year (211) x	kg CO2/kWh	kg CO2/year
Space heating (main system 1) Space heating (secondary)	Energy kWh/year (211) x (215) x	kg CO2/kWh 0.216 = 0.019 = 0.216 =	kg CO2/year 2149.23 (261) 29.38 (263)
Space heating (main system 1) Space heating (secondary) Water heating	Energy kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (2	kg CO2/kWh 0.216 = 0.019 = 0.216 =	kg CO2/year 2149.23 (261) 29.38 (263) 635.24 (264)
Space heating (main system 1) Space heating (secondary) Water heating Space and water heating	Energy kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (2	kg CO2/kWh 0.216 = 0.019 = 0.216 = 64) =	kg CO2/year 2149.23 (261) 29.38 (263) 635.24 (264) 2813.84 (265)
Space heating (main system 1) Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric kee	Energy kWh/year (211) x (215) x (215) x (219) x (261) + (262) + (263) + (2 ep-hot (231) x	kg CO2/kWh 0.216 = 0.019 = 0.216 = 64) = 0.519 =	kg CO2/year 2149.23 (261) 29.38 (263) 635.24 (264) 2813.84 (265) 678.36 (267)
Space heating (main system 1) Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric kee Electricity for lighting	Energy kWh/year (211) x (215) x (215) x (219) x (261) + (262) + (263) + (2 ep-hot (231) x	kg CO2/kWh = 0.216 = 0.019 = 0.216 = 0.216 = 0.216 = 0.216 = 0.216 = 0.519 =	kg CO2/year 2149.23 (261) 29.38 (263) 635.24 (264) 2813.84 (265) 678.36 (267) 375.3 (268)
Space heating (main system 1) Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric kee Electricity for lighting Total CO2, kg/year	Energy kWh/year (211) x (215) x (215) x (219) x (261) + (262) + (263) + (2 ep-hot (231) x	kg CO2/kWh 0.216 = 0.019 = 0.216 = 0.216 = 0.216 = 0.519 = 0.519 = Sum of (265)(271) =	kg CO2/year 2149.23 (261) 29.38 (263) 635.24 (264) 2813.84 (265) 678.36 (267) 375.3 (268) 3867.51 (272)
Space heating (main system 1) Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric kee Electricity for lighting Total CO2, kg/year <b>CO2 emissions per m<sup>2</sup></b>	Energy kWh/year (211) x (215) x (215) x (219) x (261) + (262) + (263) + (2 ep-hot (231) x	kg CO2/kWh 0.216 = 0.019 = 0.216 = 0.216 = 0.216 = 0.519 = 0.519 = Sum of (265)(271) =	kg CO2/year 2149.23 (261) 29.38 (263) 635.24 (264) 2813.84 (265) 678.36 (267) 375.3 (268) 3867.51 (272) 12.84 (273)
Space heating (main system 1) Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric kee Electricity for lighting Total CO2, kg/year <b>CO2 emissions per m<sup>2</sup></b> El rating (section 14)	Energy kWh/year (211) x (215) x (215) x (219) x (261) + (262) + (263) + (2 ep-hot (231) x	kg CO2/kWh 0.216 = 0.019 = 0.216 = 0.216 = 0.216 = 0.519 = 0.519 = Sum of (265)(271) =	kg CO2/year 2149.23 (261) 29.38 (263) 635.24 (264) 2813.84 (265) 678.36 (267) 375.3 (268) 3867.51 (272) 12.84 (273)
Space heating (main system 1) Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric kee Electricity for lighting Total CO2, kg/year <b>CO2 emissions per m<sup>2</sup></b> El rating (section 14)	Energy kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (2 (231) x (232) x Energy	kg CO2/kWh 0.216 = 0.019 = 0.216 = 64) = 0.519 = sum of (265)(271) = $(272) \div (4) =$ Primary	kg CO2/year 2149.23 (261) 29.38 (263) 635.24 (264) 2813.84 (265) 678.36 (267) 375.3 (268) 3867.51 (272) 12.84 (273) 85 (274) P. Energy
Space heating (main system 1) Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric kee Electricity for lighting Total CO2, kg/year <b>CO2 emissions per m<sup>2</sup></b> El rating (section 14) <b>13a. Primary Energy</b>	Energy kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (2 ep-hot (231) x (232) x Energy kWh/year	kg CO2/kWh 0.216 = 0.019 = 0.216 = 0.216 = 0.519 = sum of (265)(271) = $(272) \div (4) =$ Primary factor	kg CO2/year 2149.23 (261) 29.38 (263) 635.24 (264) 2813.84 (265) 678.36 (267) 375.3 (268) 3867.51 (272) 12.84 (273) 85 (274) P. Energy kWh/year



				User D	Details:						
Assessor Name:	Daniel Wa	tt			Strom	a Num	ber:		STRO	026464	
Software Name:	Stroma FS	SAP 201	2		Softwa	are Vei	rsion:		Versio	n: 1.0.5.59	
			P	roperty	Address	: The Sh	ingles				
Address :	The Shingle	es, Chelv	vey Batch	n, Back	well, BRI	STOL, E	3S48 3B	Z			
1. Overall dwelling dime	ensions:										
				Are	a(m²)		Av. Hei	ight(m)		Volume(m <sup>3</sup> )	-
Ground floor				2	11.32	(1a) x	2.	.75	(2a) =	581.13	(3a)
First floor				8	39.95	(1b) x	2.	.55	(2b) =	229.37	(3b)
Total floor area TFA = (1	a)+(1b)+(1c)+	(1d)+(1e	e)+(1n	) 3	01.27	(4)					
Dwelling volume						(3a)+(3b)	)+(3c)+(3d	)+(3e)+	.(3n) =	810.5	(5)
2. Ventilation rate:	-				-		_				
	main heating		econdar neating	у	other		total			m <sup>3</sup> per hour	
Number of chimneys	0	+	1	] + [	0	=	1	X 4	40 =	40	(6a)
Number of open flues	0	+	0	] + [	0	] = [	0	× 2	20 =	0	(6b)
Number of intermittent fa	ns						0	x ^	10 =	0	(7a)
Number of passive vents						Ē	0	x ^	10 =	0	(7b)
Number of flueless gas fi	res					Γ	0	x 4	40 =	0	(7c)
											-
									Air ch	anges per ho	ur —
Infiltration due to chimne							40		÷ (5) =	0.05	(8)
If a pressurisation test has b Number of storeys in th			ea, proceed	1 to (17),	otherwise	continue in	om (9) to (	16)		0	(9)
Additional infiltration	ie awening (ii	5)						[(9)-	-1]x0.1 =	0	(0)
Structural infiltration: 0	.25 for steel o	r timber i	frame or	0.35 fo	r masoni	ry constr	uction	1(-)		0	(11)
if both types of wall are p										-	
deducting areas of openir If suspended wooden f	• ·		ad) or 0	1 (200)	ad) alca	optor 0					
If no draught lobby, en			eu) or 0.	i (Seale	eu), eise					0	(12) (13)
Percentage of windows			rinned							0	(13)
Window infiltration		augin of	nppeu		0.25 - [0.2	2 x (14) ÷ 1	00] =			0	(15)
Infiltration rate					(8) + (10)	+ (11) + (1	-  2) + (13) +	+ (15) =		0	(16)
Air permeability value,	a50. expresse	ed in cub	oic metre	s per ho	our per s	auare m	etre of e	nvelope	area	3	(17)
If based on air permeabil				•	•	•		•		0.2	(18)
Air permeability value applie	-						is being us	sed	I	_	
Number of sides sheltere	d									2	(19)
Shelter factor					(20) = 1 -	[0.075 x (1	9)] =			0.85	(20)
Infiltration rate incorporat	ing shelter fac	ctor			(21) = (18	) x (20) =				0.17	(21)
Infiltration rate modified f	or monthly wir	nd speed	k				· · · · ·			I	
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	eed from Tab	le 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		

	actor (22	2a)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		
Adjuste	ed infiltra	ition rate	e (allowi	ng for sh	nelter an	d wind s	peed) =	(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		
	ate effec		-	rate for t	he appli	cable ca	se	-						
	echanical aust air he			ondix N (2	2h) - (22	$\rightarrow$ Emy (c	austion (	(5)) otho	nuico (22h	) = (220)			0.5	(23a)
										) = (23a)			0.5	(23b)
	anced with		-	-	-							(00 s)	75.65	(23c)
-	balance			1		i		<u> </u>	<u> </u>	· · ·		1	÷100]	(24a)
(24a)m=		0.33	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32		(24a)
,	balanced			1			r	r , ,	ŕ		, 		l	(24b)
(24b)m=		0	0	0	0	0	0	0	0	0	0	0		(24b)
,	whole ho if (22b)m				•					5 × (23b	)			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
,	natural v if (22b)m				•	•				0.5]		•		
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effec	ctive air o	change	rate - er	nter (24a	) or (24t	o) or (24	c) or (24	d) in boy	(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. He	at losses	and he	at loss p	paramete	er:									
ELEN		Gros		Openin		Net Ar	ea	U-valı	he	AXU		k-value	e A	Xk
					2									11 /
		area	(m²)	m	2	A ,r	n²	W/m2	K.,	(W/I	<)	kJ/m²∙ł	K kJ	/K
Doors		area	(m²)	m	IZ	A ,r 2.64	×	1.3	= [	(W/I 3.432	<)	kJ/m²∙ł	K kJ	/K (26)
	ws Type		(m²)	rr	2		×		= [			kJ/m²-ł	κ kJ	
Window		1	(m²)	ſſ	12	2.64	x x	1.3	0.04] =	3.432		KJ/M²+ł	K kJ	(26)
Windov Windov	ws Type	1 2	(m²)	m	2	2.64 22.67	x x1, x1,	1.3 /[1/( 1.3 )+	0.04] = [ 0.04] = [	3.432 28.01		KJ/M²+ł	κ kJ	(26) (27)
Windov Windov Windov	ws Type ws Type	1 2 3	(m²)	m	2	2.64 22.67 35.5	x x1. x1. x1. x1. x1.	1.3 /[1/( 1.3 )+ /[1/( 1.3 )+	$ \begin{array}{c} 0.04] = \\ 0.04] = \\ 0.04] = \\ \end{array} $	3.432 28.01 43.87		KJ/m²+ł	κ kJ	(26) (27) (27)
Windov Windov Windov	ws Type ws Type ws Type	1 2 3	(m²)	m	2	2.64 22.67 35.5 11.67	x x1. x1. x1. x1. x1. x1. x1.	1.3 /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+	$ \begin{array}{c} 0.04] = \\ 0.04] = \\ 0.04] = \\ \end{array} $	3.432 28.01 43.87 14.42		kJ/m²+ł	< kJ	(26) (27) (27) (27)
Windov Windov Windov Windov	ws Type ws Type ws Type	1 2 3		m 87.93		2.64 22.67 35.5 11.67 15.45	x x1. x1. x1. x1. x1. x1. x1. x2. x	1.3 /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+	$ \begin{bmatrix} 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ $	3.432 28.01 43.87 14.42 19.09		KJ/m²+ŀ	< kJ	(26) (27) (27) (27) (27)
Windov Windov Windov Windov Floor	ws Type ws Type ws Type ws Type	1 2 3 4	92			2.64 22.67 35.5 11.67 15.45 211.3	x x1. x1. x1. x1. x1. x1. x1. x2. x 9. x	1.3 /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15	$\begin{bmatrix} 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0$	3.432 28.01 43.87 14.42 19.09 31.698		kJ/m²+ł		(26) (27) (27) (27) (27) (27) (28)
Windov Windov Windov Windov Floor Walls	ws Type ws Type ws Type ws Type Type1	1 2 3 4 	92	87.9		2.64 22.67 35.5 11.67 15.45 211.3 152.9	x x1. x1. x1. x1. x1. x1. x1. x2. x 9. x	1.3 /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22	$\begin{bmatrix} 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0$	3.432 28.01 43.87 14.42 19.09 31.698 33.66		KJ/m²+ł		(26) (27) (27) (27) (27) (27) (28) (29)
Windov Windov Windov Floor Walls Roof 1 Roof 1	ws Type ws Type ws Type ws Type Type1	1 2 3 4 240.3 83.5 154	92	87.93		2.64 22.67 35.5 11.67 15.45 211.3 152.9 83.52	x x1. x1. x1. x1. x1. x1. x1. x1. x2. x 9. x x 2. x x 2. x x x x 2. x	1.3 /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22 0.14	$\begin{bmatrix} 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0 \\ 0.04 \\ 0 \end{bmatrix}$	3.432 28.01 43.87 14.42 19.09 31.698 33.66 11.69		KJ/m²+ł		(26) (27) (27) (27) (27) (28) (29) (30)
Windov Windov Windov Floor Walls Roof 1 Roof 1 Total a *for window	ws Type ws Type ws Type ws Type Type1 Type2	1 2 3 4 240.3 83.5 154 ements	92 2 , m² pws, use e	87.9 0 0	3   ndow U-va	2.64 22.67 35.5 11.67 15.45 211.3 152.9 83.52 83.52 154 689.7 alue calcul	x x1. x1. x1. x1. x1. x1. x1. x2. x y9. x x x x 6.	$ \begin{array}{c} 1.3 \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ 0.15 \\ 0.22 \\ 0.14 \\ 0.14 \\ 0.14 \end{array} $	$\begin{bmatrix} 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0 \\ 0.04 \\ 0.04 \end{bmatrix}$	3.432 28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56				(26) (27) (27) (27) (27) (28) (29) (30) (30)
Window Window Window Floor Walls Roof T Roof T Total a * for window	ws Type ws Type ws Type ws Type Type1 Type2 urea of el- dows and i	1 2 3 4 240.1 83.5 154 ements roof windo	92 2 , m <sup>2</sup> ows, use e sides of ir	87.93 0 0 effective wi	3   ndow U-va	2.64 22.67 35.5 11.67 15.45 211.3 152.9 83.52 83.52 154 689.7 alue calcul	x x1 x1 x1 x1 x1 x1 x1 x1 x1 x1 x2 x2 x y9 x x2 x x x 6 ated using	$ \begin{array}{c} 1.3 \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ 0.15 \\ 0.22 \\ 0.14 \\ 0.14 \\ 0.14 \end{array} $	$\begin{bmatrix} \\ 0.04 \\ \\ \\ 0.04 \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	3.432 28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56				(26) (27) (27) (27) (27) (28) (29) (30) (30)
Windov Windov Windov Floor Walls Roof 1 Roof 1 Total a * for winu ** includ Fabric	ws Type ws Type ws Type ws Type fype1 fype2 urea of el- dows and i le the areas	1 2 3 4 240.3 83.5 154 ements roof winde s on both s, W/K =	92 2 , m <sup>2</sup> ows, use e sides of ir = S (A x	87.93 0 0 effective wi	3   ndow U-va	2.64 22.67 35.5 11.67 15.45 211.3 152.9 83.52 83.52 154 689.7 alue calcul	x x1 x1 x1 x1 x1 x1 x1 x1 x1 x1 x2 x2 x y9 x x2 x x x 6 ated using	$ \begin{array}{c} 1.3 \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ 0.15 \\ 0.22 \\ 0.14 \\ 0.14 \\ 0.14 \\ 1 \\ 0.14 \\ 0.$	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	3.432 28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56	s given in	paragraph		(26) (27) (27) (27) (28) (29) (30) (30) (31)
Windov Windov Windov Floor Walls Roof 1 Roof 1 Total a * for winu ** includ Fabric Heat ca	ws Type ws Type ws Type ws Type rype1 rype2 area of el- dows and r dows and r le the areas heat loss	1 2 3 4 240.9 83.5 154 ements roof winde s on both s, W/K = Cm = S(	92 2 , m <sup>2</sup> ows, use e sides of ir = S (A x A x k )	87.93 0 0 offective wi aternal walk	3  ndow U-va ds and par	2.64 22.67 35.5 11.67 15.45 211.3 152.9 83.52 83.52 154 689.7 alue calculations	x x1 x1 x1 x1 x1 x1 x1 x1 x1 x2 x y9 x x y9 x x x 6 ated using	$ \begin{array}{c} 1.3 \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ 0.15 \\ 0.22 \\ 0.14 \\ 0.14 \\ 0.14 \\ 1 \\ 0.14 \\ 0.$	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	3.432 28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56	[ ] ]	paragraph	3.2 207.44	(26) (27) (27) (27) (27) (28) (29) (30) (30) (31)
Windov Windov Windov Floor Walls Roof 1 Roof 1 Total a *for wind *for wind *for call Heat ca Therma For desig	ws Type ws Type ws Type ws Type rype1 Type2 urea of el- dows and r de the areas heat loss apacity C	1 2 3 4 240.9 83.5 154 ements roof winde s on both s, W/K = cm = S(paramements wh	92 2 , m <sup>2</sup> bws, use e sides of ir = S (A x A x k ) ter (TMF ere the de	$\begin{bmatrix} 87.93\\ 0 \end{bmatrix}$	3  Indow U-va Is and par - TFA) ir	2.64 22.67 35.5 11.67 15.45 211.3 152.9 83.52 154 689.7 alue calculations	x x1. x1. x1. x1. x1. x1. x1. x2 x y2 x y2 x x x 6 ated using	$ \begin{array}{c} 1.3 \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ 0.15 \\ 0.22 \\ 0.14 \\ 0.14 \\ 0.14 \\ 0.14 \\ (26)(30) \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	3.432 28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56 re)+0.04] a .(30) + (32 tive Value:	)   	paragraph (32e) =	207.44 34562.28	(26) (27) (27) (27) (27) (28) (29) (30) (30) (30) (31) (33) (33) (34)

		00	are not kr	10wn (36) =	= 0.05 x (3	1)				(2.2)			r	<b>-</b>
	abric he									(36) =			269.27	(37)
Ventila	ation hea	r	alculated	d monthly	Í					= 0.33 × (	25)m x (5) I		1	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(00)
(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 t	ransfer (	coefficie	nt, W/K		i		i		(39)m	= (37) + (3	38)m	i	1	
(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		_
Heat le	oss para	ameter (I	HLP), W	/m²K				-		Average = = (39)m ÷		12 /12=	351.4	(39)
(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		_
Numb	er of day	ys in mo	nth (Tab	le 1a)			-	-	,	Average =	Sum(40)1.	12 /12=	1.17	(40)
	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. Wa	ater hea	ting ene	rgy requ	irement:								kWh/ye	ear:	
if TF		-		: [1 - exp	(-0.0003	849 x (TF	<sup>-</sup> A -13.9	)2)] + 0.(	0013 x ( <sup>-</sup>	TFA -13.		13	]	(42)
								(25 x N)				8.62		(43)
		-		usage by : r day (all w		-	-	to achieve	a water us	se target o	t			
normor				1					0		NL.	Du	1	
Hot wat	Jan er usage i	Feb	Mar	Apr ach month	May	Jun	Jul Table 1c x	Aug	Sep	Oct	Nov	Dec		
	119.48	115.14	110.79	106.45	102.11	97.76	97.76	102.11	106.45	110.79	115.14	119.48	1	
(44)m=	119.40	115.14	110.79	106.45	102.11	97.70	97.70	102.11		Total = Su			1303.47	(44)
Energy	content of	f hot water	used - cai	culated mo	onthly $= 4$ .	190 x Vd,r	m x nm x D	0Tm / 3600					1303.47	
(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		_
lf instan	taneous v	vater heati	ing at point	t of use (no	hot water	storage),	enter 0 in	boxes (46		Total = Su	m(45) <sub>112</sub> =	=	1709.06	(45)
(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)
	storage												1	
-		. ,					-	within sa	ame ves	sel		400		(47)
Other Water	vise if ne storage	o stored loss:	hot wate	·	icludes i	nstantar	neous co	(47) ombi boil	ers) ente	er '0' in (	47)			
				oss facto	or is kno	wn (kWł	n/day):					0		(48)
Tempe	erature f	actor fro	m Table	2b								0		(49)
b) If n	nanufac	turer's d	eclared o	e, kWh/ye cylinder l	oss fact		known:	(48) x (49)	) =		4	00	]	(50)
		-	factor fi see secti	rom Tabl on 4.3	e 2 (kW	h/litre/da	iy)				0.	.01		(51)
		from Ta									0.	67		(52)
Tempe	erature f	actor fro	m Table	2b							0.	54		(53)
-			-	e, kWh/ye	ear			(47) x (51)	x (52) x (	53) =	1.	49		(54)
Enter	(50) or	(54) in ( <del></del>	55)								1.	49		(55)

