Energy and Sustainability Statement



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Innisfree, East Horsley Energy and Sustainability Statement



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1 EXECUTIVE SUMMARY

This report considers the energy and sustainability measures to be incorporated within the proposed development in East Horsley. This document reviews the requirements at both national and local level, as set out in the National Planning Policy Framework (2023), the Guildford Local Plan: Strategy and Site (Adopted April 2019) and the Guildford Local Plan: Development Management Policies (Adopted March 2023)

The recommended sustainability features for the development, resulting from a dynamic energy model, will allow for an 100.37% reduction in carbon emission from a base Part L 2021 compliant build, this is anticipated through the incorporation of water Source Heat Pumps and passive energy efficiency measures. The sustainability features used will allow for over 100% regulated energy used on site sourced from renewable means such as PV and WSHP. A total of 79.13 kWp PV has been proposed for the development, which is in line with the local planning policy. The energy and carbon savings are to be achieved through passive design, energy efficient measures incorporating design features such as energy efficient lighting, submetering of relevant areas, upgrading of 'U' values and occupancy sensing in relative areas, as well as the incorporation of Water Source Heat Pumps. The proposed heating source for this development is 100% electric through use of WSHP. To reduce the energy demand of the development as well as help to conserve water resources within the local area, it is anticipated that the fit-out works will provide for sanitary fittings which will be water efficient through measures such as dual flush toilets and low flow taps.

The development is located within East Horsley and as such is in proximity to public transport nodes, as well as a range of primary local amenities such as food outlets. These features allow for the reduction of car-based travel and transport related pollution.

The incorporation of these sustainability measures allows for the proposed development to be deemed sustainable whilst targeting compliance with local and national policy.

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2 INTRODUCTION

This report has been prepared by Cudd Bentley Consulting Ltd, to investigate the issues of energy and sustainability surrounding the development in East Horsley.

Government policies now require significant energy reductions from proposed buildings. Building a greener future sets a planned trajectory outlined via Part L 2021 of the Building Regulations. These commitments have been the key focus point in addressing policies and strategies to reduce energy use and carbon emissions through energy efficiency and low or zero carbon technologies (LZC).

The recommended strategy takes into consideration the site layout and requirements for the building to produce a design that incorporates the most appropriate technologies available to the site that are commercially viable, whilst targeting compliance with all policies applicable to this development.

The proposed development in East Horsley is a residential dwelling. A detailed overview of the scheme is presented in the Design & Access Statement.

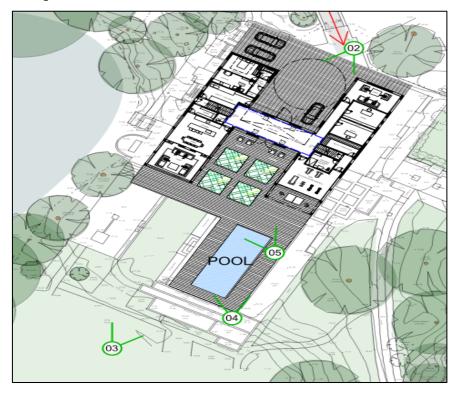


Figure 2.1: Proposed Site Plan

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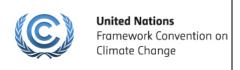
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3 DRIVERS OF SUSTAINABILITY

The term Sustainable Development, is defined by the Department for the Environment, Food and Rural Affairs as:

'... making sure people throughout the world can satisfy their basic needs now, while making sure that future generations can also look forward to the same quality of life. It recognises that the "three pillars" – economy, society and environment – are interconnected.'



To achieve this objective of sustainable development in any industry, sector strict regulations have been put in place that have filtered down through EU Directives from the European Climate Change Programme, to National UK Acts such as the Climate Change Act 2008, to Local Policy in the form of Core

Strategies. However, there are larger drivers behind the concept of sustainable development.

Kyoto Protocol

In 1997, the Kyoto Protocol was adopted as part of the United Nations Framework Convention on Climate Change, to which the UK is a signatory. The key feature of the protocol was the binding targets that were set for industrialised countries to reduce their Green House Gas emissions by 12.5% below 1990 levels by 2008-2012.

Cancun Agreements

Since the initial adoption of the Kyoto Protocol, extensive research has been put forward as to the causes and markers of climate change from the Intergovernmental Panel on Climate Change, which has led to new targets and objectives being made. In 2012, the international community met to discuss new directions for responding to climate change by adopting new agreements. The key objectives of the Cancun Agreements are:

- Establish clear objectives for reducing human-generated greenhouse gas emissions over time to keep the global average temperature rise below two degrees.
- Mobilise the development and transfer of clean technology to boost efforts to address climate change, getting it to the right place at the right time and for the best effect.
- Assist the particularly vulnerable people in the world to adapt to the inevitable impacts of climate change.
- Protect the world's forests, which are a major repository of carbon.
- Establish effective institutions and systems which will ensure these objectives are implemented successfully.

COP21: Paris Global Climate Agreement

In December 2015, a global climate deal was reached in a summit involving all of the world's nations. The targets of this aimed principally to curb the dangerous levels of climate change and drive an increase low-carbon infrastructure investment. Numerous organisations and corporations also committed to helping create a greener future by making their own pledges through the course of the summit. The key elements of the agreement are:

- To keep global temperatures "well below" 2.0°C above pre-industrial times and "endeavour to limit" them even more, to 1.5C
- To limit the amount of greenhouse gases emitted by human activity to the same levels that trees, soil and oceans can absorb naturally, beginning at some point between 2050 and 2100
- To review each country's contribution to cutting emissions every five years so they scale up to the challenge
- For rich countries to help poorer nations by providing "climate finance" to adapt to climate change and switch to renewable energy.

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BRE's COP21 Climate Pledge (December 2015)

"We commit to continue to drive best practice and carbon reduction, as we have through the use of BREEAM for the past 25 years. By reaching over 9,000 BREEAM rated buildings we predict emissions savings will be in excess of 900,000 tonnes of CO₂, compared to regulatory minimum performance requirements, by 2020. Saving not only carbon but bringing wider benefits to both the owner and occupiers."

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4 NATIONAL POLICY

National Planning Policy

An effective planning system is required to contribute to achieving sustainable development. The *National Planning Policy Framework* (NPPF), 2023, outlines what the government deems as sustainable development in England.

Sustainable development is defined as having the following three overarching objectives which are interdependent and need to be pursued in mutually supportive ways: an economic objective, a social objective, and an environmental objective.

- 1. Economic objective to help build a strong, responsive, and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation, and improved productivity; and by identifying and coordinating the provision of infrastructure.
- 2. Social objective to support strong, vibrant, and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and
- 3. Environmental objective to contribute to protecting and enhancing our natural, built, and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

The above objectives can be described as an energy trilemma, this is demonstrated in Figure 4.1 below. Each dimension is dependent on each other, and sustainable development proposals should adhere to each role. This energy statement shall ensure the proposed Development is one that contributes economically, socially, and environmentally in accordance with the NPPF, 2023.

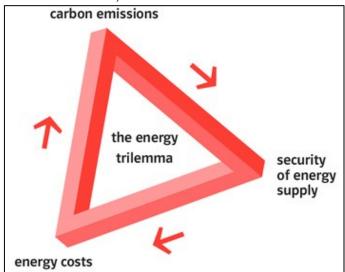


Figure 4.1 The Energy Trilemma

Guidance has been followed from the (NPPF), 2023, to provide an energy strategy which reduces energy use and carbon emissions, in line with best practice. This will provide a balanced scheme which focuses on optimal use of non-renewable resources (energy efficiency measures) whilst providing a renewable energy strategy best suited

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to the sites and their building uses. Below are some key extracts relevant to the development from Chapter fourteen 'Meeting the Challenge of Climate Change, Flooding & Coastal Change':

Paragraph 158

Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

Paragraph 159

New development should be planned for in ways that:

- a. avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and
- b. can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

Paragraph 160

To help increase the use and supply of renewable and low carbon energy and heat, plans should:

- a. provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);
- b. consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
- c. identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for locating potential heat customers and suppliers.

Paragraph 161

Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

Paragraph 162

In determining planning applications, local planning authorities should expect new development to:

- a. comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
- b. take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

Paragraph 163

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When determining planning applications for renewable and low carbon development, local planning authorities should:

- a. not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and
- b. approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

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5 LOCAL POLICY

This section aims to highlight guidance available and the minimum requirements at local level from Guildford Local Plan, which states the Council's vision, spatial strategy, and policies for the future development of the area.

Guildford Local Plan: Development Management Policies

POLICY D16: Carbon Emissions from Buildings

- 1) The development of low and zero carbon and decentralised energy, including low carbon heat distribution networks, is strongly supported and encouraged.
- 2) Where low carbon heat distribution networks already exist, new developments are required to connect to them or be connection-ready unless it can be clearly demonstrated that utilizing a different energy supply would be more sustainable or connection is not feasible.
- 3) Proposals for development within Heat Priority Areas as shown on the Policies Map and all sufficiently large or intensive developments must demonstrate that low carbon heat networks have been given adequate consideration as the primary source of heat.
- 4) New buildings must achieve an emission rate no higher than the relevant Target Emission Rate (TER) set out in the Building Regulations (Part L).

POLICY D17: Renewable and Low Carbon Energy Generation and Storage

- 1) Proposals for renewable and low carbon energy generation and energy storage development, covering both power and heat, will be supported, with strong support for community-led initiatives.
- 2) Where such development is proposed in the Green Belt, climate change mitigation and other benefits will be taken into account when considering whether very special circumstances exist.
- 3) Proposals are required to demonstrate that the design of the scheme has sought to minimise visual impacts and that the management of the site will maximise opportunities for biodiversity while avoiding practices that are harmful to biodiversity.
- 4) For temporary permissions, provision must be made for the decommissioning of the infrastructure and associated works and the full restoration of the site once operation has ceased.

POLICY P11: Sustainable Surface Water Management

All development proposals

- 1) Drainage schemes are required to intercept as much rainwater and runoff as possible, including runoff from outside the site.
- 2) Development proposals are required to maximise the use of permeable surfaces across the development site.
- 3) Drainage schemes are expected to avoid the use of boreholes or other deep structures for the discharge of surface water to ground, except for clean roof water.

POLICY D14: Sustainable and Low Impact Development

Fabric first

1) Development proposals are required to demonstrate how they have followed a 'fabric first' approach in line with the energy hierarchy.

Embodied carbon

2) Development proposals are required to demonstrate that embodied carbon emissions have been minimised by:

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- a. sourcing materials locally where possible; and
- b. taking into account the embodied carbon emissions of materials based on information provided in a respected materials rating database.

Energy improvements

4) Development proposals that will improve the energy efficiency and carbon emission rate of existing buildings to a level significantly better than the Council's adopted standards or national standards for new buildings, whichever is most challenging, are encouraged.

Waste

5) Proposals for major development, and development proposals that involve the demolition of at least one building and/or engineering works that involve the importation or excavation of hard core, soils, sand and other material, are required to submit a Site Waste Management Plan.

POLICY P4: Flooding, flood risk and groundwater protection zones

- 1) Flood zones in the borough of Guildford are defined based on definitions contained within national planning practice guidance and the Council's Strategic Flood Risk Assessment (Level 1).
- 2) Development in areas at medium or high risk of flooding, as identified on the latest Environment Agency flood risk maps and the Council's Strategic Flood Risk Assessment, including the 'developed' flood zone 3b (functional floodplain), will be permitted provided that:
 - a) the vulnerability of the proposed use is appropriate for the level of flood risk on the site
 - b) the proposal passes the sequential and exception test (where required) as outlined in the NPPF and Government guidance.
 - c) a site—specific flood risk assessment demonstrates that the development, including the access and egress, will be safe for its lifetime, taking into account climate change, without increasing flooding elsewhere, and where possible, will reduce flood risk overall.
 - d) the scheme incorporates flood protection, flood resilience and resistance measures appropriate to the character and biodiversity of the area and the specific requirements of the site.
 - e) when relevant, appropriate flood warning and evacuation plans are in place and approved.
- 3) Development proposals in the 'developed' flood zone 3b will also only be approved where the footprint of the proposed building(s) is not greater than that of the existing building(s) and there will be no increase in development vulnerability. Proposals within these areas should facilitate greater floodwater storage.
- 4) With the exception of the provision of essential infrastructure, 'undeveloped' flood zone 3b will be safeguarded for flood management purposes.
- 5) All development proposals are required to demonstrate that land drainage will be adequate and that they will not result in an increase in surface water run-off. Proposals should have regard to appropriate mitigation measures identified in the Guildford Surface Water Management Plan or Ash Surface Water Study. Priority will be given to incorporating SuDs (Sustainable Drainage Systems) to manage surface water drainage

POLICY D11: Noise Impacts

1) Development proposals for noise sensitive uses are required to clearly identify any likely adverse noise impacts on the sensitive receptors that are intended to use or occupy the development from existing nearby sources of noise.

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- Development proposals for noise generating uses are required to clearly identify any likely adverse
 noise impacts arising from the proposed development on existing nearby sensitive receptors, including
 the natural environment.
- 3) Where consideration under (1) or (2) indicates the potential for Observed Adverse Effect Levels of noise, planning applications are required to include a Noise Impact Assessment, which considers the relationship in detail.
- 4) Where evidence of an Observed Adverse Effect Level noise impact exists, as defined in the Noise Exposure Hierarchy, the applicant is required to demonstrate how the proposed development proposal will be designed and implemented in order to:
 - a) prevent any present and very disruptive Significant Observed Adverse Effect levels,
 - b) avoid any present and disruptive Significant Observed Adverse Effect levels; and
 - c) mitigate any present and intrusive Lowest Observed Adverse Effect levels.
- 5) The applicant proposing the development proposal (or 'agent of change') is responsible for ensuring that:
 - a) all potential Observed Adverse Effect Levels of noise, either impacting on or emanating from the proposed development proposal, are identified, and
 - b) the prevention, avoidance and/or mitigation measures required to manage those noise impacts are implemented effectively.
- 6) A Verification Report is required to be submitted to the Council and approved prior to the development's occupation or use, which demonstrates the agreed avoidance and mitigation measures have been implemented effectively.
- 7) Where there will be an unacceptable adverse effect on sensitive receptors which cannot be adequately prevented, avoided, and/or mitigated, the planning application will be refused.

POLICY P12: Regionally Important Geological / Geomorphological Sites

- 1) Development proposals that are likely to materially harm the conservation interests of Regionally Important Geological/Geomorphological Sites (RIGS) as shown on the Policies Map, and any unmapped features that meet the definition of a RIGS, are required to demonstrate that the need for the development clearly outweighs the impact on the conservation interests.
- 2) Development proposals are required to make every effort to prevent harm to the conservation interests of the RIGS through avoidance measures. Where this is not possible, every effort is required be made to minimise harm through mitigation measures. The applicant is required to demonstrate that any necessary avoidance and mitigation measures will be implemented and maintained effectively.

Guildford Local Plan: Strategy and Sites

POLICY D2: Climate Change, sustainable design, construction and energy

Sustainable design and construction

- Proposals for zero carbon development are strongly supported. Applications for development, including refurbishment, conversion and extensions to existing buildings should include information setting out how sustainable design and construction practice will be incorporated including (where applicable):
 - a) the efficient use of mineral resources and the incorporation of a proportion of recycled and/or secondary aggregates
 - b) waste minimisation and reusing material derived from excavation and demolition

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- c) the use of landform, layout, building orientation, massing and landscaping to reduce energy consumption
- d) water efficiency that meets the highest national standard and
- e) measures that enable sustainable lifestyles for the occupants of the buildings, including electric car charging points.
- 2) When meeting these requirements, the energy and waste hierarchies should be followed except where it can be demonstrated that greater sustainability can be achieved by utilising measures further down the hierarchy.
- 3) Major development should include a sustainability statement setting out how the matters in this policy have been addressed. Smaller developments should include information proportionate to the size of the development in the planning application.

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6 ENERGY USAGE AND CARBON EMISSIONS

Government policies require significant energy reductions from buildings. Building a Greener Future sets a planned trajectory (delivered via Part L of the building regulations 2021) with an aspiration for all non-domestic new buildings to be zero carbon by 2020. The Climate Change Act (Nov 2008) sets the UK targets of; CO_2 reduction of 26% by 2020 and CO_2 reduction of 80% by 2050.

6.1 POLICY REVIEW

National Planning Policy Framework (2023)

Paragraph 160 – Meeting the Challenge of Climate Change, Flooding and Coastal Change

To help increase the use and supply of renewable and low carbon energy and heat, plans should;

- a. provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);
- b. consider identifying suitable areas for renewable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
- c. identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for collocating potential heat customers and suppliers.

Guildford Local Plan: Development Management Policies

POLICY DE16: Carbon Emissions from Buildings

- 1) The development of low and zero carbon and decentralised energy, including low carbon heat distribution networks, is strongly supported and encouraged.
- 2) Where low carbon heat distribution networks already exist, new developments are required to connect to them or be connection-ready unless it can be clearly demonstrated that utilizing a different energy supply would be more sustainable or connection is not feasible.
- 3) Proposals for development within Heat Priority Areas as shown on the Policies Map and all sufficiently large or intensive developments must demonstrate that low carbon heat networks have been given adequate consideration as the primary source of heat.
- 4) New buildings must achieve an emission rate no higher than the relevant Target Emission Rate (TER) set out in the Building Regulations (Part L).

Policy D17: Renewable and Low Carbon Energy Generation and Storage

- 1) Proposals for renewable and low carbon energy generation and energy storage development, covering both power and heat, will be supported, with strong support for community-led initiatives.
- 2) Where such development is proposed in the Green Belt, climate change mitigation and other benefits will be taken into account when considering whether very special circumstances exist.
- 3) Proposals are required to demonstrate that the design of the scheme has sought to minimise visual impacts and that the management of the site will maximise opportunities for biodiversity while avoiding practices that are harmful to biodiversity.
- 4) For temporary permissions, provision must be made for the decommissioning of the infrastructure and associated works and the full restoration of the site once operation has ceased.

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6.2 DEVELOPEMENT SUSTAINABILITY FEATURES

Energy modelling has been undertaken which adopts the following hierarchy for reducing carbon emissions for the development; Be Lean, Be Clean, Be Green.

The total baseline energy and carbon emissions for the development (built to Part L 2021), taking into account regulated energy demands are:

- 587,191.76 kWh/annum
- 7.45 Tonnes CO₂/annum

The primary energy demands of the development will be:

- Lighting;
- General power;
- Heating and ventilation;
- Cooling
- Hot water supply.

Unregulated energy use is not covered by existing regulations and includes energy consumed by the occupants through activities and appliances; in this case it would typically be small power usage (appliances, computers etc.). The following unregulated energy use for the development was calculated:

- 36,732 kWh/annum
- 20.10 Tonnes CO₂/annum

Be Lean

To provide energy and carbon saving further to a base Part L (2021) build; targeting compliance with local and national policies, the following passive design and energy efficiency measures are recommended.

The following 'U' values shall be incorporated within the development, in accordance with Part L1 (2021):

U – Values targeted for the development:

Feature	Applied U – Value for New Build Residential (W/m².K)
External Walls	0.14
Exposed Floors	0.10
Exposed Roofs	0.11
Triple Glazing	0.8 (with a g value of 0.36)
Doors	1
Air Permeability	1 m³/hr/m²@ 50 Pa

Together with the above passive design measures, the proposed energy strategy includes the following energy efficiency measures throughout the development:

- The provision of energy efficient lighting
- The provision of zonal thermal and lighting controls;
- The provision of variable speed pumps and fans;

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- The enhancement of pipework and ductwork, thermal insulation;
- Specific Fan Powers improved beyond Part L requirements.

Be Clean

It was investigated to establish if there were any existing decentralised energy networks near the proposed site using the Department of Energy and Climate Change CHP database. It has been concluded that there are no suitable existing nearby CHP systems or source of waste heat or power to which a connection may be possible.

In order to economically justify installing a CHP unit on any site, a minimum requirement of 4,000 hours running time per year is necessary. Based on the building types being residential, there is a low heating and hot water demand for a continuous period over the year, typically a maximum of circa 2,117 hours is anticipated.

Months	Load per Day (hrs)	Load per week (hrs)	Load per month (hrs)	Load for 6 months (hrs)	
April to Sept	2	14	58.8	352.8	
October to					
March	10	70	294	1,764.0	
		Total approximate	Load for a year	2,116.8	hours
		Minimum required	hours	4,000.0	hours

Table 6.1 CHP Analysis

Be Green

Further means of reducing energy and carbon emissions for the development have been explored, through the use of renewable technologies. The following, Table 6.2, reviews the primary options for generation of on-site renewable/ Low or Zero Carbon (LZC) energy and considers their suitability for use on the development.

Renewable Technology Feasibility Assessment		
Bio Fuel Boilers	Bio-fuel boilers are specifically designed to burn solid biomass or liquid bio-fuel in order to heat water, or raise steam. This can then be used for space heating or Domestic Hot Water (DHW) supply. Bio-fuel boilers could potentially provide the annual space heating and DHW demand for the Unit, however they are not recommended for this development for the following reasons:- 1. Biomass boilers generate increased Oxides of Nitrogen (NOx) and particulates (PM10) which would affect air quality. 2. The storage requirements for the biofuel would require a large plant space, with an auxiliary storage facility to allow for a two week period where delivery of fuel might not be available.	No
Land Use Large volumes of storage is required for fuel at ground level or basement level with sufficient vehicular access for fuel delivered. Noise Noise levels are generated by the operation of the bio-fuel boiler and associated deliveries of the bio-fuel. The plant room enclosure will have to be attenuated to acceptable levels imposed by planning and Acoustician recommendations.		

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Viable? Renewable Technology Feasibility Assessment Wind Turbines Wind turbines convert the kinetic energy in the wind into mechanical energy which is then converted into electricity. Wind turbines can provide electrical power either directly to a load or via a battery system. The use of wind turbines is not recommended for this development for the following reasons:-Wind turbines, of a size necessary to make a contribution to the renewable energy requirements are inappropriate on spatial, planning, aesthetic and noise grounds. Noise pollution from commercial wind turbines can be quiet significant within a few hundred metres. 2. The site is not ideal; an ideal site is a hill with a flat, clear exposure. It should be free from strong turbulence and obstructions like large trees, houses or other buildings. As the development is No surrounded by trees, turbulent wind flow will be experienced across the site which is not ideal for wind turbine installations. 3. The financial viability of a small scale installation on the site would be compromised by the operational efficiency of the unit (circa 30%). 4. Wind turbines, can cause electrical interference within a 2km radius. 5. Finally, the main disadvantage is down to the winds unreliability factor. The wind strength is often too low in many areas, where this site is located the wind speed is 4.8 m/s at 10m, as can be seen in the wind map presented in Appendix C, in order for the wind turbines to be feasible, wind speeds of greater than 6 m/s are required. Land Use There would be an adverse visual impact on the site which will be dependent on the height at which the wind turbines are located. Noise levels are generated by the rotating blades; these noise levels will vary dependent on wind velocity and will need to be in acceptable levels imposed by planning and Acoustician recommendations. Ground Heat Space cooling and heating can be provided by circulating water cooled Source **Pumps** or heated directly by the ground or via subterranean water. Ground water cooling and heating through the use of aquifers makes use of the relatively stable ground/ water temperature which is available at a temperature range of 10 – 14°C. The use of Ground Source Heat Pumps is not recommended for this development for the following reasons:-1. Cost of boreholes may be prohibitive (subject to site No geological conditions). 2. Favourable ground conditions may not exist. 3. Problems can arise with boreholes silting up (open-loop). 4. Changes in local ground conditions could affect water quality and the amount that can be extracted (open-loop).

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Renewable Technology Fea	asibility Assessment	Viable?
would be required to inves	uire Environmental Agency approval. Ground and Hydrology analysis tigate if favourable conditions exist.	
Solar Water Heating	Solar Water Heating systems use radiant energy from the sun to heat water. Systems comprise of a roof mounted heat collector piped to a	
	coil located within a hot water storage cylinder. The use of Solar Panels are not recommended for this development for the following reasons: 1. The roof area is better utilised for the provision of PV Panels.	No
<u>Land Use</u> Roof space is better served	I for the installation of Photovoltaic panels.	
<u>Noise</u>		
Air Source Heat Pumps	by pumps at roof level, these are insignificant so should pose no issues. An Air Source Heat Pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside. It can extract heat from the air even when the outside temperature is as low as minus 15°C and typically draws approximately a quarter to a third of the electricity of a standard resistance heater for the same amount of heating, reducing utility bills. This typical efficiency compares to 70-95% for a fossil-fuel powered boiler.	No
When installing Air Source be positioned to provide s problems. Noise Noise levels are generated dependent on manufacture.	be installed on ground mounted, roof mounted or wall mounted frames. Heat Pumps there are various factors to consider; Heat Pumps should helter from high winds which can reduce efficiency by causing defrost d by fans, and compressors causing vibrations. The noise levels are rer and vary accordingly, these will need to be in acceptable levels acousticians recommendations.	No
Water Source Heat Pump	A water source heat pump (WSHP) is a type of heating, ventilation, and air conditioning (HVAC) system that uses the constant temperature of	
	a water source, as a heat exchange medium for both heating and cooling purposes. Water Source Heat Pumps (WSHP) are proposed for use within the whole development to provide the heating and cooling requirements.	Yes

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Renewable Technology Feasibility Assessment	Viable?
The benefits of WSHP are as follows:	
 WSHPs take advantage of the relatively stable temperature of water sources, which tends to remain more constant than air temperatures throughout the year. This stability enhances the efficiency of the heat exchange process. 	
Water source heat pumps are known for lower energy consumption compared to traditional air-source heat pumps, especially in regions with extreme temperature variations.	
Depending on the location and available water source, WSHPs can be installed horizontally or vertically in the ground, or directly in a water body.	
Photovoltaics Photovoltaic (PV) modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases silicon. The use of PV has been proposed for this scheme to supply renewable energy to every unit to comply with Building Regulations 2021. A total of 79.13 kWp of PV has been proposed for the development.	Yes
Land Use There are no land issues or adverse visual impacts as the photovoltaic panels are roof mounted. Noise There are no noise issues generated by this technology.	

Table 6.2 Renewable Technology Feasibility Assessment

Total PV for development	No of Panels	Area (m²)
79.13 kWp	Circa 211	Circa 379.8

Table 6.3 PV requirements

6.3 SUMMARY

By applying the above passive design measures the savings generated are displayed in Table 6.4, and Figures 6.1 - 6.2. The full calculations can be seen in Appendix D.

	Carbon Dioxide Emissions (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	7.45	20.10

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After Energy Efficient, Passive Measures and WSHP	5.97	It is anticipated that a circa 5% saving can be achieved through the use of energy efficient fittings, for example A or A+ appliances. This would reduce the unregulated carbon emissions to: 19.095
After the inclusion of PV panels	-0.03	
Total Cumulative Saving	7.48 (100.37%)	1.005 (5%)

Table 6.4 Carbon Dioxide Emissions

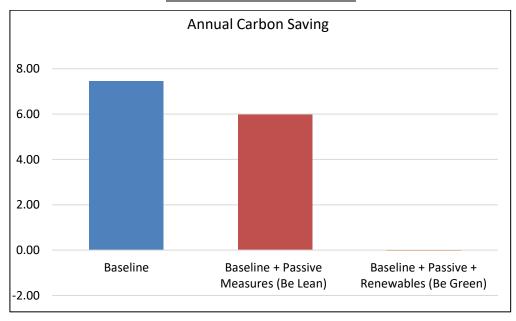


Figure 6.1 Site Carbon Emissions

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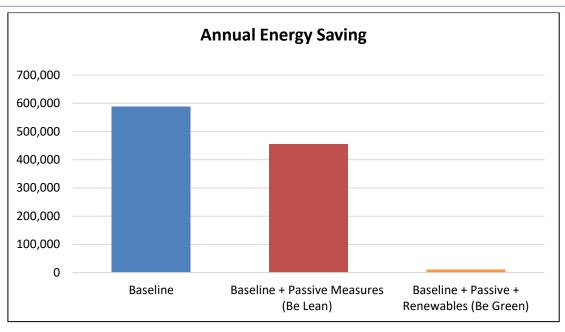


Figure 6.2 Site Energy Consumption

6.4 PROPOSED ENERGY STRATEGY

A summary of proposed energy strategy can be seen in table 6.5 below.

	Residential Elements	
Heating	On-Site Communal Heating Network via WSHP	
Hot Water	Low Temperature On-Site Communal Heating Network via WSHP	
Cooling	Cooling within all area's (except storage) via WSHP	
Ventilation	Natural Ventilation via openable windows, and Cooling system in accordance with Approved Document F	
Lighting	Energy efficient LED lighting where applicable	
This makes the scheme 100% electric		

Table 6.5 Proposed Energy Strategy

The above review has resulted in the formulation of an Energy Strategy that may be adopted for the development involving the use of passive design and energy efficiency measures aimed at achieving the targets and recommendations set out by Guildford Borough Council. The current energy strategy for the development includes the use of water Source Heat Pumps and 79.13 kWp PV.

The recommended schemes take into consideration the most appropriate technologies available to the site, which provides a scheme that is commercially viable whilst keeping in compliance with National and Local Policies. The use of further/emerging technologies may be included for use within this development if their feasibility increases in the future, in accordance with best practice.

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7 WATER CONSUMPTION

The ever-increasing impacts of climate change are continuously inflating demand for water, as well as increasing a need for awareness towards water usage. The UK is already under a large amount of pressure regarding water resources. To contribute towards mitigating this issue, the proposed development will consider various means of being economical with water consumption.

7.1 POLICY REVIEW

National Planning Policy Framework (2023)

Paragraph 180 - Conserving and enhancing the natural environment

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and

Guildford Borough Local Plan: Development Management Policies (2023):

POLICY P11: Sustainable Surface Water Management

All development proposals

- 1) Drainage schemes are required to intercept as much rainwater and runoff as possible, including runoff from outside the site.
- 2) Development proposals are required to maximise the use of permeable surfaces across the development site.
- 3) Drainage schemes are expected to avoid the use of boreholes or other deep structures for the discharge of surface water to ground, except for clean roof water.

7.2 DEVELOPMENT SUSTAINABILITY FEATURES

In order to ensure the reduction and management of water consumption within the proposed development, it is anticipated that various measures shall be undertaken, and specific features installed during the fit out works to minimise the building's portable water consumption.

It is anticipated that improvements in the consumption of portable water will be achieved through the specification of water efficient components within sanitary areas during the fit out works. Such features include the specification of low flow taps as well as dual flush toilets with reduced flush volumes.

7.3 SUMMARY

To ensure the sustainability of the development it is anticipated that water efficient fixtures will be incorporated into the design, such as low flow taps and dual flush toilets with reduced effective flush volumes.

To be further sustainable, it is anticipated that pulsed water meters will be installed on the mains water supply, to effectively monitor water consumption. The inclusion of the above sustainability features allows for the development to be deemed sustainable with regard to water consumption.

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8 TRANSPORT

Transport produces a large proportion of the country's greenhouse gas emissions, something which government at both national and local level are striving to combat, especially through planning frameworks for new developments. Solutions to transport issues are to be incorporated into the design of the development.

8.1 POLICY REVIEW

National Planning Policy Framework (2021)

Paragraph 108 - Promoting Sustainable Transport

Transport issues should be considered from the earliest stages of plan-making and development proposals, so that:

- a) the potential impacts of development on transport networks can be addressed;
- opportunities from existing or proposed transport infrastructure, and changing transport technology and usage, are realised – for example in relation to the scale, location or density of development that can be accommodated;
- c) opportunities to promote walking, cycling and public transport use are identified and pursued;

8.2 DEVELOPMENT SUSTAINABILITY FEATURES

The proposed development is located in East Horsley. The site is approximately 0.7 miles from the nearest bus stop.



Figure 8.1 Public Transport Links

The proposed development is within vicinity to the public transport links as shown in Figure 8.1.

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8.3 SUMMARY

The above provisions aim to make the proposed development easier to access for all building users, as well as offering a sustainable means of commuting rather than using a private vehicle.

The proposed development is located in East Horsley. The site is situated 10 minutes' walk from Pennymead Drive bus stop, this allows for a fair provision of public transport. These links can be used to travel to Central Guildford within 30 minutes.