Water	storage	loss cal	culated	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 cylind	er contain	s dedicate	d solar sto	orage, (57)	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	ix 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)
Primar	y circuit	loss (ar	nual) fro	om Table	e 3							0		(58)
	•	•		for each		59)m = (	58) ÷ 36	5 × (41)	m				I	
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	olar wat	er heatir	ng and a	cylinde	r thermo	stat)			
(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	i loss ca	lculated	for each	month	(61)m =	(60) ÷ 36	65 × (41)	m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat req	uired for	water h	eating ca	alculated	for eacl	n 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 DI	HW input	calculated	using App	endix G o	Appendix	H (negativ	ve quantity	v) (enter '0'	' if no sola	r contribut	ion to wate	er heating)	'	
(add a	dditiona	l lines if	FGHRS	and/or \	WWHRS	applies	see Ap	pendix G	G)		-			
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	t from w	ater hea	ter											
(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		_
								Outp	out from w	ater heate	r (annual)₁	12	2525.96	(64)
Heat g	ains fro	m water	heating	, kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 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)
inclu	ude (57)	m in calo	culation	of (65)m	only if c	ylinder is	s in the c	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. In	ternal ga	ains (see	e Table 5	5 and 5a	):									
Metab	olic gain	s (Table	5), Wat	tts	-					-	-			
	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)
Lightin	ng gains	(calcula	ted in Ap	opendix	L, equat	ion L9 oi			130.00					(00)
(67)m=	40.95	36.37	29.58				<sup>-</sup> L9a), a	lso see						(00)
Applia			29.00	22.39	16.74	14.13	,	lso see 19.85		33.82	39.48	42.08		(67)
(68)m=	nces ga	ins (calc		22.39 Append	16.74	14.13	15.27	19.85	Table 5 26.64		39.48	42.08		
	nces ga 459.29	ins (calc 464.06		1	16.74	14.13	15.27	19.85	Table 5 26.64		39.48 408.69	42.08 439.03		
	459.29	464.06	ulated ir 452.05	n Append	16.74 dix L, eq 394.2	14.13 uation L <sup>-</sup> 363.87	15.27 13 or L1 343.6	19.85 3a), also 338.84	Table 5 26.64 see Ta 350.85	ble 5 376.42	I			(67)
	459.29	464.06	ulated ir 452.05	Append 426.48	16.74 dix L, eq 394.2	14.13 uation L <sup>-</sup> 363.87	15.27 13 or L1 343.6	19.85 3a), also 338.84	Table 5 26.64 see Ta 350.85	ble 5 376.42	I			(67)
Cookir (69)m=	459.29 ng gains 38.67	464.06 (calcula	ulated ir 452.05 ted in A 38.67	Append 426.48 ppendix 38.67	16.74 dix L, eq 394.2 L, equat	14.13 uation L <sup>-</sup> 363.87 ion L15	15.27 13 or L1 343.6 or L15a)	19.85 3a), also 338.84 , also se	Table 5 26.64 see Ta 350.85 ee Table	ble 5 376.42 5	408.69	439.03		(67)
Cookir (69)m=	459.29 ng gains 38.67	464.06 (calcula 38.67	ulated ir 452.05 ted in A 38.67	Append 426.48 ppendix 38.67	16.74 dix L, eq 394.2 L, equat	14.13 uation L <sup>-</sup> 363.87 ion L15	15.27 13 or L1 343.6 or L15a)	19.85 3a), also 338.84 , also se	Table 5 26.64 see Ta 350.85 ee Table	ble 5 376.42 5	408.69	439.03	   	(67)
Cookir (69)m= Pumps (70)m=	459.29 ng gains 38.67 s and fai 3	464.06 (calcula 38.67 ns gains 3	ulated ir 452.05 ted in A 38.67 (Table s 3	Append 426.48 ppendix 38.67 5a)	16.74 dix L, eq 394.2 L, equat 38.67	14.13 uation L 363.87 ion L15 38.67 3	15.27 13 or L1 343.6 or L15a) 38.67	19.85 3a), also 338.84 , also se 38.67	Table 5 26.64 see Ta 350.85 ee Table 38.67	ble 5 376.42 5 38.67	408.69 38.67	439.03 38.67		(67) (68) (69)
Cookir (69)m= Pumps (70)m=	459.29 ng gains 38.67 s and fai 3 s e.g. ev	464.06 (calcula 38.67 ns gains 3 vaporatic	ulated ir 452.05 ted in A 38.67 (Table s 3	Appendix 426.48 ppendix 38.67 5a) 3	16.74 dix L, eq 394.2 L, equat 38.67 3 es) (Tab	14.13 uation L 363.87 ion L15 38.67 3	15.27 13 or L1 343.6 or L15a) 38.67	19.85 3a), also 338.84 , also se 38.67	Table 5 26.64 see Ta 350.85 ee Table 38.67	ble 5 376.42 5 38.67	408.69 38.67	439.03 38.67	   	(67) (68) (69)
Cookir (69)m= Pumps (70)m= Losses (71)m=	459.29 ng gains 38.67 s and fai 3 s e.g. ev -125.34	464.06 (calcula 38.67 ns gains 3 vaporatic	ulated ir 452.05 ited in A 38.67 (Table 9 3 on (nega -125.34	Appendix 426.48 ppendix 38.67 5a) 3 tive valu	16.74 dix L, eq 394.2 L, equat 38.67 3 es) (Tab	14.13 uation L 363.87 ion L15 38.67 3 le 5)	15.27 13 or L1 343.6 or L15a) 38.67 3	19.85 3a), also 338.84 , also se 38.67 3	Table 5 26.64 see Ta 350.85 ee Table 38.67 3	ble 5 376.42 5 38.67 3	408.69 38.67 3	439.03 38.67 3		(67) (68) (69) (70)
Cookir (69)m= Pumps (70)m= Losses (71)m=	459.29 ng gains 38.67 s and fai 3 s e.g. ev -125.34	464.06 (calcula 38.67 ns gains 3 vaporatic -125.34	ulated ir 452.05 ited in A 38.67 (Table 9 3 on (nega -125.34	Appendix 426.48 ppendix 38.67 5a) 3 tive valu	16.74 dix L, eq 394.2 L, equat 38.67 3 es) (Tab	14.13 uation L 363.87 ion L15 38.67 3 le 5)	15.27 13 or L1 343.6 or L15a) 38.67 3	19.85 3a), also 338.84 , also se 38.67 3	Table 5 26.64 see Ta 350.85 ee Table 38.67 3	ble 5 376.42 5 38.67 3	408.69 38.67 3	439.03 38.67 3	]     	(67) (68) (69) (70)
Cookir (69)m= Pumps (70)m= Losses (71)m= Water (72)m=	459.29 ng gains 38.67 s and fai 3 s e.g. ev -125.34 heating 153.79	464.06 (calcula 38.67 ns gains 3 vaporatic -125.34 gains (T	ulated ir 452.05 ited in A 38.67 (Table 5 an (nega -125.34 Table 5) 146.07	Appendix 426.48 ppendix 38.67 5a) 3 tive valu -125.34	16.74 dix L, eq 394.2 L, equat 38.67 3 es) (Tab -125.34	14.13 uation L 363.87 ion L15 38.67 3 le 5) -125.34 127.91	15.27 13 or L1 343.6 or L15a) 38.67 3 -125.34	19.85 3a), also 338.84 , also se 38.67 3 -125.34 129.46	Table 5 26.64 see Ta 350.85 ee Table 38.67 3 -125.34	ble 5 376.42 5 38.67 3 -125.34 139.3	408.69 38.67 3 -125.34	439.03 38.67 3 -125.34 151.29		(67) (68) (69) (70) (71)
Cookir (69)m= Pumps (70)m= Losses (71)m= Water (72)m=	459.29 ng gains 38.67 s and fai 3 s e.g. ev -125.34 heating 153.79	464.06 (calcula 38.67 ns gains 3 /aporatic -125.34 gains (T 151.28	ulated ir 452.05 ited in A 38.67 (Table 5 an (nega -125.34 Table 5) 146.07	Appendix 426.48 ppendix 38.67 5a) 3 tive valu -125.34	16.74 dix L, eq 394.2 L, equat 38.67 3 es) (Tab -125.34	14.13 uation L 363.87 ion L15 38.67 3 le 5) -125.34 127.91	15.27 13 or L1 343.6 or L15a) 38.67 3 -125.34	19.85 3a), also 338.84 , also se 38.67 3 -125.34 129.46	Table 5 26.64 see Ta 350.85 ee Table 38.67 3 -125.34	ble 5 376.42 5 38.67 3 -125.34 139.3	408.69 38.67 3 -125.34 147.58	439.03 38.67 3 -125.34 151.29		(67) (68) (69) (70) (71)

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

Orientation:	Access Factor Table 6d	-	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	11.67	x	11.28	×	0.72	×	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)
Southwest0.9x	0.77	x	15.45	x	36.79	]	0.72	x	0.8	] =	226.91	(79)
Southwest0.9x	0.77	x	15.45	x	62.67	]	0.72	x	0.8	=	386.52	(79)
Southwest0.9x	0.77	x	15.45	x	85.75	]	0.72	x	0.8	] =	528.85	(79)
Southwest0.9x	0.77	x	15.45	x	106.25	]	0.72	x	0.8	=	655.27	(79)
Southwest0.9x	0.77	x	15.45	x	119.01	]	0.72	x	0.8	=	733.96	(79)
Southwest0.9x	0.77	x	15.45	x	118.15	]	0.72	x	0.8	=	728.65	(79)
Southwest0.9x	0.77	x	15.45	x	113.91	]	0.72	x	0.8	=	702.49	(79)
Southwest0.9x	0.77	x	15.45	x	104.39	]	0.72	x	0.8	=	643.79	(79)
Southwest0.9x	0.77	x	15.45	x	92.85	]	0.72	x	0.8	=	572.63	(79)
Southwest0.9x	0.77	x	15.45	x	69.27	]	0.72	x	0.8	=	427.18	(79)
Southwest0.9x	0.77	x	15.45	x	44.07	]	0.72	x	0.8	] =	271.79	(79)
Southwest0.9x	0.77	x	15.45	×	31.49	]	0.72	×	0.8	] =	194.19	(79)
Northwest 0.9x	0.77	x	22.67	×	11.28	×	0.72	x	0.8	] =	102.1	(81)
Northwest 0.9x	0.77	x	22.67	×	22.97	×	0.72	×	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	×	22.	67	×	67.96	×	0.72	×	0.8	=	614.94	(81)	
Northwest 0.9x	0.77	×	22.	67	×	91.35	×	0.72	×	0.8	=	826.6	(81)	
Northwest 0.9x	0.77	x	22.	67	x	97.38	×	0.72	×	0.8	=	881.25	(81)	
Northwest 0.9x	0.77	×	22.	67	x	91.1	×	0.72	×	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	×	0.72	x	0.8	=	456.26	(81)	
Northwest 0.9x	0.77	x	22.	67	x	28.07	×	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, ca	alculated	for eac	h month			(83)m	n = Sum(74)m	(82)m					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $														
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)														
7. Mean internal temperature (heating season)         Temperature during heating periods in the living area from Table 9, Th1 (°C)         21         (85)														
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	r`	in Jul	A	ug Sep	Oct	Nov	Dec			
(86)m= 1	0.99	0.97	0.88	0.7	0.	_	0.4		0.95	1	1		(86)	
Moon intern		l oturo in	l living or	I			 7 in T			1				
Mean interna (87)m= 19.65	· · ·	20.3	20.7	20.92	20.		2		20.58	20.02	19.61		(87)	
									20.00	20.02	13.01		(01)	
Temperature	1	i <u> </u>	i	î	1	<u> </u>	-				1	I	(22)	
(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 fa	ctor for g	ains for	rest of d	welling,	h2,m	(see Table	e 9a)		-		-			
(89)m= 1	0.99	0.96	0.85	0.64	0.4	3 0.28	0.3	33 0.62	0.93	0.99	1		(89)	
Mean interna	al temper	ature in	the rest	of dwell	ina T	2 (follow st	eps 3	to 7 in Tab	ole 9c)					
(90)m= 18.12		19.06	19.62	19.88	19.	<u> </u>	19.		19.48	18.68	18.07		(90)	
	1		1			I	1	I	fLA = Livi	ng area ÷ (4	4) =	0.11	(91)	
		atura /fa		مام ماریم	11:m m)	41 A T4	. /4	4L A \ TO	, ,					
Mean interna (92)m= 18.28	18.67	19.2	19.74	19.99	20.	- T	+ (1	<u>_</u>	19.6	18.82	18.23		(92)	
. ,										10.02	10.23		(32)	
Apply adjust	18.67	19.2	19.74	19.99	20.		20.		19.6	18.82	18.23	l	(93)	
8. Space he				19.99	20.	20.07	20.	20.03	19.0	10.02	10.23		(00)	
Set Ti to the				ro obtair	od a	t stop 11 of	f Tabl	o Ob so th	at Ti m-	(76)m an	d re-calc	sulato		
the utilisation					ieu a			e 90, 30 in	at 11,111–	(70)11 an	u ie-caic	Julate		
Jan	Feb	Mar	Apr	May	Ju	ın Jul	A	ug Sep	Oct	Nov	Dec			
Utilisation fa	ctor for g	u ains, hm	· · ·		!			•						
(94)m= 1	0.99	0.95	0.84	0.64	0.4	3 0.29	0.3	.62	0.92	0.99	1		(94)	
Useful gains	, hmGm	, W = (94	4)m x (8-	4)m		I			<u> </u>	<b>I</b>				
(95)m= 1625.46	6 2283.6	2862.79	3148.07	2757.67	1869	9.16 1196.34	1259	9.72 1967.95	2227.9	1744.87	1469.55		(95)	
Monthly ave	rage exte	ernal terr	iperature	e from Ta	able	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 rat	te for mea	an interr	al temp	erature,	Lm ,	W =[(39)m	x [(9	3)m– (96)m	]					
(97)m= 5027.19	9 4937.77	4536.92	3811.79	2907.22	1885	5.54 1198.02	1263	3.45 2058.04	3154.35	4135.27	4981.99		(97)	
		-				-	-					•		

Spac	e heatin	g require	ement fo	r each n	nonth, k	Nh/mon	th = 0.02	24 x [(97)	)m – (95	)m] x (4	1)m			
(98)m=	2530.88	1783.6	1245.56	477.88	111.27	0	0	0	0	689.28	1721.09	2613.26		_
								Tota	l per year	(kWh/yeai	r) = Sum(9	8)15,912 =	11172.81	(98)
Spac	e heatin	g require	ement in	kWh/m²	²/year							[	37.09	(99)
9a. En	ergy rec	luiremer	nts – Ind	ividual h	eating s	ystems i	ncluding	micro-C	CHP)					
•	e heatir	-			la ser la							г		
				econdar		mentary			(201) -				0.1	(201)
				nain syst	. ,			(202) = 1 - (204) = (20)		(203)1 -		ľ	0.9	(202)
			-	main sys				(204) - (2	02) ~ [1	(200)] –		l	0.9	(204)
	-			ing syste		a cyctor	0/					l	90.9	(206)
EIIICI			· · ·	ementar	- 		i						65	(208)
Snac	Jan o boatin	Feb	Mar	Apr alculate	May d above	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
Spac	2530.88		1245.56	477.88	111.27	0	0	0	0	689.28	1721.09	2613.26		
(211)n	L	)m x (20	L  4)] } x 1	00 ÷ (20	L )6)									(211)
(211)		1765.94		473.15	110.16	0	0	0	0	682.46	1704.05	2587.38		()
								Tota	l (kWh/yea	ar) =Sum(2	211) <sub>15,1012</sub>	=	11062.19	(211)
Spac	e heatin	g fuel (s	econdar	y), kWh/	month							L		
= {[(98	)m x (20	)1)]}x1	00 ÷ (20	8)										
(215)m=	389.37	274.4	191.62	73.52	17.12	0	0	0	0	106.04	264.78	402.04		_
								Tota	l (kWh/yea	ar) =Sum(2	215) <sub>15,1012</sub>	=	1718.89	(215)
	heating		tor (aala	ulated a	hava)									
Output	246.57	217.64	229.3	ulated a 206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98		
Efficie	ncy of w	ater hea	iter										80.8	(216)
(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)
	or water													
	n = (64) 274.57	m x 100 243	) ÷ (217) 257.61	m 236.46	242.21	225.97	218.26	237.79	236.83	243.14	251.64	268.19		
(213)11-	214.51	243	257.01	230.40	242.21	225.51	210.20		l = Sum(2		231.04	200.13	2935.66	(219)
Δnnua	al totals								,		Wh/year	. L	kWh/year	
		fuel use	ed, main	system	1					K	, year	[	11062.19	7
Space	heating	fuel use	ed, seco	ndary								[	1718.89	i
Water	heating	fuel use	d	-								L [	2935.66	1
	-			electric	keep-ho	t						L		
		•			•		nout fror	n outside	ż			1232.06		(230a)
	al heatin						ip at nor		-			30		(230c)
	with a f	••••										45		(230c) (230e)
				kWh/yea	r			sum	of (230a)	(230g) =		L 40	1207.06	(2306)
	-		abuve, I	хүүн/уеа	I			Sull	Si (2000).	(2009) –		L r	1307.06	4
⊏iectri	city for li	gnting										l	723.12	(232)

Total delivered energy for all uses (211)(221) + (2	231) + (232)(237b) =		17746.93 (338)
12a. CO2 emissions – Individual heating systems	including micro-CHP		
	<b>Energy</b> kWh/year	Emission factor kg CO2/kWh	<b>Emissions</b> 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	su	m of (265)(271) =	4109.86 (272)
Dwelling CO2 Emission Rate	(2	72) ÷ (4) =	13.64 (273)
El rating (section 14)			84 (274)

				User I	Details:						
Assessor Name:	Daniel Wa	att			Strom	a Num	ber:		STRO	026464	
Software Name:	Stroma FS	SAP 201	2		Softwa	are Vei	rsion:		Versic	on: 1.0.5.59	
			P	roperty	Address	: The Sh	ingles				
Address :	The Shingl	es, Chelv	vey Batcl	n, Back	well, BRI	STOL, E	3S48 3B	Z			
1. Overall dwelling dime	ensions:										
				Are	ea(m²)		Av. Hei	ight(m)	-	Volume(m <sup>3</sup> )	_
Ground floor				2	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 = (1	a)+(1b)+(1c)+	-(1d)+(1e	e)+(1n	)	301.27	(4)					
Dwelling volume						(3a)+(3b	)+(3c)+(3d	)+(3e)+	.(3n) =	810.5	(5)
2. Ventilation rate:											
	main heating		econdar neating	у	other		total			m <sup>3</sup> per hou	•
Number of chimneys	0	+	1	+	0	] = [	0	X 4	40 =	0	(6a)
Number of open flues	0	_ + [	0	<u> </u> + [	0		0	x 2	20 =	0	(6b)
Number of intermittent fa	ans					Ī	4	x ′	10 =	40	(7a)
Number of passive vents	6					Γ	0	x ^	10 =	0	(7b)
Number of flueless gas f	ires					Г	0	x 4	40 =	0	(7c)
						L					
									Air ch	anges per ho	ur
Infiltration due to chimne	ys, flues and	fans = ( <mark>6</mark>	a)+(6b)+(7	a)+(7b)+	(7c) =	Г	40	·	÷ (5) =	0.05	(8)
If a pressurisation test has l			ed, proceed	d to (17),	otherwise	continue fr	rom (9) to (	(16)			_
Number of storeys in t	he dwelling (n	s)								0	(9)
Additional infiltration				0.05 (				[(9)-	-1]x0.1 =	0	(10)
Structural infiltration: C							UCTION			0	(11)
deducting areas of openi			sponding to	uie grea	iter wan are	a (allel					
If suspended wooden	floor, enter 0.2	2 (unseal	led) or 0.	1 (seal	ed), else	enter 0				0	(12)
If no draught lobby, er	ter 0.05, else	enter 0								0	(13)
Percentage of window	s and doors d	raught st	tripped							0	(14)
Window infiltration					0.25 - [0.2	2 x (14) ÷ 1	= [00			0	(15)
Infiltration rate					(8) + (10)	+ (11) + (1	12) + (13) +	+ (15) =		0	(16)
Air permeability value,				•		•	etre of e	nvelope	area	5	(17)
If based on air permeabi										0.3	(18)
Air permeability value applie		ion test has	s been don	e or a de	egree air pe	rmeability	is being us	sed			
Number of sides sheltere Shelter factor	ea				(20) = 1 -	[0.075 x (1	9)] =			2	(19) (20)
Infiltration rate incorpora	ting shelter fa	ctor			(21) = (18	· ·	- / 1			0.85	
Infiltration rate modified	-		4		( ) (.0	,/				0.25	(21)
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp		1 -			19					l	
(22)m= 5.1 5	4.9 4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	]	
		1 7.0	0.0	0.0	J <sup>3.7</sup>			4.0	7.1	l	

Wind F	actor (2	2a)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			
Adjuste	ed infiltra	ation rat	e (allow	ing for sl	nelter an	id wind s	peed) =	(21a) x	(22a)m						
<b>.</b>	0.32	0.32	0.31	0.28	0.27	0.24	0.24	0.24	0.25	0.27	0.29	0.3			
	ate effec echanica		-	rate for t	he appli	cable ca	se								
				endix N, (2	3h) - (23g		auation (N	N5)) other	nwieg (23h	) - (23a)			(		(23a)
			• • • •	ciency in %	, ,	, ,				) – (200)			(		(23b)
			•		•				,	⊃h.\	00k) [	4 (00 a)	(	)	(23c)
,	i							HR) (248	$\frac{a}{b} = \frac{2}{c}$	20)m + ( 0	$230) \times [$	1 – (23c) 0	÷ 100] ]		(24a)
(24a)m=	_		-						-		-	0			(244)
				entilation		1	<u> </u>	r Ó	ŕ	r í	<u>,                                     </u>		1		(24b)
(24b)m=		0	0	0	0	0	0	0	0	0	0	0			(24b)
,				ntilation of the	•	•				E (22h					
ا =(24c)m	r`´	0 0.5 ×	0		(231) = (231)			$\frac{c}{c} = (22t)$		0	0	0	1		(24c)
	÷	-	-	Ţ	-		-		-	0	0	0			(240)
,				ole hous )m = (221						0.51					
(24d)m=		0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54			(24d)
		change	rate - er	nter (24a	) or (24t	) or (24	L c) or (24	d) in boy	(25)				I		
(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	1		(25)
						1	1	I	I				1		
		s and he											_	A \/	
3. He ELEN		Gros	s	Openin Openin rr	gs	Net Ar A ,r		U-valı W/m2		A X U (W/I		k-value kJ/m²·I		A X kJ/k	
			s	Openin	gs	Net Ar A ,r 2.64	m²			A X U (W/					
ELEN Doors		Gros area	s	Openin	gs	A ,r	m <sup>2</sup>	W/m2	:K	(W/					K
ELEN Doors Windo	IENT	Gros area	s	Openin	gs	A ,r 2.64	m <sup>2</sup> x 2 x <sup>1</sup>	W/m2	K 0.04] =	(W/ 2.64					(26)
ELEN Doors Windo Windo	<b>IENT</b> ws Type	Gros area	s	Openin	gs	A ,r 2.64 19.32	m <sup>2</sup> x 2 x <sup>1</sup> / <sub>5</sub> x <sup>1</sup> / <sub>7</sub>	W/m2 1 /[1/( 1.4 )+	K 0.04] = 0.04] =	(W/ 2.64 25.61					(26) (27)
ELEN Doors Windov Windov Windov	<b>IENT</b> ws Type ws Type	Gros area 1 2 3	s	Openin	gs	A ,r 2.64 19.32 30.25	n <sup>2</sup> x 2 x <sup>1</sup> 5 x <sup>1</sup> x <sup>1</sup>	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+	K 0.04] = 0.04] = 0.04] =	(W/ 2.64 25.61 40.1	к)				<(26) (27) (27)
ELEN Doors Windov Windov Windov	<b>IENT</b> ws Type ws Type ws Type	Gros area 1 2 3	s	Openin	gs	A ,r 2.64 19.32 30.25 9.94	n <sup>2</sup> x 2 x <sup>1</sup> . 5 x <sup>1</sup> . 7 x <sup>1</sup> .	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+	K 0.04] = 0.04] = 0.04] =	(W/) 2.64 25.61 40.1 13.18	к)				<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> </ul>
ELEN Doors Windo Windo Windo Floor	<b>IENT</b> ws Type ws Type ws Type	Gros area 1 2 3	ss (m²)	Openin	gs 2	A ,r 2.64 19.32 30.25 9.94 13.17	n <sup>2</sup> x 2 x <sup>1</sup> / <sub>5</sub> x <sup>1</sup> / <sub>7</sub> x <sup>1</sup> / <sub>7</sub> x <sup>1</sup> / <sub>7</sub> 2 x	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+	K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	(W// 2.64 25.61 40.1 13.18 17.46	к)				<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> </ul>
ELEN Doors Windo Windo Windo Floor Walls	<b>IENT</b> ws Type ws Type ws Type ws Type	Gros area 1 2 3 4	92	Openin m	gs 2	A ,r 2.64 19.32 30.25 9.94 13.17 211.3	n <sup>2</sup> x x <sup>1</sup> . 5 x <sup>1</sup> . 5 x <sup>1</sup> . 7 x <sup>1</sup> . 2 x 5 x	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ 0.13	K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	(W// 2.64 25.61 40.1 13.18 17.46 27.4710	к)				<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> </ul>
ELEN Doors Windov Windov Windov	MENT ws Type ws Type ws Type ws Type Type1	Gros area 1 2 3 4 240.9	92 92	Openin m	gs 2	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6	n <sup>2</sup> x x <sup>1</sup> . 5 x <sup>1</sup> . 5 x <sup>1</sup> . 7 x <sup>1</sup> . 2 x 5 x	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ 0.13 0.18	K 0.04] =   0.04] =   0.04] =   0.04] =   0.04] =   =	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81	к)				<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> </ul>
ELEN Doors Windov Windov Floor Walls Roof	MENT ws Type ws Type ws Type ws Type Type1	Gros area 1 2 3 4 240.1 83.5 154	92 12	Openin m 75.3	gs 2	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6 83.52	n <sup>2</sup> x x <sup>1</sup> . 2 x <sup>1</sup> . 5 x <sup>1</sup> . 7 x <sup>1</sup> . 2 x 3 x 2 x 2 x 2 x 2 x	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ 0.13 0.18 0.13	K 0.04] =   0.04] =   0.04] =   0.04] =   =   =   =	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81 10.86	к)				<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> <li>(30)</li> </ul>
ELEN Doors Windo Windo Windo Windo Rindo Floor Walls Roof Roof Total a * for win	MENT ws Type ws Type ws Type ws Type fype1 fype2 area of e dows and	Gros area 1 2 3 4 240.1 83.5 154 Iements roof winder	92 92 12 1 1 1 1 1 1 1 1 1 1 1 1 1	Openin m 75.3 0 0	gs <sup>2</sup>  ndow U-va	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6 83.52 154 689.7 alue calcul	n <sup>2</sup> x x <sup>1</sup> . 2 x <sup>1</sup> . 5 x <sup>1</sup> . 7 x <sup>1</sup> . 2 x 5 x 2 x 6 x	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ 0.13 0.13 0.13	K 0.04] = 0.04] = 0.04] = 0.04] = = = = = =	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81 10.86 20.02	K)				<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> <li>(30)</li> <li>(30)</li> </ul>
ELEN Doors Windov Windov Windov Floor Walls Roof T Roof T Total a * for win ** includ	MENT ws Type ws Type ws Type ws Type fype1 fype2 area of e dows and	Gros area 1 2 3 4 240.9 83.5 154 lements roof windo is on both	92 92 12 14 15 15 15 15 15 15 15 15 15 15	Openin m 75.3 0 0 effective wi internal wal	gs <sup>2</sup>  ndow U-va	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6 83.52 154 689.7 alue calcul	m <sup>2</sup> x x1 2 x1 5 x1 7 x1 2 x 2 x 2 x 2 x 4 x 2 x 2 x 2 x 4 x 2 x 2 x 2 x 4 x 2 x 2 x 2 x 4 x 4 x 4 x 4 x 4 x 4 x 4 x 4	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ 0.13 0.13 0.13	K 0.04] =   0.04] =   0.04] =   0.04] =   1 =	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81 10.86 20.02	K)	kJ/m²-I	K	kJ/ł	<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> <li>(30)</li> <li>(30)</li> <li>(31)</li> </ul>
ELEN Doors Windov Windov Windov Floor Walls Roof Roof Total a * for win ** includ Fabric	MENT ws Type ws Type ws Type ws Type ws Type fype1 fype2 urea of e dows and le the area heat los	Gros area 1 2 3 4 240.1 83.5 154 lements roof winde s on both s, W/K =	92 92 92 92 92 92 92 92 92 93 92 93 92 93 92 93 92 93 92 94 93 92 94 93 92 94 94 95 92 95 92 95 92 95 92 95 92 95 92 95 92 95 92 95 92 95 92 95 95 95 95 95 95 95 95 95 95 95 95 95	Openin m 75.3 0 0 effective wi internal wal	gs <sup>2</sup>  ndow U-va	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6 83.52 154 689.7 alue calcul	m <sup>2</sup> x x1 2 x1 5 x1 7 x1 2 x 2 x 2 x 2 x 4 x 2 x 2 x 2 x 4 x 2 x 2 x 2 x 4 x 2 x 2 x 2 x 4 x 4 x 4 x 4 x 4 x 4 x 4 x 4	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ [ 0.13 0.13 0.13 0.13 1 formula 1	$\begin{array}{c} K \\ \hline \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ \hline \\ 0.04 \end{bmatrix} = \\ = \\ \hline \\ = \\ \\ (1/U-value) + (32) = \\ \end{array}$	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81 10.86 20.02	K)	kJ/m²-I	K	kJ/ł	<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> <li>(30)</li> <li>(30)</li> <li>(31)</li> </ul>
ELEN Doors Windov Windov Windov Floor Floor Walls Roof Roof Total a * for win ** includ Fabric Heat c	MENT ws Type ws Type ws Type ws Type ws Type fype1 fype2 urea of e dows and le the area heat los apacity (	Gross area 1 2 3 4 240.9 83.5 154 lements roof winders on both s, W/K = Cm = S(	92 92 92 , m <sup>2</sup> ows, use e sides of in = S (A x A x k )	Openin m 75.3 0 0 effective wi internal wal U)	gs <sup>2</sup> ndow U-va Is and par	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6 83.52 154 689.7 alue calcul titions	m <sup>2</sup> x x1 2 x1 5 x1 7 x1 2 x 2 x 5 x 2 x 6 s ated using	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ [ 0.13 0.13 0.13 0.13 1 formula 1	$\begin{array}{c} K \\ \hline \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ = \\ \hline \\ = \\ \\ (1/U-value) + (32) = \\ ((28). \end{array}$	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81 10.86 20.02 re)+0.04] a	K)	kJ/m²-I	K	kJ/ł	<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> <li>(30)</li> <li>(30)</li> <li>(31)</li> <li>(33)</li> <li>(34)</li> </ul>
ELEN Doors Windov Windov Windov Floor Walls Roof T Roof T Total a * for win ** includ Fabric Heat c Therm For desi	MENT ws Type ws Type ws Type ws Type ws Type Type Type urea of e dows and le the area heat los apacity al mass	Gross area 1 2 3 4 240.9 83.5 154 lements roof winde is on both s, W/K = Cm = S( parame ments wh	92 92 92 92 92 92 92 92 92 92	Openin T T T T T T T T	gs 2 2 ndow U-va Is and par - TFA) ir	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6 83.52 154 689.7 alue calcul titions	n <sup>2</sup> x x x x x x x x x x 6 x x x x x x x x	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ [ 0.13 0.13 0.13 0.13 1, (26)(30)	K = 0.04] =	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81 10.86 20.02 re)+0.04] a re)+0.04] a	K) 6 () as given in 2) + (32a). : Medium	kJ/m²-I	K	kJ/ł	<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> <li>(30)</li> <li>(30)</li> <li>(31)</li> </ul>

			are not kn	own (36) =	= 0.05 x (3	1)								
Total f	abric he	at loss							(33) +	(36) =			237.74	(37)
Ventila	ation hea	at loss ca	alculated	monthl	y				(38)m	= 0.33 × (	25)m x (5)		L	
	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 t	ransfer o	coefficier	nt, W/K						(39)m	= (37) + (3	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 =		12 /12=	381.95	(39)
	<u> </u>	`````	HLP), W/	i						= (39)m ÷			I	
(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	4.07	
Numb	er of day	vs in moi	nth (Tab	le 1a)					,	Average =	Sum(40)₁.	12 /12=	1.27	(40)
	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. Wa	ater heat	ting enei	rgy requi	irement:								kWh/ye	ear:	
A													I	
		ıpancy, l 9. N = 1	N + 1.76 x	[1 - exp	(-0.0003	49 x (TF		)2)] + 0.(	)013 x ( <sup>-</sup>	ΓFA -13.		13		(42)
	A £ 13.9	-		i onp	( 0.0000			/_/] · on			0)			
			ater usag									3.62		(43)
		-	hot water person per			-	-	to achieve	a water us	se target o	t			
							·	<u> </u>	San	Oct	Nov	Dee		
Hot wat	Jan er usage i	Feb n litres per	Mar day for ea	Apr ach month	May Vd.m = fa	Jun	Jul Table 1c x	Aug (43)	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		
(44)///-	119.40	115.14	110.79	100.43	102.11	97.70	57.70	102.11		Fotal = Su			1303.47	(44)
Energy	content of	hot water	used - cal	culated mo	onthly $= 4$ .	190 x Vd,r	m x nm x D	) ) ) ) ) ) ) ) ) ) ) ) ) ) ) ) ) ) )			· · ·		1000.47	
(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 = Su	m(45) <sub>112</sub> =		1709.06	(45)
lf instan	taneous w	ater heatii	ng 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)
	storage		includin		alar ar M		ctorago	within or				150		(47)
-		. ,	includin				-			561		150		(47)
	•	•	ind no ta hot wate		•			· · ·	ers) ente	er 'O' in (	47)			
	storage		not wate	/ (uno n		instantai	10003 00							
	-		eclared l	oss facto	or is kno	wn (kWł	n/day):				2.	52		(48)
Tempe	erature f	actor fro	m Table	2b							0.	54		(49)
Energ	y lost fro	m water	· storage	, kWh/ye	ear			(48) x (49)	) =		1.	36		(50)
			eclared o	•										
		-	factor fr		e 2 (kW	h/litre/da	ay)					0		(51)
	•	eating s from Ta	ee sectio	on 4.3									l	(50)
			bie ∠a m Table	2b								0		(52) (53)
			storage		aar			(47) x (51)	V (50) v (	53) -				
-		(54) in (5	-	, ixvii/yt	Jui			( TF ) X (OT	, , (02) ^ (			0 36		(54) (55)
	. ,	. , (-	,								·	-		· · · · ·

Water	storage	loss cal	culated	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 cylinde	er contains	s dedicate	d solar sto	orage, (57)	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	lix 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)
Primar	y circuit	loss (ar	nual) fro	om Table	93			-		-		0	(58)
	•	•	,	for each		59)m = (	(58) ÷ 36	65 × (41)	m				•
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	er heati	ng and a	cylinde	r thermo	ostat)		_
(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 ca	lculated	for each	n month (	(61)m =	(60) ÷ 36	65 × (41	)m					
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
Total h	neat requ	uired for	water h	eating ca	alculated	l for eacl	h 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 DI	HW input of	calculated	using App	endix G o	Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)	
(add a	dditiona	l lines if	FGHRS	and/or \	WWHRS	applies	, see Ap	pendix (	G)				
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
Output	t from w	ater hea	ter										_
(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	
								Outp	out from w	ater heate	r (annual)₁	12	2480.31 (64)
Heat g	ains fro	m water	heating	, kWh/m	onth 0.2	5 ´ [0.85	× (45)m	ı + (61)m	n] + 0.8 x	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)
inclu	ude (57)	m in calo	culation	of (65)m	only if c	ylinder is	s in the o	dwelling	or hot w	ater is fi	rom com	munity h	leating
5. Int	ternal ga	ains (see	e Table 5	5 and 5a	):								
Metab					/								
	olic gain	s (Table	e 5), Wat			_			_				
	olic gain Jan	s (Table Feb	5), Wat Mar		Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	]
(66)m=				tts		Jun 156.68	Jul 156.68	Aug 156.68	Sep 156.68	Oct 156.68	Nov 156.68	Dec 156.68	(66)
	Jan 156.68	Feb 156.68	Mar 156.68	tts Apr	May 156.68	156.68	156.68	156.68	156.68				(66)
Lightin	Jan 156.68	Feb <sup>156.68</sup> (calcula	Mar 156.68 ted in Aj	Apr 156.68 Dpendix	May 156.68	156.68	156.68 r L9a), a	156.68	156.68				(66)
Lightin (67)m=	Jan 156.68 g gains 40.95	Feb 156.68 (calcula 36.37	Mar 156.68 ted in Aj 29.58	Apr 156.68 Dpendix	May 156.68 L, equat 16.74	156.68 ion L9 oi 14.13	156.68 r L9a), a 15.27	156.68 Iso see 19.85	156.68 Table 5 26.64	156.68 33.82	156.68	156.68	]
Lightin (67)m=	Jan 156.68 g gains 40.95	Feb 156.68 (calcula 36.37	Mar 156.68 ted in Aj 29.58	tts Apr 156.68 opendix 22.39	May 156.68 L, equat 16.74	156.68 ion L9 oi 14.13	156.68 r L9a), a 15.27	156.68 Iso see 19.85	156.68 Table 5 26.64	156.68 33.82	156.68	156.68	]
Lightin (67)m= Applia (68)m=	Jan 156.68 g gains 40.95 nces ga 459.29	Feb 156.68 (calcula 36.37 ins (calc 464.06	Mar 156.68 ted in Ap 29.58 ulated ir 452.05	tts Apr 156.68 opendix 22.39 Append	May 156.68 L, equat 16.74 dix L, eq 394.2	156.68 ion L9 of 14.13 uation L 363.87	156.68 r L9a), a 15.27 13 or L1 343.6	156.68 Iso see 19.85 3a), also 338.84	156.68 Table 5 26.64 see Ta 350.85	156.68 33.82 ble 5 376.42	156.68 39.48	156.68 42.08	(67)
Lightin (67)m= Applia (68)m=	Jan 156.68 g gains 40.95 nces ga 459.29	Feb 156.68 (calcula 36.37 ins (calc 464.06	Mar 156.68 ted in Ap 29.58 ulated ir 452.05	tts Apr 156.68 opendix 22.39 Append 426.48	May 156.68 L, equat 16.74 dix L, eq 394.2	156.68 ion L9 of 14.13 uation L 363.87	156.68 r L9a), a 15.27 13 or L1 343.6	156.68 Iso see 19.85 3a), also 338.84	156.68 Table 5 26.64 see Ta 350.85	156.68 33.82 ble 5 376.42	156.68 39.48	156.68 42.08	(67)
Lightin (67)m= Applia (68)m= Cookir (69)m=	Jan 156.68 g gains 40.95 nces ga 459.29 ng gains 38.67	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula	Mar 156.68 ted in A 29.58 ulated ir 452.05 ted in A 38.67	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat	156.68 ion L9 of 14.13 uation L 363.87 ion L15	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a)	156.68 Iso see 19.85 3a), also 338.84 ), also se	156.68 Table 5 26.64 9 see Ta 350.85 ee Table	156.68 33.82 ble 5 376.42 5	156.68 39.48 408.69	156.68 42.08 439.03	] (67) ] (68)
Lightin (67)m= Applia (68)m= Cookir (69)m=	Jan 156.68 g gains 40.95 nces ga 459.29 ng gains 38.67	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67	Mar 156.68 ted in A 29.58 ulated ir 452.05 ted in A 38.67	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat	156.68 ion L9 of 14.13 uation L 363.87 ion L15	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a)	156.68 Iso see 19.85 3a), also 338.84 ), also se	156.68 Table 5 26.64 9 see Ta 350.85 ee Table	156.68 33.82 ble 5 376.42 5	156.68 39.48 408.69	156.68 42.08 439.03	] (67) ] (68)
Lightin (67)m= Applia (68)m= Cookir (69)m= Pumps (70)m=	Jan           156.68           og gains           40.95           nces ga           459.29           ng gains           38.67           s and fair           3	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67 ns gains 3	Mar 156.68 ted in A 29.58 ulated ir 452.05 ted in A 38.67 (Table 3 3	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67 5a)	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat 38.67	156.68 ion L9 of 14.13 uation L 363.87 ion L15 38.67	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a) 38.67	156.68 Iso see 19.85 3a), also 338.84 ), also se 38.67	156.68 Table 5 26.64 see Ta 350.85 ee Table 38.67	156.68 33.82 ble 5 376.42 5 38.67	156.68 39.48 408.69 38.67	156.68 42.08 439.03 38.67	] (67) ] (68) ] (69)
Lightin (67)m= Applia (68)m= Cookir (69)m= Pumps (70)m=	Jan           156.68           og gains           40.95           nces ga           459.29           ng gains           38.67           s and fai           3           s e.g. ev	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67 ns gains 3 raporatic	Mar 156.68 ted in A 29.58 ulated ir 452.05 ted in A 38.67 (Table 3 3	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67 5a) 3	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat 38.67	156.68 ion L9 of 14.13 uation L 363.87 ion L15 38.67	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a) 38.67	156.68 Iso see 19.85 3a), also 338.84 ), also se 38.67	156.68 Table 5 26.64 see Ta 350.85 ee Table 38.67	156.68 33.82 ble 5 376.42 5 38.67	156.68 39.48 408.69 38.67	156.68 42.08 439.03 38.67	] (67) ] (68) ] (69)
Lightin (67)m= Applia (68)m= Cookir (69)m= Pumps (70)m= Losses (71)m=	Jan 156.68 19 gains 40.95 nces ga 459.29 ng gains 38.67 s and fai 3 s e.g. ev -125.34	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67 ns gains 3 raporatic	Mar 156.68 ted in A 29.58 ulated in 452.05 ited in A 38.67 (Table 9 3 on (nega -125.34	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67 5a) 3 tive valu	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat 38.67 3 es) (Tab	156.68 ion L9 of 14.13 uation L 363.87 ion L15 38.67 3 le 5)	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a 38.67 3	156.68 Iso see 19.85 3a), also 338.84 ), also se 38.67 3	156.68 Table 5 26.64 see Ta 350.85 ee Table 38.67 3	156.68 33.82 ble 5 376.42 5 38.67 3	156.68 39.48 408.69 38.67 3	156.68 42.08 439.03 38.67 3	] (67) ] (68) ] (69) ] (70)
Lightin (67)m= Applia (68)m= Cookir (69)m= Pumps (70)m= Losses (71)m=	Jan 156.68 19 gains 40.95 nces ga 459.29 ng gains 38.67 s and fai 3 s e.g. ev -125.34	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67 ns gains 3 aporatic -125.34	Mar 156.68 ted in A 29.58 ulated in 452.05 ited in A 38.67 (Table 9 3 on (nega -125.34	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67 5a) 3 tive valu	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat 38.67 3 es) (Tab	156.68 ion L9 of 14.13 uation L 363.87 ion L15 38.67 3 le 5)	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a 38.67 3	156.68 Iso see 19.85 3a), also 338.84 ), also se 38.67 3	156.68 Table 5 26.64 see Ta 350.85 ee Table 38.67 3	156.68 33.82 ble 5 376.42 5 38.67 3	156.68 39.48 408.69 38.67 3	156.68 42.08 439.03 38.67 3	] (67) ] (68) ] (69) ] (70)
Lightin (67)m= Applia (68)m= Cookir (69)m= Pumps (70)m= Losses (71)m= Water (72)m=	Jan 156.68 19 gains 40.95 nces ga 459.29 19 gains 38.67 5 and fai 3 s e.g. ev -125.34 heating 149.62	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67 ns gains 3 raporatic -125.34 gains (T	Mar 156.68 ted in A 29.58 ulated in 452.05 ted in A 38.67 (Table 5 able 5) 141.9	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67 5a) 3 tive valu -125.34	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat 38.67 3 es) (Tab -125.34	156.68 ion L9 of 14.13 uation L 363.87 ion L15 38.67 3 le 5) -125.34 123.75	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a 38.67 38.67 3 -125.34	156.68 Iso see 19.85 3a), also 338.84 ), also se 38.67 3 -125.34	156.68 Table 5 26.64 See Ta 350.85 De Table 38.67 3 -125.34	156.68 33.82 ble 5 376.42 5 38.67 3 -125.34 135.13	156.68 39.48 408.69 38.67 3 -125.34	156.68 42.08 439.03 38.67 3 -125.34 147.12	] (67) ] (68) ] (69) ] (70) ] (71)
Lightin (67)m= Applia (68)m= Cookir (69)m= Pumps (70)m= Losses (71)m= Water (72)m=	Jan 156.68 19 gains 40.95 nces ga 459.29 19 gains 38.67 5 and fai 3 s e.g. ev -125.34 heating 149.62	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67 ns gains 3 raporatic -125.34 gains (T 147.11	Mar 156.68 ted in A 29.58 ulated in 452.05 ted in A 38.67 (Table 5 able 5) 141.9	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67 5a) 3 tive valu -125.34	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat 38.67 3 es) (Tab -125.34	156.68 ion L9 of 14.13 uation L 363.87 ion L15 38.67 3 le 5) -125.34 123.75	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a 38.67 38.67 3 -125.34	156.68 Iso see 19.85 3a), also 338.84 ), also se 38.67 3 -125.34	156.68 Table 5 26.64 See Ta 350.85 De Table 38.67 3 -125.34	156.68 33.82 ble 5 376.42 5 38.67 3 -125.34 135.13	156.68 39.48 408.69 38.67 3 -125.34 143.41	156.68 42.08 439.03 38.67 3 -125.34 147.12	] (67) ] (68) ] (69) ] (70) ] (71)

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

Orientation:	Access Factor Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	9.94	×	11.28	×	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	×	41.38	×	0.63	x	0.7	=	125.7	(75)
Northeast 0.9x	0.77	x	9.94	x	67.96	×	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	×	97.38	×	0.63	x	0.7	=	295.83	(75)
Northeast 0.9x	0.77	x	9.94	×	91.1	×	0.63	x	0.7	=	276.75	(75)
Northeast 0.9x	0.77	x	9.94	×	72.63	×	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	×	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	×	9.21	×	0.63	x	0.7	=	27.99	(75)
Southeast 0.9x	0.77	x	30.25	×	36.79	x	0.63	x	0.7	=	340.15	(77)
Southeast 0.9x	0.77	x	30.25	x	62.67	×	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	×	0.63	x	0.7	=	1100.23	(77)
Southeast 0.9x	0.77	x	30.25	×	118.15	×	0.63	x	0.7	=	1092.27	(77)
Southeast 0.9x	0.77	x	30.25	×	113.91	x	0.63	x	0.7	=	1053.07	(77)
Southeast 0.9x	0.77	x	30.25	×	104.39	×	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	×	0.63	x	0.7	=	407.42	(77)
Southeast 0.9x	0.77	x	30.25	×	31.49	×	0.63	x	0.7	=	291.1	(77)
Southwest0.9x		x	13.17	x	36.79		0.63	x	0.7	=	148.09	(79)
Southwest0.9x	0.77	x	13.17	x	62.67		0.63	x	0.7	=	252.26	(79)
Southwest0.9x	0.77	x	13.17	x	85.75	]	0.63	x	0.7	=	345.15	(79)
Southwest0.9x	0.77	x	13.17	×	106.25		0.63	x	0.7	=	427.65	(79)
Southwest0.9x	0.77	x	13.17	×	119.01		0.63	x	0.7	=	479.01	(79)
Southwest0.9x	0.77	x	13.17	x	118.15		0.63	x	0.7	=	475.54	(79)
Southwest0.9x		x	13.17	x	113.91		0.63	x	0.7	=	458.48	(79)
Southwest0.9x		x	13.17	x	104.39		0.63	x	0.7	=	420.16	(79)
Southwest0.9x	-	x	13.17	x	92.85		0.63	x	0.7	=	373.72	(79)
Southwest0.9x		x	13.17	x	69.27		0.63	x	0.7	=	278.8	(79)
Southwest0.9x	0.77	x	13.17	x	44.07		0.63	x	0.7	=	177.38	(79)
Southwest0.9x	0	x	13.17	x	31.49		0.63	x	0.7	=	126.74	(79)
Northwest 0.9x		x	19.32	×	11.28	×	0.63	x	0.7	=	66.62	(81)
Northwest 0.9x		x	19.32	×	22.97	×	0.63	×	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)