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9 CONSTRUCTION SITE MANAGEMENT

The requirement for new materials needs to be minimised, by re-using existing buildings and materials where possible and providing a Site Waste Management Plan for all construction sites. This responsibility lies with the contractor and needs to be clarified at an early design stage. It is becoming a greater requirement now to construct buildings that are flexible and can be re-used.

9.1 POLICY REVIEW

National Planning Policy Framework (2021)

Local plans should set out strategic priorities for the area; this should include strategic policies to deliver the provision of infrastructure for waste management, water supply and wastewater.

Guildford Local Plan: Development Management Policies

POLICY D14: Sustainable and Low Impact Development

Fabric first

1) Development proposals are required to demonstrate how they have followed a 'fabric first' approach in line with the energy hierarchy.

Embodied carbon

- 2) Development proposals are required to demonstrate that embodied carbon emissions have been minimised by:
 - a. sourcing materials locally where possible; and
 - b. taking into account the embodied carbon emissions of materials based on information provided in a respected materials rating database.

Energy improvements

4) Development proposals that will improve the energy efficiency and carbon emission rate of existing buildings to a level significantly better than the Council's adopted standards or national standards for new buildings, whichever is most challenging, are encouraged.

Waste

5) Proposals for major development, and development proposals that involve the demolition of at least one building and/or engineering works that involve the importation or excavation of hard core, soils, sand and other material, are required to submit a Site Waste Management Plan.

9.2 DEVELOPMENT SUSTAINABILITY FEATURES

In order to comply with national and local policy, it is anticipated that certain measures will be put into place for this development, such as a Site Waste Management Plan which monitors the site energy and water consumption and ensures that that site timber is legally and responsibly sourced in accordance with the UK Government's Timber Procurement Policy. Further to this the Site Waste Management Plan should also monitor the resource efficiency of the development construction works as well as the percentage of non-hazardous materials, excavation and construction, which have been diverted from landfill.

It is expected that the main contractor will also set targets and monitor site consumption data for water consumption, energy consumption as well as fuel from deliveries and collection of waste and materials to and

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from site. Monitoring of such actions can encourage contractors to become more resource efficient to meet given targets.

Additionally, it is expected the main contractor will comply with best standards as set out in the Considerate Constructors Scheme, achieving a score which is considered as exceeding compliance with the criteria of the scheme.

To ensure the sustainable construction of the development, the project will consider the concept of the waste hierarchy as seen in Figure 9.1 below. The waste hierarchy recognises the need for waste to be considered for a variety of waste streams before being sent to land fill as a last resort. The hierarchy is as follows:

- Waste minimisation;
- Reusing or waste or up cycling;
- Recycling of all applicable materials;
- Recovery of energy from waste (anaerobic digestion plants);
- Waste is sent to landfill.

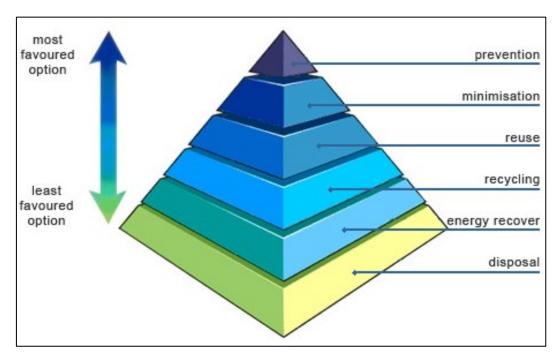


Figure 9.1 Waste Hierarchy Diagram

9.3 SUMMARY

It is anticipated that this development will produce a Site Waste Management Plan, highlighting key refurbishment materials and the correct waste streams for recycling these materials.

The development should adhere to a Considerate Constructors Scheme, achieving a targeted score which exceeds 'compliance' with the criteria of the scheme. As a result of these measures, the development may be deemed sustainable as regards to construction site management.

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10 SUSTAINABLE DESIGN

Good urban design is essential in providing a varied and sustainable environment, which can facilitate opportunities for positive contributions within communities. As part of sustainable design for developments, it is essential that suitable design principles are followed to maximise opportunities for energy reduction through design as well as ensuring buildings follow or enhance the character of an area. Developments should also give further consideration to the level of security and comfort that is provided for future building users, including thermal and visual comfort, inclusivity and safe access.

10.1 POLICY REVIEW

National Planning Policy Framework (2023)

Paragraph 131 - Achieving Well-Designed Places

The creation of high-quality buildings and places is fundamental to what the planning and development process should achieve. Good design is a key aspect of sustainable development, creates better places in which to live and work and helps make development acceptable to communities. Being clear about design expectations, and how these will be tested, is essential for achieving this. So too is effective engagement between applicants, communities, local planning authorities and other interests throughout the process.

Guildford Local Plan: Strategy and Sites

POLICY D2: Climate Change, sustainable design, construction and energy

Sustainable design and construction

- 1) Proposals for zero carbon development are strongly supported. Applications for development, including refurbishment, conversion and extensions to existing buildings should include information setting out how sustainable design and construction practice will be incorporated including (where applicable):
 - a) the efficient use of mineral resources and the incorporation of a proportion of recycled and/or secondary aggregates
 - b) waste minimisation and reusing material derived from excavation and demolition
 - c) the use of landform, layout, building orientation, massing and landscaping to reduce energy consumption
 - d) water efficiency that meets the highest national standard and
 - e) measures that enable sustainable lifestyles for the occupants of the buildings, including electric car charging points.
- 2) When meeting these requirements, the energy and waste hierarchies should be followed except where it can be demonstrated that greater sustainability can be achieved by utilising measures further down the hierarchy.
- 3) Major development should include a sustainability statement setting out how the matters in this policy have been addressed. Smaller developments should include information proportionate to the size of the development in the planning application.

10.2 DEVELOPMENT SUSTAINABILITY FEATURES

The proposed development shall include a variety of features which are regarded as having a good sustainable design. It is anticipated that any external lighting specified will be designed to reduce unnecessary light pollution during night-time hours, a lighting assessment has been undertaken to ensure this. This can be achieved through the use of time switches or daylight sensors which switch off lighting between 2300hrs and 0700hrs as well as cut off luminaires which reduce light spill.

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To ensure the risk of potential overheating is minimised building modelling of the unit has confirmed that no occupied space is at risk from excessive solar gains; this being achieved through use of glazing with a low shading coefficient. Additionally, to ensure that overheating will not occur during summer months and the building is suitably insulated as well as allowing for adaptation due to the effects of climate change, it is anticipated that the development will use building fabrics with enhanced 'U' values which go beyond the minimum requirements of Part L1 (2021), as seen within Table 10.1. Further to this the energy efficiency measures discussed within Section 6.0 will be incorporated into the design of the development. It is anticipated that such measures will lower the building's energy requirements making its operation feasible and practical for years to come.

Feature	Applied U – Value for New Build Residential (W/m².K)
External Walls	0.14
Exposed Floors	0.10
Exposed Roofs	0.11
Triple Glazing	0.8 (with a g value of 0.36)
Doors	1

Table 10.1: U - Values targeted in the New-Build Residential development.

To provide a fully sustainable development it is also anticipated that the materials used for the following main elements of the development shall be rated under the Green Guide to Specification targeting ratings between A+ and D:

- External walls;
- Ground floor;
- Roof;
- Windows.

To provide a development which remains sustainable during its operation phase, it is anticipated that space will be provided for the provision of waste storage facilities with additional space of recyclable waste streams. This is to enable building users to sort waste before collection and minimise the quantity of waste that may end up at landfill.

10.3 SUMMARY

In order to comply with national and local policies, the development shall strive to provide both to building users and the local community a building of sustainable design.

Measures should be taken to ensure the thermal comfort of future building users, through efforts such as ensuring no occupied areas will result in excessive solar gains and in turn over heating.

External lighting except safety and security lighting should be designed to be switched off automatically through the use of timers of day light sensors as well as the specification of cut off luminaires to reduce any potential light spill on to neighbouring properties as covered in the lighting assessment.

The above design features allow for the proposed development to be of sustainable design.

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11 FLOOD RISK

To prevent an increase in surface water run off through development of a site, it is imperative that consideration is given to the reduction of over land flow during storm events as well as the impact of development in potential flood risk areas.

11.1 POLICY REVIEW

National Planning Policy Framework (2021)

Paragraph 165 - Meeting the Challenge of Climate Change, Flooding and Coastal Change

Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

Guildford Local Plan: Development Management Policies

POLICY P4: Flooding, flood risk and groundwater protection zones

- 1) Flood zones in the borough of Guildford are defined based on definitions contained within national planning practice guidance and the Council's Strategic Flood Risk Assessment (Level 1).
- 2) Development in areas at medium or high risk of flooding, as identified on the latest Environment Agency flood risk maps and the Council's Strategic Flood Risk Assessment, including the 'developed' flood zone 3b (functional floodplain), will be permitted provided that:
 - a) the vulnerability of the proposed use is appropriate for the level of flood risk on the site
 - b) the proposal passes the sequential and exception test (where required) as outlined in the NPPF and Government guidance.
 - c) a site—specific flood risk assessment demonstrates that the development, including the access and egress, will be safe for its lifetime, taking into account climate change, without increasing flooding elsewhere, and where possible, will reduce flood risk overall.
 - d) the scheme incorporates flood protection, flood resilience and resistance measures appropriate to the character and biodiversity of the area and the specific requirements of the site.
 - e) when relevant, appropriate flood warning and evacuation plans are in place and approved.
- 3) Development proposals in the 'developed' flood zone 3b will also only be approved where the footprint of the proposed building(s) is not greater than that of the existing building(s) and there will be no increase in development vulnerability. Proposals within these areas should facilitate greater floodwater storage.
- 4) With the exception of the provision of essential infrastructure, 'undeveloped' flood zone 3b will be safeguarded for flood management purposes.
- 5) All development proposals are required to demonstrate that land drainage will be adequate and that they will not result in an increase in surface water run-off. Proposals should have regard to appropriate mitigation measures identified in the Guildford Surface Water Management Plan or Ash Surface Water Study. Priority will be given to incorporating SuDs (Sustainable Drainage Systems) to manage surface water drainage.

11.2 DEVELOPMENT SUSTAINABILITY FEATURES

The flood map sourced from The Government Flood Warning Information Service seen below in Figure 11.1, demonstrates that the proposed site is predominantly located within low risk of flooding from fluvial or reservoir sources.

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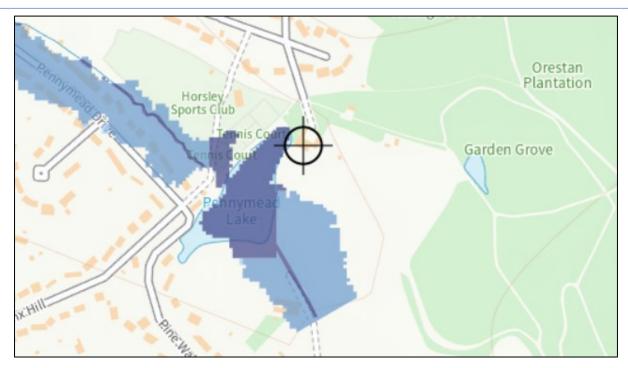


Figure 11.1: Fluvial Flooding (Sourced from Flood Warning Information Service)

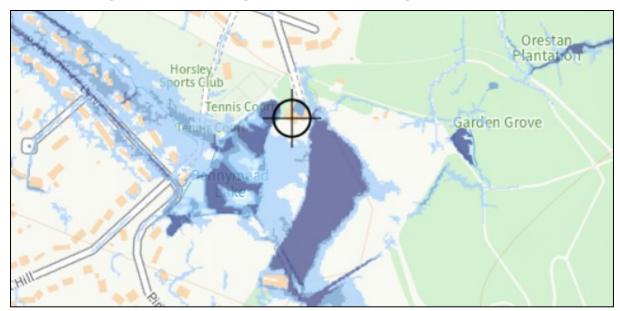


Figure A.2: Reservoir Flooding (Sourced from Flood Warning Information Service)

11.3 SUMMARY

The above map confirms that the site is located within a low-risk flooding area from reservoir sources.

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12 NOISE

Noise is a subjective concept that can affect people differently, however there are set standards as to acceptable levels of noise, for different areas and times of day. In this instance, the proposed development would be subject to potential noise pollution from road sources.

12.1 POLICY REVIEW

National Planning Policy Framework (2021)

Paragraph 180 - Conserving and Enhancing the Natural Environment

Planning policies and decisions should contribute to and enhance the natural and local environment by:

 a) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.

Guildford Local Plan: Development Management Policies

POLICY D11: Noise Impacts

- 1) Development proposals for noise sensitive uses are required to clearly identify any likely adverse noise impacts on the sensitive receptors that are intended to use or occupy the development from existing nearby sources of noise.
- 2) Development proposals for noise generating uses are required to clearly identify any likely adverse noise impacts arising from the proposed development on existing nearby sensitive receptors, including the natural environment.
- 3) Where consideration under (1) or (2) indicates the potential for Observed Adverse Effect Levels of noise, planning applications are required to include a Noise Impact Assessment, which considers the relationship in detail.
- 4) Where evidence of an Observed Adverse Effect Level noise impact exists, as defined in the Noise Exposure Hierarchy, the applicant is required to demonstrate how the proposed development proposal will be designed and implemented in order to:
 - a) prevent any present and very disruptive Significant Observed Adverse Effect levels,
 - b) avoid any present and disruptive Significant Observed Adverse Effect levels; and
 - c) mitigate any present and intrusive Lowest Observed Adverse Effect levels.
- 5) The applicant proposing the development proposal (or 'agent of change') is responsible for ensuring that:
 - a) all potential Observed Adverse Effect Levels of noise, either impacting on or emanating from the proposed development proposal, are identified, and
 - b) the prevention, avoidance and/or mitigation measures required to manage those noise impacts are implemented effectively.
- 6) A Verification Report is required to be submitted to the Council and approved prior to the development's occupation or use, which demonstrates the agreed avoidance and mitigation measures have been implemented effectively.
- 7) Where there will be an unacceptable adverse effect on sensitive receptors which cannot be adequately prevented, avoided, and/or mitigated, the planning application will be refused.

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12.2 DEVELOPMENT SUSTAINABILITY FEATURES

The proposed development is not subject to noise pollution from road and rail sources, as can be seen in Figures 12.1 and 12.2. It should be noted that the noise levels are 'A' weighted and as such only demonstrate sounds on a frequency that would affect human populations, it does not consider noise on frequencies that may affect any local habitats.



Figure 12.1: Road Noise Data Map (Postal Code Analysis, Sourced from Extrium)

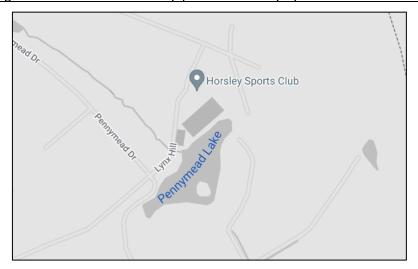


Figure 12.2 Rail Noise Data Map (Postal Code Analysis, Sourced from Extrium)

12.3 SUMMARY

The figures above demonstrate that the development will not be subject to noise pollution from the surrounding roads or rail sources. It is anticipated that any plant equipment installed will not have an impact on the local area and as such the proposed development may be deemed sustainable with regard to noise.

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13 ECOLOGY

Ecology is essential within many communities, with the mix of flora and fauna facilitating benefits such as flood alleviation and pollution amelioration. In addition to this, areas with a wealth of green spaces and an abundance of biodiversity are seen to provide a positive contribution to a community.

13.1 POLICY REVIEW

National Planning Policy Framework (2021)

Section 15 - Conserving and Enhancing the Natural Environment

The planning system should protect and enhance valued landscapes, minimise impacts on biodiversity.

Guildford Local Plan: Development Management Policies

POLICY P12: Regionally Important Geological / Geomorphological Sites

- Development proposals that are likely to materially harm the conservation interests of Regionally Important Geological/Geomorphological Sites (RIGS) as shown on the Policies Map, and any unmapped features that meet the definition of a RIGS, are required to demonstrate that the need for the development clearly outweighs the impact on the conservation interests.
- 2) Development proposals are required to make every effort to prevent harm to the conservation interests of the RIGS through avoidance measures. Where this is not possible, every effort is required be made to minimise harm through mitigation measures. The applicant is required to demonstrate that any necessary avoidance and mitigation measures will be implemented and maintained effectively.

13.2 DEVELOPMENT SUSTAINABILITY FEATURES

An ecology conservation map (sourced from MAGIC) highlights there is one Site of Special Scientific Interest (SSSI) in the vicinity of the site development, Sheepleas in the Surrey Hills.

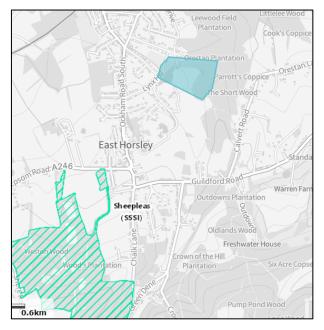


Figure 13.1 Ecological Sensitivity (Sourced from MAGIC)

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13.3 SUMMARY

An Ecology conservation map (sourced from MAGIC) highlights there is one Site of Special Scientific Interest (SSSI) in the vicinity of the development, however the SSSI is 1.5 miles away from the development so will not be affected.

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APPENDIX A - FLOOD RISK MAP

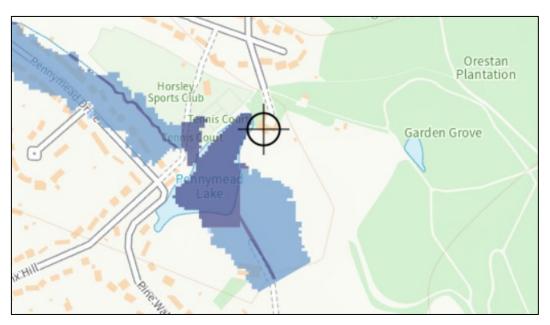


Figure 11.1: Fluvial Flooding (Sourced from Flood Warning Information Service)

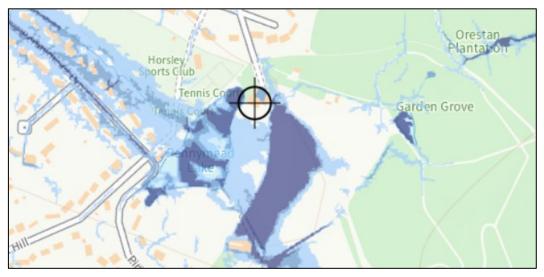


Figure A.2: Reservoir Flooding (Sourced from Flood Warning Information Service)

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APPENDIX B - CHP SEARCH

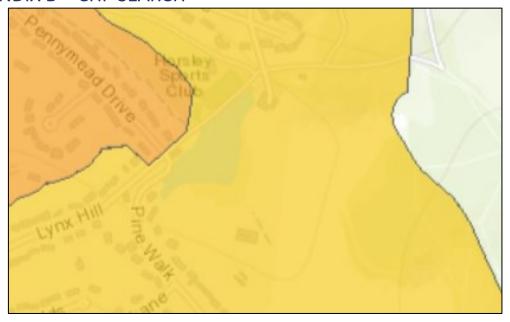


Figure B.1: CHP availability Search Area

Sector Name	Share	Total MWh
Communications and Transport	0.03%	11 MWh
Commercial Offices	0.37%	128 MWh
Domestic	95.22%	33,045 MWh
Education	1.51%	524 MWh
Government Buildings	0%	0 MWh
Hotels	0.94%	327 MWh
Large Industrial	0%	0 MWh
Health	0.22%	78 MWh
Other	0.02%	6 MWh
Small Industrial	0.83%	287 MWh
Prisons	0%	0 MWh
Retail	0.43%	148 MWh
Sport and Leisure	0.4%	138 MWh
Warehouses	0.03%	10 MWh
District Heating	0%	0 MWh
Total heat load in Area		34,702 MWh

Figure B.2: CHP Heat Load Distribution

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APPENDIX C - WIND MAP



Chart C.1 Wind Velocity Chart for the Development Site

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APPENDIX D - ENERGY CALCULATIONS

<u>Baseline</u>

	kWh/annum Baseline												
Typical Unit	Area m²	Quantity	Total Area m ²	DER	TER	Heating	Cooling	Auxillary	Lighting	Hot Water	Total Kwh/Annum	Carbon kg Co2 / Annum	Tonnes
					TER Worksheet	DER Sheet [(Row 307a) ÷ (Row 367a x 0.01)]	DER Sheet Row 321	DER Sheet (Row 313 + 331)	DER Sheet Row 332	DER Sheet [(Row 310a) ÷ (Row 367a x 0.01)]			
Innisfree House	920	1	920	8.10	8.10	537640.2689	0	6579.8697	997.4469	41974.17787	587191.7633	7452	7.45
<u>Total</u>	920	1	920								587,191.76	7,452.00	<u>7.45</u>

<u>Passive</u>

					kWh/a	nnum Baseline + Pas	sive/Energy Efficie	ncy Measures					
Typical Unit	Area m²	Quantity	Total Area m ²	DER	TER	Heating	Cooling	Auxillary	Lighting	Hot Water	Total Kwh/Annum	Carbon kg Co2 / Annum	Tonnes
					TER Worksheet	DER Sheet	DER Sheet	DER Sheet	DER Sheet	DER Sheet			
						[(Row 307a) ÷	Row 321	(Row 313 + 331)	Row 332	[(Row 310a) ÷			
						(Row 367a x 0.01)]				(Row 367a x 0.01)]			
Innisfree House	920	1	920	6.49	8.10	405361.5754	0	6418.4897	997.4469	41974.17787	454751.6899	5970.80	5.97
<u>Total</u>	920	1	920								454,751.69	5,970.80	5.97

WSHP + PV

					kWh/annu	m Baseline + Passive,	Energy Efficiency	Measures + ASHI	2				
Typical Unit	Area m²	Quantity	Total Area m ²	DER	TER	Heating	Cooling	Auxillary	Lighting.	Hot Water	Total Kwh/Annum	Carbon kg Co2 / Annum	Tonnes
					TER Worksheet	DER Sheet	DER Sheet	DER Sheet	DER Sheet	DER Sheet			
						[(Row 307a) ÷ (Row 367a x 0.01)]	Row 321	(Row 313 + 331)	Row 332	[(Row 310a) ÷ (Row 367a x 0.01)]			
Innisfree House	920	1	920	-0.03	8.10	10102.30451	1250.5982	6262.3758	997.4469	1528.611851	10,732.81	-27.60	-0.03
<u>Total</u>	920	1	920								10,732.81	<u>-27.60</u>	-0.03

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APPENDIX E – SAMPLE SAP REPORT

Date: 01/02/24 Revision: 001

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2. Ventilation rate Number of open Chimneys	Property Reference	9	Innis	free, East Ho	rsley					Is	sued on Da	ite	30/01/2024	
Supering	Assessment Refere	ence	Be G	Green					Prop Type R	ef				
Second Companies	Property													
Compatione Orders	SAP Rating					93 A		DER	-0.0	03	TER		8.10	
Companies	Environmental					100 A		% DER < TER					100.37	
Machine Mach	CO ₂ Emissions (t/y	ear)				0		DFEE	43.	35	TFEE		49.09	
Assessor Debuils Wr. Spatil Pames December Dece						See BREL		% DFEE < TFE	EE				11.69	
AND 10 SERECTION FIRST NEW Build (As Inesignat) [Version 10.2, February 2022] ALCOLARITOR OF PRELIMEN Entractors ros account floor - Oversall dealling characteristics - Oversall dealling charact	% DPER < TPER					102.06		DPER	-0.9	92	TPER		44.72	
AS 10 WERRERET FOR New Solid (Ab Dosigned) (Version 11.2, Pobroury 3022) Assertions of Security Secur	Assessor Details		Mr. Sushil	Pathak							Asses	ssor ID	Z621-000)1
ALCOLUMATION OF CHEMILIANC DIASACTORS FOR RECLIATIONS COMPLIANCE 1. Overall Belling characteristics 2. Overall Belling characteristics 3. Overall Belling characteristics 460,0000 (1b) x 3,0200 (2b) - 1461,0000 (1b) x 1,0000 (1b)														
round floor Access Company Com	AP 10 WORKSHEET	FOR New Buil	ld (As Des	signed)	(Version 10	.2, February								
may per hour tumber of open chinneys tumber of open chinneys flues attached to closed fire	Ground floor Cirst floor Cotal floor area	-		+ (1d) + (1e)	(1n)	92	20.0000		(m2) 460.0000 460.0000	(1b) x (1c) x	(m) 3.2200 2.9100	(2b) = (2c) =	(m3) 1481.2000 1338.6000	(1b) - (1c) - (1c) - (1c)
Number of flueless gas fires	Number of open ch Number of open fl Number of chimney Number of flues a Number of flues a Number of blocked Number of intermal	nimneys Lues ys / flues at attached to o d chimneys Lttent extrace	solid fuel other heat	l boiler	ire							0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 0 * 10 =	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(6a) (6b) (6c) (6d) (6e) (6f) (7a)
### Separation rate adjusted to include shelter factor Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	umber of flueles nfiltration due ressure test ressure Test Met easured/design F nfiltration rate	to chimneys,		nd fans =	= (6a)+(6b)	+(6c)+(6d)+((6e)+(6f)+((6g) + (7a) + (7	7b)+(7c) =			0 * 40 = Air change / (5) =	0.0000 es per hour 0.0000 Yes Blower Door 1.0000 0.0500	(7c) (8) (17) (18)
ind speed 5.1000 5.0000 4.9000 4.4000 4.3000 3.8000 3.8000 3.7000 4.0000 4.3000 4.5000 4.7000 (22 ind factor 1.2750 1.2500 1.2500 1.2250 1.1000 1.0750 0.9500 0.9500 0.9250 1.0000 1.0750 1.1250 1.1750 (22 dj infilt rate 0.0638 0.0625 0.0613 0.0550 0.0537 0.0475 0.0475 0.0463 0.0500 0.0537 0.0563 0.0588 (22 Balanced mechanical ventilation with heat recovery f mechanical ventilation f exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (23 f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (23 f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (23 f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (23 f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (23 f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (23 f f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (23 f f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (23 f f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (25 f f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (25 f f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (25 f f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (25 f f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (25 f f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.8000 (25 f f balanced with heat recovery: efficiency in % allowing for in-use factor (from Table		e adjusted to	o include	shelter fa	actor									
Effective ac 0.1948 0.1935 0.1923 0.1860 0.1847 0.1785 0.1785 0.1773 0.1810 0.1847 0.1872 0.1898 (25) Heat losses and heat loss parameter	Jind factor dj infilt rate Balanced mechani ff mechanical ver ff exhaust air he	5.1000 S 1.2750 S 0.0638 (cal ventilation eat pump using	5.0000 1.2500 0.0625 tion with ng Appendi	4.9000 1.2250 0.0613 heat reco	4.4000 1.1000 0.0550 very) = (23a) x	4.3000 1.0750 0.0537	3.8000 0.9500 0.0475	3.8000 0.9500 0.0475	3.7000 0.9250 0.0463 $(23b) = (23b)$	4.0000 1.0000 0.0500	4.3000 1.0750	4.5000 1.1250	4.7000 1.1750 0.0588 0.5000 0.5000	(22a) (22b) (23a) (23b)
Heat losses and heat loss parameter Hement										0.1810	0.1847	0.1872		
m2 m	. Heat losses ar	nd heat loss	parameter	c										
Heefnal Wall 1 433.7400 443.0000 479.0000 370.000 479.00000 479.00	indow (Uw = 0.80 lazed Door ormal Door eatloss Floor 1 round Floor Exteirst Floor Exteirst Floor Exteirst Floor Exteirstennal Roof otal net area of abric heat loss, nternal Wall 1	ernal Wall rnal Wall F external e		4	m2 32.8000 48.3200	m2 260.3900	441. 12. 9. 460. 172. 245. 460. 1801.	m2 1300 6000 4000 0000 4100 5800 0000 1200 (26)(3	W/m2K 0.7752 0.8000 1.0000 0.1000 0.1400 0.1400 0.1100	W/K 341.9612 10.0800 9.4000 46.0000 24.1374 34.3812 50.6000	11(19(19(9	0.0000 0.0000 0.0000 0.0000 9.0000	kJ/K 50600.0000 32757.9000 46660.2000 4140.0000	(27) (26a) (26) (28a) (29a) (29a) (30) (31) (33) (32c)
eat capacity Cm = Sum(A x k) (28)(30) + (32) + (32a)(32e) = 146881.7600 (34 hermal mass parameter (TMP = Cm / TFA) in kJ/m2K 159.6541 (35	eat capacity Cm				27				(28)	(30) + (32)			146881.7600	(34)

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List of Thermal Bridges K1 Element E2 Other lintels (including E3 Sill E4 Jamb E5 Ground floor (normal) E6 Intermediate floor within E16 Corner (normal) E17 Corner (inverted - inter E10 Eaves (insulation at cer E12 Gable (insulation at cer E13 Gable (insulation at cer E13 Gable (insulation at cer Thermal bridges (Sum(L x Psi) calcul Point Thermal bridges Total fabric heat loss	n a dwelling rnal area greater tha: iling level) iling level) fter level)		rea)		157 157 162 148 148 49 24 233	.4600 .4600 .2800 .7300 .7300 .0400 .5200 .5200 .9600 .2400	Psi-value 0.3000 0.0220 0.0160 0.0530 0.0010 0.0380 -0.0750 0.1200 0.2500 33) + (36)	Tot 47.23 3.14 2.59 7.88 0.14 1.86 -1.83 28.02 14.24 17.06 (36a) = + (36a) =	80 92 65 27 87 335 90 24	
Ventilation heat loss calculated mor										
Jan Feb (38)m 181.2215 180.0583 Heat transfer coeff	Mar Apr 178.8952 173.0793	May 171.9162	Jun 166.1003	Jul 166.1003	Aug 164.9372	Sep 168.4267	Oct 171.9162	Nov 174.2425	Dec 176.5688	(38)
818.1434 816.9802 Average = Sum(39)m / 12 =	815.8170 810.0012	808.8380	803.0222	803.0222	801.8590	805.3485	808.8380	811.1644	813.4907 809.7104	(39)
Jan Feb HLP 0.8893 0.8880	Mar Apr 0.8868 0.8804	May 0.8792	Jun 0.8729	Jul 0.8729	Aug 0.8716	Sep 0.8754	Oct 0.8792	Nov 0.8817	Dec 0.8842	(40)
HLP (average) Days in mont 31 28	31 30	31	30	31	31	30	31	30	0.8801 31	
4. Water heating energy requirements	s (kWh/year)									
Assumed occupancy Hot water usage for mixer showers									3.9379	(42)
0.0000 0.0000 Hot water usage for baths	0.0000 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
109.6601 108.0315 Hot water usage for other uses	105.7381 101.5094	98.3431	94.8321	92.9356	95.2130	97.6926	101.4495	105.7653	109.2894	
57.8509 55.7472 Average daily hot water use (litres,	53.6435 51.5399 /day)	49.4362	47.3325	47.3325	49.4362	51.5399	53.6435	55.7472	57.8509 154.2639	
Jan Feb Daily hot water use	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
167.5110 163.7787 Energy conte 265.2965 233.2187 Energy content (annual)	159.3816 153.0493 244.9637 209.5169	147.7793 198.9393	142.1646 174.8080	140.2682 169.6422	144.6492 179.1059	149.2325 184.0186	155.0931 210.4598 Total = S	161.5125 230.1041 um(45)m =	167.1403 261.7013 2561.7751	
Distribution loss $(46)m = 0.15 \times (48)m = 0.15 \times ($	36.7445 31.4275	29.8409	26.2212	25.4463	26.8659	27.6028	31.5690	34.5156	39.2552	(46)
Store volume a) If manufacturer declared loss fa Temperature factor from Table 2b Enter (49) or (54) in (55)	actor is known (kWh/	day):							1000.0000 1.4600 0.7800 1.1388	(48) (49)
Total storage loss 35.3028 31.8864	35.3028 34.1640	35.3028	34.1640	35.3028	35.3028	34.1640	35.3028	34.1640	35.3028	(56)
If cylinder contains dedicated solar 35.3028 31.8864 Primary loss 23.2624 21.0112 Combi loss 0.0000 0.0000	35.3028 34.1640 23.2624 22.5120 0.0000 0.0000	35.3028 23.2624 0.0000	34.1640 22.5120 0.0000	35.3028 23.2624 0.0000	35.3028 23.2624 0.0000	34.1640 22.5120 0.0000	35.3028 23.2624 0.0000	34.1640 22.5120 0.0000	35.3028 23.2624 0.0000	(59)
Total heat required for water heating 323.8617 286.1163 WHRS 0.0000 0.0000 PV diverter -0.0000 -0.0000 Solar input 0.0000 0.0000 FGHRS 0.0000 0.0000	ng calculated for each 303.5289 266.1929 0.0000 0.0000 -0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		231.4840 0.0000 -0.0000 0.0000 0.0000	228.2074 0.0000 -0.0000 0.0000 0.0000	237.6711 0.0000 -0.0000 0.0000 0.0000	240.6946 0.0000 -0.0000 0.0000 0.0000	269.0250 0.0000 -0.0000 0.0000 0.0000	286.7801 0.0000 -0.0000 0.0000 0.0000	320.2665 0.0000 -0.0000 0.0000 0.0000	(63a) (63b) (63c)
Output from w/h 323.8617 286.1163 12Total per year (kWh/year)	303.5289 266.1929	257.5045	231.4840	228.2074	237.6711 Total p		269.0250 h/year) = S	286.7801 um(64)m =	320.2665 3251.3331 3251	(64)
Electric shower(s)	0.0000 0.0000				0.0000			0.0000	0.0000	(64a)
Heat gains from water heating, kWh/r	month	tal Energy u	=				=			
135.0632 119.8633						106.5270	116.8301	121.8504	133.8678	(65)
5. Internal gains (see Table 5 and 5	5a)									
Metabolic gains (Table 5), Watts Jan Feb		May		Jul			Oct	Nov	Dec	
(66)m 196.8965 196.8965 Lighting gains (calculated in Append	dix L, equation L9 or	L9a), also	see Table 5							
436.6935 483.4820 Appliances gains (calculated in Appe 865.7936 874.7779	endix L, equation L13	or L13a), a	lso see Tab	le 5						
Cooking gains (calculated in Appenditude 42.6897 42.6897	ix L, equation L15 or	L15a), also	see Table	5					42.6897	
Pumps, fans 0.0000 0.0000 Losses e.g. evaporation (negative va	0.0000 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
-157.5172 -157.5172 Water heating gains (Table 5)	-157.5172 -157.5172									
181.5366 178.3680 Total internal gains										
1566.0927 1618.6969						1342.6446	1385.3615	1472.9660	1526.2848	(73)
6. Solar gains										
[Jan]	Area m2	Solar flux Table 6a W/m2	Speci or	g fic data Table 6b	Specific or Tab	FF data le 6c	Acce fact Table	ss or 6d	Gains W	
Northeast Southeast Southwest	115.2500 123.6100 122.1800						0.77 0.77 0.77		360.4595 1260.7293 1246.1444	(75) (77) (79)

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Northwest			80.)900	11.282	9	0.3600		.0000	0.77	00	250.4920	(81)
Solar gains Total gains	3117.8253 4683.9179							11045.0563 12345.5677					
7. Mean inter													
Temperature d Utilisation f				nil,m (see	Table 9a)		Jul	Aug	Son	Oct	Nov	21.0000	(85)
tau alpha util living a	49.8696 4.3246	49.9406 4.3294 0.9664	50.0118 4.3341 0.8857	Apr 50.3709 4.3581 0.7068	May 50.4433 4.3629	4.3872	50.8087 4.3872	4.3922	Sep 50.6619 4.3775	50.4433 4.3629 0.8512	50.2987 4.3532 0.9806	Dec 50.1548 4.3437	
MIT	19.4258	19.9056	20.4224	20.8204	20.9624	20.9941	20.9989	20.9977	20.9697	20.6632	19.9262	19.3355	(87)
Th 2 util rest of	20.1766 house 0.9922	0.9600	20.1788	20.1842	20.1852	20.1906	20.1906		20.1885	20.1852 0.8203	20.1831	20.1809	
MIT 2 Living area f		19.1928	19.6873 19.7625	20.0463	20.1604	20.1876			20.1713 fLA = 20.2530	19.9226 Living are		18.6324 0.1024	(91)
MIT Temperature a adjusted MIT		19.2657	19.7625	20.1255	20.2425	20.2702		20.2735	20.2530	19.9984	19.2932	18.7043 0.0000 18.7043	
8. Space heat													
Utilisation Useful gains Ext temp.	4.3000	Feb 0.9512 6784.0456 4.9000	Mar 0.8567 8247.1891 6.5000	Apr 0.6702 8321.1538 8.9000	May 0.4674 6763.1179 11.7000	4534.7988	2947.0120	3100.5483	Sep 0.4666 4852.2950 14.1000	Oct 0.8123 6193.5508 10.6000	Nov 0.9693 5083.3292 7.1000	Dec 0.9929 4141.0245 4.2000	(95)
Heat loss rat Space heating	11855.9849	11736.5303	10819.7855	9092.6879	6909.4772	4553.2774	2949.5225	3105.9722	4955.3104	7601.8128	9890.6935	11799.1392	(97)
Space heating Solar heating	5374.2775 requiremen		1914.0117 per year (k		108.8914	0.0000	0.0000	0.0000	0.0000	1047.7469	3461.3023	5697.6373 21487.4413	(98a)
Solar heating	0.0000 contributi	0.0000 on - total	0.0000 per year (0.0000 kWh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Space heating Space heating Space heating	5374.2775 requiremen			555.5045 ution - tota			0.0000	0.0000	0.0000	1047.7469	3461.3023) / (4) =	5697.6373 21487.4413 23.3559	
8c. Space coc	ling requir	ement											
Ext. temp. Heat loss rat	Jan 4.3000	Feb 4.9000	Mar 6.5000		May 11.7000	Jun 14.6000	Jul 16.6000	Aug 16.4000	Sep 14.1000	Oct 10.6000	Nov 7.1000	Dec 4.2000	
Utilisation Useful loss Total gains	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000	0.9838 7425.9308	5942.3641 0.9921 5895.2570 16136.5912	0.9860 6008.8954	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	(101) (102)
Space cooling Cooled fracti	0.0000	0.0000	0.0000	0.0000	0.0000	6842.9204	7619.5526	6106.0251	0.0000 fc =	0.0000 cooled are	0.0000 a / (4) =	0.0000	
Intermittency	factor (Ta 0.2500	ble 10b) 0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	
Space cooling	0.0000	0.0000 t	0.0000	0.0000	0.0000	1664.2429	1853.1249	1485.0251	0.0000	0.0000	0.0000	0.0000 5002.3929	
9b. Energy re	quirements												
Fraction of s Fraction of s Fractor for co Factor for ch Distribution Efficiency of Space heating	pace heat f leat from control and control and control and control methods factor secondary/	rom communi mmunity Geo harging met od (Table 4 (Table 120	ity system othermal-Spa chod (Table 1c(3)) for to	ace and Wate 4c(3)) for water heatin	er space heat:							0.0000 1.0000 1.0000 1.0500 1.0500 1.5000 0.0000	(302) (303a) (305) (305a) (306)
Space heating Space heat fr	5374.2775	3328.0697	1914.0117	555.5045	108.8914	0.0000	0.0000	0.0000	0.0000	1047.7469	3461.3023	5697.6373	(98)
307a Space heating	8464.4871 requiremen	5241.7098 t	3014.5685	874.9196	171.5039	0.0000		0.0000		1650.2014			
Efficiency of Space heating	secondary/ fuel for s	supplementa econdary/sı	ary heating upplementar	y system	k (from Tab	le 4a or Ap	pendix E)			1650.2014		0.0000	(308)
Water heating		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Annual water Water heat fr	323.8617	286.1163		266.1929 05 x 1.50	257.5045	231.4840	228.2074	237.6711	240.6946	269.0250	286.7801	320.2665	(64)
310a Water heating	510.0822 fuel	450.6332	478.0580	419.2538	405.5696		359.4266		379.0940	423.7144	451.6787	504.4197	
Cooling Syste Space coolin			478.0580 atio 0.0000	419.2538	405.5696 0.0000		359.4266 463.2812		379.0940	423.7144	451.6787	504.4197 4.0000 0.0000	(314)
Pumps and Fa Lighting	503.1299 123.5906	454.4399 99.1490	503.1299 89.2727	486.8999 65.4050	503.1299 50.5207	486.8999	503.1299	503.1299	486.8999 77.8109	503.1299 102.0921	486.8999 115.3128	503.1299 127.0256	(331)
Electricity g (333a)m Electricity g (334a)m	-855.3092	-939.6664	-1006.7756	-805.9568	-661.5888	ity)		-656.0203 0.0000	-763.8507 0.0000	-932.2154 0.0000	-862.0799 0.0000	-773.4890 0.0000	

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Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000 0.0000 0.0000 e quantity)	0.0000	0.0000 0.0000 0.0000	0.0000	0.0000 0.0000 0.0000 0.0000	0.0000	0.0000	(333b) (334b) (335b) (307) (309) (310) (311) (313) (321) (330a) (331) (332) (333) (334) (335a) (335) (335)
Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total Total CO2, kg/year EPC Dwelling Carbon Dioxide Emission Rate (DER)		1		Emissic kç	on factor g CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443 0.1413 0.0000	1	Emissions kg C02/year 335.0000 111.1253 60.5945 0.0048 188.5346 142.9322 21.7247 143.9624 -1329.0362 -0.0000 -1329.0362 -31.8822 -0.0300	(367) (367) (372) (386) (373) (373) (376) (377) (378) (379)
Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total Total Primary energy kWh/year Dwelling Primary energy Rate (DPER)		1	Energy				mary energy kWh/year 335.0000 515.2175 613.8963 0.0310 1207.0730 1207.0730 1777.3551 8961.7495 1529.9174 -14323.6359 0.0000 -14323.6359 -847.5408 0-9200	(467a) (467) (472) (486) (473) (476) (477) (478) (479) (480) (483)
SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 20 CALCULATION OF TARGET EMISSIONS 1. Overall dwelling characteristics Ground floor First floor Total floor area TFA = (la)+(lb)+(lc)+(ld)+(le)(ln) 920.0 Dwelling volume	022)		Area (m2) 460.0000 460.0000	(1b) x	ey height (m) 3.2200 (2t 2.9100 (2c +(3d)+(3e)	c) =	Volume (m3) 1481.2000	(1b) - (3b) (1c) - (3c) (4)
2. Ventilation rate						Ī	m3 per hour	

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Number of open of Number of open of chimme Number of chimme Number of flues Number of flues Number of block Number of passis Number of passis Number of passis Number of flues Infiltration duressure test Pressure Test Measured/design Infiltration rai	flues eys / flue attached attached attached dc chimney mittent ex ve vents ess gas fi e to chimn ethod AP50	to solid f to other h ys ktract fans ires	Tuel boiler Leater)+(6c)+(6d)	+(6e)+(6f)+	(6g)+(7a)+(.7b)+(7c) =		40.0000) / (5) =	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0142 Yes slower Door	(6b) (6c) (6d) (6e) (6f) (7a) (7b) (7c)
Number of sides Shelter factor		d							(20) = 1	- [0.075 x	x (19)] =		(19)
Infiltration ra	te adjuste	ed to inclu	ide shelter	factor					(21) = (18)	x (20) =	0.2642	(21)
Wind speed Wind factor Adj infilt rate	Jan 5.1000 1.2750	Feb 5.0000 1.2500	Mar 4.9000 1.2250	Apr 4.4000 1.1000	May 4.3000 1.0750	Jun 3.8000 0.9500	Jul 3.8000 0.9500	Aug 3.7000 0.9250	Sep 4.0000 1.0000	Oct 4.3000 1.0750	Nov 4.5000 1.1250	Dec 4.7000 1.1750	
Effective ac	0.3368 0.5567	0.3302 0.5545	0.3236 0.5524	0.2906 0.5422	0.2840 0.5403	0.2510 0.5315	0.2510 0.5315	0.2444 0.5299	0.2642 0.5349	0.2840 0.5403	0.2972 0.5442	0.3104 0.5482	
3. Heat losses a													
TER Opaque door TER Semi-glazed TER Opening Typ Heatloss Floor Ex Ground Floor Ext External Roof Total net area Fabric heat loss	door e (Uw = 1. 1 ternal Wal ernal Wall of externa	ll l al elements	aum(A, m2)	Gross m2 432.8000 448.3200 460.0000	Opening m 134.380 95.550	9 12 207 460 0 298 0 352 460	tArea m2 .4000 .6000 .9300 .0000 .4200 .7700 .0000 .1200 (26)(U-value W/m2K 1.0000 1.0000 1.1450 0.1300 0.1800 0.1800 0.1100	A x 9.40 12.60 238.08 59.80 53.71 63.49 50.60	/K 00 00 78 00 56 86 00	K-value kJ/m2K	A x K kJ/K	
Thermal mass par List of Thermal		TMP = Cm /	TFA) in kJ/	m2K								159.6541	(35)
E3 Sill E4 Jamb E5 Grou E6 Inte: E16 Cor E17 Cor E10 Eav E12 Gab	nd floor rmediate for the control of	(normal) floor withi al) rted - inte ation at ce ation at ra	n a dwellin ernal area g ciling level ciling level fiter level) clated using	g reater than))		rea)		157 157 162 148 148 49 24 233	.4600 .4600 .2800 .7300 .7300 .0400 .5200 .5200 .9600 .2400	Psi-value 0.0500 0.05500 0.05500 0.1600 0.0000 0.0900 -0.0900 0.0600 0.0600 0.0800 33) + (36)	Tot 7.8° 7.8° 8.11 23.7° 0.00 4.41 -2.2(14.01) 3.41 5.45 (36a) = + (36a) =	30 30 40 68 00 36 68 12 76	
Ventilation hear	t loss cal Jan	lculated mo	nthly (38)m Mar	= 0.33 x (25)m x (5) May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer co	oeff 078.5092	1076.4594	513.9965 1074.4501						497.7398 1058.1934				(39)
Average = Sum(3: HLP HLP (average)	Jan 1.1723	Feb 1.1701	Mar 1.1679	Apr 1.1576	May 1.1557	Jun 1.1468	Jul 1.1468	Aug 1.1451	Sep 1.1502	Oct 1.1557	Nov 1.1596	Dec 1.1636 1.1576	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	
4. Water heating	g energy 1	requirement	s (kWh/year)									
Assumed occupand Hot water usage	for mixe											3.9379	
Hot water usage		0.0000 s 102.6299	0.0000	0.0000 96.4340	0.0000 93.4259	0.0000 90.0905	0.0000 88.2888	0.0000 90.4523	0.0000	0.0000 96.3771	0.0000	0.0000	
Hot water usage	for other 54.9583	r uses 52.9599	50.9614	48.9629	46.9644	44.9659	44.9659	46.9644	48.9629	50.9614	52.9599	54.9583	(42c)
Average daily ho	ot water ı Jan	ıse (litres Feb	(/day) Mar	Apr	Mary	Jun	Jul	Aug	Con	Oct	Nov	146.5507 Dec	(43)
Daily hot water	use		151.4126	145.3969	May 140.3903	135.0564	133.2548	Aug 137.4167	Sep 141.7709		153.4369	158.7833	(44)
Energy conte 2 Energy content Distribution los	252.0317 (annual)	221.5578	232.7155	199.0410	188.9924	166.0676	161.1601	170.1506	174.8177	199.9369		248.6162 2433.6864	(45)
Water storage lo	37.8048		34.9073	29.8562	28.3489	24.9101	24.1740	25.5226	26.2227	29.9905	32.7898	37.2924	(46)
Store volume a) If manufactor Temperature for Enter (49) or (urer decla actor from 54) in (55	n Table 2b	actor is kn	own (kWh/d	ay):							1000.0000 4.5050 0.5400 2.4327	(48) (49)
Total storage lo	75.4137	68.1156	75.4137 ir storage	72.9810	75.4137	72.9810	75.4137	75.4137	72.9810	75.4137	72.9810	75.4137	(56)
Primary loss Combi loss	75.4137 23.2624 0.0000	68.1156 21.0112 0.0000	75.4137 23.2624 0.0000	72.9810 22.5120 0.0000	75.4137 23.2624 0.0000	72.9810 22.5120 0.0000	75.4137 23.2624 0.0000	75.4137 23.2624 0.0000	72.9810 22.5120 0.0000	75.4137 23.2624 0.0000	72.9810 22.5120 0.0000	75.4137 23.2624 0.0000	(59)
Total heat requ:			331.3916 0.0000		287.6685 0.0000	261.5606	259.8362 0.0000	268.8267 0.0000	270.3107 0.0000	298.6130 0.0000	314.0919	347.2923 0.0000	

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PV diverter Solar input	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	
FGHRS Output from w	0.0000 n/h 350.7078	0.0000	0.0000	0.0000	0.0000 287.6685	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
12Total per y Electric show	vear (kWh/ye										Sum (64) m =		(64)
	0.0000	0.0000	0.0000	0.0000 Tot	0.0000 al Energy u	0.0000 used by inst	0.0000 antaneous e	0.0000 electric sho	0.0000 wer(s) (kWh	0.0000 /year) = Su	0.0000 nm(64a)m =	0.0000	
Heat gains fr			/month 156.3188	142.5755	141.7808	131.6119	132.5266	135.5160	134.5213	145.4199	149.0785	161.6058	(65)
5. Internal g													
Metabolic gai	Jan	Feb	Mar 196.8965		May 196.8965	Jun 196.8965	Jul 196.8965	Aug 196.8965	Sep 196.8965	Oct 196.8965	Nov 196.8965	Dec 196.8965	(66)
Lighting gain Appliances ga	436.6142	483.3943	436.6142	451.1680	436.6142	451.1680	436.6142	436.6142	451.1680	436.6142	451.1680	436.6142	(67)
Cooking gains	865.7936 (calculate	874.7779 ed in Append	852.1379 dix L, equat	803.9401 ion L15 or	743.0990 L15a), also	685.9170 see Table	647.7159 5		661.3716	709.5694	770.4105	827.5925	
Pumps, fans Losses e.g. e	42.6897 3.0000	3.0000	42.6897 3.0000 zalues) (Tah	3.0000		42.6897 0.0000	42.6897 0.0000	42.6897 0.0000	42.6897 0.0000	42.6897 3.0000	42.6897 3.0000	42.6897 3.0000	
Water heating	-157.5172 gains (Tab	-157.5172 ole 5)	-157.5172	-157.5172								-157.5172	
Total interna	al gains		210.1059 1583.9269	198.0216	190.5656	182.7943	178.1272	182.1451	186.8351	195.4568	207.0535	217.2121	
	1000.2133	1030.9094	1303.9209	1330.1307	1433.3476	1401.9402	1344.3202	1339.3399	1301.4437	1420.7094	1313.7010	1300.4070	(73)
6. Solar gain													
[Jan]				m2	Solar flux Table 6a W/m2	Speci		Specific or Tab	FF data le 6c	Acce fact Table	or	Gains W	
Northeast Southeast			54.3		11.2829)		0	.7000	0.77		187.3414 655.1147	
Southwest Northwest			57.6 37.7	5100 7300	36.7938 36.7938 11.2829)	0.6300 0.6300	0	.7000 .7000	0.77	700	647.8056 130.1011	(79)
Solar gains Total gains													
7. Mean inter													
Temperature d	luring heati	ng periods	in the livi	ing area fro	om Table 9,							21.0000	(85)
Temperature of Utilisation f	during heati factor for g Jan 37.8305	ng periods gains for li Feb 37.9025	in the livi iving area, Mar 37.9734	ing area fro nil,m (see Apr 38.3099	m Table 9, Table 9a) May 38.3735	Th1 (C) Jun 38.6724	Jul 38.6724	Aug 38.7283	Sep 38.5567	Oct 38.3735	Nov 38.2450	Dec 38.1116	
Temperature d	during heati factor for g Jan 37.8305 3.5220	ng periods gains for li Feb	in the livi iving area, Mar	ing area fro nil,m (see Apr 38.3099	m Table 9, Table 9a) May 38.3735	Th1 (C) Jun	Jul	Aug				Dec	
Temperature of Utilisation f tau alpha util living a	during heati factor for c Jan 37.8305 3.5220 area 0.9981	ng periods gains for li Feb 37.9025 3.5268 0.9935	in the livi iving area, Mar 37.9734 3.5316 0.9808	ing area fro nil,m (see Apr 38.3099 3.5540 0.9397 20.0055	om Table 9, Table 9a) May 38.3735 3.5582 0.8457	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404	Jul 38.6724 3.5782 0.5457 20.9496	Aug 38.7283 3.5819 0.6171 20.9220	38.5567 3.5704 0.8461 20.6492	38.3735 3.5582 0.9726 19.9386	38.2450 3.5497 0.9956 19.1498	Dec 38.1116 3.5408 0.9986 18.5538	(86)
Temperature of Utilisation for tau alpha util living a	during heati factor for control of the control of t	ng periods gains for li Feb 37.9025 3.5268 0.9935 18.9169 19.9440	in the livi iving area, Mar 37.9734 3.5316 0.9808 19.3915 19.9458	ing area fro ni1,m (see Apr 38.3099 3.5540 0.9397 20.0055 19.9541	m Table 9, Table 9a) May 38.3735 3.5582 0.8457 20.5244 19.9556	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983	(86) (87) (88) (89)
Temperature of Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f	Unring heatifactor for control of the control of th	nng periods pains for li Feb 37.9025 3.5268 0.9935 18.9169 19.9440 0.9919 17.5062	in the livi lving area, Mar 37.9734 3.5316 0.9808 19.3915 19.9458 0.9760 18.1119	ing area fro nil,m (see Apr 38.3099 3.5540 0.9397 20.0055 19.9541 0.9239 18.8868	om Table 9, Table 9a) May 38.3735 3.5582 0.8457 20.5244 19.9556 0.8046 19.5067	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137 19.8479	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326 19.9392	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032 19.9238	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA =	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 ea / (4) =	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447 0.1024	(86) (87) (88) (89) (90) (91)
Temperature of Utilisation for tau alpha util living a MIT Th 2 util rest of MIT 2	luring heati factor for c Jan 37.8305 3.5220 irea 0.9981 18.6010 19.9422 house 0.9976 17.1010 fraction 17.2545	ng periods pains for 1: Feb 37.9025 3.5268 0.9935 18.9169 19.9440 0.9919 17.5062	in the livi iving area, Mar 37.9734 3.5316 0.9808 19.3915 19.9458	ing area fro ni1,m (see Apr 38.3099 3.5540 0.9397 20.0055 19.9541	m Table 9, Table 9a) May 38.3735 3.5582 0.8457 20.5244 19.9556	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA =	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162 Living are 18.9311	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 ea / (4) = 17.9478	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447	(86) (87) (88) (89) (90) (91) (92)
Temperature of Utilisation for tau alpha util living a MIT Th 2 util rest of MIT 2 Living area for MIT Temperature a	luring heati factor for c Jan 37.8305 3.5220 irea 0.9981 18.6010 19.9422 house 0.9976 17.1010 fraction 17.2545	ng periods pains for 1: Feb 37.9025 3.5268 0.9935 18.9169 19.9440 0.9919 17.5062	in the liviving area, Mar 37.9734 3.5316 0.9808 19.3915 19.9458 0.9760 18.1119	ing area fro nil, m (see Apr 38.3099 3.5540 0.9397 20.0055 19.9541 0.9239 18.8868	m Table 9, Table 9a) May 38.3735 3.5582 0.8457 20.5244 19.9556 0.8046 19.5067	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137 19.8479 19.9495	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326 19.9392 20.0426	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032 19.9238 20.0260	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA = 19.7672	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162 Living are 18.9311	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 ea / (4) = 17.9478	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447 0.1024 17.1992 0.0000	(86) (87) (88) (89) (90) (91) (92)
Temperature of Utilisation for tau alpha util living a MIT Th 2 util rest of MIT 2 Living area for MIT Temperature a	Nuring heati Nactor for c Jan 37.8305 3.5220 18.6010 19.9422 house 0.9976 17.1010 fraction 17.2545 ddjustment 17.2545	ng periods pains for 1: Feb 37.9025 3.5268 0.9935 18.9169 19.9440 0.9919 17.5062 17.6506	in the liviving area, Mar 37.9734 3.5316 0.9808 19.3915 19.9458 0.9760 18.1119 18.2429	ing area fro nil, m (see Apr 38.3099 3.5540 0.9397 20.0055 19.9541 0.9239 18.8868 19.0013	m Table 9, Table 9a) May 38.3735 3.5582 0.8457 20.5244 19.9556 0.8046 19.5067 19.6108	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137 19.8479 19.9495	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326 19.9392 20.0426	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032 19.9238 20.0260	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA = 19.7672	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162 Living are 18.9311	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 ea / (4) = 17.9478	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447 0.1024 17.1992 0.0000	(86) (87) (88) (89) (90) (91) (92)
Temperature of Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a adjusted MIT Temperature a. S. Space heat	Jan 37.8305 3.5220 irea 0.9981 18.6010 19.9422 house 0.9976 17.1010 fraction 17.2545 ddjustment 17.2545	ng periods pains for l: Feb 37.9025 3.5268 0.9935 18.9169 19.9440 0.9919 17.5062 17.6506	in the liviving area, Mar 37.9734 3.5316 0.9808 19.3915 19.9458 0.9760 18.1119 18.2429 18.2429	ing area fro nil, m (see Apr 38.3099 3.5540 0.9397 20.0055 19.9541 0.9239 18.8868 19.0013	m Table 9, Table 9a) Table 9a) May 38.3735 3.5582 0.8457 20.5244 19.9556 0.8046 19.5067 19.6108	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137 19.8479 19.9495	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326 19.9392 20.0426	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032 19.9238 20.0260 20.0260	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA = 19.7672	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162 Living are 18.9311 18.9311	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 2a / (4) = 17.9478 17.9478	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447 0.1024 17.1992 0.0000 17.1992	(86) (87) (88) (89) (90) (91) (92) (93)
Temperature of Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a adjusted MIT 8. Space heat	luring heatifactor for cyan 37.8305 3.5220 lirea 0.9981 18.6010 19.9422 house 0.9976 17.1010 fraction 17.2545 dijustment 17.2545 ling requires Jan 0.9956 3212.3386	nng periods pains for 1: Feb 37.9025 3.5268 0.9935 18.9169 19.9440 0.9919 17.5062 17.6506 17.6506	in the liviving area, Mar 37.9734 3.5316 0.9808 19.3915 19.9458 0.9760 18.1119 18.2429 18.2429	ing area fro nil, m (see Apr 38.3099 3.5540 0.9397 20.0055 19.9541 0.9239 18.8868 19.0013 19.0013	m Table 9, Table 9a) May 38.3735 3.5582 0.8457 20.5244 19.9556 0.8046 19.5067 19.6108 19.6108	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137 19.8479 19.9495 19.9495	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326 19.9392 20.0426 20.0426	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032 19.9238 20.0260 20.0260	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA = 19.7672 19.7672	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162 Living are 18.9311 18.9311	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 17.9478 17.9478	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447 7.1992 0.0000 17.1992 Dec 0.9968 2931.3045	(86) (87) (88) (89) (90) (91) (92) (93)
Temperature of Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a adjusted MIT 8. Space heat Utilisation Useful gains Ext temp. Heat loss rat	Jan 17.2545 djustment 17.2545 3.212.3386 4.3000 ee W 13971.5643	ng periods pains for 1: Feb 37.9025 3.5268 0.9935 18.9169 19.9440 0.9919 17.5062 17.6506 17.6506	in the livi living area, Mar 37.9734 3.5316 0.9808 19.3915 19.9458 0.9760 18.1119 18.2429 18.2429	Apr 0.9050 6527.7479 8.9000	m Table 9, Table 9a) May 38.3735 3.5582 0.8457 20.5244 19.9556 0.8046 19.5067 19.6108 19.6108	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137 19.8479 19.9495 Jun 0.6125 5099.7794 14.6000	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326 19.9392 20.0426 20.0426	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032 20.0260 20.0260 Aug 0.5106 3614.9114 16.4000	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA = 19.7672 19.7672	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162 Living are 18.9311 18.9311	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 ea / (4) = 17.9478 17.9478 Nov 0.9902 3439.6497 7.1000	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447 0.1024 17.1992 0.0000 17.1992	(86) (87) (88) (89) (90) (91) (92) (93)
Temperature of Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a adjusted MIT 8. Space heat Utilisation Useful gains Ext temp. Heat loss rat Space heating	Jan 0.9956 3212.3386 4.3000 te W 13971.5643 g kWh 8004.8639	ng periods rains for 1: Feb 37.9025 3.5268 0.9935 18.9169 19.9440 0.9919 17.5062 17.6506 17.65	in the liviving area, Mar 37.9734 3.5316 0.9808 19.3915 19.9458 0.9760 18.1119 18.2429 18.2429 Mar 0.9645 5579.2811 6.5000 12617.1855	Apr 0.9397 20.0055 19.9541 0.9239 18.8868 19.0013 19.0013 19.0013 19.0013 19.0013	may 0.7886 6497.6872 11.7000 8411.1694	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137 19.8479 19.9495 Jun 0.6125 5099.7794 14.6000	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326 19.9392 20.0426 20.0426	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032 20.0260 20.0260 Aug 0.5106 3614.9114 16.4000	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA = 19.7672 19.7672 \$\$ep\$ 0.7753 4719.9536 14.1000	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162 Living are 18.9311 18.9311 Oct 0.9488 4430.1224 10.6000	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 12.9478 17.9478 17.9478 17.9478 17.9478 17.9478	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447 0.1024 17.1992 0.0000 17.1992 Dec 0.9968 2931.3045 4.2000 13916.3166 8172.8490	(86) (87) (88) (89) (90) (91) (92) (93)
Temperature of Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a adjusted MIT 8. Space heat Utilisation Useful gains Ext temp. Heat loss rat Space heating Space heating Solar heating	Jan 17.2545 dispersion of the control of the contro	ng periods pains for 1: Feb 37.9025 3.5268 0.9935 18.9169 19.9440 0.9919 17.5062 17.6506 17.6506 17.6506 17.6506 17.6506 17.6506 17.6506	in the liviving area, Mar 37.9734 3.5316 0.9808 19.3915 19.9458 0.9760 18.1119 18.2429 18.2429 Mar 0.9645 5579.2811 6.5000 12617.1855 5236.2009 per year (kW	Apr 0.9030 19.0013 19.0013 19.0013 19.0013 19.0013 19.0013 19.0013 19.0013 19.0013 19.0013	m Table 9, Table 9a) Table 9a) May 38.3735 3.5582 0.8457 20.5244 19.9556 0.8046 19.5067 19.6108 19.6108 497.6872 11.7000 8411.1694 1423.6308	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137 19.8479 19.9495 19.9495	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326 19.9392 20.0426 20.0426 Jul 0.4418 3508.6953 16.6000 3632.0891	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032 19.9238 20.0260 20.0260	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA = 19.7672 19.7672 \$\$ep\$ 0.7753 4719.9536 14.1000	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162 Living are 18.9311 18.9311 Oct 0.9488 4430.1224 10.6000	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 12.9478 17.9478 17.9478 17.9478 17.9478 17.9478	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447 0.1024 17.1992 0.0000 17.1992 Dec 0.9968 2931.3045 4.2000 13916.3166 8172.8490 41257.4744 0.0000	(86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98a)
Temperature of Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a adjusted MIT 8. Space heat Utilisation Useful gains Ext temp. Heat loss rat Space heating	Jan 0.9956 3212.3386 4.3000 19 kWh 8004.8639 g requiremer g kWh 0.0000 g contributing factor for contributing two	Ing periods rains for 1: Feb 37.9025 3.5268 0.9935 18.9169 19.9440 0.9919 17.5062 17.6506 17.6	in the liviving area, Mar 37.9734 3.5316 0.9808 19.3915 19.9458 0.9760 18.1119 18.2429 18.2429 Mar 0.9645 5579.2811 6.5000 12617.1855 5236.2009 per year (kW	Apr 0.9397 20.0055 19.9541 0.9239 18.8868 19.0013 19.0013 19.0013 19.0013 19.0013 19.0013	may 0.7886 6497.6872 11.7000 8411.1694 1423.6308 0.0000	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137 19.8479 19.9495 19.9495 Jun 0.6125 5099.7794 14.6000 5643.8452 0.0000	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326 19.9392 20.0426 20.0426 Jul 0.4418 3508.6953 16.6000 3632.0891 0.0000	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032 20.0260 20.0260 20.0260	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA = 19.7672 19.7672 Sep	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162 Living are 18.9311 18.9311 0 Oct 0.9488 4430.1224 10.6000 8857.9817 3294.3273	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 2a / (4) = 17.9478 17.9478 17.9478 17.9478 17.9478	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447 0.1024 17.1992 0.0000 17.1992 Dec 0.9968 2931.3045 4.2000 13916.3166 8172.8490 41257.4744 0.0000 0.0000	(86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98a)
Temperature of Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a adjusted MIT 8. Space heat Utilisation Useful gains Ext temp. Heat loss rat Space heating Solar heating	Jan 0.9956 3212.3386 4.3000 e W 13971.5643 f kWh 8004.8639 g requiremer \$ 8004.8639 g requiremer	Ing periods rains for 1: Feb 37.9025 18.9169 19.9440 0.9919 17.5062 17.6506 17	in the liviving area, Mar 37.9734 3.5316 0.9808 19.3915 19.9458 0.9760 18.1119 18.2429 18.2429 Mar 0.9645 5579.2811 6.5000 12617.1855 5236.2009 per year (W	Apr 0.9050 6527.7479 8.9000 UWh/year) 3045.8067	m Table 9, Table 9a) Table 9a) May 38.3735 3.5582 0.8457 20.5244 19.9556 0.8046 19.5067 19.6108 19.6108 40.7886 6497.6872 11.7000 8411.1694 1423.6308 0.0000	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137 19.8479 19.9495 19.9495 Jun 0.6125 509.7794 14.6000 5643.8452 0.0000 0.0000	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326 19.9392 20.0426 20.0426 Jul 0.4418 3508.6953 16.6000 3632.0891 0.0000	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032 19.9238 20.0260 20.0260	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA = 19.7672 19.7672 Sep	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162 Living are 18.9311 18.9311 0.000 8857.9817 3294.3273	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 12.4 (14) = 17.9478 17.9478 Nov 0.9902 3439.6497 7.1000 11572.6115 5855.7326 0.0000 5855.7326	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447 0.1024 17.1992 0.0000 17.1992 0.0000 17.1992 0.968 2931.3045 4.2000 13916.3166 8172.8490 0.0000 0.0000 8172.8490 41257.4744	(86) (87) (88) (99) (90) (91) (92) (93) (94) (95) (96) (97) (98a) (98b)
Temperature of Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a adjusted MIT Space heating	Jan (17.2545 ddjustment (17.2545 ds) (18.6010 ds) (18.601	Ing periods rains for 1: Feb 37.9025 18.9169 19.9440 0.9919 17.5062 17.6506 17	mar 37.9734 3.5316 0.9808 19.3915 19.9458 0.9760 18.1119 18.2429 18.24	Apr 0.9050 6527.7479 8.9000 Wh/year) 3045.8067 rini (see	may 0.7886 6497.6872 11.7000 8411.1694 1423.6308 1 per year	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137 19.8479 19.9495 19.9495 Jun 0.6125 509.7794 14.6000 5643.8452 0.0000 0.0000 (kWh/year)	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326 19.9392 20.0426 20.0426 Jul 0.4418 3508.6953 16.6000 3632.0891 0.0000 0.0000	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032 19.9238 20.0260 20.0260 20.0260 3614.914 16.4000 3820.0257 0.0000 0.0000 0.0000	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA = 19.7672 19.7672 Sep	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162 Living are 18.9311 18.9311 0.000 8857.9817 3294.3273	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 2a / (4) = 17.9478 17.9478 17.9478 17.9478 0.9902 3439.6497 7.1000 11572.6115 5855.7326	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447 0.1024 17.1992 0.0000 17.1992 0.0000 17.1992 0.968 2931.3045 4.2000 13916.3166 8172.8490 0.0000 0.0000 8172.8490 41257.4744	(86) (87) (88) (99) (90) (91) (92) (93) (94) (95) (96) (97) (98a) (98b)
Temperature of Utilisation f tau alpha util living a MIT Th 2 util rest of MIT 2 Living area f MIT Temperature a adjusted MIT 8. Space heat Utilisation Useful gains Ext temp. Heat loss rat Space heating Solar heating Solar heating Space heating	Jan 37.8305 3.5220 1888 0.9981 18.6010 19.9422 house 0.9976 17.1010 17.2545 17	Ing periods rains for 1: Feb 37.9025 18.9169 19.9440 0.9919 17.5062 17.6506 17	mar 37.9734 3.5316 0.9808 19.3915 19.9458 0.9760 18.1119 18.2429 18.2429 18.2429 18.2429 18.2429 18.2617.1855 579.2811 6.5000 12617.1855 5236.2009 per year (kw 0.0000 per year (kw 5236.2009 per year (kw 5236.2009 per year (kw 1.00000 per year (kw 1.0000000 per year (kw 1.000000000000000000000000000000000000	Apr 0.9397 20.0055 19.9541 0.9239 18.8868 19.0013 19.0013 19.0013 19.0013 19.0013 19.0013 19.0013 19.0013 19.0013	may 0.7886 6497.6872 11.7000 8411.1694 1423.6308 12 per year ciluding micr	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137 19.8479 19.9495 19.9495 Jun 0.6125 5099.7794 14.6000 5643.8452 0.0000 0.0000 0.0000 (kWh/year)	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326 19.9392 20.0426 20.0426 Jul 0.4418 3508.6953 16.6000 3632.0891 0.0000 0.0000	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032 19.9238 20.0260 20.0260 Aug 0.5106 3614.9114 16.4000 3820.0257 0.0000 0.0000	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA = 19.7672 19.7672 Sep	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162 Living are 18.9311 18.9311 0.000 8857.9817 3294.3273	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 2a / (4) = 17.9478 17.9478 17.9478 17.9478 0.9902 3439.6497 7.1000 11572.6115 5855.7326	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447 0.1024 17.1992 0.0000 17.1992 0.0000 17.1992 0.968 2931.3045 4.2000 13916.3166 8172.8490 0.0000 0.0000 8172.8490 41257.4744	(86) (87) (88) (99) (90) (91) (92) (93) (94) (95) (96) (97) (98a) (98b)
Temperature of Utilisation for tau alpha util living a util living a util rest of MIT 2 util rest of MIT 2 Living area for MIT Temperature a adjusted MIT Temperature a adjusted MIT Space heating Spa	Jan 37.8305 3.5220 1888 0.9981 18.6010 19.9422 house 0.9976 17.1010 18.6010 17.2545 17	Ing periods (ains for 1: Feb 37.9025 (ains for 1: Feb 37.9025 (ains for 1: Feb 37.9025 (ains for 1: Feb 37.9026 (ains for 1: Feb 37.6506 (ains for	mar 37.9734 3.5316 0.9808 19.3915 19.9458 0.9760 18.1119 18.2429 18.24	Apr 0.9050 6527.7479 8.9000 10758.0350 3045.8067 7th/year) 3045.8067 2939 3045.8067 200000 200000 200000 200000 200000 200000 200000 200000 2000000	May 0.7886 6497.6872 11.7000 8411.1694 1423.6308 1 per year	Th1 (C) Jun 38.6724 3.5782 0.6936 20.8404 19.9628 0.6137 19.8479 19.9495 19.9495 Jun 0.6125 5099.7794 14.6000 0.0000 0.0000 0.0000 0.0000 0.0000	Jul 38.6724 3.5782 0.5457 20.9496 19.9628 0.4326 19.9392 20.0426 20.0426 Jul 0.4418 3508.6953 16.6000 3632.0891 0.0000 0.0000	Aug 38.7283 3.5819 0.6171 20.9220 19.9642 0.5032 19.9238 20.0260 20.0260 Aug 0.5106 3614.9114 16.4000 3820.0257 0.0000 0.0000	38.5567 3.5704 0.8461 20.6492 19.9600 0.7883 19.6667 fLA = 19.7672 19.7672 Sep	38.3735 3.5582 0.9726 19.9386 19.9556 0.9628 18.8162 Living are 18.9311 18.9311 0.000 8857.9817 3294.3273	38.2450 3.5497 0.9956 19.1498 19.9525 0.9943 17.8107 2a / (4) = 17.9478 17.9478 17.9478 17.9478 0.9902 3439.6497 7.1000 11572.6115 5855.7326	Dec 38.1116 3.5408 0.9986 18.5538 19.9492 0.9983 17.0447 0.1024 17.1992 0.0000 17.1992 0.0000 17.1992 0.968 2931.3045 4.2000 13916.3166 8172.8490 0.0000 0.0000 8172.8490 41257.4744	(86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98a) (98c) (99)