Northwoot	<b>.</b>								1	<b></b>						
Northwest		0.77	x	19.	32	x	6	57.96	X		0.63		0.7	=	401.24	(81)
Northwest		0.77	×	19.	32	x	9	1.35	X		0.63	×	0.7	=	539.35	(81)
Northwest	0.9x	0.77	x	19.	32	x	9	7.38	X		0.63	×	0.7	=	575	(81)
Northwest	0.9x	0.77	×	19.	32	x	ę	91.1	x		0.63	x	0.7	=	537.9	(81)
Northwest	0.9x	0.77	x	19.	32	x	7	2.63	x		0.63	x	0.7	=	428.82	(81)
Northwest	0.9x	0.77	x	19.	32	x	5	60.42	×		0.63	×	0.7	=	297.71	(81)
Northwest	0.9x	0.77	x	19.	32	x	2	8.07	×		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	9.21	x		0.63	x	0.7	=	54.4	(81)
Solar <u>gair</u>	ns in v	vatts, ca	alculated	for eac	h month				(83)m	n = Su	ım(74)m .	(82)m				
(83)m= 58	39.14	1037.03	1507.93	2017.61	2396.07	24	38.65	2326.19	2034	4.68	1682.99	1170.14	711.75	500.23		(83)
Total gair	ns – in	ternal a	ind solar	<sup>-</sup> (84)m =	= (73)m	+ (8	83)m	, watts								
(84)m= 1	312	1757.58	2204.46	2674.3	3010.24	30	013.4	2876.31	2591	1.66	2261.28	1788.52	1376.34	1201.47		(84)
7. Mean	interr	al temp	erature	(heating	season	)										
Tempera	ature o	during h	leating p	eriods i	n the livi	ng	area l	from Tab	ole 9	, Th1	l (°C)				21	(85)
Utilisatio	on fact	or for g	ains for l	living are	ea, h1,m	n (se	ee Ta	ble 9a)								
	Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec	]	
(86)m=	1	1	0.99	0.97	0.88	(	0.72	0.56	0.6	63	0.88	0.99	1	1		(86)
Mean int	ternal	temper	ature in	living ar	ea T1 (fe	ollo	w ste	ps 3 to 7	' in T	able	e 9c)				-	
	9.44	19.65	19.97	20.38	20.73	-	0.93	20.98	20.		20.81	20.33	19.8	19.4	]	(87)
Tempera		durina h		oriode i	roct of		olling	from To		 ) Th	2 (°C)				1	
· ·	9.86	19.86	19.86	19.87	19.87	-	9.87	19.87	19.		19.87	19.87	19.86	19.86	1	(88)
					1	I				-					J	~ /
Utilisatio					<u> </u>	1		i	<u> </u>	_	0.04	0.00			1	(90)
(89)m=	1	1	0.99	0.95	0.84		0.63	0.43	0.	S	0.81	0.98	1	1	J	(89)
Mean int		temper			· · · · · ·	<u> </u>			r <u> </u>		in Tabl	e 9c)		r	1	
(90)m= 1	7.77	18.07	18.54	19.13	19.6	1	9.82	19.87	19.	86	19.71	19.07	18.3	17.72		(90)
											f	LA = Livi	ng area ÷ (4	4) =	0.11	(91)
Mean int	ternal	temper	ature (fo	r the wh	ole dwe	llin	g) = fl	LA × T1	+ (1	– fL	A) × T2				_	
(92)m= 1	7.94	18.24	18.69	19.26	19.72	1	9.94	19.99	19.	98	19.83	19.2	18.46	17.9		(92)
Apply ac	djustm	ent to tl	he mear	interna	l temper	atu	ire fro	m Table	4e,	whe	re appro	opriate			1	
(93)m= 1	7.94	18.24	18.69	19.26	19.72	1	9.94	19.99	19.	98	19.83	19.2	18.46	17.9		(93)
8. Space	e heat	ing requ	uirement													
						ned	at ste	ep 11 of	Tabl	le 9b	, so tha	t Ti,m=	(76)m an	d re-calo	culate	
the utilis	Jan	Feb	Mar		May	Г	Jun	Jul		ug	Sep	Oct	Nov	Dec	1	
<u>`</u> Utilisatio				Apr	Iviay		Jun	Jui	A	ug	Sep	001		Dec	J	
(94)m=	1	1	0.98	0.94	0.83		0.63	0.44	0.5	51	0.81	0.97	1	1	]	(94)
Useful g	ains. I	hmGm .						-							]	
			2168.37		<u> </u>	19	10.04	1267.51	1324	4.19	1826.11	1738.72	1371.82	1200.48	]	(95)
Monthly	avera	ge exte	rnal tem	perature	e from T	abl	e 8			1			1		1	
	4.3	4.9	6.5	8.9	11.7	1	14.6	16.6	16	.4	14.1	10.6	7.1	4.2		(96)
Heat los	s rate	for mea	an intern	al temp	erature,	Lm	i , W =	=[(39)m :	x [(9:	3)m-	- (96)m	]				
(97)m= 52	60.41	5135.15	4687.19	3958.35	3059.77	20	25.82	1284.03	1356	5.19	2176.72	3281.91	4343.15	5251.32		(97)

Space	heatin	g require	ement fo	r each n	honth, k	Wh/mont	th = 0.02	24 x [(97	)m – (95	)m] x (4	1)m			
(98)m=	2938.81	2275.21	1874.01	1037.64	417.91	0	0	0	0	1148.14	2139.35	3013.82		_
								Tota	l per year	(kWh/year	<sup>.</sup> ) = Sum(9	8)15,912 =	14844.9	(98)
Space	heatin	g require	ement in	kWh/m²	/year							[	49.27	(99)
9a. Ene	ergy rec	luiremer	nts – Ind	ividual h	eating s	ystems i	ncluding	micro-C	CHP)					
-	heatir	•										г		٦
				econdar		mentary			(004)				0	(201)
				nain syst	. ,			(202) = 1		(000)]		ļ	1	(202)
			0	main sys				(204) = (2	02) × [1 –	(203)] =			1	(204)
	•			ing syste								ļ	93.5	(206)
Efficie	ncy of s	seconda	ry/suppl	ementar	y heating	g system	ז, % ו		· · · · · ·		· · · · · ·		0	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
· · ·		ř	ement (c	alculate $1037.64$	d above, 417.91	)	0	0	0	1148.14	2130 35	3013.82		
L				00 ÷ (20		0	0	0	0	1140.14	2100.00	0010.02		(211)
`́г		2433.38	<u>, , , , , , , , , , , , , , , , , , , </u>	1109.77	446.97	0	0	0	0	1227.95	2288.08	3223.34		(211)
L								-	-	ar) =Sum(2			15876.9	(211)
Space	heatin	g fuel (s	econdar	y), kWh/	month							L		J
= {[(98)	m x (20	01)]}x1	00 ÷ (20	)8)										
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		_
								Tota	l (kWh/yea	ar) =Sum(2	215) <sub>15,1012</sub>	F	0	(215)
Water I	-	•												
Output	trom wa 242.7	ater hea 214.14	ter (calc 225.42	ulated a	0 <b>0VE)</b> 199.28	178.83	172.48	188.26	187.61	210.27	221.41	237.11		
L Efficien		ater hea	1										79.8	(216)
(217)m=	9.58	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/m	onth										
			$\frac{1}{2} \div (217)$		000 70	0044	040.44	005.04	005.4	007.40	0.47 70	004.50		
(219)m=	270.92	239.35	252.67	229.01	229.73	224.1	216.14	235.91	235.1 I = Sum(2	237.16	247.73	264.56	0000.00	
Annual	totale							1010	ii – Curri(2		Wh/yeaı		2882.38 kWh/year	(219)
			ed, main	system	1					N	wii/yeai	[	15876.9	1
-	-	fuel use		-								Ĺ	2882.38	1
	-			electric	kaan-ha	t						L		J
				cicotric		ſ								(000 -)
		ig pump										30		(230c)
boiler	with a f	an-assis	sted flue									45		(230e)
Total el	ectricity	/ for the	above, l	kWh/yea	r			sum	of (230a).	(230g) =			75	(231)
Electric	ity for li	ghting										[	723.12	(232)
Total de	elivered	l energy	for all u	ses (211	)(221)	+ (231)	+ (232).	(237b)	=			[	19557.4	(338)
12a. C	O2 em	issions ·	– Individ	ual heati	ing syste	ems inclu	uding mi	cro-CHF	)			L		-

	<b>Energy</b> kWh/year	Emission factor kg CO2/kWh	<b>Emissions</b> 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**

Project Informati	ion:			
ssessed By:	Daniel Watt (STR	RO026464)	Building Type:	Detached House
Dwelling Details	:			
EW DWELLING	DESIGN STAGE		Total Floor Area: 3	801.27m²
ite Reference :	Ridgeway Road		Plot Reference:	The Shingles- Be Green
ddress :	The Shingles, Ch	elvey Batch, Backwell, BRISTO	DL, BS48 3BZ	
Client Details:	-			
ame:				
ddress :				
his report cove	ers items included v	within the SAP calculations.		
-	ete report of regula			
1a TER and DE	R			
uel for main hea	ting system: Electric	city		
uel factor: 1.55 (				
-	oxide Emission Rate	. ,	22.22 kg/m <sup>2</sup>	01/
b TFEE and D	Dioxide Emission Ra	ate (DER)	13.28 kg/m <sup>2</sup>	OK
	ergy Efficiency (TFE	E)	63.1 kWh/m²	
-	Energy Efficiency (DF		53.3 kWh/m <sup>2</sup>	
		/		OK
2 Fabric U-valu	es			
Element	t	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	10	0.14 (max. 0.20) 1.30 (max. 2.00)	0.14 (max. 0.35)	OK OK
Opening 2a Thermal bric		1.50 (IIIax. 2.00)	1.30 (max. 3.30)	UK
		from linear thermal transmittan	ces for each junction	
3 Air permeabil				
-	ability at 50 pascals		3.00 (design val	ue)
Maximum			10.0	OK
4 Heating effici	encv			
	ing system:			
maintroat	ng oyotonn	Heat pumps with radiators of	or underfloor heating - elect	ric
		NIBE F2040-16	Ū	
Conservation of the second	h a a tha a successory			
Secondary	heating system:	Room heaters - wood Closed room heater		
		Efficiency 65.0 %		
		Minimum 65.0 %		ОК
5 Cylinder insu	lation			
5 Cylinder insu Hot water 3		Measured cylinder loss: 2.7	5 kWh/day	

# **Regulations Compliance Report**

Primary pipework insulated	Yes		OK
Controls			
Space heating controls	TTZC by plumbing and el	ectrical services	OK
Hot water controls:	Cylinderstat		OK
	Independent timer for DH	W	OK
Boiler interlock:	Yes		OK
' Low energy lights			
Percentage of fixed lights w	ith low-energy fittings	100.0%	
Minimum		75.0%	OK
B Mechanical ventilation			
Continuous supply and extr	act system		
Specific fan power:		0.89	
Maximum		1.5	OK
MVHR efficiency:		89%	
Minimum		70%	OK
Summertime temperature			
Overheating risk (South We	st England):	Not significant	OK
ased on:			
Overshading:		Average or unknown	
Windows facing: North Wes	t	22.67m <sup>2</sup>	
Windows facing: South Eas	t	35.5m <sup>2</sup>	
Windows facing: North East	:	11.67m <sup>2</sup>	
Windows facing: South Wes	st	15.45m <sup>2</sup>	
Ventilation rate:		8.00	
Blinds/curtains:		Dark-coloured curtain or roller	blind
		Closed 100% of daylight hours	6

#### 10 Key features

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

# **SAP Input**

Property Details:	The Shingles- Be Green					
Address:		The Shingles, Chelvey Ba	tch, Backwell, BR	ISTOL, BS48 3B	Z	
Located in:		England				
Region:		South West England				
UPRN:		UPRN-000024066096				
Date of assess		20 January 2023				
Date of certific		20 January 2023				
Assessment ty	•	New dwelling design stag	le			
Transaction ty	pe:	New dwelling				
Tenure type: Related party of	dicelocure	Owner-occupied Employed by the professi	onal dealing with	the property tra	nsaction	
Thermal Mass		Indicative Value Medium	onal dealing with	the property the	Insaction	
	125 litres/person/d					
PCDF Version:		510				
Property descript	ion:					
Dwelling type:		House				
Detachment:		Detached				
Year Completed:		2023				
Floor Location		Floor area:				
	•		(	Storey height	:	
Floor 0		211.32 m <sup>2</sup>		2.75 m	-	
Floor 1		89.95 m <sup>2</sup>		2.55 m		
				2.00 11		
Living area: Front of dwelling	faces:	32 m <sup>2</sup> (fraction 0.127) North West				
Opening types:						
Name:	Source:	Type:	Glazing:		Argon:	Frame:
Front Door	Manufacturer	Solid				Wood
Front	Manufacturer	Windows		0.05, soft coat	Yes	Metal, thermal break
Rear	SAP 2012	Windows		0.05, soft coat	Yes	Metal, thermal break
Right	SAP 2012	Windows		0.05, soft coat	Yes	Metal, thermal break
Left	SAP 2012	Windows	IOW-E, EN =	0.05, soft coat	Yes	Metal, thermal break
Name:	Gap:	Frame Facto		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 0.72	1.3 1.3	22.67 35.5	1
Rear Right	16mm or more 16mm or more	0.8 0.8	0.72	1.3	35.5 11.67	1
Left	16mm or more	0.8	0.72	1.3	15.45	1
Len		0.0	0.72	1.5	15.45	I
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	5:					
Type:		nings: Net area:	U-value:	Ru value:	Curtain	wall: Kappa:
External Element External Walls	<u>ts</u> 240.92 87.	.93 152.99	0.22	0	False	N/A
FLat ceiling	83.52 0	83.52	0.22	0	ו מואכ	N/A
Sloped roof	154 0	154	0.14	0		N/A
	101 0	101	0.11	5		i v/ / V

# **SAP Input**

Ground <u>Internal Elem</u> Party Elemer				0.15		N/A
Thermal brid	ges:					
Thermal brid					Y-Value = 0.0896	
	[Approved]	Length 31	Psi-value	e E2	Other lintels (including other steel I	lintals)
	[Approved]	22	0.3	E3	Sill	linteis)
	[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 great	ter than external area)
Ventilation:						
Pressure test Ventilation:		Number of Ductwork: I Approved Ir	ith heat recov wet rooms: Ki nsulation, rigi nstallation Sch	tchen + 4 d neme: False	9	
Number of cl	5		secondary: 1,	other: 0)		
Number of o		0				
Number of fa		0 0				
	assive stacks: des sheltered:	2				
Pressure test		3				
Main heating						
Main heating		Electric hea Fuel: Electri Info Source Database: ( Brand name Model: F204 Model quali (provides D Underfloor I Central hea Design flow Room-seale Boiler interl	icity : Boiler Datab rev 510, prod e: NIBE 40-16 fier: Underfloo HW all year) heating, pipes ting pump : 2 temperature: d	ase uct index 1 or in screed a 013 or late Design flo	02043, SEDBUK 386%): above insulation	
Main heating						
Main heating		Time and te services Control cod		ne control	by suitable arrangement of pluml	bing and electrical
Secondary he	eating system:					
Secondary he	eating system:	Fuel :wood	oom heaters logs : SAP Tables n heater			

## **SAP Input**

Wat	hoa	tino
vvai	пеа	ung

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

Assessor Name: Daniel Watt Stroma Number: STRO026464	RO026464		
Software Name:Stroma FSAP 2012Software 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(m <sup>2</sup> ) Av. Height(m) Volume(m <sup>3</sup> )			
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 secondary other total m <sup>3</sup> per hour heating heating			
Number of chimneys $0 + 1 + 0 = 1 \times 40 = 40$	(6a)		
Number of open flues $0 + 0 + 0 = 0 \times 20 = 0$	(6b)		
Number of intermittent fans $0 \times 10 = 0$	(7a)		
Number of passive vents $0 \times 10 = 0$	(7b)		
Number of flueless gas fires $0 \times 40 = 0$	(7c)		
Air changes per hou	r		
Infiltration due to chimneys, flues and fans = $(6a)+(6b)+(7a)+(7c) = 40$ $\div$ (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)0Additional infiltration[(9)-1]x0.1 =0	(9)		
	(10) (11)		
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	(11)		
deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	(12)		
If no draught lobby, enter 0.05, else enter 0	(13)		
Percentage of windows and doors draught stripped0	(14)		
Window infiltration $0.25 - [0.2 \times (14) \div 100] =$ 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 $(18) = [(17) \div 20] + (8)$ , 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	(10)		
Number of sides sheltered         2           Shelter factor $(20) = 1 - [0.075 \times (19)] =$ $0.85$	(19) (20)		
Infiltration rate incorporating shelter factor $(21) = (18) \times (20) =$ $0.17$	(21)		
Infiltration rate modified for monthly wind speed	L` '		
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec			
Monthly average wind speed from Table 7			
(22)m= 5.1 5 4.9 4.4 4.3 3.8 3.8 3.7 4 4.3 4.5 4.7			