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Space heating requirement		1400 6000	0.0000		0.0000	0.0000	2004 2072	5055 7006	0170 0400	(00)
8004.8639 6224.0633 5236.200 Space heating efficiency (main heating system 92.3000 92.3000 92.3000 92.3000	em 1)	92.3000	0.0000	0.0000	0.0000	0.0000	3294.3273			
Space heating fuel (main heating system)			0.0000	0.0000	0.0000		92.3000	92.3000	92.3000	
8672.6586 6743.2972 5673.023 Space heating efficiency (main heating system 0.0000 0.0000 0.000	em 2)	0.0000	0.0000	0.0000	0.0000	0.0000	3569.1520 0.0000	0.0000	0.0000	
Space heating fuel (main heating system 2) 0.0000 0.0000 0.000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating fuel (secondary) 0.0000 0.0000 0.000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Water heating Water heating requirement 350.7078 310.6846 331.393	.6 294.5340	287.6685	261.5606	259.8362	268.8267	270.3107	298.6130	314.0919	347.2923	(64)
Efficiency of water heater (217)m 88.3816 88.3264 88.20		87.1478	79.8000	79.8000	79.8000	79.8000	87.9754	88.2931	79.8000 88.3936	(216)
Fuel for water heating, kWh/month 396.8108 351.7461 375.693			327.7702	325.6092	336.8756		339.4279	355.7379		
Space cooling fuel requirement (221)m 0.0000 0.0000 0.000			0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Pumps and Fa 7.3041 6.5973 7.304 Lighting 90.7198 72.7788 65.529	7.0685	7.3041	7.0685 30.2979	7.3041 33.8292	7.3041 43.9725	7.0685 57.1159	7.3041 74.9392	7.0685 84.6436	7.3041	(231)
Electricity generated by PVs (Appendix M) (r (233a)m -300.5941 -371.7723 -468.922	egative quant	tity)								
Electricity generated by wind turbines (Appe (234a)m 0.0000 0.0000 0.000	endix M) (nega	ative quanti		0.0000	0.0000	0.0000	0.0000	0.0000		(234a)
Electricity generated by hydro-electric gene (235a)m 0.0000 0.0000 0.000	rators (Apper	ndix M) (neg				0.0000	0.0000	0.0000		(235a)
Electricity used or net electricity generate (235c)m 0.0000 0.0000 0.000	ed by micro-CF	HP (Appendia	N) (negati		generation)	0.0000	0.0000	0.0000		(235c)
Electricity generated by PVs (Appendix M) (r (233b)m -372.9365 -746.5084 -1420.018	egative quant	tity)								
Electricity generated by wind turbines (Appe (234b)m 0.0000 0.0000 0.000	endix M) (nega	ative quanti		0.0000	0.0000	0.0000	0.0000	0.0000		(234b)
Electricity generated by hydro-electric gene (235b)m 0.0000 0.0000 0.000	rators (Apper	ndix M) (neg	gative quant			0.0000	0.0000	0.0000		(235b)
Electricity used or net electricity generate (235d)m 0.0000 0.0000 0.000	ed by micro-CH	HP (Appendia	N) (negati		generation)		0.0000	0.0000		(235d)
Annual totals kWh/year Space heating fuel - main system 1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	44699.3222	
Space heating fuel - main system 2 Space heating fuel - secondary									0.0000	(213)
Efficiency of water heater Water heating fuel used									79.8000 4206.3732	
Space cooling fuel									0.0000	(221)
Electricity for pumps and fans: Total electricity for the above, kWh/year Electricity for lighting (calculated in Appe	endix L)								86.0000 732.1609	
Energy saving/generation technologies (Apper PV generation	ndices M ,N ar	nd Q)						-	-22736.6525	(233)
Wind generation Hydro-electric generation (Appendix N)									0.0000	(234)
Electricity generated - Micro CHP (Appendix Appendix Q - special features	N)								0.0000	
Energy saved or generated Energy used									-0.0000	
Total delivered energy for all uses									26987.2038	(238)
12a. Carbon dioxide emissions - Individual h										
					Energy kWh/year		sion factor kg CO2/kWh	1	Emissions	
Space heating - main system 1 Total CO2 associated with community systems					44699.3222		0.2100		9386.8577	
Water heating (other fuel) Space and water heating					4206.3732		0.2100		883.3384 10270.1960	
Pumps, fans and electric keep-hot Energy for lighting					86.0000 732.1609		0.1387 0.1443		11.9293 105.6734	
Energy saving/generation technologies										
PV Unit electricity used in dwelling PV Unit electricity exported					-4570.4441 -18166.2084		0.1376 0.1271		-629.0287 -2309.2691	
Total Total CO2, kg/year									-2938.2978 7449.5009	(272)
EPC Target Carbon Dioxide Emission Rate (TER	₹)								8.1000	(273)
13a. Primary energy - Individual heating sys	tems includir	ng micro-CHE	•							
							ergy factor kg CO2/kWh		mary energy kWh/year	
Space heating - main system 1 Total CO2 associated with community systems					44699.3222		1.1300		50510.2341	(275)
Water heating (other fuel) Space and water heating					4206.3732		1.1300		4753.2017 55263.4358	(278)
Pumps, fans and electric keep-hot Energy for lighting					86.0000 732.1609		1.5128 1.5338		130.1008 1123.0128	(281)
Energy saving/generation technologies										
PV Unit electricity used in dwelling PV Unit electricity exported					-4570.4441 -18166.2084		1.5088 0.4667		-6895.9692 -8477.5261	
Total Total Primary energy kWh/year									-15373.4953 41143.0541	(286)
Target Primary Energy Rate (TPER)									44.7200	(287)

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)



CALCULATION OF FABRIC ENERGY EFFICIENCY 1. Overall dwelling characteristics Storey height Volume (m3) 1481.2000 (1b) - (3b) 1338.6000 (1c) - (3c) First floor
Total floor area TFA = (la)+(lb)+(lc)+(ld)+(le)...(ln)
Dwelling volume 460.0000 (1c) 2.9100 (2c) 920.0000 2. Ventilation rate m3 per hour Number of open chimneys
Number of open flues
Number of chimneys / flues attached to closed fire
Number of flues attached to solid fuel boiler
Number of flues attached to other heater
Number of blocked chimneys
Number of intermittent extract fans
Number of passive vents
Number of flueless gas fires 0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 4 * 10 = 0.0000 (6a) 0.0000 (6b) 0.0000 (6c) 0.0000 (6d) 0.0000 (6e) 0.0000 (6f) 40.0000 (7a) 4 * 10 = 0 * 10 = 0 * 40 = 40.0000 0.0000 (7b) 0.0000 (7c) Air changes per hour Infiltration due to chimneys, flues and fans = (6a) + (6b) + (6c) + (6d) + (6e) + (6f) + (6g) + (7a) + (7b) + (7c) =40.0000 / (5) = 0.0142 (8) Pressure test Pressure Test Method Measured/design AP50 Infiltration rate 0.0642 (18) Number of sides sheltered $(20) = 1 - [0.075 \times (19)] = (21) = (18) \times (20) =$ 1.0000 (20) Infiltration rate adjusted to include shelter factor 0.0642 (21) May 4.3000 1.0750 Aug 3.7000 0.9250 Sep Wind speed Wind factor Adj infilt rate 5.1000 1.2750 5.0000 1.2500 4.9000 1.2250 4.4000 1.1000 3.8000 0.9500 3.8000 0.9500 4.0000 4.3000 4.5000 1.1250 4.7000 (22) 1.1750 (22a) 1.0000 0.0818 0.0802 0.0690 0.0786 0.0706 0.0610 0.0610 0.0642 0.0722 0.0594 0.0690 0.0000 (23b) 0.0000 (23c) 0.5028 (25) 3. Heat losses and heat loss parameter $\,$ U-value Gross Openings NetArea W/K 341.9612 10.0800 9.4000 m2 W/m2K kJ/m2K kJ/K Window (Uw = 0.80) Glazed Door Normal Door 441.1300 0.7752 0.8000 1.0000 (27) 12.6000 460.0000 50600.0000 (28a) Heatloss Floor 1 0.1000 46.0000 110.0000 Ground Floor External Wall First Floor External Wall 432 8000 0.1400 24.1374 34.3812 190.0000 32757.9000 (29a) 46660.2000 (29a) External Roof
Total net area of external elements Aum(A, m2) 460.0000 460.0000 0.1100 50.6000 9.0000 4140.0000 1801.1200 (26)...(30) + (32) = 493.7400 Fabric heat loss, W/K = Sum (A x U) Internal Wall 1 516.5598 Internal Floor 1 18.0000 460.0000 8280.0000 (32d) Heat capacity Cm = Sum(A x k) Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K List of Thermal Bridges $(28)\dots(30) + (32) + (32a)\dots(32e) = 146881.7600 (34) \\ 159.6541 (35)$ Richard Directors KI Element E2 Other lintels (including other steel lintels) E3 Sill E4 Jamb 157.4600 157.4600 162.2800 0.3000 47.2380 3.1492 0.0160 2.5965 E5 Ground floor (normal)
E6 Intermediate floor within a dwelling 148.7300 148.7300 0.0530 7.8827 E16 Corner (normal)
E17 Corner (inverted - internal area greater than external area) 1.8635 49.0400 0.0380 24.5200 -0.0750 -1.8390 E17 Corner (inverted - internal area greater than 6 E10 Eaves (insulation at ceiling level)
E12 Gable (insulation at ceiling level)
E13 Gable (insulation at rafter level)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Point Thermal bridges
Total fabric heat loss 233.5200 56.9600 28.0224 0.1200 68.2400 0.2500 17.0600 120.3620 (36) Jun Jul Aug 466.9071 Sep Oct 467.1838 467.4821 466.9969 467.9134 (38) 466.9969 Heat transfer coeff 1105.3048 1105.1838 1105.0652 1104.5082 1104.4040 1103.9188 1103.9188 1103.8289 1104.1057 1104.4040 1104.6148 Average = Sum(39)m / 12 = Sep 1.2001 1.2004 1.2014 1.2013 1.2012 1.2006 1.1999 1.1999 1.1998 1.2004 1.2007 1.2009 (40) HLP (average) Days in mont 4. Water heating energy requirements (kWh/year) Assumed occupancy 3.9379 (42)

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Hot water usag	ge for mixe: 0.0000	r showers 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usag		S	37.5396	36.0384	34.9142	33.6677	32.9944	33.8030	34.6833	36.0171	37.5493	38.8004	
Hot water usag		r uses	50.9614	48.9629	46.9644	44.9659	44.9659	46.9644	48.9629	50.9614	52.9599	54.9583	
Average daily	hot water	use (litres	s/day)									86.0583	(43)
Daily hot wate		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte		91.3137 130.0295	88.5010 136.0228	85.0013 116.3625	81.8786 110.2244	78.6337 96.6893	77.9604 94.2863	80.7674 100.0069	83.6462 103.1441	86.9785 118.0290		93.7588 146.8036	
Energy content Distribution	loss (46) m										um(45)m =		
Water storage		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Total storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder co	0.0000	0.0000 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Primary loss Combi loss Total heat red	0.0000 0.0000	0.0000	0.0000	0.0000 0.0000	0.0000 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
			115.6194	98.9081 0.0000		82.1859 0.0000	80.1434	85.0058 0.0000	87.6725 0.0000	100.3246	109.6048	124.7831 0.0000	
PV diverter Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
FGHRS Output from w	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
		110.5251	115.6194	98.9081	93.6907	82.1859	80.1434	85.0058 Total p		100.3246 h/year) = S			
12Total per ye Electric show		ar)							1 (, 1,	(/	1215	
	72.2722	64.3951	70.3170	67.1027 Tot	68.3618 al Energy u	65.2106 sed by inst	67.3842 antaneous	68.3618 electric sho	67.1027 wer(s) (kWh	70.3170 /year) = Su	68.9948 m(64a)m =	72.2722 822.0923	
Heat gains fro	om water hea 49.6667		month 46.4841	41.5027	40.5131	36.8491	36.8819	38.3419	38.6938	42.6604	44.6499	49.2638	(65)
5. Internal ga													
Metabolic gair	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m Lighting gains	s (calculate	ed in Apper	ndix L, equa	tion L9 or		see Table 5		196.8965	196.8965	196.8965	196.8965	196.8965	
Appliances gas	ins (calcula	ated in App	oendix L, eq	uation L13		lso see Tab	le 5	436.6935	451.2499	436.6935	451.2499	436.6935	
Cooking gains		d in Append		ion L15 or		see Table		638.7316 42.6897	661.3716 42.6897	709.5694 42.6897	770.4105 42.6897	827.5925 42.6897	
Pumps, fans Losses e.g. ev	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
mosses e.g. e	-157.5172				-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	(71)
Water heating	raine (Tah)	1 - 51											
Water heating	66.7563	le 5) 65.0745	62.4786	57.6426	54.4531	51.1793	49.5724	51.5348	53.7414	57.3393	62.0138	66.2148	(72)
Water heating Total internal	66.7563 l gains	65.0745			54.4531 1316.3146								
_	66.7563 l gains	65.0745											
Total interna	66.7563 l gains 1451.3123	65.0745 1505.4033	1433.3789	1394.9016		1270.4151	1216.0507	1209.0289					
Total interna:	66.7563 l gains 1451.3123	65.0745 1505.4033	1433.3789	1394.9016	1316.3146	1270.4151	1216.0507	1209.0289	1248.4318	1285.6711	1365.7431	1412.5697	
Total interna	66.7563 l gains 1451.3123	65.0745 1505.4033	1433.3789	1394.9016	1316.3146 Solar flux Table 6a	1270.4151	1216.0507	1209.0289	1248.4318 FF data	1285.6711 Acce	1365.7431 ss or		(73)
Total interna: 6. Solar gain: [Jan]	66.7563 1 gains 1451.3123	65.0745	1433.3789	1394.9016	1316.3146 Solar flux Table 6a W/m2	1270.4151 Speci	1216.0507	1209.0289 Specific or Tab	1248.4318 FF data le 6c	1285.6711 Acce fact Table	1365.7431 ss or 6d	1412.5697 Gains W	(73)
Total internal 6. Solar gain: [Jan] Northeast Southeast	66.7563 1 gains 1451.3123	65.0745	1433.3789	1394.9016	1316.3146 Solar flux Table 6a W/m2	1270.4151 Speci	1216.0507	1209.0289 Specific or Tab	1248.4318 FF data le 6c	1285.6711 Acce fact Table	1365.7431 ss or 6d	Gains W 360.4595 1260.7293	(73) (75) (77)
6. Solar gain: [Jan] Northeast Southeast Southwest Northwest	66.7563 1 gains 1451.3123	65.0745	1433.3789 A 115.2 123.6 122.1 80.0	1394.9016	Solar flux Table 6a W/m2 11.2829 36.7938 36.7938 11.2829	1270.4151	1216.0507 gfic data Table 6b 0.3600 0.3600 0.3600 0.3600 0.3600	Specific or Tab	1248.4318 FF data le 6c	1285.6711 Acce fact Table	1365.7431 ss or 6d	Gains W	(73) (75) (77) (79)
Total internal 6. Solar gains [Jan] Northeast Southeast Southwest Northwest	66.7563 1 gains 1451.3123	65.0745	1433.3789 A 115.2 123.6 122.1 80.0	1394.9016 rea m2 500 100 800 900	1316.3146 Solar flux Table 6a W/m2 11.2829 36.7938 11.2829	1270.4151	1216.0507 gfic data Table 6b 0.3600 0.3600 0.3600	Specific or Tab	FF data le 6c .0000 .0000 .0000 .0000	Acce fact Table 0.77 0.77 0.77	ss or 6d 00 00 00 00 00	Gains W 360.4595 1260.7293 1246.1444 250.4920	(73) (75) (77) (79) (81)
6. Solar gain: [Jan] Northeast Southeast Southwest Northwest	66.7563 1 gains 1451.3123	65.0745 1505.4033	1433.3789 A 115.2 123.6 122.1 80.0	rea m2 500 100 800 900	Solar flux Table 6a W/m2 11.2829 36.7938 36.7938 11.2829	1270.4151 Speci or	1216.0507 gfic data Table 6b 0.3600 0.3600 0.3600 0.3600	1209.0289 Specific or Tak	FF data le 6c .0000 .0000 .0000 .0000 .0000 .0000	Acce fact Table 0.77 0.77 0.77	ss or 6d 00 00 00 3771.3921	Gains W 360.4595 1260.7293 1246.1444 250.4920	(73) (75) (77) (79) (81)
Total internal 6. Solar gain: [Jan] Northeast Southeast Southwest Northwest	66.7563 1 gains 1451.3123	65.0745 1505.4033	1433.3789 A 115.2 123.6 122.1 80.0	rea m2 500 100 800 900	Solar flux Table 6a W/m2 11.2829 36.7938 36.7938 11.2829	1270.4151 Speci or	1216.0507 gfic data Table 6b 0.3600 0.3600 0.3600 0.3600	1209.0289 Specific or Tak	FF data le 6c .0000 .0000 .0000 .0000 .0000 .0000	Acce fact Table 0.77 0.77 0.77	ss or 6d 00 00 00 3771.3921	Gains W 360.4595 1260.7293 1246.1444 250.4920	(73) (75) (77) (79) (81)
6. Solar gain: [Jan] Northeast Southeast Southwest Northwest Solar gains Total gains	66.7563 1 gains 1451.3123 5 5 3117.8253 4569.1376	65.0745 1505.4033	1433.3789 A 115.2 123.6 122.1 80.0 8083.1715 9516.5504	1394.9016 rea m2 500 100 800 900 10918.9337 12313.8352	Solar flux Table 6a W/m2 11.2829 36.7938 11.2829 13054.7816 14371.0962	Speci or 	1216.0507 gfic data Table 6b 0.3600 0.3600 0.3600 0.3600 12693.9516 13910.0024	Specific or Tab	FF data le 6c .0000 .0000 .0000 .0000 .0000 .0000	Acce fact Table 0.77 0.77 0.77	ss or 6d 00 00 00 3771.3921	Gains W 360.4595 1260.7293 1246.1444 250.4920	(73) (75) (77) (79) (81)
Total internations of the state	66.7563 1 gains 1451.3123 5 5 3117.8253 4569.1376	65.0745 1505.4033	1433.3789 A A 115.2 123.6 122.1 80.0 8083.1715 9516.5504 ing season) in the livi	1394.9016 rea m2 500 100 800 900 10918.9337 12313.8352	Solar flux Table 6a W/m2 11.2829 36.7938 31.2829 13054.7816 14371.0962	Speci or	1216.0507 g fic data Table 6b 0.3600 0.3600 0.3600 12693.9516 13910.0024	Specific or Tak	FF data le 6c .0000 .0000 .0000 .0000 .0000 .0000	Acce fact Table 0.77 0.77 0.77	ss or 6d 00 00 00 3771.3921	Gains W 360.4595 1260.7293 1246.1444 250.4920	(73) (75) (77) (79) (81) (83) (84)
6. Solar gain: [Jan] Northeast Southeast Northwest Northwest Total gains Total gains	3117.8253 4569.1376	65.0745 1505.4033 1505.4033 5513.7430 7019.1463 ture (heati-	1433.3789 A A 115.2 123.6 122.1 80.0 8083.1715 9516.5504 ing season) in the livi	rea m2	Solar flux Table 6a W/m2 11.2829 36.7938 11.2829 13054.7816 14371.0962	Speci or 	1216.0507 fic data Table 6b 0.3600 0.3600 0.3600 12693.9516 13910.0024	Specific or Tak	FF data le 6c .0000 .0000 .0000 .0000 .0000 .0000	Acce fact Table 0.77 0.77 0.77	ss or 6d 00 00 00 3771.3921	Gains W 360.4595 1260.7293 1246.1444 250.4920 2644.2953 4056.8650	(73) (75) (77) (79) (81) (83) (84)
Total internations of the state	3117.8253 4569.1376	65.0745 1505.4033 1505.403	1433.3789 A A 115.22 123.6 122.1 80.0 8083.1715 9516.5504 Ling season) in the livitiving area, Mar 36.9213	1394.9016 rea m2 500 100 800 900 10918.9337 12313.8352 rig area frc nil,m (see Apr 36.9400	Solar flux Table 6a W/m2 11.2829 36.7938 11.2829 13054.7816 14371.0962	Speci or 13323.1193 14593.5344 Th1 (C) Jun 36,9597	1216.0507 fic data Table 6b 0.3600 0.3600 0.3600 12693.9516 13910.0024	Specific or Tab 11045.0563 12254.0852	FF data le 6c .0000 .000	Acce fact Table 0.77 0.77 0.77 0.77 5239.1965 7524.8676	ss or 6d 00 00 00 00 3771.3921 5137.1352	Gains W 360.4595 1260.7293 1246.1444 250.4920 2644.2953 4056.8650	(73) (75) (77) (79) (81) (83) (84)
Total internal 6. Solar gains [Jan] Northeast Southeast Southwest Northwest 7. Mean internal Temperature di Utilisation fortal	3117.8253 4569.1376 act of for gradient of the second of t	65.0745 1505.4033 1505.4033 5513.7430 7019.1463 ture (heating periods ains for light september 1968) 36.9174 3.4612	1433.3789 A 115.2 123.6 122.1 80.0 8083.1715 9516.5504 ing season) in the liviting area, Mar 36.9213 3.4614	rea m2 500 100 800 900 10918.9337 12313.8352 ng area froni, m (see Apr 36.9400 3.4627	Solar flux Table 6a W/m2 11.2829 36.7938 11.2829 13054.7816 14371.0962 mm Table 9a) May 36.9434	Speci or 13323.1193 14593.5344 Th1 (C) Jun 36.9597 3.4640	1216.0507 gfic data Table 6b 0.3600 0.3600 0.3600 0.3600 12693.9516 13910.0024	Specific or Tab 11045.0563 12254.0852	FF data le 6c .0000 .000	Acce fact Table 0.77 0.77 0.77 0.77 524.8676	ss or 6d 00 00 00 3771.3921 5137.1352 Nov 36.9364 3.4624	Gains W 360.4595 1260.7293 1246.1444 250.4920 2644.2953 4056.8650 21.0000 Dec 36.9290 3.4619	(73) (75) (77) (79) (81) (83) (84)
6. Solar gain: [Jan] Northeast Southeast Southeast Northwest Northwest 7. Mean inter Temperature di Utilisation fa	3117.8253 4569.1376 act for graduation for graduati	5513.7430 7019.1463 ture (heat) repriods ains for li Feb 36.9174 3.4612 0.9754	1433.3789 A A 115.22 123.6 122.1 80.0 8083.1715 9516.5504 ing season) in the livitiving area, Mar 36.9213 3.4614 0.9259 19.8386	rea m2	Solar flux Table 6a W/m2 11.2829 36.7938 31.2829 13054.7816 14371.0962 mm Table 9a) May 36.9434 3.4629 0.6327 20.8101	Speci or 13323.1193 14593.5344 Th1 (C) Jun 36.9597 3.4640 0.4631 20.9505	Jul 36.9597 3.4640 0.3432 20.9866	Specific or Tab 11045.0563 12254.0852 Aug 36.9627 3.4642 0.4027 20.9769	FF data le 6c	Acce fact Table 0.77 0.77 0.77 0.77 6239.1965 7524.8676 Oct 36.9434 3.4629 0.9060 20.2482	ss or 6d 00 00 00 00 00 00 00 00 00 00 00 00 00	Gains W 360.4595 1260.7293 1246.1444 250.4920 2644.2953 4056.8650 21.0000 Dec 36.9290 3.4619 0.9960 18.6617	(73) (75) (77) (79) (81) (83) (84)
6. Solar gain: [Jan] Northeast Southeast Southwest Northwest Total gains 7. Mean inter Temperature duffilisation fatual	3117.8253 4569.1376 and temperal actor for gr Jan 36.9133 3.4609 rea 0.9940 18.7593 19.9189 nouse	5513.7430 7019.1463 ture (heating periods ains for life) 36.9174 3.4612 0.9754 19.2374 19.9190	1433.3789 A 115.2 123.6 122.1 80.0 8083.1715 9516.5504 Ling season) in the livi living area, Mar 36.9213 3.4614 0.9259 19.8386 19.9191	rea m2 500 100 800 900 10918.9337 12313.8352 ng area fr. nil,m (see Apr 36.9400 3.4627 0.8066 20.4472 19.9196	Solar flux Table 6a W/m2 11.2829 36.7938 11.2829 13054.7816 14371.0962 mm Table 9, Table 9a) May 36.9434 3.4629 0.6327 20.8101 19.9196	Speci or 	Jul 36.9597 3.4640 0.3432 20.9866 19.9201	Specific or Tab 11045.0563 12254.0852 Aug 36.9627 3.4642 0.4027 20.9769 19.9201	FF data le 6c .0000 .000	Acce fact Table 0.77 0.77 0.77 0.77 6239.1965 7524.8676 Oct 36.9434 3.4629 0.9060 20.2482 19.9196	ss or 6d 00 00 00 00 3771.3921 5137.1352 Nov 36.9364 3.4624 0.9849 19.3421 19.9195	Gains W 360.4595 1260.7293 1246.1444 250.4920 2644.2953 4056.8650 21.0000 Dec 36.9290 3.4619 0.9960 18.6617 19.9193	(73) (75) (77) (79) (81) (83) (84) (85)
6. Solar gain: [Jan] Northeast Southeast Southwest Northwest Total gains 7. Mean interior divided in the solar gains Total gains Total gains MIT Th 2 util rest of b	3117.8253 4569.1376 actor for g Jan 36.9133 3.4609 rea 0.9940 18.7593 19.9189 shouse 0.9926 17.8695	5513.7430 7019.1463 ture (heating periods ains for life Feb 36.9174 3.4612 0.9754 19.2374 19.9190 0.9700	1433.3789 A A 115.22 123.6 122.1 80.0 8083.1715 9516.5504 ing season) in the livitiving area, Mar 36.9213 3.4614 0.9259 19.8386	rea m2 500 100 800 900 10918.9337 12313.8352 ng area fr. nil,m (see Apr 36.9400 3.4627 0.8066 20.4472 19.9196	Solar flux Table 6a W/m2 11.2829 11.2829 13054.7816 14371.0962 13054.7816 14371.0962 13054.7816 14371.0962	Speci or 13323.1193 14593.5344 Th1 (C) Jun 36.9597 3.4640 0.4631 20.9505 19.9201 0.3920	Jul 36.9597 3.4640 0.3432 20.9866 19.9201 0.2616	Specific or Tab 11045.0563 12254.0852 Aug 36.9627 3.4642 0.4027 20.9769 19.9201	FF data le 6c .0000 .000	Acce fact Table 0.77 0.77 0.77 0.77 6239.1965 7524.8676 Oct 36.9434 3.4629 0.9060 20.2482 19.9196 0.8793 19.3276	Nov 36.9364 3.4624 0.9849 19.3421 19.9195 0.9808 18.4504	Gains W 360.4595 1260.7293 1246.1444 250.4920 2644.2953 4056.8650 21.0000 Dec 36.9290 3.4619 0.9960 18.6617 19.9193 0.9950 17.7726	(73) (75) (77) (79) (81) (83) (84) (85)
Total internal 6. Solar gains Coutheast Southeast Southwest Northwest Total gains 7. Mean internal Temperature di Utilisation fatural living as MIT Th 2 util rest of living area films	3117.8253 4569.1376 319.9189 4569.1376 317.8253 4569.1376 319.9189 4569.1376	5513.7430 7019.1463 ture (heating periods ains for lifeb 36.9174 3.4612 0.9754 19.2374 19.9190 0.9700 18.3426	1433.3789 A 115.2 123.6 122.1 80.0 8083.1715 9516.5504 ing season) in the livitiving area, Mar 36.9213 3.4614 0.9259 19.8386 19.9191 0.9105 18.9265	rea m2	Solar flux Table 6a W/m2 11.2829 36.7938 36.7938 11.2829 13054.7816 14371.0962 mm Table 9a) May 36.9434 3.4629 0.6327 20.8101 19.9196 0.5773 19.7937	Speci or 13323.1193 14593.5344 Th1 (C) Jun 36.9597 3.4640 0.4631 20.9505 19.9201 0.3920 19.8955	Jul 36.9597 3.4640 0.3432 20.9866 19.9201 0.2616	Specific or Tab 11045.0563 12254.0852 Aug 36.9627 3.4642 0.4027 20.9769 19.9201 0.3130 19.9121	FF data le 6c	Acce fact Table 0.77 0.77 0.77 0.77 6239.1965 7524.8676 Oct 36.9434 3.4629 0.9060 20.2482 19.9196 0.8793	ss or 6d 00 00 00 00 00 00 00 00 00 00 00 00 00	Gains W 360.4595 1260.7293 1246.1444 250.4920 2644.2953 4056.8650 21.0000 Dec 36.9290 3.4619 0.9960 18.6617 19.9193 0.9950 17.7726 0.1024 17.8637	(73) (75) (77) (79) (81) (83) (84) (85)
Total internal 6. Solar gain: [Jan] Northeast Southeast Southwest Northwest 7. Mean internal Temperature di Utilisation fatau alpha util living as MIT Th 2 util rest of b MIT 2 Living area f:	3117.8253 4569.1376 and temperal 3117.8253 4569.1376 and temperal 36.9133 3.4609 rea 0.9940 18.7593 19.9189 nouse 0.9926 67.8695 raction 17.9606 djustment	5513.7430 7019.1463 ture (heating periods ains for life) 36.9174 3.4612 0.9754 19.2374 19.9190 0.9700 18.3426 18.4342	1433.3789 A 115.2 123.6 122.1 80.0 8083.1715 9516.5504 ing season) in the liviting area, Mar 36.9213 3.4614 0.9259 19.8386 19.9191 0.9105 18.9265 19.0198	rea m2 500 100 800 900 10918.9337 12313.8352 ng area fr. nil,m (see Apr 36.9400 3.4627 0.8066 20.4472 19.9196 0.7714 19.4892	Solar flux Table 6a W/m2 11.2829 36.7938 31.2829 13054.7816 14371.0962 13054.7816 14371.0962 13054.7816 14371.0962 0.6327 20.8101 19.9196 0.5773 19.7937	Speci or 	Jul 36.9597 3.4640 0.3432 20.9866 19.9158 20.0254	Specific or Tab 11045.0563 12254.0852 Aug 36.9627 3.4642 0.4027 20.9769 19.9201 0.3130 19.9121	FF data le 6c .0000 .000	Acce fact Table 0.77 0.77 0.77 0.77 6239.1965 7524.8676 Oct 36.9434 3.4629 0.9060 20.2482 19.9196 0.8793 19.3276 Living are 19.4218	Nov 36.9364 3.4624 0.9849 19.3421 19.9195 0.9808 18.4504 a / (4) = 18.5417	Gains W 360.4595 1260.7293 1246.1444 250.4920 2644.2953 4056.8650 21.0000 Dec 36.9290 3.4619 0.9960 18.6617 19.9193 0.9950 17.7726 0.1024 17.8637 0.0000	(73) (75) (77) (79) (81) (83) (84) (85)
Total internal 6. Solar gain: [Jan] Northeast Southeast Southwest Northwest 7. Mean internal Temperature du Utilisation for tau alpha util living an MIT Th 2 util rest of l MIT 2 Living area for MIT Temperature ac	3117.8253 4569.1376 and temperal 3117.8253 4569.1376 and temperal 36.9133 3.4609 rea 0.9940 18.7593 19.9189 nouse 0.9926 67.8695 raction 17.9606 djustment	5513.7430 7019.1463 ture (heating periods ains for life) 36.9174 3.4612 0.9754 19.2374 19.9190 0.9700 18.3426 18.4342	1433.3789 A 115.2 123.6 122.1 80.0 8083.1715 9516.5504 ing season) in the liviting area, Mar 36.9213 3.4614 0.9259 19.8386 19.9191 0.9105 18.9265 19.0198	rea m2 500 100 800 900 10918.9337 12313.8352 ng area fr. nil,m (see Apr 36.9400 3.4627 0.8066 20.4472 19.9196 0.7714 19.4892	Solar flux Table 6a W/m2 11.2829 36.7938 31.2829 13054.7816 14371.0962 13054.7816 14371.0962 13054.7816 14371.0962 0.6327 20.8101 19.9196 0.5773 19.7937	Speci or 	Jul 36.9597 3.4640 0.3432 20.9866 19.9158 20.0254	Specific or Tab CO	FF data le 6c .0000 .000	Acce fact Table 0.77 0.77 0.77 0.77 6239.1965 7524.8676 Oct 36.9434 3.4629 0.9060 20.2482 19.9196 0.8793 19.3276 Living are 19.4218	Nov 36.9364 3.4624 0.9849 19.3421 19.9195 0.9808 18.4504 a / (4) = 18.5417	Gains W 360.4595 1260.7293 1246.1444 250.4920 2644.2953 4056.8650 21.0000 Dec 36.9290 3.4619 0.9960 18.6617 19.9193 0.9950 17.7726 0.1024 17.8637 0.0000	(73) (75) (77) (79) (81) (83) (84) (85)
6. Solar gain: [Jan] Northeast Southeast Southwest Northwest Northwest 7. Mean interiting ains Total gains Total gains Total gains Total gains WIT 2 Living area f: MIT 2 Living area f: MIT 7 Temperature acadjusted MIT	3117.8253 4569.1376 3147.8253 4569.1376 36.9133 3.4609 18.7593 19.9189 house 0.9940 18.7593 19.9189 house 17.8695 raction 17.9606	65.0745 1505.4033 1505.4033 5513.7430 7019.1463 ture (heating periods ains for life) Feb 36.9174 3.4612 0.9754 19.2374 19.9190 0.9700 18.3426 18.4342	1433.3789 A 115.2 123.6 122.1 80.0 8083.1715 9516.5504 in the livi ving area, Mar 36.9213 3.4614 0.9259 19.8386 19.9191 0.9105 18.9265 19.0198 19.0198	rea m2 100 100 800 900 10918.9337 12313.8352 ng area frc nii,m (see Apr 36.9400 3.4627 0.8066 20.4472 19.9196 0.7714 19.4892 19.5872	Solar flux Table 6a W/m2 11.2829 36.7938 31.2829 13054.7816 14371.0962 m Table 9a) May 36.9434 3.4629 0.6327 20.8101 19.9196 0.5773 19.8978	Speci or	Jul 36.9597 3.4640 0.3432 20.9866 19.9201 0.2616 19.9158 20.0254	Aug 36.9627 3.4642 0.4027 20.9769 19.9201 20.0211 20.0211	FF data le 6c .0000 .000	Acce fact Table 0.77 0.77 0.77 0.77 6239.1965 7524.8676 Oct 36.9434 3.4629 0.9060 20.2482 19.9196 0.8793 19.3276 Living are 19.4218	Nov 36.9364 3.4624 0.9849 19.3421 19.9195 0.9808 18.4504 a / (4) = 18.5417	Gains W 360.4595 1260.7293 1246.1444 250.4920 2644.2953 4056.8650 21.0000 Dec 36.9290 3.4619 0.9960 18.6617 19.9193 0.9950 17.7726 0.1024 17.8637 0.0000	(73) (75) (77) (79) (81) (83) (84) (85)
Total internations of the state	1451.3123 1451.3123	65.0745 1505.4033 1505.403	1433.3789 A 115.2 123.6 122.1 80.0 8083.1715 9516.5504 Ing season) in the livitiving area, Mar 36.9213 3.4614 0.9259 19.8386 19.9191 0.9105 18.9265 19.0198 19.0198	rea m2	Solar flux Table 6a W/m2 11.2829 36.7938 31.2829 13054.7816 14371.0962 mm Table 9a) May 36.9434 3.4629 0.6327 20.8101 19.9196 0.5773 19.8978 19.8978	Speci or	Jul 36.9597 3.4640 0.3432 20.9866 19.9201 0.2616 19.9158 20.0254	Aug 36.9627 3.4642 0.4027 20.9769 19.9201 0.3130 19.9121 20.0211	FF data le 6c .0000 .000	Acce fact Table 0.77 0.77 0.77 0.77 6239.1965 7524.8676 Oct 36.9434 3.4629 0.9060 20.2482 19.9196 0.8793 19.3276 Living are 19.4218	Nov 36.9364 3.4624 0.9849 19.3421 19.9195 0.9808 18.4504 a / (4) = 18.5417	Gains W 360.4595 1260.7293 1246.1444 250.4920 2644.2953 4056.8650 21.0000 Dec 36.9290 3.4619 0.9960 18.6617 19.9193 0.9950 17.7726 0.1024 17.8637 0.0000	(73) (75) (77) (79) (81) (83) (84) (85)
Total internal 6. Solar gain: (Jan) Northeast Southeast Southwest Northwest 7. Mean internal 7. Mean internal Temperature di Utilisation for tau alpha util living an MIT Th 2 util rest of b MIT 2 Living area for MIT Temperature accadjusted MIT 8. Space heat:	3117.8253 4569.1376 mal temperar 3117.8253 4569.1376 mal temperar 36.9133 3.4609 rea 0.9940 18.7593 19.9189 house 0.9926 17.8695 raction 17.9606 djustment 17.9606	65.0745 1505.4033 1505.4033 5513.7430 7019.1463 ture (heati- ng periods ains feb 36.9174 3.4612 0.9754 19.2374 19.9190 0.9700 18.3426 18.4342 18.4342	1433.3789 A 115.2 123.6 122.1 80.0 8083.1715 9516.5504 ing season) in the livitiving area, Mar 36.9213 3.4614 0.9259 19.8386 19.9191 0.9105 18.9265 19.0198 19.0198	rea m2	Solar flux Table 6a W/m2 11.2829 36.7938 31.2829 13054.7816 14371.0962 mm Table 9a) May 36.9434 3.4629 0.6327 20.8101 19.9196 0.5773 19.7937 19.8978	Speci or 13323.1193 14593.5344 Th1 (C) Jun 36.9597 3.4640 0.4631 20.9505 19.9201 0.3920 19.8955 20.0035	Jul 36.9597 3.4640 0.3432 20.9866 19.9201 0.2616 19.9158 20.0254	Aug 36.9627 3.4642 0.4027 20.9769 19.9201 0.3130 19.9121 20.0211	FF data le 6c	Acce fact Table	SS or 6d 00 00 00 00 00 00 00 00 00 00 00 00 00	Gains W 360.4595 1260.7293 1246.1444 250.4920 2644.2953 4056.8650 21.0000 Dec 36.9290 3.4619 0.9960 18.6617 19.9193 0.9950 17.7726 0.1024 17.8637 0.0000 17.8637	(73) (75) (77) (79) (81) (83) (84) (85)
Total internal 6. Solar gains Couthwest Southwest Northwest Northwest Total gains 7. Mean internal Temperature do Utilisation for tau alpha util living as MIT Th 2 util rest of l MIT 2 Living area f: MIT Temperature ac adjusted MIT 8. Space heat:	3117.8253 4569.1376 action for gr Jan 0.9926 17.9606 djustment 17.9606 Jan 0.9926 17.9606 djustment 17.9606	65.0745 1505.4033 1505.403	1433.3789 A A 115.2 123.6 122.1 80.0 8083.1715 9516.5504 Ing season) in the livitiving area, Mar 36.9213 3.4614 0.9259 19.8386 19.9191 0.9105 18.9265 19.0198 19.0198 Mar 0.8947 8514.3041	1394.9016 rea m2 500 100 800 900 10918.9337 12313.8352 rea frc nil,m (see Apr 36.9400 3.4627 0.8066 20.4472 19.9196 0.7714 19.4892 19.5872 19.5872 Apr 0.7592 9349.1829	Solar flux Table 6a W/m2 11.2829 36.7938 31.2829 13054.7816 14371.0962 mm Table 9a) May 36.9434 3.4629 0.6327 20.8101 19.9196 0.5773 19.8978 19.8978	Speci or Spe	Jul 36.9597 3.4640 0.3432 20.9866 19.9201 0.2616 19.9158 20.0254 Jul 0.2697 3751.0399	Aug 36.9627 3.4642 0.4027 20.9769 19.9201 20.0211 20.0211 20.0211 Aug 0.3216 3941.1393	FF data le 6c	Acce fact Table	SS or 6d 00 00 00 00 00 00 00 00 00 00 00 00 00	Gains W 360.4595 1260.7293 1246.1444 250.4920 2644.2953 4056.8650 21.0000 Dec 36.9290 3.4619 0.9960 18.6617 19.9193 0.9950 17.7726 0.1024 17.8637 0.0000 17.8637	(73) (75) (77) (79) (81) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93)

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Heat loss rate W 15099.1022 14	1957.8068 1	.3835.2489 1	11804.1300	9053.6455	5965.0208	3781.3555	3997.0847	6445.1080	9742.8654	12638.6730	15096.0969	(97)	
Space heating kWh 7872.3460 5 Space heating requirement				576.5040	0.0000	0.0000	0.0000	0.0000	2411.6107	5500.1106	8236.6005 35847.2563	(98a)	
Solar heating kWh 0.0000 Solar heating contribution	0.0000 n - total p	0.0000 er vear (kV	0.0000 Wh/vear)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)	
Space heating kWh 7872.3460 5 Space heating requirement	5523.7397	3958.7829	1767.5620		0.0000	0.0000	0.0000	0.0000	2411.6107	5500.1106		(98c)	
Space heating requirement Space heating per m2	arter sola	ir contribut	ion - tota	ı per year	(kwn/year)				(980	c) / (4) =	38.9644	(99)	
8c. Space cooling requirem	nent												
Calculated for June, July Jan	and August	. See Table	e 10b Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Ext. temp. 4.3000 Heat loss rate W	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000				
0.0000 Utilisation 0.0000	0.0000	0.0000	0.0000	0.0000	0.9188	8168.9989 0.9501	0.9258	0.0000	0.0000	0.0000	0.0000	(101)	
Useful loss 0.0000 Total gains 0.0000 Space cooling kWh	0.0000	0.0000	0.0000			7761.5061 16036.0091		0.0000	0.0000				
0.0000 Cooled fraction	0.0000	0.0000	0.0000	0.0000	5250.9062	6156.2303	4719.4060	0.0000 fC =	0.0000 cooled are	0.0000 ea / (4) =	0.0000		
Intermittency factor (Tabl 0.2500	le 10b) 0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500		
Space cooling kWh 0.0000	0.0000	0.0000	0.0000	0.0000	1312.7265	1539.0576	1179.8515	0.0000	0.0000	0.0000			
Space cooling requirement Energy for space heating Energy for space cooling											4031.6356 38.9644 4.3822	(99)	
Total Fabric Energy Efficiency ((DFEE)										43.3466		
SAP 10 WORKSHEET FOR New E				0.2, Februa									
CALCULATION OF TARGET FABR	RIC ENERGY	EFFICIENCY											
1. Overall dwelling charac													
Ground floor							Area (m2) 460.0000		rey height (m) 3.2200		Volume (m3) 1481.2000	(1h) -	(3h)
First floor Total floor area TFA = (1a	a)+(1b)+(1c	:)+(1d)+(1e)	(1n)		920.0000		460.0000		2.9100		1338.6000		
Dwelling volume		, , , , , , ,	,				(3	3a) + (3b) + (3c))+(3d)+(3e))(3n) =	2819.8000		
2. Ventilation rate													
										1	m3 per hour		
Number of open chimneys										0 * 80 =	0.0000		
Number of open flues Number of chimneys / flues			fire							0 * 20 = 0 * 10 = 0 * 20 =	0.0000	(6c)	
Number of flues attached t Number of flues attached t Number of blocked chimneys	to other he									0 * 35 = 0 * 20 =	0.0000 0.0000 0.0000	(6e)	
Number of intermittent ext Number of passive vents										4 * 10 = 0 * 10 =	40.0000	(7a)	
Number of flueless gas fir	res									0 * 40 =	0.0000	(7c)	
Infiltration due to chimne	eys, flues	and fans	= (6a)+(6b)+(6c)+(6d)	+(6e)+(6f)+	+(6g)+(7a)+	(7b) + (7c) =		40.0000	Air change 0 / (5) =		(8)	
Pressure test Pressure Test Method Measured/design AP50										1	Yes Blower Door 5.0000		
Infiltration rate Number of sides sheltered											0.2642		
Shelter factor								(20) = 1			1.0000	(20)	
Infiltration rate adjusted	to includ	e shelter f	actor					(2	21) = (18)	x (20) =	0.2642	(21)	
Jan Wind speed 5.1000	Feb 5.0000	Mar 4.9000		May 4.3000					Oct 4.3000				
Wind factor 1.2750 Adj infilt rate	1.2500	1.2250	1.1000	1.0750				1.0000	1.0750				
0.3368 If exhaust air heat pump u If balanced with heat reco			(23a)	x Fmv (equa	ation (N5)),	otherwise	(23b) = (23)		0.2840	0.2972	0.3104 0.0000 0.0000	(23b)	
Effective ac 0.5567	0.5545	0.5524						0.5349	0.5403	0.5442			
3 Host looses and here?													
3. Heat losses and heat lo			Gross	Openino		etArea	U-value	Ах	Ū Ī	K-value	AxK		
TER Opaque door			m2		n2	m2	W/m2K	W,	/K	kJ/m2K	kJ/K		
					2	9.4000	1.0000	9.400	00			(26)	

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TER Opening Type Heatloss Floor 1 Ground Floor Ext First Floor Exte External Roof Total net area o Fabric heat loss	ernal Wal	ll l al elements	Aum (A, m2)	432.8000 448.3200 460.0000	134.380 95.550	460 0 298 0 352 460	.9300 .0000 .4200 .7700 .0000 .1200 (26)(1.1450 0.1300 0.1800 0.1800 0.1100 (30) + (32)	238.08 59.80 53.71 63.49 50.60	000 56 986 000			(27) (28a) (29a) (29a) (30) (31) (33)
E3 Sill E4 Jamb E5 Groun E6 Inter E16 Corn E17 Corn E10 Eave E12 Gabl	Bridges nt lintels d floor mediate : er (norm er (inve s (insul e (insul e (insul c (Sum(L x idges	(including (normal) floor withi al) rted - inte ation at ce ation at ra	n a dwellir rnal area c iling level iling level fter level)	el lintels) ng greater than	n external a	rea)		157 157 162 148 148 49 24 233	7.4600 7.4600 7.4600 7.2600 7.7300	Psi-value 0.0500 0.0500 0.0500 0.1600 0.0000 0.0900 -0.0900 0.0600 0.0600 0.0800	Tot 7.87 7.87 8.11 23.79 0.00 4.41 -2.20 14.01 3.41 5.45 (36a) = + (36a) =	30 30 40 68 00 36 68 12 76	(36)
Ventilation heat													
(38) m 5	Jan 18.0556	Feb 516.0058	Mar 513.9965	Apr 504.5591	May 502.7934	Jun 494.5737	Jul 494.5737	Aug 493.0515	Sep 497.7398	Oct 502.7934	Nov 506.3654	Dec 510.0998	(38)
Heat transfer co		1076.4594	1074.4501	1065.0127	1063.2470	1055.0273	1055.0273	1053.5051	1058.1934	1063.2470	1066.8190	1070.5534	(39)
Average = Sum(39)m / 12 =	=										1065.0042	
HLP	Jan 1.1723	Feb 1.1701	Mar 1.1679	Apr 1.1576	May 1.1557	Jun 1.1468	Jul 1.1468	Aug 1.1451	Sep 1.1502	Oct 1.1557	Nov 1.1596	Dec 1.1636	(40)
HLP (average) Days in mont	31	28	31	30	31	30	31	31	30	31	30	1.1576	,
Days IN Mont	31	20	31	30	31	30	31	31	30	31	30	31	
4. Water heating	energy :	requirement	s (kWh/year	î)									
Assumed occupanc Hot water usage		r showers										3.9379	(42)
Hot water usage	0.0000 for bath:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage	38.9321 for othe:	38.3539 r uses	37.5396	36.0384	34.9142	33.6677	32.9944	33.8030	34.6833	36.0171	37.5493	38.8004	(42b)
Average daily ho	54.9583 t water	52.9599 use (litres	50.9614 /day)	48.9629	46.9644	44.9659	44.9659	46.9644	48.9629	50.9614	52.9599	54.9583 86.0583	
Daily hot water	Jan use	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	93.8904 48.6994	91.3137 130.0295	88.5010 136.0228	85.0013 116.3625	81.8786 110.2244	78.6337 96.6893	77.9604 94.2863	80.7674 100.0069	83.6462 103.1441	86.9785 118.0290 Total = S	90.5091 128.9469 um(45)m =	93.7588 146.8036 1429.2446	(45)
Distribution los Water storage lo	s (46)m 0.0000	= 0.15 x (45) m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Total storage lo		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder cont				0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Primary loss Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
	26.3945	110.5251	115.6194	98.9081	93.6907	82.1859	80.1434	85.0058	87.6725	100.3246	109.6048	124.7831	
WWHRS PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Solar input FGHRS	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Output from w/h		110.5251	115.6194	98.9081	93.6907	82.1859	80.1434	85.0058	87.6725	100.3246	109.6048		
12Total per year			110.0131	30.3001	30.0307	02.1003	00.1101			Ih/year) = S			(64)
Electric shower(s)		70 2170	67.1007	60 2610	65 0106	67 2040	60 2610	67.1007	70 2170	60.0040		
	72.2722	64.3951	70.3170	67.1027 Tot	68.3618 al Energy u	65.2106 sed by inst	67.3842 antaneous e						
Heat gains from	water hea 49.6667	43.7301	46.4841	41.5027	40.5131	36.8491	36.8819	38.3419	38.6938	42.6604	44.6499	49.2638	(65)
E Internal gain													
5. Internal gain													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(60)
Lighting gains (calculate	ed in Appen	dix L, equa	ation L9 or		see Table 5				196.8965		196.8965	
Appliances gains	(calcula	ated in App	endix L, eq	quation L13		lso see Tab	le 5			436.6142	451.1680	436.6142	
Cooking gains (c	alculated	d in Append	lix L, equat	ion L15 or		see Table	5		661.3716		770.4105	827.5925	
Pumps, fans	0.0000	0.0000	0.0000	0.0000	42.6897 0.0000	42.6897 0.0000	42.6897 0.0000	42.6897 0.0000	42.6897 0.0000	42.6897 0.0000	42.6897 0.0000	42.6897 0.0000	
Losses e.g. evap		(negative v	alues) (Tab	ole 5)	-157.5172	-157.5172			-157.5172				
Water heating ga	ins (Tab	le 5)	62.4786			51.1793	49.5724	51.5348	53.7414	57.3393	62.0138	66.2148	
Total internal g	ains				1316.2353								
14			. = . = /				2.27.23						,
6. Solar gains													
[Jan]				Area	Solar flux		q		FF	Acce	99	Gains	
[04]			P	m2	Table 6a		fic data	Specific		fact		W	

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					W/m2		Table 6b	or Tab	le 6c	Table	6d		
ortheast outheast outhwest orthwest			54.3 58.2 57.6 37.7	600 100	11.2829 36.7938 36.7938 11.2829		0.6300 0.6300 0.6300 0.6300	0	.7000 .7000 .7000 .7000	0.77 0.77 0.77 0.77	00	187.3414 655.1147 647.8056 130.1011	(77) (79)
	1620.3629 3071.5960												
. Mean inter	nal tempera	ture (heati	ng season)										
emperature o	during heating	ng periods	in the livi	ng area fro	m Table 9,							21.0000	(85)
au lpha	Jan 37.8305 3.5220	Feb 37.9025 3.5268	Mar 37.9734 3.5316	Apr 38.3099 3.5540	May 38.3735 3.5582	Jun 38.6724 3.5782	Jul 38.6724 3.5782	Aug 38.7283 3.5819	Sep 38.5567 3.5704	Oct 38.3735 3.5582	Nov 38.2450 3.5497	Dec 38.1116 3.5408	
til living a	0.9984	0.9942	0.9822	0.9429	0.8511	0.7006	0.5529	0.6256	0.8531	0.9749	0.9961	0.9989	(86)
IT h 2 til rest of		18.8926 19.9440	19.3688 19.9458	19.9871 19.9541	20.5123 19.9556	20.8349 19.9628	20.9474 19.9628	20.9185 19.9642	20.6376 19.9600	19.9179 19.9556	19.1261 19.9525	18.5289 19.9492	(88)
IT 2 iving area 1	0.9980 17.7031 fraction	0.9928 18.0201	0.9778 18.4944	0.9277 19.1051	0.8108 19.5957	0.6209 19.8698	0.4390 19.9435	0.5112 19.9311	0.7967 19.7225 fLA =	0.9659 19.0478 Living are	0.9950 18.2598 a / (4) =	0.9986 17.6608 0.1024	(90)
IIT 'emperature a	17.7925 adjustment	18.1094	18.5839	19.1954	19.6895	19.9686	20.0463	20.0322	19.8161	19.1369	18.3485	17.7497 0.0000	(92)
djusted MIT		18.1094	18.5839	19.1954	19.6895	19.9686	20.0463	20.0322	19.8161	19.1369	18.3485	17.7497	
. Space heat	ing require	ment											
xt temp.		Feb 0.9891 4323.3786 4.9000	Mar 0.9696 5463.0018 6.5000	Apr 0.9136 6458.7539 8.9000	May 0.7988 6470.5553 11.7000	Jun 0.6214 5091.9502 14.6000	Jul 0.4488 3506.1314 16.6000	Aug 0.5194 3609.5327 16.4000	Sep 0.7873 4688.1437 14.1000	Oct 0.9559 4328.6489 10.6000	Nov 0.9924 3300.3354 7.1000	Dec 0.9977 2780.2128 4.2000	(95)
eat loss rat pace heating	14551.7427	14219.3787	12983.5852	10964.7319	8494.8402	5663.9865	3635.9483	3826.5249	6048.7916	9076.7925	12000.1102	14505.6647	(97)
	8548.7635 g requirement		5595.3140 per year (kW		1506.0679	0.0000	0.0000	0.0000	0.0000	3532.6188	6263.8378	8723.7362 44064.7544	
olar heating	0.0000 g contribution	0.0000 on - total	0.0000 per year (k	0.0000 Wh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
pace heating pace heating pace heating	8548.7635 g requirement		5595.3140 ar contribu			0.0000 (kWh/year)	0.0000	0.0000	0.0000			8723.7362 44064.7544 47.8965	
3c. Space coo	oling require	ement											
	or June, Jul Jan	y and Augus Feb	st. See Tabl Mar	e 10b Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
xt. temp. eat loss rat	4.3000 te W 0.0000	4.9000	0.0000	8.9000		14.6000 9917.2566	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
tilisation seful loss otal gains	0.0000 0.0000 0.0000	0.0000 0.0000 0.0000	0.0000 0.0000 0.0000	0.0000	0.0000		0.8300 6480.0804	0.7769 6220.5359	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	(101)
pace cooling	0.0000	0.0000	0.0000	0.0000	0.0000	1318.4202	1807.4532	1256.1264	0.0000 fc =	0.0000 cooled are	0.0000	0.0000	
ooled fracti				0.0500		0.0500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	
	/ factor (Tal 0.2500	ole 10b) 0.2500	0.2500	0.2500	0.2500	0.2500		0.2300					
Intermittency Space cooling Space cooling Energy for sp	0.2500 g kWh 0.0000 g requirement bace heating	0.2500	0.2500	0.0000	0.2500		451.8633	314.0316	0.0000	0.0000	0.0000	0.0000 1095.4999 47.8965 1.1908	(107) (99)
Intermittency Space cooling Space cooling Energy for sp Energy for sp Total	0.2500 g kWh 0.0000 g requirement pace heating pace cooling	0.2500 0.0000								0.0000	0.0000	1095.4999 47.8965 1.1908 49.0872	(107) (99) (108)
Intermittency Space cooling Space cooling Energy for sp Energy for sp Total	0.2500 g kWh 0.0000 g requirement pace heating pace cooling	0.2500 0.0000								0.0000	0.0000	1095.4999 47.8965 1.1908 49.0872	(107) (99) (108) (109)
space cooling space cooling space cooling snergy for sp specification	0.2500 g kWh 0.0000 g requirement pace heating pace cooling	0.2500 0.0000								0.0000	0.0000	1095.4999 47.8965 1.1908 49.0872	(107) (99) (108) (109)
ntermittency pace cooling pace cooling mergy for sy mergy for sy otal abric Energy	g kWh 0.2500 g kWh 0.0000 g requirement oace heating oace cooling are grant of the cooling of th	0.2500 0.0000 t (TFEE)	0.0000	0.0000	0.0000	329.6051	451.8633	314.0316		0.0000	0.0000	1095.4999 47.8965 1.1908 49.0872	(107) (99) (108) (109)
Entermittency Space cooling Space cooling Chergy for sy Chergy for sy Cotal Fabric Energy SAP 10 WORKSK	0.2500 g kWh 0.0000 g requirement oace heating bace cooling g Efficiency	0.2500 0.0000 t (TFEE) Build (As	0.0000 Designed)	0.0000 (Version 1	0.0000 0.2, Februa	329.6051	451.8633	314.0316		0.0000	0.0000	1095.4999 47.8965 1.1908 49.0872	(107) (99) (108) (109)
Cooled fraction of the cooling of th	0.2500 g kWh 0.0000 g requirement oace heating oace cooling oace cooling to the cooling oace cooling oace cooling to the cooling oace cool	0.2500 0.0000t (TFEE) Build (As	0.0000	0.0000 (Version 1	0.0000 0.2, Februa	329.6051	451.8633	314.0316		0.0000	0.000	1095.4999 47.8965 1.1908 49.0872	(107) (99) (108) (109)
Entermittency Space cooling Space cooling Chergy for sy Chergy for sy Chergy for sy Chal Fabric Energy SAP 10 WORKSE CALCULATION COOL	0.2500 g kWh 0.0000 g requirement oace heating pace cooling y Efficiency g Efficiency HEET FOR New F ENERGY RATTERS TO THE ENERGY RA	0.2500 0.0000 t (TFEE) Build (As	0.0000 Designed)	0.0000 (Version 1	0.0000	329.6051	451.8633	314.0316	0.0000	rey height	0.0000	1095.4999 47.8965 1.1908 49.0872 49.1	(107) (99) (108) (109)
Entermittency Space cooling Space cooling Energy for sp Chergy for sp Charles Tabric Energy SAP 10 WORKSE CALCULATION (0.2500 g kWh 0.0000 g requirement oace heating pace cooling y Efficiency g Efficiency HEET FOR New F ENERGY RATTERS TO THE ENERGY RA	0.2500 0.0000 t (TFEE) Build (As	0.0000 Designed)	0.0000 (Version 1	0.0000	329.6051	451.8633	314.0316	0.0000 Sto (1b) x		(2b) =	1095.4999 47.8965 1.1908 49.0872 49.1	(107) (99) (108) (109) (109)