Wind F	actor (2	2a)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		
Adjuste	ed infiltra	ation rate	e (allowi	ng for sł	nelter an	d wind s	peed) =	(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		
	ate effec		-	rate for t	he appli	cable ca	se							
	echanica aust air he			andix NL (2	2h) _ (22	$\sim$	auction (N		nuico (22h	) - (220)			0.5	(23a)
	anced with	• •	0 11		, (	, (		<i>,, ,</i>	<b>`</b>	) = (23a)			0.5	(23b)
			-	-	-					<b>)</b>	006)	1 (00 c)	75.65	(23c)
,	i	0.33	0.33	0.31	0.3	at recove	0.28	HR) (24a	0.29	2D)m + (. 0.3	23D) × [ 0.31	1 – (23c) 0.32	÷100]	(24a)
(24a)m=												0.32	I	(24a)
,	balance		anical ve			neat rec			m = (22)	2) + m(a 0	, I		l	(24b)
(24b)m=		Ţ		-	-	-	-	_		0	0	0		(240)
,	whole ho if (22b)m				•	•				5 v (23h				
(24c)m=	r í í	0	0		0 = (201)		0	$\frac{0}{0} = \frac{221}{2}$	0		,, 0	0	1	(24c)
	natural \	Ţ	Ţ	Ŧ	-	-	-		-	Ů	ů	ů	ľ	( - <b>/</b>
,	if (22b)m				•	•				0.5]				
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effe	ctive air	change	rate - en	iter (24a	) or (24	b) or (24	c) or (24	d) in boy	(25)				J	
(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)
2 40	at losses	and be	at loce r	aramat	or:			•						
ELEN		Gros		Openin		Net Ar	ea	U-valı	IP	AXU		k-value	Δ Δ	Xk
		area		m	-	A ,r		W/m2		(W/I	<b>&lt;</b> )	kJ/m²·ł		
Doors						2.64	x	r		3.432				(26)
Window						2.01	^	1.3	=	28.01				( -/
	ws Type	1				22.67	<b>-</b>	1.3 /[1/( 1.3 )+	!	20.01				(27)
Window	ws Type ws Type						×1,		0.04] =	43.87				
		2				22.67	x1,	/[1/( 1.3 )+	0.04] = 0.04] =					(27)
Windov	ws Type	2 3				22.67 35.5	x1, x1, x1, x1,	/[1/( 1.3 )+ /[1/( 1.3 )+	0.04] = 0.04] = 0.04] =	43.87				(27) (27)
Windov	ws Type ws Type	2 3				22.67 35.5 11.67 15.45	x1) x1) x1) x1) x1)	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+	0.04] = 0.04] = 0.04] =	43.87 14.42 19.09			-,	(27) (27) (27) (27)
Windov Windov Floor	ws Type ws Type	2 3 4	92	87.9	3	22.67 35.5 11.67 15.45 211.3	x 1, x 1, x 1, x 1, x 1, x 1, x 1, x 2, x	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 	0.04] = [ 0.04] = [ 0.04] = [ 0.04] = [	43.87 14.42 19.09 31.698			]	(27) (27) (27) (27) (27) (28)
Windov Windov Floor Walls	ws Type ws Type ws Type	2 3 4 		87.9	3	22.67 35.5 11.67 15.45 211.3 152.9	x 1/ x 1/ x 1/ x 1/ x 1/ x 1/ x 2 x 2 y x	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22	$\begin{array}{c} 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \end{array} = \\ \\ \\ \\$	43.87 14.42 19.09 31.698 33.66				(27) (27) (27) (27) (27) (28) (28) (29)
Windov Windov Floor Walls Roof 1	ws Type ws Type ws Type Type1	2 3 4 240.9 83.5	2	0	3	22.67 35.5 11.67 15.45 211.3 152.9 83.52	x 11, x 11, x 11, x 11, x 11, x 11, x 11, 2 x x 2 x 2 x	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22 0.14	$\begin{array}{c} 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	43.87 14.42 19.09 31.698 33.66 11.69				(27) (27) (27) (27) (28) (28) (29) (30)
Windov Windov Floor Walls Roof 1 Roof 1	ws Type ws Type ws Type Type1 Type2	2 3 4 240.1 83.5 154	2 		3	22.67 35.5 11.67 15.45 211.3 152.9 83.52 154	x 1/ x 1/ x 1/ x 1/ x 1/ z x 1/ z x 1/ z x 9 x 2 x 2 x 2 x x x	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22	$\begin{array}{c} 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \end{array} = \\ \\ \\ \\$	43.87 14.42 19.09 31.698 33.66				(27) (27) (27) (27) (28) (29) (30) (30)
Windov Windov Floor Walls Roof 1 Roof 1 Total a	ws Type ws Type ws Type Type1 Type2 area of el	2 3 4 240.3 83.5 154	2 1 , m²	0		22.67 35.5 11.67 15.45 211.3 152.9 83.52 154 689.7	x 1/ x 1/ x 1/ x 1/ x 1/ 2 x 9 x 2 x 9 x 2 x 6	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22 0.14 0.14	$\begin{array}{c} 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	43.87 14.42 19.09 31.698 33.66 11.69 21.56		paragraph		(27) (27) (27) (27) (28) (28) (29) (30)
Windov Windov Floor Walls Roof 1 Roof 1 Total a	ws Type ws Type ws Type Type1 Type2 area of el	2 3 4 240.1 83.5 154 lements roof winder	, m <sup>2</sup>	0 0	ndow U-va	22.67 35.5 11.67 15.45 211.3 152.9 83.52 154 689.7 alue calcul	x 1/ x 1/ x 1/ x 1/ x 1/ 2 x 9 x 2 x 9 x 2 x 6	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22 0.14 0.14	0.04] = [ 0.04] = [ 0.04] = [ 0.04] = [ 0.04] = [ 0.04] = [	43.87 14.42 19.09 31.698 33.66 11.69 21.56		paragraph	3.2	(27) (27) (27) (27) (28) (29) (30) (30)
Windov Floor Walls Roof 1 Roof 1 Total a * for win ** includ	ws Type ws Type ws Type Type1 Type2 area of el dows and	2 3 4 240.9 83.5 154 lements roof winde s on both	, m <sup>2</sup> , m <sup>2</sup> sides of in	0 0 ffective wi	ndow U-va	22.67 35.5 11.67 15.45 211.3 152.9 83.52 154 689.7 alue calcul	x 1/ x 1/ x 1/ x 1/ x 1/ 2 x 9 x 2 x 2 x 2 x 4 6 ated using	/[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22 0.14 0.14	$\begin{array}{c} 0.04] = \\ 0.04] = \\ 0.04] = \\ 0.04] = \\ \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	43.87 14.42 19.09 31.698 33.66 11.69 21.56		paragraph	D 3.2	(27) (27) (27) (27) (28) (29) (30) (30)
Windov Floor Floor Walls Roof 1 Roof 1 Total a * for win ** includ Fabric	ws Type ws Type ws Type Type1 Type2 area of el dows and le the area	2 3 4 240.1 83.5 154 lements roof winde s on both s, W/K =	, m <sup>2</sup> , m <sup>2</sup> ows, use e sides of in = S (A x	0 0 ffective wi	ndow U-va	22.67 35.5 11.67 15.45 211.3 152.9 83.52 154 689.7 alue calcul	x 1/ x 1/ x 1/ x 1/ x 1/ 2 x 9 x 2 x 2 x 2 x 4 6 ated using	$ \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[0.15]{0.22}}{0.12} \frac{[0.14]{0.14}}{0.14} $	$\begin{array}{c} 0.04] = \\$	43.87 14.42 19.09 31.698 33.66 11.69 21.56	as given in			(27) (27) (27) (27) (28) (29) (30) (30) (31)
Windov Floor Floor Walls Roof T Roof T Total a * for win ** includ Fabric Heat ca	ws Type ws Type ws Type Type1 Type2 area of el dows and le the area heat los	2 3 4 240.3 83.5 154 lements roof winde s on both s, W/K = Cm = S(	, m <sup>2</sup> ,	ffective winternal wall	ndow U-va	22.67 35.5 11.67 15.45 211.3 152.9 83.52 154 689.7 alue calculations	x 1/ x 1/ x 1/ x 1/ x 1/ 2 x 9 x 2 x 9 x 2 x 9 x 2 x 6 x 6 ated using	$ \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[0.15]{0.22}}{0.12} \frac{[0.14]{0.14}}{0.14} $	$\begin{array}{c} 0.04] = \\ 0.04] = \\ \\ 0.04] = \\ \\ 0.04] = \\ \\ \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	43.87 14.42 19.09 31.698 33.66 11.69 21.56 re)+0.04] a	as given in 2) + (32a).		207.44	(27) (27) (27) (27) (28) (29) (30) (30) (31) (33)
Windov Floor Floor Walls Roof T Roof T Total a * for win ** includ Fabric Heat c Therma For desig	ws Type ws Type ws Type Type1 Type2 area of el dows and le the area heat los apacity (	2 3 4 240.9 83.5 154 lements roof winde s on both s, W/K = Cm = S(parame ments wh	, m <sup>2</sup> , m <sup>2</sup> sides of in = S (A x A x k ) ter (TMF ere the det	ffective winternal wall U)	ndow U-va Is and par	22.67 35.5 11.67 15.45 211.3 152.9 83.52 83.52 154 689.7 689.7 alue calculations	x 1/ x 1/ x 1/ x 1/ x 1/ 2 x 9 x 2 x 9 x 2 x 6 ated using	$ \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[1/(1.3)+}{[1/(1.3)+} \frac{[1/(1.3)+}{[1/(1.3)+} \frac{0.15}{0.22} \frac{0.14}{0.14} $	$\begin{array}{c} 0.04] = \\ 0.04] = \\ \\ 0.04] = \\ \\ 0.04] = \\ \\ \\ \\ 0.04] = \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	43.87 14.42 19.09 31.698 33.66 11.69 21.56 (a)+0.04] a .(30) + (32 tive Value	2) + (32a).	(32e) =	207.44 34562.28	(27) (27) (27) (27) (28) (29) (30) (30) (31) (31) (33) (33) (34)

			are not kr	own (36) =	= 0.05 x (3	1)								_
Total fa	abric he	at loss							(33) +	(36) =			269.27	(37)
Ventila	tion hea	at loss ca	alculated	monthly	y		r		(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 tr	ansfer o	coefficier	nt, W/K						(39)m	= (37) + (3	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		
Heat lo	ss para	ımeter (H	HLP), W	/m²K						Average = = (39)m ÷		12 /12=	351.4	(39)
(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		
Numbe	er of day	/s in moi	nth (Tab	le 1a)			-		,	Average =	Sum(40)1.	12 /12=	1.17	(40)
	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. Wa	ter heat	ting enei	rgy requ	irement:								kWh/ye	ear:	
Assum if TF.	ed occu	ipancy, l 9, N = 1	N		(-0.0003	949 x (TF	FA -13.9	)2)] + 0.(	)013 x ( <sup>-</sup>	TFA -13.		13		(42)
Reduce	the annua	al average	hot water	usage by a	5% if the a	lwelling is	designed t	(25 x N) to achieve		se target o		8.62		(43)
not more	e that 125	litres per j	person pei	r day (all w	ater use, l	not and co	ld)							
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot wate	er usage i	n litres per	day for ea	ach month	Vd,m = fa	ctor from T	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		_
Energy c	content of	hot water	used - cal	culated mo	onthly $= 4$ .	190 x Vd,r	m x nm x D	0Tm / 3600		Total = Su oth (see Ta	× /		1303.47	(44)
(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		
lf instant	aneous w	vater heatii	ng at point	t of use (no	o hot water	• storage),	enter 0 in	boxes (46,		Total = Su	m(45) <sub>112</sub> =	-	1709.06	(45)
(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)
	storage		includir	na anv so	alar or M		storada	within sa	mavas	مما		400		(47)
-		. ,		ink in dw			-			301		400		(47)
Otherw	•	o stored			-			ombi boil	ers) ente	er '0' in (	47)			
a) If m	anufact	urer's de	eclared I	oss facto	or is kno	wn (kWł	n/day):					0		(48)
Tempe	rature f	actor fro	m Table	2b								0		(49)
Energy lost from water storage, kWh/year b) If manufacturer's declared cylinder loss factor is not know								(48) x (49) = 400 n:						(50)
Hot water storage loss factor from Table 2 (kWh/litre/day) If community heating see section 4.3											0.	.01		(51)
		from Ta		0							0.	.67		(52)
Temperature factor from Table 2b											0.	54		(53)
•••		m water (54) in (5	-	e, kWh/y€	ear			(47) x (51) x (52) x (53) = 1.49 1.49				(54) (55)		

Water	storage	loss cal	culated	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 cylind	er contain	s dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	lix 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)
Prima	y circuit	loss (ar	nual) fro	om Table	e 3							0		(58)
	•		,			59)m = (	(58) ÷ 36	65 × (41)	m				1	
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	er heatii	ng and a	cylinde	r thermo	ostat)			
(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)
Comb	i loss ca	lculated	for each	month	(61)m =	(60) ÷ 36	65 × (41)	)m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat req	uired for	water h	eating ca	alculated	l for eacl	n 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 D	HW input	calculated	using App	endix G o	Appendix	H (negativ	ve quantity	/) (enter '0	if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or \	WWHRS	applies	, see Ap	pendix (	G)		-			
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Outpu	t from w	ater hea	ter	-	-			-		_		-		
(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		-
								Outp	out from w	ater heate	r (annual)₁	12	2525.96	(64)
Heat g	ains fro	m water	heating,	kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	) + 0.8 x	k [(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)
inclu	ude (57)	m in calo	culation	of (65)m	only if c	ylinder is	s in the o	dwelling	or hot w	ater is f	rom com	munity h	eating	
5. In	ternal ga	ains (see	e Table 5	5 and 5a	):									
Metab	olic gain	is (Table	e 5), Wat	ts	-			-				-		
	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)
Lightir	ng gains	(calcula	ted in Ap	opendix	L, equat	ion L9 oi	r L9a), a	lso 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)
Applia	nces ga	ins (calc	ulated in	Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 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)
Cookii	ng gains	(calcula	ated in A	ppendix	L, equat	ion L15	or L15a)	), also se	e 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)
Pump	s and fa	ns gains	(Table s	5a)				-		-	-	-		
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0		(70)
Losse	s e.g. ev	vaporatic	n (nega	tive valu	es) (Tab	le 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 (T	able 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)
<b>T</b>	-		•	-	-	-							•	
l otal	internal	gains =	:			(66)	m + (67)m	n + (68)m +	- (69)m +	(70)m + (7	'1)m + (72)	m		
10tal (73)m=	<b></b>	<b>gains =</b> 1054.43	r	951.11	884.21	(66) 825.94	m + (67)m 793.03	n + (68)m + 804.42	- (69)m + 841.83	(70)m + (7 905.28	(1)m + (72) 975.87	m 1031.37		(73)

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

Orientation:	Access Facto Table 6d	r	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	×	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	×	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	×	118.15	x	0.72	x	0.8	=	1674.24	(77)
Southeast 0.9x	0.77	x	35.5	×	113.91	x	0.72	x	0.8	=	1614.15	(77)
Southeast 0.9x	0.77	x	35.5	×	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	×	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		x	35.5	x	31.49	x	0.72	x	0.8	=	446.2	(77)
Southwest <sub>0.9x</sub>		x	15.45	x	36.79		0.72	x	0.8	=	226.91	(79)
Southwest <sub>0.9x</sub>		x	15.45	x	62.67		0.72	x	0.8	=	386.52	(79)
Southwest <sub>0.9x</sub>	0.77	x	15.45	x	85.75		0.72	x	0.8	=	528.85	(79)
Southwest <sub>0.9x</sub>	0.77	x	15.45	x	106.25		0.72	x	0.8	=	655.27	(79)
Southwest0.9x		x	15.45	x	119.01		0.72	x	0.8	=	733.96	(79)
Southwest0.9x	_	x	15.45	×	118.15		0.72	x	0.8	=	728.65	(79)
Southwest0.9x		x	15.45	x	113.91		0.72	x	0.8	=	702.49	(79)
Southwest0.9x		x	15.45	x	104.39		0.72	x	0.8	=	643.79	(79)
Southwest0.9x		x	15.45	x	92.85		0.72	x	0.8	=	572.63	(79)
Southwest0.9x	0.77	x	15.45	x	69.27		0.72	x	0.8	=	427.18	(79)
Southwest0.9x		x	15.45	×	44.07		0.72	x	0.8	=	271.79	(79)
Southwest <sub>0.9x</sub>		x	15.45	×	31.49		0.72	x	0.8	=	194.19	(79)
Northwest 0.9x	_	x	22.67	×	11.28	x	0.72	x	0.8	=	102.1	(81)
Northwest 0.9x	-	x	22.67	×	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	×	6	7.96	×		0.72	×	0.8	=	614.94	(81)
Northwest 0.9x	0.77	×	22.	67	×	9	1.35	×		0.72	×	0.8	=	826.6	(81)
Northwest 0.9x	0.77	x	22.	67	× [	9	7.38	×		0.72	x	0.8	=	881.25	(81)
Northwest 0.9x	0.77	x	22.	67	×	ç	91.1	x		0.72	×	0.8	=	824.39	(81)
Northwest 0.9x	0.77	x	22.	67	×	7	2.63	x		0.72		0.8	=	657.21	(81)
Northwest 0.9x	0.77	x	22.	67	x [	5	0.42	x		0.72	×	0.8	=	456.26	(81)
Northwest 0.9x	0.77	x	22.	67	x [	2	8.07	x		0.72	×	0.8	=	253.98	(81)
Northwest 0.9x	0.77	x	22.	67	x [	1	4.2	x		0.72	_ × [	0.8	=	128.47	(81)
Northwest 0.9x	0.77	x	22.	67	x [	ç	9.21	x		0.72	×	0.8	=	83.38	(81)
								_							
Solar gains ir	n watts, ca	lculated	for eac	h month	l			(83)m	= Su	m(74)m .	(82)m		-	_	
(83)m= 902.96	6 1589.44	2311.2	3092.4	3672.51	37	37.78	3565.4	3118.	.58	2579.52	1793.47	1090.89	766.69		(83)
Total gains –	internal ar	nd solar	(84)m =	= (73)m	+ (8	33)m ,	, watts							_	
<mark>(84)m=</mark> 1964.2	3 2643.88	3325.52	4043.51	4556.72	45	63.72	4358.44	392	23 3	3421.35	2698.75	2066.76	1798.07		(84)
7. Mean inte	ernal tempe	erature (	(heating	seasor	ı)										
Temperatur	e during he	eating p	eriods ir	n the livi	ng a	area f	rom Tab	ole 9,	Th1	(°C)				21	(85)
Utilisation fa	•	• •			-					( )					
Jan	Feb	Mar	Apr	May	T`	Jun	Jul	Au	Ja	Sep	Oct	Nov	Dec	1	
(86)m= 1	0.99	0.96	0.85	0.67	-	).48	0.35	0.4	<u> </u>	0.66	0.93	0.99	1	1	(86)
Mean intern	al tempera	ture in l	ivina ar			w ster	ns 3 to 7	in T	ahle	9c)				1	
(87)m= 21	21	21	21	21	-	21	21	21		21	21	21	21	1	(87)
		I			1									J	
	<u> </u>	eating po			-		19.96			. ,	19.95	19.94	19.94	1	(88)
(88)m= 19.93	19.93	19.93	19.95	19.95		9.96	19.96	19.9	97	19.96	19.95	19.94	19.94	]	(00)
Utilisation fa	actor for ga	ins for r	est of d	welling,	h2,	m (se	e Table	9a)						-	
(89)m= 1	0.98	0.94	0.82	0.61	(	0.4	0.27	0.3	1	0.58	0.9	0.99	1		(89)
Mean intern	al tempera	ature in t	he rest	of dwell	ing	T2 (fo	ollow ste	ps 3	to 7	in Tabl	e 9c)				
(90)m= 19.93		19.93	19.95	19.95	-	9.96	19.96	19.9		19.96	19.95	19.94	19.94	]	(90)
		I								f	LA = Livi	ng area ÷ (4	4) =	0.11	(91)
Mean intern	al tempera	atura (fo	r tha wh	olo dwe	lling	ר) – fl	Δ 🗸 Τ1 .	т (1 _	_ fl /	) <b>v</b> T2					
(92)m= 20.04	<u> </u>	20.04	20.06	20.06	<u> </u>	0.07	20.07	20.0		20.07	20.06	20.06	20.05	1	(92)
Apply adjust													20100	]	
(93)m= 20.04		20.04	20.06	20.06	-	0.07	20.07	20.0		20.07	20.06	20.06	20.05	1	(93)
8. Space he	ating regu	irement			1									<u> </u>	
Set Ti to the			nperatu	re obtair	ned	at ste	ep 11 of	Table	e 9b.	. so tha	t Ti.m=	(76)m an	d re-cal	culate	
the utilisatio									,	,		(* • • • • • • • •		_	
Jan	Feb	Mar	Apr	May	、	Jun	Jul	Au	лg	Sep	Oct	Nov	Dec		
Utilisation fa	actor for ga	ins, hm	:											-	
(94)m= 1	0.98	0.94	0.82	0.62	0	).41	0.27	0.32	2	0.59	0.91	0.99	1		(94)
Useful gains	s, hmGm ,	W = (94	)m x (84	4)m										-	
<mark>(95)m=</mark> 1956.8	8 2603.07	3140.05	3314.35	2805.76	18	75.09	1196.99	1261.	.24	2002.76	2444.46	2044.35	1793.64		(95)
Monthly ave	erage exter	nal tem	perature	e from T	able	e 8						-		-	
(96)m= 4.3	4.9	6.5	8.9	11.7	1	4.6	16.6	16.4	4	14.1	10.6	7.1	4.2	]	(96)
Heat loss ra					1		- ,		<u> </u>	. ,		· · · · ·	r	7	
<mark>(97)m=</mark> 5660.0	9 5428.13	4840.18	3924.15	2930.91	18	88.06	1198.28	1264.	.03	2072.15	3316.52	4570.91	5628.1		(97)

						Fu kW	<b>el</b> /h/year			<b>Fuel P</b> (Table			<b>Fuel Cost</b> £/year	
10a. F	uel cos	ts - indiv	idual he	eating sy	stems:									
Total de	eliverec	lenergy	for all us	ses (211	)(221)	+ (231)	+ (232).	(237b)	=			[	7356.98	(338)
Electric	ity for li	ghting										[	723.12	(232)
Total el	ectricity	for the	above, ł	kWh/yea	ır			sum	of (230a).	(230g) =		[	1232.06	(231)
mecha	anical v	entilatior	ו - balan	nced, ext	ract or p	ositive ii	nput fron	n outside	Э			1232.06		(230a)
Electric	ity for p	umps, fa	ans and	electric l	keep-ho	t						Ľ		-
Water h	neating	fuel use	d										2351.92	Ī
		fuel use	d, main	system	1						, cui	[	3049.88	]
Annual	l totals							TOLA	ii = 3um(2		Wh/year	. l	2351.92 kWh/year	(219)
(219)m=	229.58	202.64	213.5	192.33	189.16	170	164.2	178.89	178.18 Il = Sum(2	199.39	209.65	224.38		٦
		heating, <u>m x 100</u>												
(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)
г	-	ater hea											107.4	(216)
L	246.57	217.64	229.3	206.56	203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98		-
<b>Water I</b> Output	-		<u>ter (calc</u>	ulated al	bove)			Tota	il (kWh/yea	ar) =Sum(2	2 <b>15)</b> <sub>15,1012</sub>	<i>.</i>	0	(215)
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		-
= {[(98)		g fuel (se 1)] } x 1		y), kWh/ 8)	month			Tota	ll (kWh/yea	ar) =Sum(2	2 <b>11)</b> <sub>15,10</sub> 12	<u>-</u>	3049.88	(211)
	713.84	491.87	327.72	113.76	24.13	0	0	0	0	168.1	471.32	739.14		٦
(211)m	= {[(98		4)]	00 ÷ (20	)6)									(211)
	2755.19	1898.44	1264.89	439.06	93.12	0	0	0	0	648.81	1819.12	2852.84		
Space				alculated	· ·		•••		000	•••				
Γ	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	65 kWh/yea	](208) ar
	Efficiency of secondary/supplementary heating system, %													
			-	ing syste					<i>,</i> .	· / /		l	385.96	(206)
				main syst	. ,			(204) = (204)		(203)] =		l	1	(204)
				econdary nain syst		mentary		(202) = 1 -	- (201) =				0	(201)
	e heatir					,	9							_
•		• •		ividual h		vstems i	ncludina	micro-C	HP)			l		<u> </u>
Space	heatin	a reauire	ement in	⊨kWh/m²	²/vear					(,	,(-	- ,	39.07	](99)
(98)m=	2755.19	1898.44	1264.89	439.06	93.12	0	0	0 Tota	0	648.81 (kWh/year	1819.12	<u> </u>	11771.47	(98)
· -		<u> </u>	-		<u> </u>		r		ŕ	í - `	<i>,</i>	2052.04		

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 (23 Energy for lighting	30g) separately (232)		d apply fuel price acc 13.19	cording to $\begin{bmatrix} x & 0.01 \end{bmatrix}$	Table 12a 95.38	(250)
Additional standing charges (Table 12)					0	(251)
Appendix Q items: repeat lines (253) and <b>Total energy cost</b>	d (254) as neede (245)(247) + (250				970.39	(255)
11a. SAP rating - individual heating sys	tems					4
	[(255) x (256)] ÷ [(4	ł) + 45.0] =			0.42	(256)
SAP rating (Section 12) 12a. CO2 emissions – Individual heatin	a systems inclu	ding micro-CHP			83.58	(258)
			Enviroine (		Enviroiment	
		<b>ergy</b> h/year	Emission fa kg CO2/kWl		Emissions kg CO2/yea	r
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) + (2	64) =		2803.53	(265)
Electricity for pumps, fans and electric ke	eep-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 m <sup>2</sup>			(272) ÷ (4) =		12.67	(273)
El rating (section 14)					85	(274)
13a. Primary Energy						
		<b>ergy</b> h/year	Primary factor		<b>P. Energy</b> 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) + (2	64) =		16583.52	(265)
Electricity for pumps, fans and electric keep	ep-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)