2. Ventilation rate

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Number of open Number of open Number of chimn Number of flues	flues neys / flue s attached	to solid f	uel boiler	fire							0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 =	0.0000 0.0000 0.0000 0.0000 0.0000	(6b) (6c) (6d)
Number of flues Number of block Number of inter Number of passi Number of fluel	red chimney mittent ex ve vents	rs tract fans									0 * 35 = 0 * 20 = 0 * 10 = 0 * 10 = 0 * 40 =	0.0000 0.0000 0.0000 0.0000	(6f) (7a) (7b)
Infiltration du Pressure test Pressure Test M Measured/design Infiltration ra	Method n AP50	eys, flues	and fans	= (6a)+(6b)+(6c)+(6d)+	(6e)+(6f)+	(6g)+(7a)+(7b)+(7c) =		0.0000	Air change / (5) = B	s per hour 0.0000 Yes lower Door 1.0000 0.0500	(17)
Number of sides Shelter factor Infiltration ra			de shelter	factor					(20) = 1 -	[0.075 x 1) = (18)		0 1.0000 0.0500	
Wind speed Wind factor	Jan 5.1000 1.2750	Feb 5.0000 1.2500	Mar 4.9000 1.2250	Apr 4.4000 1.1000	May 4.3000 1.0750	Jun 3.8000 0.9500	Jul 3.8000 0.9500	Aug 3.7000 0.9250	Sep 4.0000 1.0000	Oct 4.3000 1.0750	Nov 4.5000 1.1250	Dec 4.7000 1.1750	
Adj infilt rate	0.0638	0.0625	0.0613	0.0550	0.0537	0.9300	0.0475	0.0463	0.0500	0.0537	0.0563	0.0588	
Balanced mecha If mechanical v If exhaust air If balanced wit	rentilation heat pump	using Appe	ndix N, (23)	o) = (23a) :					1)			0.5000 0.5000 73.8000	(23b)
Effective ac	0.1948	0.1935	0.1923	0.1860	0.1847	0.1785	0.1785	0.1773	0.1810	0.1847	0.1872	0.1898	(25)
3. Heat losses	and heat 1	oss parame	ter										
Element				Gross m2	Openings m2		tArea m2	U-value W/m2K	A x W/	K	-value kJ/m2K	A x K kJ/K	
Window (Uw = 0. Glazed Door Normal Door	.80)					12	.1300 .6000 .4000	0.7752 0.8000 1.0000	341.961 10.080 9.400	0			(27) (26a) (26)
Heatloss Floor Ground Floor Ex	ternal Wal			432.8000	260.3900	460 172	.0000	0.1000 0.1400	46.000 24.137	0 11 4 19	0.0000	50600.0000 32757.9000	(28a) (29a)
First Floor Ext External Roof Total net area			4	448.3200 460.0000	202.7400	460	.5800 .0000 .1200	0.1400 0.1100	34.381 50.600		0.0000 9.0000	46660.2000 4140.0000	
Fabric heat los Internal Wall 1 Internal Floor	ss, W/K = S					493		30) + (32) =	516.559		9.0000 8.0000	4443.6600 8280.0000	(33) (32c)
Heat capacity C Thermal mass pa List of Thermal	arameter (T		TFA) in kJ/1	n2K				(28).	.(30) + (32) + (32a).	(32e) = 1	46881.7600 159.6541	
K1 Elem E2 Othe E3 Si11 E4 Jamb E5 Grou E6 Inte E16 Cor E17 Cor E10 Eav	ment or lintels or lin	normal) floor withi (1) ted - inte	iling level;	g reater than	external ar	ea)		157 157 162 148 148 49 24 233	4600 4600 2800 7300 7300 0400 5200 5200 9600	si-value 0.3000 0.0200 0.0160 0.0530 0.0010 0.0380 -0.0750 0.1200 0.2500	Tot 47.23 3.14 2.59 7.88 0.14 1.86 -1.83 28.02	80 92 65 27 87 35 90 24	
Thermal bridges Point Thermal b Total fabric he	s (Sum(L x oridges		fter level) lated using	Appendix K)			68.	.2400	0.2500	17.06 (36a) = + (36a) =	120.3620 0.0000 636.9219	
Ventilation hea	at loss cal	culated mo	nthly (38)m Mar	= 0.33 x (25)m x (5) May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	,
(38)m Heat transfer c	181.2215		178.8952	173.0793	171.9162	166.1003	166.1003	164.9372	168.4267	171.9162	174.2425	176.5688	(38)
Average = Sum(3	818.1434 39)m / 12 =		815.8170	810.0012	808.8380	803.0222	803.0222	801.8590	805.3485	808.8380	811.1644	813.4907 809.7104	(39)
HLP	Jan 0.8893	Feb 0.8880	Mar 0.8868	Apr 0.8804	May 0.8792	Jun 0.8729	Jul 0.8729	Aug 0.8716	Sep 0.8754	Oct 0.8792	Nov 0.8817	Dec 0.8842	(40)
HLP (average) Days in mont	31	28	31	30	31	30	31	31	30	31	30	0.8801	
4. Water heatin	ng energy r	equirement	s (kWh/year))									
	ng energy r ncy	equirement	s (kWh/year))								3.9379	(42)
4. Water heatin	ng energy r ncy e for mixer 0.0000 e for baths	showers 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
4. Water heatin	ng energy r ncy e for mixer 0.0000 e for baths 109.6601 e for other	showers 0.0000 108.0315 uses	0.0000 105.7381	0.0000	0.0000	0.0000	0.0000	0.0000	97.6926	101.4495	105.7653	0.0000	(42a) (42b)
4. Water heatin	ng energy r ncy e for mixer 0.0000 e for baths 109.6601 e for other 57.8509 not water u	showers 0.0000 108.0315 uses 55.7472 see (litres	0.0000 105.7381 53.6435 /day)	0.0000 101.5094 51.5399	0.0000 98.3431 49.4362	0.0000 94.8321 47.3325	0.0000 92.9356 47.3325	0.0000 95.2130 49.4362	97.6926 51.5399	101.4495 53.6435	105.7653 55.7472	0.0000 109.2894 57.8509 154.2639	(42a) (42b) (42c)
4. Water heatin Assumed occupan Hot water usage Hot water usage Average daily h Daily hot water	ng energy r ncy e for mixer 0.0000 e for baths 109.6601 e for other 57.8509 not water u Jan : use	showers 0.0000 108.0315 uses 55.7472 use (litres	0.0000 105.7381 53.6435 /day)	0.0000 101.5094 51.5399 Apr	0.0000 98.3431 49.4362 May	0.0000 94.8321 47.3325 Jun	0.0000 92.9356 47.3325 Jul	0.0000 95.2130 49.4362 Aug	97.6926 51.5399 Sep	101.4495 53.6435 Oct	105.7653 55.7472 Nov	0.0000 109.2894 57.8509 154.2639	(42a) (42b) (42c) (43)
4. Water heatin Assumed occupan Hot water usage Hot water usage Average daily h Daily hot water	ng energy r ncy e for mixer 0.0000 e for baths 109.6601 e for other 57.8509 not water u Jan r use 167.5110 265.2965 (annual) sss (46)m	equirement showers 0.0000 108.0315 108.0315 'uses 55.7472 Ise (litres Feb 163.7787 233.2187 = 0.15 x (0.0000 105.7381 53.6435 /day) Mar 159.3816 244.9637	0.0000 101.5094 51.5399 Apr 153.0493 209.5169	0.0000 98.3431 49.4362 May 147.7793 198.9393	0.0000 94.8321 47.3325 Jun 142.1646 174.8080	0.0000 92.9356 47.3325 Jul 140.2682 169.6422	0.0000 95.2130 49.4362 Aug 144.6492 179.1059	97.6926 51.5399 Sep 149.2325 184.0186	101.4495 53.6435 Oct 155.0931 210.4598 Total = S	105.7653 55.7472 Nov 161.5125 230.1041 tum(45)m =	0.0000 109.2894 57.8509 154.2639 Dec 167.1403 261.7013 2561.7751	(42a) (42b) (42c) (43) (44) (45)
4. Water heatin Assumed occupan Hot water usage Hot water usage Average daily h Daily hot water Energy conte	ng energy r ng energy r ncy e for mixer 0.0000 e for baths 109,6601 e for other 57.8509 not water u Jan r use 167.5110 265.2965 (annual) 39.7945	requirement 	0.0000 105.7381 53.6435 /day) Mar 159.3816 244.9637 45)m 36.7445	0.0000 101.5094 51.5399 Apr 153.0493 209.5169 31.4275	0.0000 98.3431 49.4362 May 147.7793 198.9393	0.0000 94.8321 47.3325 Jun 142.1646	0.0000 92.9356 47.3325 Jul 140.2682	0.0000 95.2130 49.4362 Aug 144.6492	97.6926 51.5399 Sep 149.2325	101.4495 53.6435 Oct 155.0931 210.4598	105.7653 55.7472 Nov 161.5125 230.1041	0.0000 109.2894 57.8509 154.2639 Dec 167.1403 261.7013	(42a) (42b) (42c) (43) (44) (45) (46) (47)

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Temperature factor fro	om Table 2b										0.7800	(49)
Enter (49) or (54) in (5 Total storage loss											1.1388	
35.3028 If cylinder contains dec	dicated sola			35.3028	34.1640	35.3028	35.3028	34.1640	35.3028	34.1640	35.3028	
Primary loss 23.2624	21.0112 0.0000	35.3028 23.2624 0.0000 ing calculat	22.5120 0.0000	23.2624	22.5120	35.3028 23.2624 0.0000	23.2624		35.3028 23.2624 0.0000	22.5120	23.2624	(59)
323.8617 WWHRS 0.0000 PV diverter -0.0000 Solar input 0.0000	0.0000	303.5289 0.0000 -0.0000 0.0000	0.0000	257.5045 0.0000 -0.0000 0.0000	0.0000	228.2074 0.0000 -0.0000 0.0000	0.0000	-0.0000	269.0250 0.0000 -0.0000 0.0000	0.0000	0.0000 -0.0000	(63a) (63b)
FGHRS 0.0000 Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
323.8617		303.5289	266.1929	257.5045	231.4840	228.2074		240.6946 er year (kW				
		0.0000		0.0000 al Energy u		0.0000 antaneous e		0.0000 wer(s) (kWh	0.0000 /year) = Su	0.0000 m(64a)m =		
Heat gains from water he 135.0632	eating, kWh/ 119.8633	/month 128.3026	115.0052	112.9995	103.4645	103.2582	106.4049	106.5270	116.8301	121.8504	133.8678	(65)
5. Internal gains (see 5												
Metabolic gains (Table 5	5), Watts	Mar				Jul		Sep	Oct	Nov	Dec	
(66)m 236.2758 Lighting gains (calculat	236.2758	236.2758	236.2758	236.2758	236.2758	236.2758	236.2758	236.2758				(66)
141.1989 Appliances gains (calcul	125.4116 Lated in App	101.9916 pendix L, eq	77.2142 quation L13	57.7185 or L13a), a	48.7284 lso see Tab	52.6528 le 5			116.6375			
1292.2293 Cooking gains (calculate	1305.6386 ed in Append	1271.8476 dix L, equat	1199.9106 ion L15 or	1109.1030 L15a), also	1023.7567 see Table	966.7401 5						
Pumps, fans 0.0000	0.0000		0.0000	62.5655 0.0000		62.5655 0.0000	62.5655 0.0000	62.5655 0.0000	62.5655 0.0000	62.5655 0.0000	62.5655 0.0000	
Losses e.g. evaporation -157.5172 Water heating gains (Tak	-157.5172	-157.5172		-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	(71)
		172.4497	159.7294	151.8810	143.7006	138.7879	143.0173	147.9542	157.0296	169.2367	179.9299	(72)
	1750.7424	1687.6130	1578.1783	1460.0267	1357.5098	1299.5049	1306.1123	1368.2602	1474.0501	1596.5604	1701.5900	(73)
6. Solar gains												
[Jan]		A	Mrea m2	Solar flux Table 6a W/m2	Speci or	g fic data Table 6b	Specific or Tab	FF data le 6c	Acce fact Table	ss or 6d	Gains W	
Northeast Southeast Southwest Northwest		115.2 123.6 122.1 80.0	2500 5100 .800				0 0 0 0	.0000	0.77 0.77 0.77 0.77			(75) (77) (79) (81)
Southeast Southwest Northwest		115.2 123.6 122.1 80.0	2500 5100 800 9900	11.2829 36.7938 36.7938 11.2829		0.3600 0.3600 0.3600 0.3600	0 0 0 0	.0000 .0000 .0000		00 00 00 00	360.4595 1260.7293 1246.1444 250.4920	
Southeast Southwest Northwest	5513.7430	115.2 123.6 122.1 80.0	2500 5100 .800 .9900 	11.2829 36.7938 36.7938 11.2829	13323.1193	0.3600 0.3600 0.3600 0.3600	0 0 0 0 0 	.0000 .0000 .0000 .0000	6239.1965	00 00 00 00 00 00	360.4595 1260.7293 1246.1444 250.4920 2644.2953	(83)
Southeast Southwest Northwest Solar gains 3117.8253	5513.7430 7264.4853	115.2 123.6 122.1 80.0 8083.1715 9770.7845	2500 5100 .800 .9900 	11.2829 36.7938 36.7938 11.2829 	 13323.1193 14680.6291	0.3600 0.3600 0.3600 0.3600 	0 0 0 0 11045.0563 12351.1686	.0000 .0000 .0000 .0000	6239.1965	00 00 00 00 00 00	360.4595 1260.7293 1246.1444 250.4920 2644.2953	(83)
Southeast Southwest Northwest Solar gains 3117.8253	5513.7430 7264.4853	115.2 123.6 122.1 80.0 8083.1715 9770.7845	2500 5100 .800 .9900 	11.2829 36.7938 36.7938 11.2829 	 13323.1193 14680.6291	0.3600 0.3600 0.3600 0.3600 	0 0 0 0 11045.0563 12351.1686	.0000 .0000 .0000 .0000	6239.1965	00 00 00 00 00 00	360.4595 1260.7293 1246.1444 250.4920 2644.2953	(83)
Southeast Southwest Northwest Solar gains 3117.8253 Total gains 4874.1142	5513.7430 7264.4853 ature (heati	115.2 123.6 122.1 80.0 8083.1715 9770.7845	2500 1100 8800 19900 10918.9337 12497.1119	11.2829 36.7938 36.7938 11.2829 13054.7816 14514.8083	13323.1193 14680.6291	0.3600 0.3600 0.3600 0.3600 	0 0 0 0 11045.0563 12351.1686	.0000 .0000 .0000 .0000	6239.1965	00 00 00 00 00 00	360.4595 1260.7293 1246.1444 250.4920 2644.2953	(83) (84)
Southeast Southwest Northwest Solar gains 3117.8253 Total gains 4874.1142 7. Mean internal temperature during heat: Utilisation factor for Garage Jan tau 49.8696	5513.7430 7264.4853 ature (heati- ing periods gains for li Feb 49.9406	115.2 123.6 122.1 80.0 8083.1715 9770.7845 ing season) in the livi iving area, Mar 50.0118	10918.9337 12497.1119 	11.2829 36.7938 36.7938 11.2829 13.054.7816 14514.8083 m Table 9, Table 9a) May 50.4433	13323.1193 14680.6291 Th1 (C) Jun 50.8087	0.3600 0.3600 0.3600 0.3600 0.3600 12693.9516 13993.4565	00 00 00 01 11045.0563 12351.1686	.0000 .0000 .0000 .0000 .0000 9056.4739 10424.7341	6239.1965 7713.2465 Oct 50.4433	00 00 00 00 3771.3921 5367.9525	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548	(83) (84)
Southeast Southwest Northwest Solar gains 3117.8253 Total gains 4874.1142 7. Mean internal temperature during heat: Utilisation factor for gain factor fa	5513.7430 7264.4853 atture (heating periods pains for life Feb 49.9406 4.3294	115.2 123.6 122.1 80.0 8083.1715 9770.7845 ing season) in the livitiving area, Mar 50.0118 4.3341	2500 5100 5100 8800 9900 10918.9337 12497.1119 	11.2829 36.7938 36.7938 11.2829 13054.7816 14514.8083 m Table 9, Table 9a) May 50.4433 4.3629	13323.1193 14680.6291 Th1 (C) Jun 50.8087 4.3872	0.3600 0.3600 0.3600 0.3600 0.3600 12693.9516 13993.4565 Jul 50.8087 4.3872	00 00 00 01 11045.0563 12351.1686	.0000 .0000 .0000 .0000 .0000 9056.4739 10424.7341 Sep 50.6619 4.3775	0ct 50.4433 4.3629	00 00 00 00 3771.3921 5367.9525 Nov 50.2987 4.3532	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437	(83) (84)
Southeast Southwest Northwest	5513.7430 7264.4853 ature (heati- ing periods gains for li Feb 49.9406 4.3294 0.9642	115.2 123.6 122.1 80.0 8083.1715 9770.7845 ing season) in the livi iving area, Mar 50.0118 4.3341 0.8811	2500 1000 1000 10918.9337 12497.1119 	11.2829 36.7938 36.7938 11.2829 13054.7816 14514.8083 13054.7816 14514.8083 13054.7816 14514.8083 14514.8083 14514.8083 14514.8083 14514.8083 14514.8083 14514.8083 14514.8083	13323.1193 14680.6291 	0.3600 0.3600 0.3600 0.3600 12693.9516 13993.4565 Jul 50.8087 4.3872 0.2520	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	.0000 .0000 .0000 .0000 .0000 9056.4739 10424.7341 Sep 50.6619 4.3775 0.5166	Oct 50.4433 4.3629 0.8470	00 00 00 00 3771.3921 5367.9525 Nov 50.2987 4.3532 0.9789	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437 0.9953	(83) (84)
Southeast Southwest Northwest Solar gains 3117.8253 Total gains 4874.1142 7. Mean internal temperature during heat: Utilisation factor for gain factor fa	5513.7430 7264.4853 ature (heati- ing periods gains for li Feb 49.9406 4.3294 0.9642	115.2 123.6 122.1 80.0 8083.1715 9770.7845 ing season) in the livitiving area, Mar 50.0118 4.3341	2500 5100 5100 8800 9900 10918.9337 12497.1119 	11.2829 36.7938 36.7938 11.2829 13054.7816 14514.8083 m Table 9, Table 9a) May 50.4433 4.3629	13323.1193 14680.6291 Th1 (C) Jun 50.8087 4.3872	0.3600 0.3600 0.3600 0.3600 0.3600 12693.9516 13993.4565 Jul 50.8087 4.3872	00 00 00 01 11045.0563 12351.1686	.0000 .0000 .0000 .0000 .0000 9056.4739 10424.7341 Sep 50.6619 4.3775	0ct 50.4433 4.3629	00 00 00 00 3771.3921 5367.9525 Nov 50.2987 4.3532	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437 0.9953	(83) (84) (85)
Southeast Southwest Northwest	5513.7430 7264.4853 ature (heating periods pains for life 49.9406 4.3294 0.9642 19.9252 20.1777	115.2 123.6 122.1 80.0 8083.1715 9770.7845 1019 season) in the livitiving area, Mar 50.0118 4.3341 0.8811 20.4370	2500 1000 1001 10918.9337 12497.1119 	11.2829 36.7938 36.7938 11.2829 13054.7816 14514.8083 14514.8083 14514.8083 14514.8083 14514.8083 14514.8083 14514.8083 14514.8083	13323.1193 14680.6291 Th1 (C) Jun 50.8087 4.3872 0.3478 20.9941	Jul 50.8087 4.3872 0.2520 20.9989	Aug 50.8824 4.3922 0.2976 20.9977	.0000 .0000	Oct 50.4433 4.3629 0.8470 20.6708 20.1852 0.8156 19.9291	00 00 00 00 3771.3921 5367.9525 Nov 50.2987 4.3532 0.9789 19.9458 20.1831 0.9739 19.2402	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437 0.9953 19.3655 20.1809 0.9943 18.6622	(83) (84) (85) (86) (87) (88) (89) (90)
Southeast Southwest Northwest	5513.7430 7264.4853 atture (heati- ing periods pains for li Feb 49.9406 4.3294 0.9642 19.9252 20.1777 0.9575 19.2118	115.2 123.6 122.1 80.0 8083.1715 9770.7845 ing season) in the livi lving area, Mar 50.0118 4.3341 0.8811 20.4370 20.1788 0.8622	2500 1100 1100 1100 1100 1100 1100 1100	11.2829 36.7938 36.7938 31.2829 13.054.7816 14514.8083 17.2829 13.054.7816 14514.8083 14	13323.1193 14680.6291 Th1 (C) Jun 50.8087 4.3872 0.3478 20.9941 20.1906 0.3046	Jul 50.8087 4.3872 0.2520 20.9989 20.1906	11045.0563 12351.1686 Aug 50.8824 4.3922 0.2976 20.9977 20.1917	.0000 .0000	Oct 50.4433 4.3629 0.8470 20.6708 20.1852 0.8156	00 00 00 00 3771.3921 5367.9525 Nov 50.2987 4.3532 0.9789 19.9458 20.1831 0.9739 19.2402	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437 0.9953 19.3655 20.1809 0.9943 18.6622 0.1024 18.7342	(83) (84) (85) (86) (87) (88) (89) (90) (91)
Southeast Southwest Northwest	5513.7430 7264.4853 atture (heati- ing periods gains for li Feb 49.9406 4.3294 0.9642 19.9252 20.1777 0.9575 19.2118 19.2848	115.2 123.6 122.1 80.0 8083.1715 9770.7845 ing season) in the livitiving area, Mar 50.0118 4.3341 0.8811 20.4370 20.1788 0.8622 19.7006	2500 1100 1100 1100 1100 1100 1100 1100	11.2829 36.7938 36.7938 11.2829 13.054.7816 14514.8083 17.2829 13.054.7816 14514.8083 17.2829 13.054.7816 14.3629 15.4433 16.3629 16.5036 16.5	Th1 (C) Jun 50.8087 4.3872 0.3478 20.9941 20.1906 0.3046 20.1876	Jul 50.8087 4.3872 0.2520 20.9989 20.1902	Aug 50.8824 4.3922 0.2976 20.9977 20.1917 0.2458 20.1909	.0000 .0000	Oct 50.4433 4.3629 0.8470 20.6708 20.1852 0.8156 19.9291 Living are	Nov 50.2987 4.3532 0.9789 19.9458 20.1831 0.9739 19.2402 a. / (4) =	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437 0.9953 19.3655 20.1809 0.9943 18.6622 0.1024 18.7342 0.0000	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
Southeast Southwest Northwest Northwest Solar gains 3117.8253 Total gains 4874.1142 7. Mean internal temperature during heat: Utilisation factor for gains tau 49.8696 alpha 4.3246 util living area 0.9925 MIT 19.4579 Th 2 20.1766 util rest of house 0.9909 MIT 2 18.7509 Living area fraction MIT 18.8233 Temperature adjustment adjusted MIT 18.8233	5513.7430 7264.4853 ature (heating periods years for life to the feb 49.9406 4.3294 0.9642 19.9252 20.1777 0.9575 19.2118 19.2848	115.2 123.6 122.1 80.0 8083.1715 9770.7845 ing season) in the livi iving area, Mar 50.0118 4.3341 0.8811 20.4370 20.1788 0.8622 19.7006 19.7760	2500 1100 1100 1100 1100 1100 1100 1100	11.2829 36.7938 36.7938 31.2829 13054.7816 14514.8083 Table 9a) May 50.4433 4.3629 0.5036 20.9628 20.1852 0.4632 20.1607 20.2428 20.2428	Th1 (C) Jun 50.8087 4.3872 0.3478 20.9941 20.1906 0.3046 20.1876 20.2702	Jul 50.8087 4.3872 0.2520 20.9989 20.1906 20.2730 20.2730	Aug 50.8824 4.3922 0.2976 20.1917 0.2458 20.1909 20.2735	.0000 .0000	Oct 50.4433 4.3629 0.8470 20.6708 20.1852 0.8156 19.9291 Living are 20.0050	Nov 50.2987 4.3532 0.9789 19.9458 20.1831 0.9739 19.2402 a/(4) = 19.3125	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437 0.9953 19.3655 20.1809 0.9943 18.6622 0.1024 18.7342 0.0000	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
Southeast Southwest Northwest	5513.7430 7264.4853 ature (heating periods pains for life periods 49.9406 4.3294 0.9642 19.9252 20.1777 0.9575 19.2118 19.2848 19.2848	115.2 123.6 122.1 80.0 8083.1715 9770.7845 ing season) in the livitiving area, Mar 50.0118 4.3341 0.8811 20.4370 20.1788 0.8622 19.7006 19.7760	2500 (100 (100 (100 (100 (100 (100 (100 (11.2829 36.7938 36.7938 11.2829 13.054.7816 14514.8083 17.2829 13.054.7816 14514.8083 17.2829 13.054.7816 14.3629 15.4433 16.3629 16.5036 16.5	Th1 (C) Jun 50.8087 4.3872 0.3478 20.9941 20.1906 0.3046 20.1876 20.2702	Jul 50.8087 4.3872 0.2520 20.9989 20.1906 0.2059 20.2730 20.2730	Aug 50.8824 4.3922 0.2976 20.9977 20.1917 0.2458 20.1909 20.2735 20.2735	.0000 .0000	Oct 50.4433 4.3629 0.8470 20.6708 20.1852 0.8156 19.9291 Living are 20.0050	Nov 50.2987 4.3532 0.9789 19.9458 20.1831 0.9739 19.2402 a/(4) = 19.3125	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437 0.9953 19.3655 20.1809 0.9943 18.6622 0.1024 18.7342 0.0000	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
Southeast Southwest Northwest	5513.7430 7264.4853 ature (heating periods pains for life periods 49.9406 4.3294 0.9642 19.9252 20.1777 0.9575 19.2118 19.2848 19.2848	115.2 123.6 122.1 80.0 8083.1715 9770.7845 ing season) in the livitiving area, Mar 50.0118 4.3341 0.8811 20.4370 20.1788 0.8622 19.7006 19.7760	2500 (100 (100 (100 (100 (100 (100 (100 (11.2829 36.7938 36.7938 11.2829 13.054.7816 14514.8083 17.2829 13.054.7816 14514.8083 17.2829 13.054.7816 14.3629 15.4433 16.3629 16.5036 16.5	Th1 (C) Jun 50.8087 4.3872 0.3478 20.9941 20.1906 0.3046 20.1876 20.2702	Jul 50.8087 4.3872 0.2520 20.9989 20.1906 0.2059 20.2730 20.2730	Aug 50.8824 4.3922 0.2976 20.9977 20.1917 0.2458 20.1909 20.2735 20.2735	.0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0010	Oct 50.4433 4.3629 0.8470 20.6708 20.1852 0.8156 19.9291 Living are 20.0050	Nov 50.2987 4.3532 0.9789 19.9458 20.1831 0.9739 19.2402 a/(4) = 19.3125	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437 0.9953 19.3655 20.1809 0.9943 18.6622 0.1024 18.7342 0.0000	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92)
Southeast Southwest Northwest Northwest Solar gains 3117.8253 Total gains 4874.1142 7. Mean internal tempered for the solution of the solutio	5513.7430 7264.4853 atture (heating periods gains for life periods 4.3294 0.9642 19.9252 20.1777 0.9575 19.2118 19.2848 19.2848	115.2 123.6 122.1 80.0 8083.1715 9770.7845 ing season) in the livi iving area, Mar 50.0118 4.3341 20.4370 20.1788 0.8622 19.7760	2500 si000 s	11.2829 36.7938 36.7938 11.2829 13054.7816 14514.8083 Table 9a) May 50.4433 4.3629 0.5036 20.9628 20.1852 0.4632 20.1607 20.2428 20.2428	Th1 (C) Jun 50.8087 4.3872 0.3478 20.9941 20.1906 20.2702 20.2702	0.3600 0.3600 0.3600 0.3600 0.3600 12693.9516 13993.4565 Jul 50.8087 4.3872 0.2520 20.9989 20.1906 0.2059 20.1902 20.2730 20.2730 Jul 0.2106	Aug 50.8824 4.3922 0.2976 20.9977 20.1917 0.2458 20.2735 20.2735	.0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0010	Oct 50.4433 4.3629 0.8470 20.6708 20.1852 0.8156 19.9291 Living are 20.0050 20.0050	00 00 00 00 3771.3921 5367.9525 Nov 50.2987 4.3532 0.9789 19.9458 20.1831 0.9739 19.2402 a / (4) = 19.3125 19.3125	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437 0.9953 19.3655 20.1809 0.9943 18.6622 0.1024 18.7342 0.0000 18.7342 Dec 0.9918	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93)
Southeast Southwest Northwest	5513.7430 7264.4853 atture (heating periods gains for life heating heatin	115.2 123.6 122.1 80.0 8083.1715 9770.7845 ing season) in the livitiving area, Mar 50.0118 4.3341 0.8811 20.4370 20.1788 0.8622 19.7760 19.7760	2500 si000 s	11.2829 36.7938 36.7938 31.2829 13054.7816 14514.8083 Table 9a) May 50.4433 4.3629 0.5036 20.9628 20.1852 0.4632 20.1607 20.2428 20.2428	13323.1193 14680.6291 Th1 (C) Jun 50.8087 4.3872 0.3478 20.9941 20.1906 0.3046 20.1876 20.2702 20.2702 Jun 0.3089 4534.7680 14.6000	Jul 50.8087 4.3872 0.2520 20.2730 20.2730 Jul 0.2106 2947.0071 16.6000	Aug 50.8824 4.3922 0.2976 20.9977 20.1917 0.2458 20.2735 20.2735 20.2735 Aug 0.2510 3100.5597 16.4000	.0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0010	Oct 50.4433 4.3629 0.8470 20.6708 20.1852 0.8156 19,9291 Living are 20.0050 20.0050	Nov 50.2987 4.3532 0.9789 19.9458 20.1831 0.9739 19.2402 a / (4) = 19.3125 19.3125	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437 0.9953 19.3655 20.1809 0.9943 18.6622 0.1024 18.7342 Dec 0.9918 4310.1478 4.2000	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93)
Southeast Southwest Northwest Northwest Solar gains 3117.8253 Total gains 4874.1142 7. Mean internal temperature during heat: Utilisation factor for gains 49.8696 alpha 4.3246 util living area 0.9925 MIT 19.4579 Th 2 20.1766 util rest of house 0.9909 MIT 2 18.7509 Living area fraction MIT 18.8233 Temperature adjustment adjusted MIT 18.8233 8. Space heating required Utilisation 0.9874 Useful gains 4812.6299 Ext temp. 4.3000 Heat loss rate W 11882.1025 Space heating kWh 5259.6876 Space heating requirements	5513.7430 7264.4853 atture (heating periods spains for lifeb 49.9406 4.3294 0.9642 19.9252 20.1777 0.9575 19.2118 19.2848 19.2848 19.2848 19.2848 20.1777 19.2118 21.2848 21.2848 21.2848 21.2848 21.2848 21.2848 21.2848	115.2 123.6 122.1 180.0 8083.1715 9770.7845 ing season) in the livitiving area, Mar 50.0118 4.3341 0.8811 20.4370 20.1788 0.8622 19.7760 19.7760 19.7760 Mar 0.8518 8323.0860 6.5000 10830.7700 1865.7169	2500 si000 s	11.2829 36.7938 36.7938 31.2829 13054.7816 14514.8083 Table 9a) May 50.4433 4.3629 0.5036 20.9628 20.1852 0.4632 20.1607 20.2428 20.2428	13323.1193 14680.6291 Th1 (C) Jun 50.8087 4.3872 0.3478 20.9941 20.1906 0.3046 20.1876 20.2702 20.2702 Jun 0.3089 4534.7680 14.6000	Jul 50.8087 4.3872 0.2520 20.2730 20.2730 Jul 0.2106 2947.0071 16.6000	Aug 50.8824 4.3922 0.2976 20.9977 20.1917 0.2458 20.2735 20.2735 20.2735 Aug 0.2510 3100.5597 16.4000	.0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0010	Oct 50.4433 4.3629 0.8470 20.6708 20.1852 0.8156 19,9291 Living are 20.0050 20.0050	Nov 50.2987 4.3532 0.9789 19.9458 20.1831 0.9739 19.2402 a / (4) = 19.3125 19.3125 Nov 0.9669 5190.5176 7.1000 9906.3087	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437 0.9953 19.3655 20.1809 0.9943 18.6622 0.1024 18.7342 0.0000 18.7342 Dec 0.9918 4310.1478 4.2000 11823.4608	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97)
Southeast Southwest Northwest Northwest Solar gains 3117.8253 Total gains 4874.1142 7. Mean internal temperature during heat: Utilisation factor for gains 49.8696 alpha 4.3246 util living area 0.9925 MIT 19.4579 Th 2 20.1766 util rest of house 0.9909 MIT 2 18.7509 Living area fraction MIT 18.8233 Temperature adjustment adjusted MIT 18.8233 8. Space heating requires Utilisation 0.9874 Useful gains 4812.6299 Ext temp. 4.3000 Heat loss rate W 11882.1025 Space heating kWh Solar heating contribut:	5513.7430 7264.4853 ature (heating periods pains for life periods pains periods pains for life periods pains periods p	115.2 123.6 122.1 80.0 8083.1715 9770.7845 ing season) in the livi living area, Mar 50.0118 4.3341 0.8811 20.4370 20.1788 0.8622 19.7006 19.7760 19.7760 Mar 0.8518 8323.0860 6.5000 10830.7700 1865.7169 per year (kW	2500 1000 1000 1000 1000 1000 1000 1000	11.2829 36.7938 36.7938 31.2829 13054.7816 14514.8083 m Table 9, Table 9a) May 50.4433 4.3629 0.5036 20.9628 20.1852 0.4632 20.1607 20.2428 20.2428 May 0.4661 6764.9857 11.7000 6909.7156	Th1 (C) Jun 50.8087 4.3872 0.3478 20.9941 20.1906 0.3046 20.1876 20.2702 20.2702 Jun 0.3089 4534.7680 14.6600 4553.2735	Jul 50.8087 4.3872 0.2520 20.2730 20.2730 Jul 0.2106 2947.0071 16.6000 2949.5219	Aug 50.8824 4.3922 0.2976 20.9977 20.1917 0.2458 20.1909 20.2735 20.2735 20.2735	.0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0010	Oct 50.4433 4.3629 0.8470 20.6708 20.1852 0.8156 19.9291 Living are 20.0050 20.0050 Oct 0.8079 6231.1871 10.66000 7607.1362	Nov 50.2987 4.3532 0.9789 19.9458 20.1831 0.9739 19.2402 a / (4) = 19.3125 19.3125 Nov 0.9669 5190.5176 7.1000 9906.3087	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437 0.9953 19.3655 20.1809 0.9943 18.6622 0.1024 18.7342 0.0000 18.7342 Dec 0.9918 4310.1478 4.2000 11823.4608 5589.9049	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98a)
Southeast Southwest Northwest Northwest Northwest Solar gains 3117.8253 Total gains 4874.1142 7. Mean internal temperature during heat: Utilisation factor for 6 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5513.7430 7264.4853 atture (heating periods gains for life feb 49.9406 4.3294 0.9642 19.9252 20.1777 0.9575 19.2118 19.2848 19.2848 19.2848	115.2 123.6 122.1 80.0 8083.1715 9770.7845 ing season) in the livi living area, Mar 50.0118 4.3341 0.8811 20.4370 20.1788 0.8622 19.7006 19.7760 Mar 0.8518 8323.0860 6.5000 10830.7700 1865.7169 per year (kw 0.0000 per year (kw 1865.7169	2500 1000 1000 1000 1000 1000 1000 1000	11.2829 36.7938 36.7938 36.7938 11.2829 13054.7816 14514.8083 Table 9, Table 9a) May 50.4433 4.3629 0.5036 20.9628 20.1852 20.1607 20.2428 20.2428 May 0.4661 6764.9857 11.7000 6909.7156 107.6791 0.0000	Jun 0.3046 20.2702 20.2702 Jun 0.3089 4.3478 20.9941 20.1906 20.1876 20.2702 20.2702	0.3600 0.3600 0.3600 0.3600 0.3600 0.3600 0.3600 0.3600 0.3600 0.3600 0.3600 0.3600 0.3600 0.3600 0.3600 0.3600 0.3600 0.2690 0.2520 0.2730 20.2730 20.2730 20.2730 20.2730 20.2730 20.2730 20.2730 20.2730 20.2730	Aug 50.8824 4.3922 0.2976 20.9977 20.1917 0.2458 20.1909 20.2735 20.2735 Aug 0.2510 3100.5597 16.4000 3105.9737	.0000 .0000	Oct 50.4433 4.3629 0.8470 20.6708 20.1852 0.8156 19.9291 Living are 20.0050 20.0050 0.8079 6231.1871 10.6000 7607.1362 1023.7061 0.0000	Nov 50.2987 4.3532 0.9789 19.9458 20.1831 0.9739 19.2402 2a / (4) = 19.3125 19.3125 19.3125 19.3125	360.4595 1260.7293 1246.1444 250.4920 2644.2953 4345.8853 21.0000 Dec 50.1548 4.3437 0.9953 19.3655 20.1809 0.9943 18.6622 0.1024 18.7342 Dec 0.9918 4310.1478 4.2000 1823.4608 5589.9049 21055.1147 0.0000 0.0000	(83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98a) (98b)

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8c. Space cooling													
Calculated for Ju													
	Jan 4.3000	Feb 4.9000	Mar 6.5000	Apr 8.9000	May 11.7000	Jun 14.6000	Jul 16.6000	Aug 16.4000	Sep 14.1000	Oct 10.6000	Nov 7.1000	Dec 4.2000	
Utilisation Useful loss	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000	7548.4085 0.9838 7425.9308 16929.9869	0.9921 5895.2570	0.9860 6008.8954	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	(101) (102)
	0.0000	0.0000 10b)	0.0000	0.0000	0.0000	6842.9204	7619.5526	6106.0251	0.0000 fC =	0.0000 cooled are	0.0000 a / (4) =	0.0000 0.9728	
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
	0.0000	0.0000	0.0000	0.0000	0.0000	1664.2429	1853.1249	1485.0251	0.0000	0.0000	0.0000	0.0000 5002.3929	
9b. Energy requir Fraction of space Fraction of space Fraction of heat Factor for contro Factor for chargi Distribution loss Efficiency of sec Space heating: Space heating req	heat from heat from from commun l and charn ng method factor (To ondary/sup)	secondary community nity Geotl ging meth (Table 4c able 12c) plementary	y/supplemen y system hermal-Spac od (Table 4 (3)) for war for commun. y heating s	tary system e and Water c(3)) for s ter heating	Table 11)			0.0000	1023,7061	3395.3696	0.0000 1.0000 1.0000 1.0500 1.0500 1.5500 0.0000	(302) (303a) (305) (305a) (306) (208)
Space heat from G 307a 828	eothermal = 4.0080 51			x 1.50 859.4662	169.5946	0.0000	0.0000	0.0000	0.0000	1612.3372	5347.7072	8804.1002	
Efficiency of sec	4.0080 51 ondary/sup	plementary	y heating s		169.5946 (from Tabl	0.0000 e 4a or App	0.0000 endix E)	0.0000	0.0000	1612.3372	5347.7072	8804.1002 0.0000	
	1 for seco: 0.0000	ndary/sup 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
	3.8617 2	86.1163	303.5289	266.1929	257.5045	231.4840	228.2074	237.6711	240.6946	269.0250	286.7801	320.2665	(64)
	0.0822 4			x 1.50 419.2538	405.5696	364.5873	359.4266	374.3320	379.0940	423.7144	451.6787	504.4197	
	0.0822 4		478.0580	419.2538	405.5696	364.5873	359.4266	374.3320	379.0940	423.7144	451.6787	504.4197	
Pumps and Fa 50 Lighting 12	0.0000 3.1299 4 3.5906	0.0000 54.4399 99.1490	0.0000 503.1299 89.2727	0.0000 486.8999 65.4050	0.0000 503.1299 50.5207	416.0607 486.8999 41.2758	463.2812 503.1299 46.0867	371.2563 503.1299 59.9052	0.0000 486.8999 77.8109	0.0000 503.1299 102.0921	0.0000 486.8999 115.3128	4.0000 0.0000 503.1299 127.0256	(315) (331)
	5.3092 -9	39.6664 -	1006.7756	-805.9568	-661.5888		-581.1824	-656.0203	-763.8507	-932.2154	-862.0799	-773.4890	(333a)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity gener (333b)m Electricity gener	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333b)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)
Space heating fue Space heating fue Water heating fue Efficiency of wat Electricity used Space cooling fue	1 - commun. 1 - second. 1 - commun. er heater for heat d.	ary ity heatin	ng									33161.8056 0.0000 5120.8497 0.0000 331.6181 1250.5982	(309) (310) (311) (313)
Electricity for p (BalancedWith mechanical ven Total electricity Electricity for l	HeatRecove tilation for for the al	ry, Databa ans (SFP : bove, kWh.	= 1.73 /year	220)	1.4000, SFP	· = 1.7220)						5923.9486 5923.9486 997.4469	(331)
Energy saving/gen PV generation Wind generation Hydro-electric ge Electricity gener	neration (i	Appendix 1	N)	es M ,N and	d Q)							-9408.5224 0.0000 0.0000 0.0000	(334) (335a)
Appendix Q - spec Energy saved or g Energy used Total delivered e	enerated											-0.0000 0.0000 37046.1266	(337)
10b. Fuel costs -	using Tab	le 12 pri	ces										
Space heating fro Space heating tot	m Geotherm	al						Fuel kWh/year 33161.8056		Fuel price p/kWh 3.1100		Fuel cost £/year 1031.3322 1031.3322	(340)
Total CO2 associa Space heating - s Water heating fro Water heating tot	econdary m Geotherm		systems					0.0000 5120.8497		0.0000 3.1100		0.0000 0.0000 159.2584 159.2584	(341) (342a)
Energy for instan Space cooling Pumps, fans and e	taneous ele lectric ke		ower(s)					0.0000 1250.5982 5923.9486		16.4900 16.4900 16.4900		0.0000 206.2236 976.8591	(347a) (348) (349)
Energy for lighti Additional standi	ng charges	,						997.4469		16.4900		164.4790 92.0000	
Energy saving/ge PV Unit electrici PV Unit electrici	ty used in	dwelling						-9408.5224 0.0000		16.4900 5.5900		-1551.4653 0.0000	

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-1551.4653 (352)

Total Total energy cos	t											-1551.4653 1078.6870		
11b. SAP rating														
Energy cost defl Energy cost fact SAP value SAP rating (Sect SAP band	ator (Table or (ECF)								(255) x (25	6)] / [(4) -	- 45.0] =	93.4769	(357) (358)	
12b. Carbon diox	ide emissio	ns - Commu	nity heatin	g scheme										
								Energy kWh/year		sion factor kg CO2/kWh		Emissions kg CO2/year		
Efficiency of he Space and Water Electrical energ Overall CO2 fact Total CO2 associ	heating fro y for heat or for heat	m Geothern distributi network	on (space &	water)			1	1427.6583 331.6181		0.0110 0.0000		335.0000 108.8895 59.5215 0.0048 185.2257	(367) (372) (386)	
Space and water Space cooling Pumps, fans and Energy for light	heating electric ke							1250.5982 5923.9486 997.4469		0.1143 0.1387 0.1443		185.2257 142.9322 821.7247 143.9624	(377) (378)	
Energy saving/g PV Unit electric Total Total CO2, kg/ye CO2 emissions pe EI value EI rating EI band	ity used ir ity exporte ar	dwelling	es				-	9408.5224		0.1413 0.0000		-1329.0362 0.0000 -1329.0362 -35.1911 -0.0400 100.0489	(380) (383) (384) (384a) (385)	
SAP 10 WORKSHEET CALCULATION OF E	FOR New Bu	ild (As De	esigned) (Version 10 ENERGY	.2, Februar	y 2022) 								
1. Overall dwell		eristics												
Ground floor First floor Total floor area Dwelling volume	TFA = (1a)	+(1b)+(1c)	+(1d)+(1e).	(1n)	9	20.0000		Area (m2) 460.0000 460.0000	(1b) x (1c) x		(2c) =	Volume (m3) = 1481.2000 = 1338.6000 = 2819.8000	(1b) - (1c) - (4)	
2. Ventilation r	ate													
												m3 per hour		
Number of open of Number of open f Number of chimme Number of flues Number of flues Number of blocke Number of interm Number of passiv Number of fluele	lues ys / flues attached to attached to d chimneys ittent extr e vents	solid fue other hea act fans	el boiler	re								= 0.0000 = 0.0000 = 0.0000 = 0.0000 = 0.0000	(6b) (6c) (6d) (6e) (6f) (7a) (7b)	
Infiltration due	to chimney	s, flues a	and fans =	(6a)+(6b)	+(6c)+(6d)+	(6e)+(6f)+(6g)+(7a)+(7	(b) + (7c) =		0.000	Air chan) / (5) =	nges per hour 0.0000 Yes	(8)	
Pressure Test Me Measured/design Infiltration rat Number of sides	AP50 e											Blower Door 1.0000 0.0500	(17)	
Shelter factor Infiltration rat	e adjusted	to include	e shelter fa	ctor						- [0.075 z (21) = (18)				
	1.3000	5.2000	5.0000			Jun 3.9000 0.9750	Jul 3.7000 0.9250	Aug 3.7000 0.9250	Sep 4.1000 1.0250	4.6000	Nov 4.800 1.200	00 4.7000		
Adj infilt rate Balanced mechan If mechanical ve If exhaust air h	0.0650 ical ventil ntilation eat pump us	ation with	lix N, (23b)	ery = (23a) x	Fmv (equat	ion (N5)),	otherwise (23b) = (2		0.0575	0.060	0.5000	(23a) (23b)	
If balanced with Effective ac						0.1798			0.1822	0.1885	0.19	73.8000 10 0.1898		

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3. Heat losses and heat loss	parame	ter										
Element			Gross	Opening		 tArea	U-value	Ах		-value	АхК	
Window (Uw = 0.80) Glazed Door Normal Door			m2	m	441 12 9	m2 .1300 .6000 .4000	W/m2K 0.7752 0.8000 1.0000	341.96 10.08 9.40	12 00 00	kJ/m2K	kJ/K	(27) (26a) (26)
Heatloss Floor 1 Ground Floor External Wall First Floor External Wall External Roof Total net area of external e	lements		432.8000 448.3200 460.0000	260.390 202.740	0 172 0 245 460	.0000 .4100 .5800 .0000 .1200	0.1000 0.1400 0.1400 0.1100	46.00 24.13 34.38 50.60	74 19 12 19	0.0000	50600.0000 32757.9000 46660.2000 4140.0000	(29a) (29a)
Fabric heat loss, W/K = Sum Internal Wall 1 Internal Floor 1	(A x U)					(26)(.7400 .0000	(30) + (32)	= 516.55		9.0000 8.0000	4443.6600 8280.0000	
Heat capacity Cm = Sum(A x k Thermal mass parameter (TMP this tof Thermal Bridges		TFA) in kJ/1	m2K							(32e) = 1	159.6541	
K1 Element E2 Other lintels (in: E3 Sill E4 Jamb E5 Ground floor (nor: E6 Intermediate floo E16 Corner (normal) E17 Corner (inverted E10 Eaves (insulatio: E12 Gable (insulatio: E13 Gable (insulatio: Thermal bridges (Sum(L x Psi	mal) r within - inten n at cen n at cen n at ren n at ren	n a dwelling rnal area g iling level iling level fter level)	g reater than)		rea)		157 157 162 148 148 49 24 233	ength .4600 .2800 .7300 .7300 .0400 .5200 .5200 .9600 .2400	Psi-value 0.3000 0.0200 0.0160 0.0530 0.0010 0.0380 -0.0750 0.1200 0.2500 0.2500	Tot 47.23 3.14 2.59 7.88 0.14 1.86 -1.83 28.02 14.24	80 92 65 27 87 335 990 24	(36)
Point Thermal bridges Total fabric heat loss	Caica	racea asing	пррепата	.,				(33) + (36)	(36a) = + (36a) =	0.0000 636.9219	
Ventilation heat loss calcul- Jan (38)m 182.3847 18. Heat transfer coeff	Feb	Mar	= 0.33 x Apr 173.0793	May	Jun 167.2635	Jul 164.9372	Aug 164.9372	Sep 169.5898	Oct 175.4057	Nov 177.7320	Dec 176.5688	(38)
	9.3065	816.9802	810.0012	808.8380	804.1853	801.8590	801.8590	806.5117	812.3275	814.6539	813.4907 810.7766	(39)
	Feb 0.8906	Mar 0.8880	Apr 0.8804	May 0.8792	Jun 0.8741	Jul 0.8716	Aug 0.8716	Sep 0.8766	Oct 0.8830	Nov 0.8855	Dec 0.8842 0.8813	(40)
Days in mont 31	28	31	30	31	30	31	31	30	31	30	31	
4. Water heating energy requ) 									
Assumed occupancy Hot water usage for mixer sh		0.0000	0.0000	0 0000	0.0000	0 0000	0.0000	0.0000	0 0000	0.0000	3.9379	
0.0000 Hot water usage for baths 109.6601 10	0.0000	0.0000	0.0000	0.0000 98.3431	0.0000 94.8321	0.0000 92.9356	0.0000 95.2130	0.0000 97.6926	0.0000	0.0000	0.0000	
Hot water usage for other us	es 5.7472	53.6435	51.5399	49.4362	47.3325	47.3325	49.4362	51.5399	53.6435	55.7472	57.8509 154.2639	(42c)
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use 167.5110 16 Energy conte 265.2965 23 Energy content (annual)	3.7787 3.2187	159.3816 244.9637	153.0493 209.5169	147.7793 198.9393	142.1646 174.8080	140.2682 169.6422	144.6492 179.1059	149.2325 184.0186	155.0931 210.4598 Total = S	161.5125 230.1041 Sum(45)m =	167.1403 261.7013 2561.7751	
Distribution loss (46)m = 0	.15 x (4.9828	45)m 36.7445	31.4275	29.8409	26.2212	25.4463	26.8659	27.6028	31.5690	34.5156	39.2552	(46)
Store volume a) If manufacturer declared Temperature factor from Tal Enter (49) or (54) in (55)		actor is kn	own (kWh/	day):							1000.0000 1.4600 0.7800 1.1388	(48) (49)
	1.8864	35.3028	34.1640	35.3028	34.1640	35.3028	35.3028	34.1640	35.3028	34.1640	35.3028	(56)
		35.3028 23.2624	34.1640 22.5120 0.0000			35.3028 23.2624 0.0000	23.2624			22.5120	35.3028 23.2624 0.0000	(59)
Total heat required for wate 323.8617 28 WWHRS 0.0000	r heati: 6.1163 0.0000	ng calculate 303.5289 0.0000	ed for eacl	n month 257.5045 0.0000	231.4840	228.2074	237.6711	240.6946	269.0250 0.0000	286.7801 0.0000	320.2665	(62) (63a)
Solar input 0.0000	0.0000	-0.0000 0.0000 0.0000		0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000			-0.0000 0.0000 0.0000		-0.0000 0.0000 0.0000	(63c)
323.8617 28	6.1163	303.5289	266.1929	257.5045	231.4840	228.2074	237.6711 Total p			286.7801 Sum(64)m =		
Electric shower(s) 0.0000	0.0000	0.0000	0.0000 Tot	0.0000 al Energy u	0.0000 sed by inst	0.0000 antaneous e		0.0000 wer(s) (kWh	0.0000 /vear) = Su	0.0000 um(64a)m =	0.0000	
Heat gains from water heatin 135.0632 11												
5. Internal gains (see Table												
Metabolic gains (Table 5), W. Jan (66)m 236.2758 23 Lighting gains (calculated in	Feb 6.2758						Aug 236.2758	Sep 236.2758	Oct 236.2758	Nov 236.2758	Dec 236.2758	(66)
141.1989 12 Appliances gains (calculated	5.4116	101.9916	77.2142	57.7185	48.7284	52.6528	68.4401	91.8601	116.6375	136.1332	145.1233	(67)
1292.2293 130 Cooking gains (calculated in	5.6386	1271.8476	1199.9106	1109.1030	1023.7567	966.7401	953.3308	987.1218	1059.0588	1149.8664	1235.2127	(68)
62.5655 6. Pumps, fans 0.0000	2.5655	62.5655 0.0000	62.5655 0.0000	62.5655 0.0000	62.5655	62.5655 0.0000	62.5655 0.0000	62.5655 0.0000	62.5655 0.0000	62.5655 0.0000	62.5655 0.0000	
Losses e.g. evaporation (neg- -157.5172 -15 Water heating gains (Table 5	7.5172			-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	(71)

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181.5366 178.3680 172.4497 159.7294 151.8810 143.7006 138.7879 143.0173 147.9542 157.0296 169.2367 179.9299 (72)
Total internal gains
1756.2890 1750.7424 1687.6130 1578.1783 1460.0267 1357.5098 1299.5049 1306.1123 1368.2602 1474.0501 1596.5604 1701.5900 (73)

6. Solar gain	s												
[Jan]				rea m2	Solar flux Table 6a W/m2	Spec:	g ific data Table 6b	Specific or Tak	FF c data ole 6c	Acce fact Table	or	Gains W	
Northeast Southeast Southwest Northwest			115.2 123.6 122.1 80.0	500 100 800 900	10.0309 33.4622 33.4622 10.0309	2 2 2	0.3600 0.3600 0.3600 0.3600	(((0.77 0.77 0.77 0.77	00 00 00 00	320.4609 1146.5729 1133.3086 222.6960	(77) (79)
Solar gains Total gains													
7. Mean inter	nal tempera	ature (heati	ing season)										
Temperature d	uring heat:	ing periods	in the livi	ng area fro	m Table 9,	Th1 (C)						21.0000	(85)
Jtilisation f tau alpha	Jan 49.7988 4.3199	Feb 49.7988	Mar 49.9406	Apr 50.3709	May 50.4433	Jun	Jul 50.8824 4.3922						
itil living a		0.9712	0.8975	0.7180	0.5310	0.4143	0.3377	0.3972	0.6009	0.8868	0.9845	0.9965	(86)
IIT Th 2	19.3484 20.1755		20.3420 20.1777	20.7930 20.1842	20.9496 20.1852	20.9856 20.1896		20.9904 20.1917		20.5504 20.1820			
util rest of	0.9935 18.6410		0.8814 19.6095	0.6869 20.0213	0.4933 20.1502	0.3729 20.1810	0.2937 20.1893	0.3470 20.1868		0.8628 19.8174 Living are		18.5582	(90)
Living area f MIT Temperature a	18.7134	19.1696	19.6845	20.1003	20.2320	20.2634	20.2717	20.2691		19.8924			
adjusted MIT			19.6845	20.1003	20.2320	20.2634	20.2717	20.2691	20.2271	19.8924	19.1929	18.6302	(93)
8. Space heat	ing require	ement											
Utilisation Useful gains	4536.7783	6771.9316			May 0.4955 7505.4902 10.7000		4292.3034				Nov 0.9751 4977.3705 6.6000	4125.2204	(95)
eat loss rat	e W		11506.7654										
pace heating pace heating	kWh 5654.3540 requiremen	3636.0740	2198.4030	652.1151		0.0000		0.0000		1428.8930			(98a
olar heating	0.0000		0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating Space heating Space heating	kWh 5654.3540 requiremen	3636.0740	2198.4030	652.1151			0.0000	0.0000	0.0000	1428.8930 (98c			(980
 3c. Space coo	ling requi:												
Calculated fo	r June, Ju	Ly and Augus	st. See Tabl	e 10b								_	
xt. temp. eat loss rat	Jan 3.9000 e W	Feb 4.3000	Mar 5.6000	Apr 7.9000	May 10.7000	Jun 13.2000	Jul 14.9000	Aug 14.8000	Sep 12.8000	0ct 9.7000	Nov 6.6000	Dec 3.7000	
tilisation Seful loss otal gains	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000	0.9748 8465.9773	7296.9170 0.9847 7185.2432 16610.8126	0.9724 7173.7686	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000	(10)
pace cooling	kWh 0.0000	0.0000	0.0000	0.0000			7012.6236		0.0000	0.0000 cooled are	0.0000	0.0000 0.9728	(10
ntermittency	factor (Ta 0.2500	able 10b) 0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	
space cooling space cooling	0.0000	0.0000 nt	0.0000	0.0000	0.0000	1535.7505	1705.5158	1280.0916	0.0000	0.0000	0.0000	0.0000 4521.3579	
b. Energy re raction of s												0.0000	(30
Praction of some control of the cont	eat from control and of arging method loss factor secondary,	ommunity Geo charging met nod (Table 4 r (Table 120	othermal-Spa thod (Table Ac(3)) for w c) for commu	4c(3)) for ater heatin nity heatin	space heati g	ing						1.0000 1.0000 1.0500 1.0500 1.5000 0.0000	(303 (305 (306
pace heating pace heating	requiremen		2198.4030	652.1151	152.0616	0.0000	0.0000	0.0000	0.0000	1428.8930	3802.6741	5967.1548	(98
pace heat fr 107a	om Geothern 8905.6075	nal = (98) > 5726.8166		5 x 1.50		0.0000	0.0000	0.0000		2250.5065			/
Space heating	requirement 8905.6075	5726.8166	3462.4848	1027.0813	239.4970	0.0000	0.0000	0.0000		2250.5065		9398.2687	
Efficiency of Space heating					(from Tabl	le 4a or App	pendix E)					0.0000	(30

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0.0000 0.0000 0.0000 0.0000 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(303)
Annual water heating requirement 323.8617 286.1163 303.5289 266.1929 257.5045 231.4840 Water heat from Geothermal = (64) x 1.00 x 1.05 x 1.50	228.2074	237.6711	240.6946	269.0250	286.7801	320.2665	(64)
310a 510.0822 450.6332 478.0580 419.2538 405.5696 364.5873 Water heating fuel		374.3320	379.0940	423.7144	451.6787	504.4197	
510.0822 450.6332 478.0580 419.2538 405.5696 364.5873 Cooling System Energy Efficiency Ratio		374.3320	379.0940	423.7144	451.6787	504.4197 4.0000	(314)
Space coolin 0.0000 0.0000 0.0000 0.0000 0.0000 383,9376 Pumps and Fa 503.1299 454.4399 503.1299 486.8999 503.1299 486.8999 Lighting 123.5906 99.1490 89.2727 65.4050 50.5207 41.2758		320.0229 503.1299 59.9052	0.0000 486.8999 77.8109	0.0000 503.1299 102.0921	0.0000 486.8999 115.3128	0.0000 503.1299 127.0256	(331)
Electricity generated by PVs (Appendix M) (negative quantity) (333a)m -812.4773 -933.1904 -1006.2351 -779.2296 -633.2200 -558.7076				-932.9504		-739.7350	
Electricity generated by wind turbines (Appendix M) (negative quantity) (334a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quanti (335a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	.ty) 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by FVs (Appendix M) (negative quantity) (333b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333b)
(334b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Electricity generated by hydro-electric generators (Appendix M) (negative quanti	0.0000 ty)	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
(335b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Annual totals kWh/year	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)
Space heating fuel - community heating Space heating fuel - secondary						36999.4742	(309)
Water heating fuel - community heating Efficiency of water heater Electricity used for heat distribution						5120.8497 0.0000 369.9947	(311)
Space cooling fuel						1130.3395	
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.7220)							
mechanical ventilation fans (SFP = 1.7220) Total electricity for the above, kWh/year						5923.9486 5923.9486	(331)
Electricity for lighting (calculated in Appendix L) Energy saving/generation technologies (Appendices M ,N and Q)						997.4469	(332)
PV generation Wind generation Wind generation						-9217.2214 0.0000	
Hydro-electric generation (Appendix N) Electricity generated - Micro CHP (Appendix N)						0.0000	(335a)
Appendix Q - special features Energy saved or generated						-0.0000	
Energy used Total delivered energy for all uses						0.0000 40954.8374	
10b. Fuel costs - using BEDF prices (535)							
		Fuel kWh/year		Fuel price p/kWh		Fuel cost £/year	
Space heating from Geothermal Space heating total	36	5999.4742		5.2900		1957.2722 1957.2722	(340)
Total CO2 associated with community systems Space heating - secondary Nature heating from Costhormal	-	0.0000		0.0000		0.0000	(341)
Water heating from Geothermal Water heating total Energy for instantaneous electric shower(s)	_	0.0000		5.2900 25.1600		270.8929 270.8929 0.0000	(342)
Space cooling Pumps, fans and electric keep-hot	5	130.3395		25.1600 25.1600		284.3934 1490.4655	(348)
Energy for lighting Additional standing charges		997.4469		25.1600		250.9576 102.0000	
Energy saving/generation technologies PV Unit electricity used in dwelling	_0	9217.2214		25.1600		-2319.0529	
PV Unit electricity exported Total	_	0.0000		5.8100		0.0000 -2319.0529	(352)
Total energy cost						2036.9287	(355)
12b. Carbon dioxide emissions - Community heating scheme							
		Energy kWh/year	Emiss	ion factor kg CO2/kWh	υ	Emissions	
Efficiency of heat source Geothermal Space and Water heating from Geothermal		2573.2310		0.0110		335.0000 121.4908	
Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network		369.9947		0.0000		65.4026 0.0048	(372) (386)
Total CO2 associated with community systems Space and water heating	4	130.3395		0.1143		203.7081 203.7081 129.2431	(376)
Space cooling Pumps, fans and electric keep-hot Energy for lighting	5	923.9486 997.4469		0.1143 0.1387 0.1443		821.7247 143.9624	(378)
Energy saving/generation technologies							,
PV Unit electricity used in dwelling PV Unit electricity exported	- 9	0.0000		0.1411		-1300.9910 0.0000	(300)
Total CO2, kg/year						-1300.9910 -2.3527	
13b. Primary energy - Community heating scheme							
		Energy F		rgy factor kg CO2/kWh		kWh/year	
Efficiency of heat source Geothermal Space and Water heating from Geothermal	12	2573.2310		0.0510		335.0000 563.2756	(467a) (467)
Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Tatal CO2 sessoited with community systems		369.9947		0.0000		663.2674 0.0310	(486)
Total CO2 associated with community systems Space and water heating						1304.5022 1304.5022	(476)
Space cooling	1	130.3395		1.4214		1606.6408	(477)