Assessor Name:Daniel WattStroma Number:STRO026464Software Name:Stroma FSAP 2012Software 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(m <sup>2</sup> ) Av. Height(m) Volume(m <sup>3</sup> )	
Ground floor 211.32 (1a) x 2.75 (2a) = 581.13 (3a)	a)
First floor 89.95 (1b) x 2.55 (2b) = 229.37 (3b)	b)
Total floor area TFA = $(1a)+(1b)+(1c)+(1d)+(1e)+(1n)$ (4)	
Dwelling volume $(3a)+(3b)+(3c)+(3d)+(3e)+(3n) = 810.5$ (5)	)
2. Ventilation rate:	
main secondary other total m <sup>3</sup> per hour heating heating	
Number of chimneys $0 + 1 + 0 = 1 \times 40 = 40$ (6a)	a)
Number of open flues $0 + 0 + 0 = 0 \times 20 = 0$ (6)	b)
Number of intermittent fans	a)
Number of passive vents $0 \times 10 = 0$ (7)	b)
Number of flueless gas fires	c)
Air changes per hour	
	<b>`</b>
Infiltration due to chimneys, flues and fans = $(6a)+(6b)+(7a)+(7b)+(7c) = 40$ If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16) $\div$ (5) = 0.05 (8)	)
Number of storeys in the dwelling (ns)	)
Additional infiltration [(9)-1]x0.1 = 0 (10	0)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	1)
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	2)
If no draught lobby, enter 0.05, else enter 0	3)
Percentage of windows and doors draught stripped 0 (14	4)
Window infiltration $0.25 - [0.2 \times (14) \div 100] =$ 0       (15)	5)
Infiltration rate $(8) + (10) + (11) + (12) + (13) + (15) = 0$ (16)	6)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	7)
If based on air permeability value, then $(18) = [(17) \div 20]+(8)$ , otherwise $(18) = (16)$ 0.2 (18)	8)
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 $(20) = 1 - [0.075 \times (19)] =$ $0.85$ (20)	
$\frac{1}{2}$	÷
Infiltration rate modified for monthly wind speed $(21) = (10) \times (20) = 0.17$ (22)	•)
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	

	actor (22	2a)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		
Adjuste	ed infiltra	ition rate	e (allowi	ng for sh	nelter an	d wind s	peed) =	(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		
	ate effec		-	rate for t	he appli	cable ca	se	-						
	echanical aust air he			ondix N (2	2h) - (22	$\rightarrow$ Emy (c	austion (	(5)) otho	nuico (22h	) - (220)			0.5	(23a)
										) = (23a)			0.5	(23b)
	anced with		-	-	-							(00 s)	75.65	(23c)
-	balance			1		i		<u> </u>	<u> </u>	· · ·		1	÷100]	(24a)
(24a)m=		0.33	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32		(24a)
,	balanced			1			r	r , ,	ŕ		, 		l	(24b)
(24b)m=		0	0	0	0	0	0	0	0	0	0	0		(24b)
,	whole ho if (22b)m				•					5 × (23b	)			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
,	natural v if (22b)m				•	•				0.5]		•		
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effec	ctive air o	change	rate - er	nter (24a	) or (24t	o) or (24	c) or (24	d) in boy	(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. He	at losses	and he	at loss p	paramete	er:									
ELEN		Gros		Openin		Net Ar	ea	U-valı	he	AXU		k-value	e A	Xk
					2									11 /
		area	(m²)	r	2	A ,r	n²	W/m2	K.,	(W/I	<)	kJ/m²∙ł	K kJ	/K
Doors		area	(m²)	m	IZ	A ,r 2.64	×	1.3	= [	(W/I 3.432	<)	kJ/m²∙ł	K kJ	/K (26)
	ws Type		(m²)	rr	2		×		= [			kJ/m²-ł	K kJ	
Window		1	(m²)	ſſ	12	2.64	x x	1.3	0.04] =	3.432		KJ/M²+ł	K kJ	(26)
Windov Windov	ws Type	1 2	(m²)	m	2	2.64 22.67	x x x <sup>1</sup> x <sup>1</sup>	1.3 /[1/( 1.3 )+	0.04] = [ 0.04] = [	3.432 28.01		KJ/M²+ł	κ kJ	(26) (27)
Windov Windov Windov	ws Type ws Type	1 2 3	(m²)	m	2	2.64 22.67 35.5	x x1. x1. x1. x1.	1.3 /[1/( 1.3 )+ /[1/( 1.3 )+	0.04] = 0.04] = 0.04] = 0.04] =	3.432 28.01 43.87		KJ/m²+ł	κ kJ	(26) (27) (27)
Windov Windov Windov	ws Type ws Type ws Type	1 2 3	(m²)	m	2	2.64 22.67 35.5 11.67	x x1. x1. x1. x1. x1. x1. x1.	1.3 /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+	0.04] = 0.04] = 0.04] = 0.04] =	3.432 28.01 43.87 14.42		kJ/m²-ŀ	< kJ	(26) (27) (27) (27)
Windov Windov Windov Windov	ws Type ws Type ws Type	1 2 3		m 87.93		2.64 22.67 35.5 11.67 15.45	x x1. x1. x1. x1. x1. x1. x1. x2. x	1.3 /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+	$ \begin{bmatrix} 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ $	3.432 28.01 43.87 14.42 19.09		KJ/m²+ŀ	< kJ	(26) (27) (27) (27) (27)
Windov Windov Windov Windov Floor	ws Type ws Type ws Type ws Type	1 2 3 4	92			2.64 22.67 35.5 11.67 15.45 211.3	x x1. x1. x1. x1. x1. x1. x1. x2. x 9. x	1.3 /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15	$\begin{bmatrix} 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0$	3.432 28.01 43.87 14.42 19.09 31.698		kJ/m²+ł		(26) (27) (27) (27) (27) (28)
Windov Windov Windov Windov Floor Walls	ws Type ws Type ws Type ws Type Type1	1 2 3 4 	92	87.9		2.64 22.67 35.5 11.67 15.45 211.3 152.9	x x1. x1. x1. x1. x1. x1. x1. x2. x 9. x	1.3 /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22	$\begin{bmatrix} 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0.04 \\ 0$	3.432 28.01 43.87 14.42 19.09 31.698 33.66		KJ/m²+ł		(26) (27) (27) (27) (27) (27) (28) (29)
Windov Windov Windov Floor Walls Roof 1 Roof 1	ws Type ws Type ws Type ws Type Type1	1 2 3 4 240.3 83.5 154	92	87.93		2.64 22.67 35.5 11.67 15.45 211.3 152.9 83.52	x x1. x1. x1. x1. x1. x1. x1. x1. x2. x 9. x x 2. x x 2. x x x x 2. x x x 1. x1. x1. x1. x1. x1. x1. x1. x	1.3 /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ /[1/( 1.3 )+ 0.15 0.22 0.14	$\begin{bmatrix} 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0 \\ 0.04 \\ 0 \end{bmatrix}$	3.432 28.01 43.87 14.42 19.09 31.698 33.66 11.69		KJ/m²+ł		(26) (27) (27) (27) (27) (28) (29) (30)
Windov Windov Windov Floor Walls Roof 1 Roof 1 Total a *for window	ws Type ws Type ws Type ws Type Type1 Type2	1 2 3 4 240.3 83.5 154 ements	92 2 , m² pws, use e	87.9 0 0	3   ndow U-va	2.64 22.67 35.5 11.67 15.45 211.3 152.9 83.52 83.52 154 689.7 alue calcul	x x1. x1. x1. x1. x1. x1. x1. x2. x y9. x x x x 6.	$ \begin{array}{c} 1.3 \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ 0.15 \\ 0.22 \\ 0.14 \\ 0.14 \\ 0.14 \\ \end{array} $	$\begin{bmatrix} 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0 \\ 0.04 \\ 0.04 \end{bmatrix} = \begin{bmatrix} 0 \\ 0.04 \\ 0.04 \end{bmatrix}$	3.432 28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56				(26) (27) (27) (27) (27) (28) (29) (30) (30)
Window Window Window Floor Walls Roof T Roof T Total a * for window	ws Type ws Type ws Type ws Type Type1 Type2 urea of el- dows and i	1 2 3 4 240.1 83.5 154 ements roof windo	92 2 , m <sup>2</sup> ows, use e sides of ir	87.93 0 0 effective wi	3   ndow U-va	2.64 22.67 35.5 11.67 15.45 211.3 152.9 83.52 83.52 154 689.7 alue calcul	x x1 x1 x1 x1 x1 x1 x1 x1 x1 x1 x2 x2 x y9 x x2 x x x 6 ated using	$ \begin{array}{c} 1.3 \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ 0.15 \\ 0.22 \\ 0.14 \\ 0.14 \\ 0.14 \\ \end{array} $	$\begin{bmatrix} \\ 0.04 \\ \\ \\ 0.04 \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	3.432 28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56				(26) (27) (27) (27) (27) (28) (29) (30) (30)
Windov Windov Windov Floor Walls Roof 1 Roof 1 Total a * for winu ** includ Fabric	ws Type ws Type ws Type ws Type fype1 fype2 urea of el- dows and i le the areas	1 2 3 4 240.3 83.5 154 ements roof winde s on both s, W/K =	92 2 , m <sup>2</sup> ows, use e sides of ir = S (A x	87.93 0 0 effective wi	3   ndow U-va	2.64 22.67 35.5 11.67 15.45 211.3 152.9 83.52 83.52 154 689.7 alue calcul	x x1 x1 x1 x1 x1 x1 x1 x1 x1 x1 x2 x2 x y9 x x2 x x x 6 ated using	$ \begin{array}{c} 1.3 \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ 0.15 \\ 0.22 \\ 0.14 \\ 0.14 \\ 0.14 \\ 1 \\ 0.14 \\ 0.$	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	3.432 28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56	s given in	paragraph		(26) (27) (27) (27) (28) (29) (30) (30) (31)
Windov Windov Windov Floor Walls Roof 1 Roof 1 Total a * for winu ** includ Fabric Heat ca	ws Type ws Type ws Type ws Type Type1 Type2 area of el- dows and r dows and r te the areas heat loss	1 2 3 4 240.9 83.5 154 ements roof winde s on both s, W/K = Cm = S(	92 2 , m <sup>2</sup> ows, use e sides of ir = S (A x A x k )	87.93 0 0 offective wi aternal walk	3  ndow U-va ds and par	2.64 22.67 35.5 11.67 15.45 211.3 152.9 83.52 83.52 154 689.7 alue calculations	x x1. x1. x1. x1. x1. x1. x1. x2. x y9. x y9. x x x 6. x	$ \begin{array}{c} 1.3 \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ 0.15 \\ 0.22 \\ 0.14 \\ 0.14 \\ 0.14 \\ 1 \\ 0.14 \\ 0.$	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	3.432 28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56	[ ] ]	paragraph	3.2 207.44	(26) (27) (27) (27) (27) (28) (29) (30) (30) (31)
Windov Windov Windov Floor Walls Roof 1 Roof 1 Total a *for wind *for wind *for call Heat ca Therma For desig	ws Type ws Type ws Type ws Type rype1 Type2 urea of el- dows and r de the areas heat loss apacity C	1 2 3 4 240.9 83.5 154 ements roof winde s on both s, W/K = cm = S( parame ments wh	92 2 , m <sup>2</sup> bws, use e sides of ir = S (A x A x k ) ter (TMF ere the de	$\begin{bmatrix} 87.93\\ 0 \end{bmatrix}$	3  Indow U-va Is and par - TFA) ir	2.64 22.67 35.5 11.67 15.45 211.3 152.9 83.52 154 689.7 alue calculations	x x1. x1. x1. x1. x1. x1. x1. x2 x y2 x y2 x x x 6 ated using	$ \begin{array}{c} 1.3 \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ /[1/(1.3)+ \\ 0.15 \\ 0.22 \\ 0.14 \\ 0.14 \\ 0.14 \\ 0.14 \\ (26)(30) \end{array} $	$\begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	3.432 28.01 43.87 14.42 19.09 31.698 33.66 11.69 21.56 re)+0.04] a .(30) + (32 tive Value:	)   	paragraph (32e) =	207.44 34562.28	(26) (27) (27) (27) (27) (28) (29) (30) (30) (30) (31) (33) (33) (34)

		00	are not kr	nown (36) =	= 0.05 x (3	1)				(2.2)			r	<b>-</b>
	abric he									(36) =			269.27	(37)
Ventila	ation hea	r	alculated	d monthly	Í					= 0.33 × (	25)m x (5) I		1	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(00)
(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 t	ransfer (	coefficie	nt, W/K		i		i		(39)m	= (37) + (3	38)m	i	1	
(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		_
Heat le	oss para	ameter (I	HLP), W	/m²K				-		Average = = (39)m ÷		12 /12=	351.4	(39)
(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		_
Numb	er of day	ys in mo	nth (Tab	le 1a)			-	-	,	Average =	Sum(40)1.	12 /12=	1.17	(40)
	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. Wa	ater hea	ting ene	rgy requ	irement:								kWh/ye	ear:	
if TF		-		: [1 - exp	(-0.0003	849 x (TF	<sup>-</sup> A -13.9	)2)] + 0.(	0013 x ( <sup>-</sup>	TFA -13.		13	]	(42)
								(25 x N)				8.62		(43)
		-		usage by : r day (all w		-	-	to achieve	a water us	se target o	t			
normor				1					0		NL.	Du	1	
Hot wat	Jan er usage i	Feb	Mar	Apr ach month	May	Jun	Jul Table 1c x	Aug (43)	Sep	Oct	Nov	Dec		
	119.48	115.14	110.79	106.45	102.11	97.76	97.76	102.11	106.45	110.79	115.14	119.48	1	
(44)m=	119.40	115.14	110.79	106.45	102.11	97.70	97.70	102.11		Total = Su			1303.47	(44)
Energy	content of	f hot water	used - cai	culated mo	onthly $= 4$ .	190 x Vd,r	m x nm x D	0Tm / 3600					1303.47	
(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		_
lf instan	taneous v	vater heati	ing at point	t of use (no	hot water	storage),	enter 0 in	boxes (46		Total = Su	m(45) <sub>112</sub> =	=	1709.06	(45)
(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)
	storage												1	
-		. ,					-	within sa	ame ves	sel		400		(47)
Other Water	vise if ne storage	o stored loss:	hot wate	·	icludes i	nstantar	neous co	(47) ombi boil	ers) ente	er '0' in (	47)			
				oss facto	or is kno	wn (kWł	n/day):					0		(48)
Tempe	erature f	actor fro	m Table	2b								0		(49)
b) If n	nanufac	turer's d	eclared o	e, kWh/ye cylinder l	oss fact		known:	(48) x (49)	) =		4	00	]	(50)
		-	factor fi see secti	rom Tabl on 4.3	e 2 (kW	h/litre/da	iy)				0.	.01		(51)
		from Ta									0.	67		(52)
Tempe	erature f	actor fro	m Table	2b							0.	54		(53)
-			-	e, kWh/ye	ear			(47) x (51)	x (52) x (	53) =	1.	49		(54)
Enter	(50) or	(54) in ( <del></del>	55)								1.	49		(55)

Water	storage	loss cal	culated	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 cylind	er contains	s dedicate	d solar sto	orage, (57)	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	ix 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)
Primar	v circuit	loss (ar	Inual) fro	om Table	9 3	•				•		0		(58)
	•	•	,	for each		59)m = (	(58) ÷ 36	65 × (41)	m				I	
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	er heatii	ng and a	cylinde	r thermo	ostat)			
(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 ca	lculated	for each	n month (	(61)m =	(60) ÷ 36	65 × (41)	)m						
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	neat requ	uired for	water h	eating ca	alculated	for eac	h 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 DI	-IW input o	calculated	using App	endix G o	Appendix	KH (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)	'	
(add a	dditiona	l lines if	FGHRS	and/or \	WWHRS	applies	, see Ap	pendix (	G)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	t from w	ater hea	ter							-				
(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		-
								Outp	out from w	ater heate	r (annual)₁	12	2525.96	(64)
Heat g	ains fro	m water	heating	, kWh/m	onth 0.2	5 ´ [0.85	× (45)m	+ (61)m	n] + 0.8 x	k [(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)
inclu	ıde (57)	m in calo	culation	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	ater is fi	rom com	munity h	eating	
5. In	ternal ga	ains (see	e Table S	5 and 5a	):									
Metab	olic gain	s (Table	5), Wat	ts						-				
	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)
Lightin	g gains	(calcula	ted in A	opendix	L, equat	ion L9 o	r L9a), a	lso 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)
Applia	nces ga	ins (calc	ulated ir	n Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 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)
Cookir	ng gains	(calcula	ited in A	ppendix	L, equat	tion L15	or L15a)	), also se	e 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	s and fai	ns gains	(Table :	5a)										
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0		(70)
Losse	s e.g. ev	aporatio	n (nega	tive valu	es) (Tab	ole 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 (T	able 5)		-		-	-	-	-		-		
(72)m=	r		1	1	1		400.44		1		1	454.00	1	(72)
	153.79	151.28	146.07	138.99	134.39	127.91	122.41	129.46	131.97	139.3	147.58	151.29		(/
		151.28 gains =		138.99	134.39						147.58 (1)m + (72)			(/
				138.99 657.86	134.39 615.34						Į			(73)

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

Orientation:	Access Factor Table 6d	-	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	11.67	x	11.28	×	0.72	×	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)
Southwest0.9x	0.77	x	15.45	x	36.79	]	0.72	x	0.8	] =	226.91	(79)
Southwest0.9x	0.77	x	15.45	x	62.67	]	0.72	x	0.8	=	386.52	(79)
Southwest0.9x	0.77	x	15.45	x	85.75	]	0.72	x	0.8	] =	528.85	(79)
Southwest0.9x	0.77	x	15.45	x	106.25	]	0.72	x	0.8	=	655.27	(79)
Southwest0.9x	0.77	x	15.45	x	119.01	]	0.72	x	0.8	=	733.96	(79)
Southwest0.9x	0.77	x	15.45	x	118.15	]	0.72	x	0.8	=	728.65	(79)
Southwest0.9x	0.77	x	15.45	x	113.91	]	0.72	x	0.8	=	702.49	(79)
Southwest0.9x	0.77	x	15.45	x	104.39	]	0.72	x	0.8	=	643.79	(79)
Southwest0.9x	0.77	x	15.45	x	92.85	]	0.72	x	0.8	=	572.63	(79)
Southwest0.9x	0.77	x	15.45	x	69.27	]	0.72	x	0.8	=	427.18	(79)
Southwest0.9x	0.77	x	15.45	x	44.07	]	0.72	x	0.8	] =	271.79	(79)
Southwest0.9x	0.77	x	15.45	×	31.49	]	0.72	×	0.8	] =	194.19	(79)
Northwest 0.9x	0.77	x	22.67	×	11.28	×	0.72	x	0.8	] =	102.1	(81)
Northwest 0.9x	0.77	x	22.67	×	22.97	×	0.72	×	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	-											
Northwest 0.9x 0.77	×	22.67	x	67.9		×	0.72		0.8	=	614.94	(81)
Northwest 0.9x 0.77	×	22.67	x	91.3	35	x	0.72	×	0.8	=	826.6	(81)
Northwest 0.9x 0.77	x	22.67	x	97.3	38	x	0.72	×	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	72.6	63	x	0.72	x	0.8	=	657.21	(81)
Northwest 0.9x 0.77	x	22.67	x	50.4	42	x	0.72	x	0.8	=	456.26	(81)
Northwest 0.9x 0.77	x	22.67	x	28.0	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	×	22.67	x	9.2	1	x	0.72	x	0.8	=	83.38	(81)
Solar gains in watts, calcu	lated	for each mont	h			(83)m =	Sum(74)m .	(82)m				
(83)m= 902.96 1589.44 23	11.2	3092.4 3672.5	1 37	737.78 3	3565.4	3118.5	8 2579.52	1793.47	1090.89	766.69		(83)
Total gains – internal and	solar	(84)m = (73)m	1 + (	83)m , w	vatts		-					
(84)m= 1626.99 2311.16 30	08.9	3750.27 4287.8	5 4	313.7 4 <sup>-</sup>	116.69	3676.7	3 3158.98	2413.01	1756.64	1469.1		(84)
7. Mean internal tempera	ature (	heating seaso	n)									
Temperature during heat	ting pe	eriods in the liv	ving	area fro	m Tab	ole 9, T	<sup>-</sup> h1 (°C)				21	(85)
Utilisation factor for gains	s for li	ving area, h1,ı	n (s	ee Table	e 9a)							
Jan Feb I	Mar	Apr May	'	Jun	Jul	Aug	J 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 temperatu	re in li	iving area T1 (	follo	w steps	3 to 7	in Tal	ole 9c)					
	21	21 21	T	21	21	21	21	21	21	21		(87)
Temperature during heat		ariode in rest o	f du	elling fr	om Ta	hla Q	 Th2 (የር)					
	9.93	19.95 19.95	-	<u> </u>	19.96	19.97	- <u>,</u> ,	19.95	19.94	19.94		(88)
				I								( )
Utilisation factor for gains		i	-	<u> </u>		,	0.00	0.00	0.00			(80)
(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 temperatu	re in t	he rest of dwe	lling	T2 (follo	ow ste	ps 3 to	o 7 in Tabl	e 9c)			I	
(90)m= 19.93 19.93 19	9.93	19.95 19.95	1	9.96	19.96	19.97		19.95	19.94	19.94		(90)
							f	iLA = Livir	ig area ÷ (4	1) =	0.11	(91)
Mean internal temperatu	re (foi	the whole dw	ellin	g) = fLA	× T1 ·	+ (1 –	fLA) × T2					
(92)m= 20.04 20.04 20	0.04	20.06 20.06	2	20.07	20.07	20.08	20.07	20.06	20.06	20.05		(92)
Apply adjustment to the	mean	internal tempe	eratu	ire from	Table	4e, wl	nere appro	opriate	•			
(93)m= 20.04 20.04 20	0.04	20.06 20.06	2	20.07 2	20.07	20.08	20.07	20.06	20.06	20.05		(93)
8. Space heating require	ment											
Set Ti to the mean intern				l at step	11 of	Table	9b, so tha	t Ti,m=(	76)m an	d re-calc	ulate	
the utilisation factor for g	- 1			.		<u> </u>				_		
	Mar	Apr May	′	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains (94)m= $\begin{bmatrix} 1 & 0.99 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \end{bmatrix}$	1	I		0.42	0.20	0.24	0.62	0.02	0.00	1		(94)
(94)m= <u>1</u> 0.99 0 Useful gains, hmGm , W	.96			0.43	0.29	0.34	0.63	0.93	0.99	1		(94)
(95)m= 1624.34 2290.64 28	<u> </u>	<u> </u>	1	871.5 1	196.6	1260.2	8 1978.84	2254 30	1747 13	1467 65		(95)
Monthly average externa					100.0	1200.2	~   '0'0.04	2207.09	''''''''	1-01.00		
	6.5	8.9 11.7			16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean i												
		3924.15 2930.9	-	388.06 1	<u> </u>	1264.0		3316.52	4570.91	5628.1		(97)
, ,	-											

							<b>ergy</b> /h/year			Emiss kg CO2	<b>ion fac</b> 2/kWh	tor	Emissions kg CO2/yea	
12a. (	CO2 em	issions -	– Individ	lual heati	ing syste	ems inclu	uding mi	cro-CHP						
Total d	elivered	l energy	for all u	ses (211	)(221)	+ (231)	+ (232).	(237b)	=				7707.4	(338)
Electric	city for li	ighting											723.12	(232)
	-		above, I	kWh/yea	r			sum	of (230a).	(230g) =			1232.06	(231)
				nced, ext	-	ositive i	nput fron					1232.06		(230a)
Electric	city for p	oumps, fa	ans and	electric	keep-ho	t								
Water	heating	fuel use	d										2351.92	]
Space	heating	fuel use	ed, main	system	1								3400.3	
Annua	l totals									k	Wh/year		kWh/year	
(213)11-	220.00	202.04	210.0	102.00	100.10	170	104.2		I = Sum(2)		200.00	224.00	2351.92	(219)
(219)m (219)m=		m x 100 202.64	) ÷ (217) 213.5	)m 192.33	189.16	170	164.2	178.89	178.18	199.39	209.65	224.38		
		heating,	kWh/m	I onth										
(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)
 Efficier		ater hea		200.50	203.10	102.30	170.35	192.13	191.30	214.15	225.10	240.90	107.4	(216)
	heating from w		ter (calc 229.3	ulated al	bove) 203.16	182.58	176.35	192.13	191.36	214.15	225.16	240.98		J
·····				Ľ			Ľ		-	ar) =Sum(2	-		0	(215)
•		g fuel (se 01)] } x 1 0		ry), kWh/ )8) 0	month 0	0	0	0	0	0	0	0		
I		010.21	010.11	100.01	20.00	Ů	Ů	-	-	ar) =Sum(2			3400.3	(211)
(211)m	= {[(98 777.95	)m x (20 546.27	4)] } x 1 375.71	00 ÷ (20 136.91	29.98	0	0	0	0	204.74	526.76	801.98		(211)
	3002.6	2108.4	1450.11	528.43	115.7	0	0	0	0	790.23	2033.12	3095.37		(244)
Space		<u> </u>			,				0	700.00	0000 40	2005 27		
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Efficie	ency of s	seconda	ry/suppl	ementar	y heating	g systen	n, %			-			65	(208)
Efficie	ency of I	main spa	ace heat	ing syste	em 1								385.96	(206)
Fracti	on of to	tal heatir	ng from	main sys	stem 1			(204) = (20	02) × [1 –	(203)] =			1	(204)
Fracti	on of sp	ace hea	it from m	nain syst	em(s)			(202) = 1 -	- (201) =			ĺ	1	(202)
•	<b>e heatir</b> on of sp	-	it from s	econdar	y/supple	mentary	v system					[	0	(201)
9a. Ene	ergy rec	quiremen	nts – Ind	ividual h	eating sy	ystems i	ncluding	micro-C	HP)					_
Space	e heatin	g require	ement in	ı kWh/m²	/year							ĺ	43.56	(99)
								Tota	l per year	(kWh/year	) = Sum(9	8)15,912 =	13123.96	(98)
98)m=	3002.6	2108.4	1450.11	528.43	115.7	0	0 = 0.02	0	0	790.23	2033.12	3095.37		
Space	heatin	a require	ement fo	or each m	nonth k	Nh/mon	th = 0.02	24 x [(97)	)m – (95	m x (4)	1)m			

Space heating (secondary) $(215) \times$ $0.019 =$ $0$ (263)         Water heating $(219) \times$ $0.519 =$ $1220.64$ (264)         Space and water heating $(261) + (262) + (263) + (264) =$ $2985.4$ (265)         Electricity for pumps, fans and electric keep-hot $(231) \times$ $0.519 =$ $639.44$ (267)         Electricity for lighting $(232) \times$ $0.519 =$ $375.3$ (268)         Total CO2, kg/year       sum of (265)(271) = $4000.14$ (272)         Dwelling CO2 Emission Rate $(272) \div (4) =$ $13.28$ (273)						
Water heating $(219) \times$ $0.519$ $=$ $1220.64$ $(264)$ Space and water heating $(261) + (262) + (263) + (264) =$ $2985.4$ $(265)$ Electricity for pumps, fans and electric keep-hot $(231) \times$ $0.519$ $=$ $639.44$ $(267)$ Electricity for lighting $(232) \times$ $0.519$ $=$ $375.3$ $(268)$ Total CO2, kg/yearsum of $(265)(271) =$ $4000.14$ $(272)$ Dwelling CO2 Emission Rate $(272) \div (4) =$ $13.28$ $(273)$	Space heating (main system 1)	(211) x	0.519	=	1764.75	(261)
Notest notating $(201) + (202) + (263) + (264) =$ $(201) + (262) + (263) + (264) =$ $(2985.4) (265)$ Electricity for pumps, fans and electric keep-hot $(231) \times$ $0.519$ $=$ $639.44$ $(267)$ Electricity for lighting $(232) \times$ $0.519$ $=$ $375.3$ $(268)$ Total CO2, kg/yearsum of $(265)(271) =$ $4000.14$ $(272)$ Dwelling CO2 Emission Rate $(272) \div (4) =$ $13.28$ $(273)$	Space heating (secondary)	(215) x	0.019	=	0	(263)
Electricity for pumps, fans and electric keep-hot $(231) \times$ $0.519 =$ $639.44$ $(267)$ Electricity for lighting $(232) \times$ $0.519 =$ $375.3$ $(268)$ Total CO2, kg/yearsum of $(265)(271) =$ $4000.14$ $(272)$ Dwelling CO2 Emission Rate $(272) \div (4) =$ $13.28$ $(273)$	Water heating	(219) x	0.519	=	1220.64	(264)
Electricity for lighting       (232) x $0.519$ = $375.3$ (268)         Total CO2, kg/year       sum of (265)(271) = $4000.14$ (272)         Dwelling CO2 Emission Rate       (272) ÷ (4) =       13.28       (273)	Space and water heating	(261) + (262) + (263) +	(264) =		2985.4	(265)
Total CO2, kg/year       sum of (265)(271) = $4000.14$ (272)         Dwelling CO2 Emission Rate       (272) ÷ (4) =       13.28 (273)	Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	639.44	(267)
Dwelling CO2 Emission Rate $(272) \div (4) =$ $(272) \div (4) =$ $(273)$	Electricity for lighting	(232) x	0.519	=	375.3	(268)
	Total CO2, kg/year		sum of (265)(271) =		4000.14	(272)
El rating (section 14) 85 (274)	Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.28	(273)
	EI rating (section 14)				85	(274)

				User I	Details:						
Assessor Name:	Daniel Wa	tt			Strom	a Num	ber:		STRO	026464	
Software Name:	Stroma FS	AP 201	2		Softwa	are Vei	rsion:		Versio	on: 1.0.5.59	
			Pi	operty	Address	: The Sh	ingles- E	Be Greer	า		
Address :	The Shingle	es, Chelv	vey Batch	n, Back	well, BRI	STOL, E	3S48 3B	Z			
1. Overall dwelling dime	nsions:										
				Are	ea(m²)		Av. Hei	ight(m)	-	Volume(m <sup>3</sup> )	
Ground floor				2	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	a)+(1b)+(1c)+	(1d)+(1e	e)+(1n	)	301.27	(4)					
Dwelling volume						(3a)+(3b	)+(3c)+(3d	)+(3e)+	.(3n) =	810.5	(5)
2. Ventilation rate:											
	main heating		econdar neating	у	other		total			m <sup>3</sup> per hou	•
Number of chimneys	0	+	1	+	0	] = [	0	x 4	40 =	0	(6a)
Number of open flues	0	_ + _	0	<u> </u> + [	0		0	x 2	20 =	0	(6b)
Number of intermittent fa	ns					Ī	4	x ^	10 =	40	(7a)
Number of passive vents						Γ	0	x ^	10 =	0	(7b)
Number of flueless gas fi	res					Г	0	x 4	40 =	0	(7c)
						L					
									Air ch	anges per ho	ur
Infiltration due to chimne	ys, flues and f	ans = <mark>(6</mark>	a)+(6b)+(7	a)+(7b)+	(7c) =	Г	40	· [	÷ (5) =	0.05	(8)
If a pressurisation test has b			ed, proceed	l to (17),	otherwise	continue fr	rom (9) to (	16)			_
Number of storeys in th	ne dwelling (na	5)								0	(9)
Additional infiltration	<b>.</b>					_		[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0							uction			0	(11)
if both types of wall are pr deducting areas of openir			ponaing to	the grea	iter wall are	a (anter					
If suspended wooden f	loor, enter 0.2	(unseal	led) or 0.	1 (seal	ed), else	enter 0				0	(12)
If no draught lobby, en	ter 0.05, else	enter 0								0	(13)
Percentage of windows	s and doors di	aught st	ripped							0	(14)
Window infiltration					0.25 - [0.2	2 x (14) ÷ 1	= [00			0	(15)
Infiltration rate					(8) + (10)	+ (11) + (1	12) + (13) +	+ (15) =		0	(16)
Air permeability value,	q50, expresse	ed in cub	oic metre	s per h	our per s	quare m	etre of e	nvelope	area	5	(17)
If based on air permeabil	ity value, then	(18) = [(1	7) ÷ 20]+(8	), otherv	vise (18) =	(16)				0.3	(18)
Air permeability value applie		on test has	s been don	e or a de	egree air pe	rmeability	is being us	sed			_
Number of sides sheltere	d				(20) = 1 -	[0 075 v (1	10)1			2	(19)
Shelter factor						· ·	[9]]=			0.85	(20)
Infiltration rate incorporat	-				(21) = (18	) x (20) =				0.25	(21)
Infiltration rate modified for		1						N.L.		l	
	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp		i	,							I	
(22)m= 5.1 5	4.9 4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		

Wind F	actor (2	2a)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			
Adjuste	ed infiltra	ation rat	e (allow	ing for sl	nelter an	id wind s	peed) =	(21a) x	(22a)m						
<b>.</b>	0.32	0.32	0.31	0.28	0.27	0.24	0.24	0.24	0.25	0.27	0.29	0.3			
	ate effec echanica		-	rate for t	he appli	cable ca	se								
				endix N, (2	3h) - (23g		auation (N	N5)) other	nwieg (23h	) - (23a)			(		(23a)
			• • • •	ciency in %	, ,	, ,				) – (200)			(		(23b)
			•		•				,	⊃h.\	00k) [	4 (00 a)	(	)	(23c)
,	i							HR) (248	$\frac{a}{b} = \frac{2}{c}$	20)m + ( 0	$230) \times [$	1 – (23c) 0	÷ 100] ]		(24a)
(24a)m=	_		-						-		-	0			(244)
				entilation		1	<u> </u>	r Ó	ŕ	r í	<u>,                                     </u>		1		(24b)
(24b)m=		0	0	0	0	0	0	0	0	0	0	0			(24b)
,				ntilation of the	•	•				E (22h					
ا =(24c)m	r`´	0 0.5 ×	0		(231) = (231)			$\frac{c}{c} = (22t)$			0	0	1		(24c)
	÷	-	-	÷	-		-		-	0	0	0			(240)
,				ole hous )m = (221						0.51					
(24d)m=		0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54			(24d)
		change	rate - er	nter (24a	) or (24t	) or (24	L c) or (24	d) in boy	(25)				I		
(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	1		(25)
						1	1	I	I				1		
		s and he											_	A \/	
3. He ELEN		Gros	s	Openin Openin rr	gs	Net Ar A ,r		U-valı W/m2		A X U (W/I		k-value kJ/m²·I		A X kJ/k	
			s	Openin	gs	Net Ar A ,r 2.64	m²			A X U (W/					
ELEN Doors		Gros area	s	Openin	gs	A ,r	m <sup>2</sup>	W/m2	:K	(W/					K
ELEN Doors Windo	IENT	Gros area	s	Openin	gs	A ,r 2.64	m <sup>2</sup> x 2 x <sup>1</sup>	W/m2	K 0.04] =	(W/ 2.64					(26)
ELEN Doors Windo Windo	<b>IENT</b> ws Type	Gros area	s	Openin	gs	A ,r 2.64 19.32	m <sup>2</sup> x 2 x <sup>1</sup> / <sub>5</sub> x <sup>1</sup> / <sub>7</sub>	W/m2 1 /[1/( 1.4 )+	K 0.04] = 0.04] =	(W/ 2.64 25.61					(26) (27)
ELEN Doors Windov Windov Windov	<b>IENT</b> ws Type ws Type	Gros area 1 2 3	s	Openin	gs	A ,r 2.64 19.32 30.25	n <sup>2</sup> x 2 x <sup>1</sup> 5 x <sup>1</sup> x <sup>1</sup>	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+	K 0.04] = 0.04] = 0.04] =	(W/ 2.64 25.61 40.1	к)				<(26) (27) (27)
ELEN Doors Windov Windov Windov	<b>IENT</b> ws Type ws Type ws Type	Gros area 1 2 3	s	Openin	gs	A ,r 2.64 19.32 30.25 9.94	n <sup>2</sup> x 2 x <sup>1</sup> . 5 x <sup>1</sup> . 7 x <sup>1</sup> .	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+	K 0.04] = 0.04] = 0.04] =	(W/) 2.64 25.61 40.1 13.18	к)				<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> </ul>
ELEN Doors Windo Windo Windo Floor	<b>IENT</b> ws Type ws Type ws Type	Gros area 1 2 3	ss (m²)	Openin	gs 2	A ,r 2.64 19.32 30.25 9.94 13.17	n <sup>2</sup> x 2 x <sup>1</sup> / <sub>5</sub> x <sup>1</sup> / <sub>7</sub> x <sup>1</sup> / <sub>7</sub> x <sup>1</sup> / <sub>7</sub> 2 x	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+	K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	(W// 2.64 25.61 40.1 13.18 17.46	к)				<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> </ul>
ELEN Doors Windo Windo Windo Floor Walls	<b>IENT</b> ws Type ws Type ws Type ws Type	Gros area 1 2 3 4	92	Openin m	gs 2	A ,r 2.64 19.32 30.25 9.94 13.17 211.3	n <sup>2</sup> x x <sup>1</sup> . 5 x <sup>1</sup> . 5 x <sup>1</sup> . 7 x <sup>1</sup> . 2 x 5 x	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ 0.13	K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	(W// 2.64 25.61 40.1 13.18 17.46 27.4710	к)				<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> </ul>
ELEN Doors Windov Windov Windov	MENT ws Type ws Type ws Type ws Type Type1	Gros area 1 2 3 4 240.9	92 92	Openin m	gs 2	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6	n <sup>2</sup> x x <sup>1</sup> . 5 x <sup>1</sup> . 5 x <sup>1</sup> . 7 x <sup>1</sup> . 2 x 5 x	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ 0.13 0.18	K 0.04] =   0.04] =   0.04] =   0.04] =   0.04] =   =	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81	к)				<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> </ul>
ELEN Doors Windov Windov Floor Walls Roof	MENT ws Type ws Type ws Type ws Type Type1	Gros area 1 2 3 4 240.1 83.5 154	92 12	Openin m 75.3	gs 2	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6 83.52	n <sup>2</sup> x x <sup>1</sup> . 2 x <sup>1</sup> . 5 x <sup>1</sup> . 7 x <sup>1</sup> . 2 x 3 x 2 x 2 x 2 x 2 x	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ 0.13 0.18 0.13	K 0.04] =   0.04] =   0.04] =   0.04] =   =   =   =	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81 10.86	к)				<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> <li>(30)</li> </ul>
ELEN Doors Windo Windo Windo Windo Rindo Floor Walls Roof Roof Total a * for win	MENT ws Type ws Type ws Type ws Type fype1 fype2 area of e dows and	Gros area 1 2 3 4 240.1 83.5 154 Iements roof winder	92 92 12 1 1 1 1 1 1 1 1 1 1 1 1 1	Openin m 75.3 0 0	gs <sup>2</sup>  ndow U-va	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6 83.52 154 689.7 alue calcul	n <sup>2</sup> x x <sup>1</sup> . 2 x <sup>1</sup> . 5 x <sup>1</sup> . 7 x <sup>1</sup> . 2 x 5 x 2 x 6 x	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ 0.13 0.13 0.13	K 0.04] = 0.04] = 0.04] = 0.04] = = = = = =	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81 10.86 20.02	K)				<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> <li>(30)</li> <li>(30)</li> </ul>
ELEN Doors Windov Windov Windov Floor Walls Roof T Roof T Total a * for win ** includ	MENT ws Type ws Type ws Type ws Type fype1 fype2 area of e dows and	Gros area 1 2 3 4 240.9 83.5 154 lements roof windo is on both	92 92 12 14 15 15 15 15 15 15 15 15 15 15	Openin m 75.3 0 0 effective wi internal wal	gs <sup>2</sup>  ndow U-va	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6 83.52 154 689.7 alue calcul	m <sup>2</sup> x x1 2 x1 5 x1 7 x1 2 x 2 x 2 x 2 x 4 x 2 x 2 x 2 x 4 x 2 x 2 x 2 x 4 x 2 x 2 x 2 x 4 x 4 x 4 x 4 x 4 x 4 x 4 x 4	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ 0.13 0.13 0.13	K 0.04] =   0.04] =   0.04] =   0.04] =   1 =	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81 10.86 20.02	K)	kJ/m²-I	K	kJ/ł	<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> <li>(30)</li> <li>(30)</li> <li>(31)</li> </ul>
ELEN Doors Windov Windov Windov Floor Walls Roof Roof Total a * for win ** includ Fabric	MENT ws Type ws Type ws Type ws Type ws Type fype1 fype2 urea of e dows and le the area heat los	Gros area 1 2 3 4 240.1 83.5 154 lements roof winde s on both s, W/K =	92 92 92 92 92 92 92 92 92 93 92 93 92 93 92 93 92 93 92 94 93 92 94 93 92 94 94 95 92 95 92 95 92 95 92 95 92 95 92 95 92 95 92 95 92 95 95 92 95 95 95 95 95 95 95 95 95 95 95 95 95	Openin m 75.3 0 0 effective wi internal wal	gs <sup>2</sup>  ndow U-va	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6 83.52 154 689.7 alue calcul	m <sup>2</sup> x x1 2 x1 5 x1 7 x1 2 x 2 x 2 x 2 x 4 x 2 x 2 x 2 x 4 x 2 x 2 x 2 x 4 x 2 x 2 x 2 x 2 x 4 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ [ 0.13 0.13 0.13 0.13 1 formula 1	$\begin{array}{c} K \\ \hline \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ \hline \\ 0.04 \end{bmatrix} = \\ = \\ \hline \\ = \\ \\ (1/U-value) + (32) = \\ \end{array}$	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81 10.86 20.02	K)	kJ/m²-I	K	kJ/ł	<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> <li>(30)</li> <li>(30)</li> <li>(31)</li> </ul>
ELEN Doors Windov Windov Windov Floor Floor Walls Roof Roof Total a * for win ** includ Fabric Heat c	MENT ws Type ws Type ws Type ws Type ws Type fype1 fype2 urea of e dows and le the area heat los apacity (	Gross area 1 2 3 4 240.9 83.5 154 lements roof winders on both s, W/K = Cm = S(	92 92 92 , m <sup>2</sup> ows, use e sides of in = S (A x A x k )	Openin m 75.3 0 0 effective wi internal wal U)	gs <sub>2</sub> 2 ndow U-va Is and par	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6 83.52 154 689.7 alue calcul titions	m <sup>2</sup> x x1 2 x1 5 x1 7 x1 2 x 2 x 5 x 2 x 6 s ated using	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ [ 0.13 0.13 0.13 0.13 1 formula 1	$\begin{array}{c} K \\ \hline \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ 0.04 \end{bmatrix} = \\ = \\ \hline \\ = \\ \\ (1/U-value) + (32) = \\ ((28). \end{array}$	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81 10.86 20.02 re)+0.04] a	K)	kJ/m²-I	K	kJ/ł	<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> <li>(30)</li> <li>(30)</li> <li>(31)</li> <li>(33)</li> <li>(34)</li> </ul>
ELEN Doors Windov Windov Windov Floor Walls Roof T Roof T Total a * for win ** includ Fabric Heat c Therm For desi	MENT ws Type ws Type ws Type ws Type ws Type Type Type urea of e dows and le the area heat los apacity al mass	Gross area 1 2 3 4 240.9 83.5 154 lements roof winde is on both s, W/K = Cm = S( parame ments wh	92 92 92 92 92 92 92 92 92 92	Openin T T T T T T T T	gs 2 2 ndow U-va Is and par - TFA) ir	A ,r 2.64 19.32 30.25 9.94 13.17 211.3 165.6 83.52 154 689.7 alue calcul titions	n <sup>2</sup> x x x x x x x x x x 6 x x x x x x x x	W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ [0.13 0.13 0.13 0.13 1, (26)(30)	K = 0.04] =	(W// 2.64 25.61 40.1 13.18 17.46 27.4710 29.81 10.86 20.02 re)+0.04] a re)+0.04] a	K) 6 () as given in 2) + (32a). : Medium	kJ/m²-I	K	kJ/ł	<ul> <li>(26)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(27)</li> <li>(28)</li> <li>(29)</li> <li>(30)</li> <li>(30)</li> <li>(31)</li> </ul>

			are not kn	own (36) =	= 0.05 x (3	1)								
Total f	abric he	at loss							(33) +	(36) =			237.74	(37)
Ventila	ation hea	at loss ca	alculated	monthl	y				(38)m	= 0.33 × (	25)m x (5)		L	
	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 t	ransfer o	coefficier	nt, W/K						(39)m	= (37) + (3	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 =		12 /12=	381.95	(39)
	<u> </u>	`````	HLP), W/	i						= (39)m ÷			I	
(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	4.07	
Numb	er of day	vs in moi	nth (Tab	le 1a)					,	Average =	Sum(40)₁.	12 /12=	1.27	(40)
	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. Wa	ater heat	ting enei	rgy requi	irement:								kWh/ye	ear:	
A													I	
		ıpancy, l 9. N = 1	N + 1.76 x	[1 - exp	(-0.0003	49 x (TF		)2)] + 0.(	)013 x ( <sup>-</sup>	ΓFA -13.		13		(42)
	A £ 13.9	-		i onp	( 0.0000			/_/] · on			0)			
			ater usag									3.62		(43)
		-	hot water person per			-	-	to achieve	a water us	se target o	t			
							·	<u> </u>	San	Oct	Nov	Dee		
Hot wat	Jan er usage i	Feb	Mar day for ea	Apr ach month	May Vd.m = fa	Jun	Jul Table 1c x	Aug (43)	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		
(44)///-	119.40	115.14	110.79	100.43	102.11	97.70	57.70	102.11		Total = Su			1303.47	(44)
Energy	content of	hot water	used - cal	culated mo	onthly $= 4$ .	190 x Vd,r	m x nm x D	) ) ) ) ) ) ) ) ) ) ) ) ) ) ) ) ) ) )			· · ·		1000.47	
(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 = Su	m(45) <sub>112</sub> =		1709.06	(45)
lf instan	taneous w	ater heatii	ng 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)
	storage		includin		alar ar M		ctorago	within or				150		(47)
-		. ,	includin				-			561		150		(47)
	•	•	ind no ta hot wate		•			· · ·	ers) ente	er 'O' in (	47)			
	storage		not wate	/ (uno n		instantai	10003 00							
	-		eclared l	oss facto	or is kno	wn (kWł	n/day):				2.	52		(48)
Tempe	erature f	actor fro	m Table	2b							0.	54		(49)
Energ	y lost fro	m water	· storage	, kWh/ye	ear			(48) x (49)	) =		1.	36		(50)
			eclared o	•										
		-	factor fr		e 2 (kW	h/litre/da	ay)					0		(51)
	•	eating s from Ta	ee sectio	on 4.3									l	(50)
			bie ∠a m Table	2b								0		(52) (53)
			storage		aar			(47) x (51)	V (50) v (	53) -				
-		(54) in (5	-	, ixvii/yt	Jui			( +	, , (02) ^ (			0 36		(54) (55)
	. ,	. , (-	,								·	-		· · · · ·

Water	storage	loss cal	culated	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 cylinde	er contains	s dedicate	d solar sto	orage, (57)	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	lix 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)
Primar	y circuit	loss (ar	nual) fro	om Table	93			-		-		0	(58)
	•	•	,	for each		59)m = (	(58) ÷ 36	65 × (41)	m				•
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	er heati	ng and a	cylinde	r thermo	ostat)		_
(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 ca	lculated	for each	n month (	(61)m =	(60) ÷ 36	65 × (41	)m					
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
Total h	neat requ	uired for	water h	eating ca	alculated	l for eacl	h 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 DI	HW input of	calculated	using App	endix G o	Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)	
(add a	dditiona	l lines if	FGHRS	and/or \	WWHRS	applies	, see Ap	pendix (	G)				
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
Output	t from w	ater hea	ter										_
(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	
								Outp	out from w	ater heate	r (annual)₁	12	2480.31 (64)
Heat g	ains fro	m water	heating	, kWh/m	onth 0.2	5 ´ [0.85	× (45)m	ı + (61)m	n] + 0.8 x	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)
inclu	ude (57)	m in calo	culation	of (65)m	only if c	ylinder is	s in the o	dwelling	or hot w	ater is fi	rom com	munity h	leating
5. Int	ternal ga	ains (see	e Table 5	5 and 5a	):								
Metab					/								
	olic gain	s (Table	e 5), Wat			_			_				
	olic gain Jan	s (Table Feb	5), Wat Mar		Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	]
(66)m=				tts		Jun 156.68	Jul 156.68	Aug 156.68	Sep 156.68	Oct 156.68	Nov 156.68	Dec 156.68	(66)
	Jan 156.68	Feb 156.68	Mar 156.68	tts Apr	May 156.68	156.68	156.68	156.68	156.68				(66)
Lightin	Jan 156.68	Feb <sup>156.68</sup> (calcula	Mar 156.68 ted in Aj	Apr 156.68 Dpendix	May 156.68	156.68	156.68 r L9a), a	156.68	156.68				(66)
Lightin (67)m=	Jan 156.68 g gains 40.95	Feb 156.68 (calcula 36.37	Mar 156.68 ted in Aj 29.58	Apr 156.68 Dpendix	May 156.68 L, equat 16.74	156.68 ion L9 oi 14.13	156.68 r L9a), a 15.27	156.68 Iso see 19.85	156.68 Table 5 26.64	156.68 33.82	156.68	156.68	
Lightin (67)m=	Jan 156.68 g gains 40.95	Feb 156.68 (calcula 36.37	Mar 156.68 ted in Aj 29.58	tts Apr 156.68 opendix 22.39	May 156.68 L, equat 16.74	156.68 ion L9 oi 14.13	156.68 r L9a), a 15.27	156.68 Iso see 19.85	156.68 Table 5 26.64	156.68 33.82	156.68	156.68	
Lightin (67)m= Applia (68)m=	Jan 156.68 g gains 40.95 nces ga 459.29	Feb 156.68 (calcula 36.37 ins (calc 464.06	Mar 156.68 ted in Ap 29.58 ulated ir 452.05	tts Apr 156.68 opendix 22.39 Append	May 156.68 L, equat 16.74 dix L, eq 394.2	156.68 ion L9 of 14.13 uation L 363.87	156.68 r L9a), a 15.27 13 or L1 343.6	156.68 Iso see 19.85 3a), also 338.84	156.68 Table 5 26.64 see Ta 350.85	156.68 33.82 ble 5 376.42	156.68 39.48	156.68 42.08	(67)
Lightin (67)m= Applia (68)m=	Jan 156.68 g gains 40.95 nces ga 459.29	Feb 156.68 (calcula 36.37 ins (calc 464.06	Mar 156.68 ted in Ap 29.58 ulated ir 452.05	tts Apr 156.68 opendix 22.39 Append 426.48	May 156.68 L, equat 16.74 dix L, eq 394.2	156.68 ion L9 of 14.13 uation L 363.87	156.68 r L9a), a 15.27 13 or L1 343.6	156.68 Iso see 19.85 3a), also 338.84	156.68 Table 5 26.64 see Ta 350.85	156.68 33.82 ble 5 376.42	156.68 39.48	156.68 42.08	(67)
Lightin (67)m= Applia (68)m= Cookir (69)m=	Jan 156.68 g gains 40.95 nces ga 459.29 ng gains 38.67	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula	Mar 156.68 ted in A 29.58 ulated ir 452.05 ted in A 38.67	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat	156.68 ion L9 of 14.13 uation L 363.87 ion L15	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a)	156.68 Iso see 19.85 3a), also 338.84 ), also se	156.68 Table 5 26.64 9 see Ta 350.85 ee Table	156.68 33.82 ble 5 376.42 5	156.68 39.48 408.69	156.68 42.08 439.03	] (67) ] (68)
Lightin (67)m= Applia (68)m= Cookir (69)m=	Jan 156.68 g gains 40.95 nces ga 459.29 ng gains 38.67	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67	Mar 156.68 ted in A 29.58 ulated ir 452.05 ted in A 38.67	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat	156.68 ion L9 of 14.13 uation L 363.87 ion L15	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a)	156.68 Iso see 19.85 3a), also 338.84 ), also se	156.68 Table 5 26.64 9 see Ta 350.85 ee Table	156.68 33.82 ble 5 376.42 5	156.68 39.48 408.69	156.68 42.08 439.03	] (67) ] (68)
Lightin (67)m= Applia (68)m= Cookir (69)m= Pumps (70)m=	Jan           156.68           og gains           40.95           nces ga           459.29           ng gains           38.67           s and fair           3	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67 ns gains 3	Mar 156.68 ted in A 29.58 ulated ir 452.05 ted in A 38.67 (Table 5 3	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67 5a)	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat 38.67	156.68 ion L9 of 14.13 uation L 363.87 ion L15 38.67	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a) 38.67	156.68 Iso see 19.85 3a), also 338.84 ), also se 38.67	156.68 Table 5 26.64 see Ta 350.85 ee Table 38.67	156.68 33.82 ble 5 376.42 5 38.67	156.68 39.48 408.69 38.67	156.68 42.08 439.03 38.67	] (67) ] (68) ] (69)
Lightin (67)m= Applia (68)m= Cookir (69)m= Pumps (70)m=	Jan           156.68           og gains           40.95           nces ga           459.29           ng gains           38.67           s and fai           3           s e.g. ev	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67 ns gains 3 raporatic	Mar 156.68 ted in A 29.58 ulated ir 452.05 ted in A 38.67 (Table 5 3	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67 5a) 3	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat 38.67	156.68 ion L9 of 14.13 uation L 363.87 ion L15 38.67	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a) 38.67	156.68 Iso see 19.85 3a), also 338.84 ), also se 38.67	156.68 Table 5 26.64 see Ta 350.85 ee Table 38.67	156.68 33.82 ble 5 376.42 5 38.67	156.68 39.48 408.69 38.67	156.68 42.08 439.03 38.67	] (67) ] (68) ] (69)
Lightin (67)m= Applia (68)m= Cookir (69)m= Pumps (70)m= Losses (71)m=	Jan 156.68 19 gains 40.95 nces ga 459.29 ng gains 38.67 s and fai 3 s e.g. ev -125.34	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67 ns gains 3 raporatic	Mar 156.68 ted in A 29.58 ulated in 452.05 ited in A 38.67 (Table 9 3 on (nega -125.34	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67 5a) 3 tive valu	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat 38.67 3 es) (Tab	156.68 ion L9 of 14.13 uation L 363.87 ion L15 38.67 3 le 5)	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a 38.67 3	156.68 Iso see 19.85 3a), also 338.84 ), also se 38.67 3	156.68 Table 5 26.64 see Ta 350.85 ee Table 38.67 3	156.68 33.82 ble 5 376.42 5 38.67 3	156.68 39.48 408.69 38.67 3	156.68 42.08 439.03 38.67 3	] (67) ] (68) ] (69) ] (70)
Lightin (67)m= Applia (68)m= Cookir (69)m= Pumps (70)m= Losses (71)m=	Jan 156.68 19 gains 40.95 nces ga 459.29 ng gains 38.67 s and fai 3 s e.g. ev -125.34	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67 ns gains 3 aporatic -125.34	Mar 156.68 ted in A 29.58 ulated in 452.05 ited in A 38.67 (Table 9 3 on (nega -125.34	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67 5a) 3 tive valu	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat 38.67 3 es) (Tab	156.68 ion L9 of 14.13 uation L 363.87 ion L15 38.67 3 le 5)	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a 38.67 3	156.68 Iso see 19.85 3a), also 338.84 ), also se 38.67 3	156.68 Table 5 26.64 see Ta 350.85 ee Table 38.67 3	156.68 33.82 ble 5 376.42 5 38.67 3	156.68 39.48 408.69 38.67 3	156.68 42.08 439.03 38.67 3	] (67) ] (68) ] (69) ] (70)
Lightin (67)m= Applia (68)m= Cookir (69)m= Pumps (70)m= Losses (71)m= Water (72)m=	Jan 156.68 19 gains 40.95 nces ga 459.29 19 gains 38.67 5 and fai 3 s e.g. ev -125.34 heating 149.62	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67 ns gains 3 raporatic -125.34 gains (T	Mar 156.68 ted in A 29.58 ulated in 452.05 ted in A 38.67 (Table 5 able 5) 141.9	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67 5a) 3 tive valu -125.34	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat 38.67 3 es) (Tab -125.34	156.68 ion L9 of 14.13 uation L 363.87 ion L15 38.67 3 le 5) -125.34 123.75	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a 38.67 38.67 3 -125.34	156.68 Iso see 19.85 3a), also 338.84 ), also se 38.67 3 -125.34	156.68 Table 5 26.64 See Ta 350.85 De Table 38.67 3 -125.34	156.68 33.82 ble 5 376.42 5 38.67 3 -125.34 135.13	156.68 39.48 408.69 38.67 3 -125.34	156.68 42.08 439.03 38.67 3 -125.34 147.12	] (67) ] (68) ] (69) ] (70) ] (71)
Lightin (67)m= Applia (68)m= Cookir (69)m= Pumps (70)m= Losses (71)m= Water (72)m=	Jan 156.68 19 gains 40.95 nces ga 459.29 19 gains 38.67 5 and fai 3 s e.g. ev -125.34 heating 149.62	Feb 156.68 (calcula 36.37 ins (calc 464.06 (calcula 38.67 ns gains 3 raporatic -125.34 gains (T 147.11	Mar 156.68 ted in A 29.58 ulated in 452.05 ted in A 38.67 (Table 5 able 5) 141.9	tts Apr 156.68 opendix 22.39 Appendix 426.48 ppendix 38.67 5a) 3 tive valu -125.34	May 156.68 L, equat 16.74 dix L, eq 394.2 L, equat 38.67 3 es) (Tab -125.34	156.68 ion L9 of 14.13 uation L 363.87 ion L15 38.67 3 le 5) -125.34 123.75	156.68 r L9a), a 15.27 13 or L1 343.6 or L15a 38.67 38.67 3 -125.34	156.68 Iso see 19.85 3a), also 338.84 ), also se 38.67 3 -125.34	156.68 Table 5 26.64 See Ta 350.85 De Table 38.67 3 -125.34	156.68 33.82 ble 5 376.42 5 38.67 3 -125.34 135.13	156.68 39.48 408.69 38.67 3 -125.34 143.41	156.68 42.08 439.03 38.67 3 -125.34 147.12	] (67) ] (68) ] (69) ] (70) ] (71)

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

Orientation:	Access Factor Table 6d	r	Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	9.94	×	11.28	×	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	×	41.38	×	0.63	x	0.7	=	125.7	(75)
Northeast 0.9x	0.77	x	9.94	x	67.96	×	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	×	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	×	72.63	×	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	×	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	×	9.21	×	0.63	x	0.7	=	27.99	(75)
Southeast 0.9x	0.77	x	30.25	×	36.79	x	0.63	x	0.7	=	340.15	(77)
Southeast 0.9x	0.77	x	30.25	x	62.67	×	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	×	106.25	x	0.63	x	0.7	=	982.27	(77)
Southeast 0.9x	0.77	x	30.25	x	119.01	×	0.63	x	0.7	=	1100.23	(77)
Southeast 0.9x	0.77	x	30.25	×	118.15	×	0.63	x	0.7	=	1092.27	(77)
Southeast 0.9x	0.77	x	30.25	×	113.91	x	0.63	x	0.7	=	1053.07	(77)
Southeast 0.9x	0.77	x	30.25	×	104.39	×	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	×	0.63	x	0.7	=	407.42	(77)
Southeast 0.9x	0.77	x	30.25	×	31.49	×	0.63	x	0.7	=	291.1	(77)
Southwest0.9x		x	13.17	x	36.79		0.63	x	0.7	=	148.09	(79)
Southwest0.9x	0.77	x	13.17	x	62.67		0.63	x	0.7	=	252.26	(79)
Southwest0.9x	0.77	x	13.17	x	85.75	]	0.63	x	0.7	=	345.15	(79)
Southwest0.9x	0.77	x	13.17	×	106.25		0.63	x	0.7	=	427.65	(79)
Southwest0.9x	0.77	x	13.17	×	119.01		0.63	x	0.7	=	479.01	(79)
Southwest0.9x	0.77	x	13.17	x	118.15		0.63	x	0.7	=	475.54	(79)
Southwest0.9x		x	13.17	x	113.91		0.63	x	0.7	=	458.48	(79)
Southwest0.9x	0.77	x	13.17	×	104.39		0.63	x	0.7	=	420.16	(79)
Southwest0.9x	-	x	13.17	x	92.85		0.63	x	0.7	=	373.72	(79)
Southwest0.9x	0.77	x	13.17	x	69.27		0.63	x	0.7	=	278.8	(79)
Southwest0.9x	0.77	x	13.17	x	44.07		0.63	x	0.7	=	177.38	(79)
Southwest0.9x	0	x	13.17	x	31.49		0.63	x	0.7	=	126.74	(79)
Northwest 0.9x		x	19.32	×	11.28	×	0.63	x	0.7	=	66.62	(81)
Northwest 0.9x		x	19.32	×	22.97	×	0.63	×	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)

Northwoo	Г								1							
Northwes	Ļ	0.77	×	19.		x		57.96	X		0.63	⊣ × ⊢	0.7	=	401.24	(81)
Northwes		0.77	×	19.	32	x	g	1.35	X		0.63	_ × L	0.7	=	539.35	(81)
Northwes		0.77	x	19.	32	x	g	7.38	x		0.63	x	0.7	=	575	(81)
Northwes	st <mark>0.9x</mark>	0.77	×	19.	32	x	9	91.1	x		0.63	x	0.7	=	537.9	(81)
Northwes	st <u>0.9</u> x	0.77	x	19.	32	x	7	2.63	x		0.63	x	0.7	=	428.82	(81)
Northwes	st <u>0.9</u> x	0.77	X	19.	32	x	5	0.42	x		0.63	x	0.7	=	297.71	(81)
Northwes	st 0.9x	0.77	x	19.	32	x	2	8.07	x		0.63	x	0.7	=	165.72	(81)
Northwes	st <mark>0.9x</mark>	0.77	x	19.	32	x		14.2	x		0.63	x	0.7	=	83.82	(81)
Northwes	st <mark>0.9x</mark>	0.77	x	19.	32	x	9	9.21	x		0.63	x	0.7	=	54.4	(81)
Solar <u>ga</u>	ins in	watts, ca	alculated	for eac	h month	<u> </u>			(83)m	า = Sเ	um(74)m .	(82)m				
	589.14		1507.93					2326.19	2034	4.68	1682.99	1170.14	711.75	500.23		(83)
Total gai	ins – iı	nternal a	and solar	<sup>-</sup> (84)m =	= (73)m	+ (8	83)m	, watts						-		
(84)m=	1312	1757.58	2204.46	2674.3	3010.24	30	013.4	2876.31	2591	1.66	2261.28	1788.52	1376.34	1201.47		(84)
7. Mear	n inter	nal temp	perature	(heating	seasor	า)										
Tempe	rature	during h	neating p	eriods i	n the livi	ng	area	from Tab	ole 9	, Th′	1 (°C)				21	(85)
Utilisati	ion fac	tor for g	ains for I	living are	ea, h1,m	n (s	ee Ta	ble 9a)								
	Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
(86)m=	1	1	0.99	0.97	0.88	(	0.72	0.56	0.6	63	0.88	0.99	1	1		(86)
Mean ir	nterna	I temper	ature in	living ar	ea T1 (f	ollo	w ste	ps 3 to 7	7 in T	able	e 9c)		•			
_	19.44	19.65	19.97	20.38	20.73	-	20.93	20.98	20.		20.81	20.33	19.8	19.4		(87)
Tompo	ratura	durina k	neating p	oriode i	roct of	dw	olling	from To		 0 Tk	2 (°C)			I	1	
·	19.86	19.86	19.86	19.87	19.87	-	9.87	19.87	19.	-	19.87	19.87	19.86	19.86	]	(88)
										•			10100			()
			ains for		<u> </u>	-		i	r Ó						1	(00)
(89)m=	1	1	0.99	0.95	0.84		0.63	0.43	0.	5	0.81	0.98	1	1		(89)
Mean ir	nterna	l temper	ature in	the rest	of dwell	ing	T2 (f	ollow ste	eps 3	8 to 7	' in Tabl	e 9c)			1	
(90)m=	17.77	18.07	18.54	19.13	19.6	1	9.82	19.87	19.	86	19.71	19.07	18.3	17.72		(90)
											f	LA = Livii	ng area ÷ (4	4) =	0.11	(91)
Mean ir	nterna	l temper	ature (fo	r the wh	ole dwe	ellin	g) = fl	LA × T1	+ (1	– fL	A) × T2					
(92)m=	17.94	18.24	18.69	19.26	19.72	1	9.94	19.99	19.	98	19.83	19.2	18.46	17.9		(92)
Apply a	adjustn	nent to t	he mear	interna	l tempei	ratu	ire fro	m Table	4e,	whe	re appro	opriate				
(93)m=	17.94	18.24	18.69	19.26	19.72	1	9.94	19.99	19.	98	19.83	19.2	18.46	17.9		(93)
8. Spac	ce hea	ting requ	uirement													
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																
the utili		1	<u> </u>		1	Г					-	<b>0</b> /			1	
	Jan	Feb	Mar	Apr	Мау		Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
(94)m=	1		ains, hm 0.98	0.94	0.83		0.63	0.44	0.5	51	0.81	0.97	1	1		(94)
	' nains	hmGm	, W = (94			<u> </u>	5.00	0.44	0.0		0.01	0.57		1		(0.)
	-		2168.37		<u> </u>	19	10.04	1267.51	1324	4.19	1826.11	1738.72	1371.82	1200.48		(95)
			ernal tem						I	-					1	
(96)m=	4.3	4.9	6.5	8.9	11.7	1	14.6	16.6	16	.4	14.1	10.6	7.1	4.2		(96)
	ss rate	e for me	an intern	al temp	erature,	Lm	, W =	- =[(39)m :	x [(9	 3)m-	- (96)m	]	1	1	1	
_		5135.15	-	· ·	· · · ·	-		1284.03	<u> </u>	<del></del>	2176.72	3281.91	4343.15	5251.32		(97)
L															1	

Space	e neatin	y require	ementic	n each n	IOIIIII, KI		II = 0.02	4 X [(97	)iii – (95	))))] X (4	1)111			
(98)m=	2938.81	2275.21	1874.01	1037.64	417.91	0	0	0	0	1148.14	2139.35	3013.82		_
								Tota	l per year	(kWh/year	r) = Sum(9	8)15,912 =	14844.9	(98)
Spac	e heatin	g require	ement in	kWh/m²	/year							[	49.27	(99)
9a. En	ergy rec	quiremer	nts – Ind	ividual h	eating s	ystems i	ncluding	micro-C	CHP)					
•	e heatii	-			, .							r		<b>1</b>
	-			econdar		mentary	-	(222)	(22.1)				0	(201)
Fraction of space heat from main system(s) $(202) = 1 - (201) =$ The state of th										1	(202)			
Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$										1	(204)			
	-			ing syste									93.5	(206)
Efficie	ency of s	seconda	ry/suppl	ementar	y heating	g system	ı, %						0	(208)
_	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Space	r	ř – –	· · · ·			i i	0	0		4440.44	0400.05	2042.02		
(= , , )		2275.21		1037.64	417.91	0	0	0	0	1148.14	2139.35	3013.82		
(211)m	r	)m x (20 2433.38	1	00 ÷ (20 1109.77	96) 446.97	0	0	0	0	1227.95	2288.08	3223.34		(211)
	3143.12	2433.30	2004.29	1109.77	440.97	0	0			ar) = Sum(2)			15876.9	(211)
Snac	o hoatin	a fual (s	econdar	y), kWh/	month						- · · / 15,1012	2	13070.9	](211)
•		•	00 ÷ (20	• • •	monun									
(215)m=	í	0	0	0	0	0	0	0	0	0	0	0		
								Tota	l (kWh/yea	ar) =Sum(2	215) <sub>15,1012</sub>	F	0	(215)
Water	heating	9										L		-
Output				ulated a										
<b>F</b> #isis	242.7	214.14	225.42	202.81	199.28	178.83	172.48	188.26	187.61	210.27	221.41	237.11		
		ater hea	89.22	88.56	86.74	79.8	70.9	70.0	70.0	00.66	00.20	00.62	79.8	(216) (217)
(217)m=			kWh/m		00.74	79.8	79.8	79.8	79.8	88.66	89.38	89.62		(217)
		•	) ÷ (217)											
(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		_
								Tota	l = Sum(2	19a) <sub>112</sub> =			2882.38	(219)
	al totals									k	Wh/year	Г	kWh/year	7
				system	1								15876.9	ļ
Water	heating	fuel use	ed										2882.38	
Electri	city for p	oumps, f	ans and	electric	keep-ho	t								
central heating pump: 30								30		(230c)				
boiler with a fan-assisted flue 45									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)					

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

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

	<b>Energy</b> kWh/year	Emission factor kg CO2/kWh	<b>Emissions</b> 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)