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```
8961.7495 (478)
1529.9174 (479)
Pumps, fans and electric keep-hot 
Energy for lighting
  Energy saving/generation technologies
PV Unit electricity used in dwelling
PV Unit electricity exported
                                                                                                                                                -9217.2214
                                                                                                                                                                                                                    -14028.6550
                                                                                                                                                                                                                    0.0000
-14028.6550 (480)
-625.8452 (483)
                                                                                                                                                                                         0 0000
Total
Total Primary energy kWh/year
SAP 10 EPC IMPROVEMENTS
Be Green
Current energy efficiency rating:
                                                                                                                  A 93
A 100
Current environmental impact rating:
N Solar water heating
                                                                                                                    SAP increase too small
                                                                                                                    Already installed
Not applicable
    Solar photovoltaic panels
V2 Wind turbine
Recommended measures:
                                                                  SAP change Cost change
                                                                                                                CO2 change
Measures omitted - SAP change or cost saving too small: N Solar water heating \phantom{MMMM} + 0.2\phantom{MMM}
                                                                                                                  -1 kg (30.7%)
                                                                                                                 Energy Environmental efficiency impact
                                                                  Typical annual savings
Recommended measures
                                                                                             0.00 kg/m<sup>2</sup>
Potential energy efficiency rating:
Potential environmental impact rating:
                                                                                                                A 93
                                                                                                                               A 100
Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024) Recommendation texts revision number 6.1 (11 Jun 2019)
Typical heating and lighting costs of this home (per year, North West England):
                                                               Current
£2026
                                                                                     Potential
£2026
                                                                                                               Saving
   Community scheme
                                                                                      £2330
                                                                 £2330
                                                                                                         £O
                                                                 £3550
                                                                                     £3550
                                                                                                         £O
   Space heating
    Space cooling
Water heating
   Lighting
                                                                                      £251
   Generated (PV)
                                                               -£2319
                                                                                    -£2319
   Total cost of uses
                                                               £2037
                                                                                        £2037
                                                                                                                £0
   Delivered energy
Carbon dioxide emissions
CO2 emissions per m<sup>2</sup>
                                                               45 kWh/m<sup>2</sup>
-0.0 tonnes
-0 kg/m<sup>2</sup>
-1 kWh/m<sup>2</sup>
                                                                                        45 kWh/m<sup>2</sup>
-0.0 tonnes
-0 kg/m<sup>2</sup>
                                                                                                               0 kWh/m<sup>2</sup>
0.0 tonnes
0 kg/m<sup>2</sup>
                                                                                       -1 kWh/m²
   Primary energy
                                                                                                               0 kWh/m²
                                                                           (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING
1. Overall dwelling characteristics
                                                                                                                                                                                                                      Volume
(m3)
1481.2000 (1b) - (3b)
1238.6000 (1c) - (3c)
                                                                                                                                                                                                                            Volume
                                                                                                                                                   (m2)
460.0000 (1b)
                                                                                                                                                                                       (m)
3.2200 (2b)
Ground floor
First floor
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)
Dwelling volume
                                                                                                                                                  460.0000 (1c)
                                                                                                                                                                                         2.9100 (2c)
                                                                                                        920.0000
                                                                                                                                                              (3a) + (3b) + (3c) + (3d) + (3e) \dots (3n) =
2. Ventilation rate
                                                                                                                                                                                                                    m3 per hour
Number of open chimneys
Number of open flues
Number of chimneys / flues attached to closed fire
Number of flues attached to solid fuel boiler
Number of flues attached to other heater
Number of blocked chimneys
Number of intermittent extract fans
Number of passive vents
Number of flueless gas fires
                                                                                                                                                                                                     0 * 80 =

0 * 20 =

0 * 10 =

0 * 20 =

0 * 35 =

0 * 20 =

0 * 10 =

0 * 10 =

0 * 40 =
                                                                                                                                                                                                                            0.0000 (6a)
0.0000 (6b)
0.0000 (6c)
                                                                                                                                                                                                                                       (6d)
                                                                                                                                                                                                                            0.0000
                                                                                                                                                                                                                            0.0000
0.0000
0.0000
                                                                                                                                                                                                                                       (6e)
(6f)
                                                                                                                                                                                                                            0.0000
                                                                                                                                                                                                                                       (7b)
                                                                                                                                                                                          Air changes per hour 0.0000 / (5) = 0.0000 (8)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6q)+(7a)+(7b)+(7c) =
Pressure test
Pressure Test Method
Measured/design AP50
                                                                                                                                                                                                                    Blower Door
1.0000 (17)
```

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Infiltration rat		1										0.0500	(18) (19)
Shelter factor Infiltration rat	e adjuste	ed to includ	de shelter :	factor					(20) = 1 - (2	[0.075 x 1) = (18)		1.0000	
Wind speed Wind factor Adj infilt rate	Jan 5.1000 1.2750 0.0638	Feb 5.0000 1.2500 0.0625	Mar 4.9000 1.2250	Apr 4.4000 1.1000	May 4.3000 1.0750	Jun 3.8000 0.9500	Jul 3.8000 0.9500	Aug 3.7000 0.9250	Sep 4.0000 1.0000	Oct 4.3000 1.0750	Nov 4.5000 1.1250 0.0563	Dec 4.7000 1.1750	(22a)
Balanced mechan If mechanical ve If exhaust air h	nical vent entilation neat pump	ilation wit n using Apper	th heat recondix N, (23)	overy o) = (23a) :	x Fmv (equat	ion (N5)),	otherwise	(23b) = (23a		0.0337	0.0303	0.5000	(23a) (23b)
If balanced with Effective ac	0.1948	0.1935	0.1923	0.1860	0.1847	0.1785	0.1785	0.1773	0.1810	0.1847	0.1872	73.8000	
3. Heat losses a	and heat 1	Loss paramet	er										
Element				Gross m2	Openings m2		tArea m2	U-value W/m2K	A x		-value kJ/m2K	A x K kJ/K	
Window (Uw = 0.8 Glazed Door Normal Door	80)					441 12	.1300 .6000 .4000	0.7752 0.8000 1.0000	341.961 10.080 9.400	2 0 0			(27) (26a) (26)
Heatloss Floor 1 Ground Floor Ext First Floor Exte	ernal Wal			132.8000 148.3200	260.3900 202.7400	172 245	.0000 .4100 .5800	0.1000 0.1400 0.1400	46.000 24.137 34.381	4 19 2 19	0.0000 0.0000 0.0000	50600.0000 32757.9000 46660.2000	(29a) (29a)
External Roof Total net area of Fabric heat loss Internal Wall 1				160.0000		1801	.0000 .1200 (26)(3	0.1100 30) + (32) =	50.600 = 516.559	8	9.0000	4140.0000	(31) (33)
Internal Floor 1 Heat capacity Cm		x k)					.0000	(28).	(30) + (32	1	8.0000	8280.0000	(32d)
Thermal mass par List of Thermal	ameter (1		TFA) in kJ/r	n2K				, , , ,		, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		159.6541	
K1 Eleme E2 Other E3 Sill E4 Jamb E5 Grour E6 Inter E16 Corr E17 Corr E10 Eave	ent c lintels ad floor cmediate f er (norma er (inver	floor withir al)	n a dwelling rnal area gr lling level	g reater than	external ar	rea)		157 157 162 148 148 49 24 233	ength P.4600 .4600 .2800 .7300 .7300 .0400 .5200 .9600	si-value 0.3000 0.0200 0.0160 0.0530 0.0010 0.0380 -0.0750 0.1200 0.2500	Tot 47.23 3.14 2.59 7.88 0.14 1.86 -1.83 28.02 14.24	880 192 965 327 187 535 890	
	e (insula (Sum(L x idges	ation at raf	fter level))				.2400	0.2500	17.06 (36a) =		
Ventilation heat		culated mor	nthlv (38)m	= 0.33 x (25)m x (5)				(3	3) 1 (30)	(30a) -	030.9219	(57)
	Jan .81.2215	Feb 180.0583	Mar 178.8952	Apr 173.0793	May 171.9162	Jun 166.1003	Jul 166.1003	Aug 164.9372	Sep 168.4267	Oct 171.9162	Nov 174.2425	Dec 176.5688	(38)
	18.1434	816.9802	815.8170	810.0012	808.8380	803.0222	803.0222	801.8590	805.3485	808.8380	811.1644	813.4907 809.7104	(39)
HLP	Jan 0.8893	Feb 0.8880	Mar 0.8868	Apr 0.8804	May 0.8792	Jun 0.8729	Jul 0.8729	Aug 0.8716	Sep 0.8754	Oct 0.8792	Nov 0.8817	Dec 0.8842 0.8801	(40)
HLP (average) Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	
4. Water heating													
Assumed occupano	су											3.9379	(42)
Hot water usage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
	09.6601	108.0315	105.7381	101.5094	98.3431	94.8321	92.9356	95.2130	97.6926	101.4495	105.7653	109.2894	(42b)
Average daily ho	57.8509 ot water i	55.7472 ise (litres/	53.6435 'day)	51.5399	49.4362	47.3325	47.3325	49.4362	51.5399	53.6435	55.7472	57.8509 154.2639	
Daily hot water	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte 2 Energy content (67.5110 65.2965 (annual)		244.9637	153.0493 209.5169	147.7793 198.9393	142.1646 174.8080	140.2682 169.6422	144.6492 179.1059	149.2325 184.0186	210.4598	161.5125 230.1041 um(45)m =	261.7013	
Water storage lo	39.7945	= 0.15 x (4 34.9828		31.4275	29.8409	26.2212	25.4463	26.8659	27.6028	31.5690	34.5156	39.2552	
Store volume a) If manufactu Temperature fa Enter (49) or (5 Total storage lo	ctor from (4) in (55	n Table 2b	actor is kno	own (kWh/d	ay):							1.4600 0.7800 1.1388	(48) (49)
If cylinder cont	35.3028 ains dedi			34.1640	35.3028	34.1640	35.3028	35.3028	34.1640	35.3028	34.1640	35.3028	
Primary loss Combi loss	35.3028 23.2624 0.0000	21.0112 0.0000	35.3028 23.2624 0.0000	34.1640 22.5120 0.0000	35.3028 23.2624 0.0000	34.1640 22.5120 0.0000	35.3028 23.2624 0.0000	35.3028 23.2624 0.0000	34.1640 22.5120 0.0000	35.3028 23.2624 0.0000	34.1640 22.5120 0.0000	35.3028 23.2624 0.0000	(59)
WWHRS	0.0000	286.1163 0.0000	303.5289	266.1929 0.0000	257.5045 0.0000	0.0000	228.2074	237.6711	0.0000	269.0250	286.7801	320.2665 0.0000	(63a)
Solar input FGHRS	-0.0000 0.0000 0.0000		-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000		-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	(63c)
Output from w/h	323.8617	286.1163	303.5289	266.1929	257.5045	231.4840	228.2074		240.6946				
Electric shower	(s)							rotal pe	er year (kWh	/year) = S	um(04)M =	JZJ1.3331	(04)

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Heat gains fr								electric sho				0.0000	(64a)
	135.0632	119.8633	128.3026	115.0052	112.9995	103.4645	103.2582	106.4049	106.5270	116.8301	121.8504	133.8678	(65)
5. Internal g													
(66) m	Jan	Feb	Mar 236.2758	Apr 236.2758	May 236.2758	Jun 236.2758			Sep 236.2758	Oct 236.2758	Nov 236.2758	Dec 236.2758	(66)
Lighting gain	141.1989	125.4116	101.9916	77.2142	57.7185	48.7284	52.6528	68.4401	91.8601	116.6375	136.1332	145.1233	(67)
Appliances ga Cooking gains	1292.2293	1305.6386	1271.8476	1199.9106	1109.1030	1023.7567	966.7401	953.3308	987.1218	1059.0588	1149.8664	1235.2127	(68)
Pumps, fans	62.5655	62.5655	62.5655	62.5655	62.5655	62.5655			62.5655 0.0000	62.5655 0.0000	62.5655 0.0000		
Losses e.g. e	-157.5172	-157.5172	values) (Tak -157.5172		-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	-157.5172	(71)
Water heating Total interna	181.5366		172.4497	159.7294	151.8810	143.7006	138.7879	143.0173	147.9542	157.0296	169.2367	179.9299	(72)
TOTAL INCOLINA		1750.7424	1687.6130	1578.1783	1460.0267	1357.5098	1299.5049	1306.1123	1368.2602	1474.0501	1596.5604	1701.5900	(73)
6. Solar gain													
[Jan]				m2		Spec: or		Specific or Tab		Acce fact Table		Gains W	
Northeast Southeast Southwest			115.2 123.6 122.1	2500 5100 1800	11.2829 36.7938 36.7938) 3 3	0.3600 0.3600 0.3600	((0.0000 0.0000 0.0000	0.77 0.77 0.77	00	360.4595 1260.7293 1246.1444	(77)
Northwest			80.0	900	11.2829) 	0.3600		0.0000	0.77		250.4920	
Solar gains Total gains													
7. Mean inter													
Temperature d' Utilisation f	uring heati	ng periods	in the livi	ing area fro	om Table 9,							21.0000	(85)
tau	Jan	Feb	Mar 50.0118	Apr		Jun 50.8087	Jul 50.8087		Sep 50.6619	Oct 50.4433	Nov 50.2987	Dec 50.1548	
alpha util living a	rea		4.3341		4.3629				4.3775	4.3629			
MIT	0.9925	0.9642 19.9252		0.7037		0.3478		0.2976	0.5166	0.8470	0.9789		
Th 2 util rest of	20.1766	20.1777		20.1842	20.1852	20.1906		20.1917	20.1885	20.1852			
MIT 2	0.9909 18.7509		0.8622 19.7006	0.6696 20.0488	0.4632 20.1607	0.3046 20.1876			0.4610 20.1714	0.8156 19.9291	19.2402	18.6622	(90)
Living area f MIT Temperature a	18.8233	19.2848	19.7760	20.1281	20.2428	20.2702	20.2730	20.2735		Living are 20.0050		0.1024 18.7342 0.0000	(92)
adjusted MIT		19.2848	19.7760	20.1281	20.2428	20.2702	20.2730	20.2735	20.2532	20.0050	19.3125	18.7342	
8. Space heat	ing require	ement											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation Useful gains Ext temp. Heat loss rate	0.9874 4812.6299 4.3000	0.9484	0.8518 8323.0860	0.6671		0.3089	0.2106		0.4656	0.8079	0.9669	0.9918 4310.1478	(95)
	11882.1025 kWh		10830.7700										
Space heating	requiremen		1865.7169 per year (kW		107.6791	0.0000	0.0000	0.0000	0.0000	1023.7061	3395.3696	5589.9049 21055.1147	
Solar heating	0.0000 contributi			0.0000 (Wh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating Space heating	5259.6876		1865.7169			0.0000 (kWh/vear)	0.0000	0.0000	0.0000	1023.7061	3395.3696	5589.9049 21055.1147	(98c)
Space heating						(, 1-0-)				(980	:) / (4) =	22.8860	(99)
8c. Space coo	ling requir	ement											
Calculated fo	r June, Jul Jan	y and Augus Feb	st. See Tabl Mar	le 10b Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp. Heat loss rate	4.3000 e W 0.0000	4.9000		8.9000		14.6000 7548.4085		16.4000 6094.1285	14.1000	0.0000	7.1000		
Utilisation Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9838 7425.9308	0.9921 5895.2570	0.9860 6008.8954	0.0000	0.0000	0.0000	0.0000	(101) (102)
Total gains Space cooling		0.0000	0.0000	0.0000				14215.9184	0.0000	0.0000	0.0000		
Cooled fracti		0.0000 able 10b)	0.0000	0.0000	0.0000	0042.9204	/019.5526	6106.0251	0.0000 fC =	0.0000 cooled are	0.0000 ea / (4) =	0.0000 0.9728	
Space cooling	0.2500 kWh	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	
	0.0000	0.0000	0.0000	0.0000	0.0000	1664.2429	1853.1249	1485.0251	0.0000	0.0000	0.0000	0.0000	(107)

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Space cooling requirement 5002.3929 (107)

9b. Energy requirements						
Fraction of space heat from secondary/supplementary system (Table 11) Fraction of space heat from community system Fraction of heat from community Geothermal-Space and Water Factor for control and charging method (Table 4c(3)) for space heating Factor for charging method (Table 4c(3)) for water heating Distribution loss factor (Table 12c) for community heating system Efficiency of secondary/supplementary heating system, % Space heating:					0.0000 1.0000 1.0000 1.0500 1.0500 1.5000 0.0000	(302) (303a) (305) (305a) (306)
Space heating requirement 5259.6876 3267.3576 1865.7169 545.6928 107.6791 0.0000 0.000	0.0000	0.0000	1023.7061	3395.3696	5589.9049	(98)
Space heat from Geothermal = (98) x 1.00 x 1.05 x 1.50 307a 8284.0080 5146.0882 2938.5041 859.4662 169.5946 0.0000 0.000	0.0000	0.0000	1612.3372	5347.7072	8804.1002	
Space heating requirement 8284.0080 5146.0882 2938.5041 859.4662 169.5946 0.0000 0.000 Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) Space heating fuel for secondary/supplementary system	0.0000	0.0000	1612.3372	5347.7072	8804.1002 0.0000	
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating Annual water heating requirement						
323.8617 286.1163 303.5289 266.1929 257.5045 231.4840 228.207 Water heat from Geothermal = (64) x 1.00 x 1.05 x 1.50		240.6946	269.0250	286.7801	320.2665	(64)
310a 510.0822 450.6332 478.0580 419.2538 405.5696 364.5873 359.426 Water heating fuel		379.0940	423.7144	451.6787	504.4197	
510.0822 450.6332 478.0580 419.2538 405.5696 364.5873 359.426 Cooling System Energy Efficiency Ratio		379.0940	423.7144	451.6787	504.4197	(314)
Space coolin 0.0000 0.0000 0.0000 0.0000 0.0000 416.0607 463.281 Pumps and Fa 503.1299 454.4399 503.1299 486.8999 503.1299 486.8999 503.1299 486.8999 503.1293 460.8899 503.1293 460.8899 503.1299 486.8999 503.1293 460.8899 460.8899 503.1293 460.8899 503.1293 460.88999 503.1293 460.88999 503.1293 460.88999 503.1293 46	9 503.1299	0.0000 486.8999 77.8109	0.0000 503.1299 102.0921	0.0000 486.8999 115.3128	0.0000 503.1299 127.0256	(331)
(333a)m -855,3092 -939.6664 -1006.7756 -805.9568 -661.5888 -570.3878 -581.182 Electricity generated by wind turbines (Appendix M) (negative quantity)	4 -656.0203	-763.8507	-932.2154	-862.0799	-773.4890	(333a)
(334a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
(335a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
(333b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	(333b)
(334b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
(335b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Annual totals kWh/year	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)
Space heating fuel - community heating Space heating fuel - secondary Water heating fuel - community heating Efficiency of water heater Electricity used for heat distribution Space cooling fuel					33161.8056 0.0000 5120.8497 0.0000 331.6181 1250.5982	(309) (310) (311) (313)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.7220) mechanical ventilation fans (SFP = 1.7220) Total electricity for the above, kWh/year Electricity for lighting (calculated in Appendix L)					5923.9486 5923.9486 997.4469	(331)
Energy saving/generation technologies (Appendices M ,N and Q) PV generation Wind generation Hydro-electric generation (Appendix N) Electricity generated - Micro CHP (Appendix N)					-9408.5224 0.0000 0.0000 0.0000	(334) (335a)
Appendix Q - special features Energy saved or generated Energy used Total delivered energy for all uses					-0.0000 0.0000 37046.1266	(337)
10b. Fuel costs - using Table 12 prices						
Space heating from Geothermal Space heating total	Fuel kWh/year 33161.8056		Fuel price p/kWh 3.1100		fuel cost f/year 1031.3322 1031.3322	(340a)
Total CO2 associated with community systems Space heating - secondary Water heating from Geothermal Water heating total	0.0000 5120.8497		0.0000 3.1100		0.0000 0.0000 159.2584 159.2584	(473) (341) (342a)
water healths total Energy for instantaneous electric shower(s) Space cooling	0.0000 1250.5982		16.4900 16.4900		0.0000	(347a)
Pumps, fans and electric keep-hot Energy for lighting Additional standing charges	5923.9486 997.4469		16.4900 16.4900		976.8591 164.4790 92.0000	(349) (350)
Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost	-9408.5224 0.0000		16.4900 5.5900		-1551.4653 0.0000 -1551.4653 1078.6870	
11b. SAP rating - Community heating scheme						
Energy cost deflator (Table 12):					0.3600	
Energy cost factor (ECF) SAP value SAP rating (Section 12) SAP band	[(255) x (256)] / [(4) +	45.0] =	0.4024 93.4769 93 A	(358)

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12b. Carbon dioxide emissions - Community heating scheme					
	Energy kWh/year	Emission		Emissions kg CO2/year	
Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating	11427.6583 331.6181	_	0.0110 0.0000	335.0000 108.8895 59.5215 0.0048 185.2257 185.2257	(367) (367) (372) (386) (373)
Space cooling Space cooling Pumps, fans and electric keep-hot Energy for lighting	1250.5982 5923.9486 997.4469		0.1143 0.1387 0.1443	142.9322 821.7247 143.9624	(377) (378)
Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total Total CO2, kg/year CO2 emissions per m2 EI value EI rating	-9408.5224 0.0000		0.1413 0.0000	-1329.0362 0.0000 -1329.0362 -35.1911 -0.0400 100.0489	(380) (383) (384)
EI band SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING				Α	
1. Overall dwelling characteristics					
Ground floor First floor Total floor area TFA = (la)+(lb)+(lc)+(ld)+(le)(ln) Dwelling volume 920.0000	Area (m2) 460.0000 460.0000	(1b) x (1c) x		Volume (m3) 1481.2000 1338.6000 2819.8000	(1b) - (3h (1c) - (3d (4)
2. Ventilation rate				2	
Number of open chimneys Number of open flues Number of chimneys / flues attached to closed fire Number of flues attached to solid fuel boiler Number of flues attached to other heater Number of blocked chimneys Number of intermittent extract fans Number of passive vents Number of flueless gas fires			0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 0 * 10 = 0 * 40 =	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(6a) (6b) (6c) (6d) (6e) (6f) (7a) (7b)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+ Pressure test Pressure Test Method Measured/design AP50 Infiltration rate Number of sides sheltered	(6g) + (7a) + (7b) + (7c) =		Air chang 0.0000 / (5) =	Yes Blower Door 1.0000 0.0500	(8)
Shelter factor Infiltration rate adjusted to include shelter factor			$[0.075 \times (19)] = (18) \times (20) =$		
Jan Feb Mar Apr May Jun	Jul Aug 3.7000 3.7000 0.9250 0.9250 0.0463 0.0463	1.0250	Oct Nov 4.6000 4.8000 1.1500 1.2000 0.0575 0.0600	0.0588	(22a) (22b)
If mechanical ventilation If exhaust air heat pump using Appendix N, $(23b) = (23a) \times Fmv$ (equation $(N5)$), If balanced with heat recovery: efficiency in % allowing for in-use factor (fro		3a)		0.5000 0.5000 73.8000	(23b)
Effective ac 0.1960 0.1960 0.1935 0.1860 0.1847 0.1798	0.1773 0.1773	0.1822	0.1885 0.1910	0.1898	(25)
3. Heat losses and heat loss parameter					
m2 m2	tArea U-value m2 W/m2K .1300 0.7752	A x U W/K 341.9612	K-value kJ/m2K	A x K kJ/K	
Normal Door 9 9 460 60 172 7 174	6000 0.8000 .4000 1.0000 .0000 0.1000 .4100 0.1400 .5800 0.1400 .0000 0.1100	10.0800 9.4000 46.0000 24.1374 34.3812 50.6000	110.0000 190.0000 190.0000 9.0000	50600.0000 32757.9000 46660.2000 4140.0000	(29a) (29a)
Fabric heat loss, W/K = Sum (A x U) Internal Wall 1 493	(26)(30) + (32) 3.7400 3.0000	= 516.5598	9.0000 18.0000	4443.6600 8280.0000	(33) (32c)
Heat capacity Cm = Sum(A \times k) Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	(28)	(30) + (32)	+ (32a)(32e) =	146881.7600 159.6541	

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List of Thermal Bridges K1 Element E2 Other lintels (including other steel lintels) E3 Sill E4 Jamb E5 Ground floor (normal) E6 Intermediate floor within a dwelling E16 Corner (normal) E17 Corner (inverted - internal area greater than external area) E10 Eaves (insulation at ceiling level) E12 Gable (insulation at ceiling level) E13 Gable (insulation at rafter level) Thermal bridges (Sum(L x Psi) calculated using Appendix K) Point Thermal bridges Total fabric heat loss	Length Psi-value Total 157.4600 0.3000 47.2380 157.4600 0.0200 3.1492 162.2800 0.0160 2.5965 148.7300 0.0530 7.8827 148.7300 0.0010 0.1487 49.0400 0.0380 1.8635 24.5200 -0.0750 -1.8390 233.5200 0.1200 28.0224 56.9600 0.2500 14.2400 68.2400 0.2500 17.0600 (36a) = 0.0000 (33) + (36) + (36a) = 636.9219 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) Jan Feb Mar Apr May Ju	n Jul Aug Sep Oct Nov Dec
(38)m 182.3847 182.3847 180.0583 173.0793 171.9162 167. Heat transfer coeff	2635 164.9372 164.9372 169.5898 175.4057 177.7320 176.5688 (38)
819.3065 819.3065 816.9802 810.0012 808.8380 804. Average = Sum(39)m / 12 =	1853 801.8590 801.8590 806.5117 812.3275 814.6539 813.4907 (39) 810.7766
Jan Feb Mar Apr May Ju HLP 0.8906 0.8906 0.8880 0.8804 0.8792 0.8102 HLP (average) 0.8006 </td <td>n Jul Aug Sep Oct Nov Dec 8741 0.8716 0.8716 0.8766 0.8830 0.8855 0.8842 (40) 0.8813</td>	n Jul Aug Sep Oct Nov Dec 8741 0.8716 0.8716 0.8766 0.8830 0.8855 0.8842 (40) 0.8813
Days in mont 31 28 31 30 31	30 31 31 30 31 30 31
4. Water heating energy requirements (kWh/year)	
Assumed occupancy Hot water usage for mixer showers	3.9379 (42)
Hot water usage for baths	0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (42a) 8321 92.9356 95.2130 97.6926 101.4495 105.7653 109.2894 (42b)
Hot water usage for other uses	3325 47.3325 49.4362 51.5399 53.6435 55.7472 57.8509 (42c)
Average daily hot water use (litres/day)	154.2639 (43)
Jan Feb Mar Apr May Ju Daily hot water use 167.5110 163.7787 159.3816 153.0493 147.7793 142.	n Jul Aug Sep Oct Nov Dec 1646 140.2682 144.6492 149.2325 155.0931 161.5125 167.1403 (44)
Energy conte 265.2965 233.2187 244.9637 209.5169 198.9393 174. Energy content (annual)	
	2212 25.4463 26.8659 27.6028 31.5690 34.5156 39.2552 (46)
Water storage loss: Store volume a) If manufacturer declared loss factor is known (kWh/day): Temperature factor from Table 2b Enter (49) or (54) in (55)	1000.0000 (47) 1.4600 (48) 0.7800 (49) 1.1388 (55)
Total storage loss	1640 35.3028 35.3028 34.1640 35.3028 34.1640 35.3028 (56)
	1640 35.3028 35.3028 34.1640 35.3028 34.1640 35.3028 (57) 5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
	0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (61)
323.8617 286.1163 303.5289 266.1929 257.5045 231. WWHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.	4840 228.2074 237.6711 240.6946 269.0250 286.7801 320.2665 (62) 0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.	0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 (63b) 0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63c) 0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63d)
Output from w/h	4840 228.2074 237.6711 240.6946 269.0250 286.7801 320.2665 (64)
Electric shower(s) 0.0000 0.0000 0.0000 0.0000 0.0000 0.	Total per year (kWh/year) = Sum(64)m = 3251.3331 (64)
Total Energy used by Heat gains from water heating, kWh/month	instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
135.0632 119.8633 128.3026 115.0052 112.9995 103.	4645 103.2582 106.4049 106.5270 116.8301 121.8504 133.8678 (65)
5. Internal gains (see Table 5 and 5a)	
Metabolic gains (Table 5), Watts Jan Feb Mar Apr May Ju	n Jul Aug Sep Oct Nov Dec
	2758 236.2758 236.2758 236.2758 236.2758 236.2758 236.2758 (66)
141.1989 125.4116 101.9916 77.2142 57.7185 48. Appliances gains (calculated in Appendix L, equation L13 or L13a), also se	7284 52.6528 68.4401 91.8601 116.6375 136.1332 145.1233 (67) e Table 5
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see T	
Pumps, fans 0.0000 0.0000 0.0000 0.0000 0.0000 0.	5655 62.5655 6
Losses e.g. evaporation (negative values) (Table 5) -157.5172 -157.5172 -157.5172 -157.5172 -157.5172 -157.5172 -157.	5172 -157.5172 -157.5172 -157.5172 -157.5172 -157.5172 -157.5172 (71)
181.5366 178.3680 172.4497 159.7294 151.8810 143. Total internal qains	7006 138.7879 143.0173 147.9542 157.0296 169.2367 179.9299 (72)
1756.2890 1750.7424 1687.6130 1578.1783 1460.0267 1357.	5098 1299.5049 1306.1123 1368.2602 1474.0501 1596.5604 1701.5900 (73)
6. Solar gains	
	g FF Access Gains Specific data factor W or Table 6b or Table 6c Table 6d
	or Table 6b or Table 6c Table 6d
Northeast 115.2500 10.0309 Southeast 123.6100 33.4622 Southwest 122.1800 33.4622 Northwest 80.0900 10.0309	0.3600 0.0000 0.7700 320.4609 (75) 0.3600 0.0000 0.7700 1146.5729 (77) 0.3600 0.0000 0.7700 1133.3086 (79) 0.3600 0.0000 0.7700 222.6960 (81)

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Solar gains Total gains										5980.3053 7454.3553			
7. Mean inter													
Temperature d	uring heati	ng periods	in the livi	ing area fro	om Table 9,							21.0000	(85)
Utilisation f	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
alpha util living a	49.7988 4.3199	49.7988 4.3199	49.9406 4.3294	50.3709 4.3581	50.4433 4.3629	50.7352 4.3823	50.8824 4.3922	50.8824 4.3922	50.5888 4.3726	50.2266 4.3484	50.0832 4.3389	50.1548 4.3437	
util living a	0.9946	0.9712	0.8975	0.7180	0.5310	0.4143	0.3377	0.3972	0.6009	0.8868	0.9845	0.9965	(86)
MIT Th 2	19.3484 20.1755	19.8097 20.1755	20.3420 20.1777	20.7930 20.1842	20.9496 20.1852	20.9856 20.1896	20.9950 20.1917	20.9904 20.1917	20.9360 20.1874	20.5504 20.1820	19.8271 20.1798	19.2613 20.1809	
util rest of		0.9659	0.8814	0.6869	0.4933	0.3729	0.2937	0.3470	0.5504	0.8628	0.9809	0.9958	
MIT 2 Living area f	18.6410 raction	19.0966	19.6095	20.0213	20.1502	20.1810	20.1893	20.1868	20.1463 fLA =	19.8174 Living area	19.1206 a / (4) =	18.5582 0.1024	
MIT Temperature a		19.1696	19.6845	20.1003	20.2320	20.2634	20.2717	20.2691	20.2271	19.8924	19.1929	18.6302 0.0000	
adjusted MIT	18.7134	19.1696	19.6845	20.1003	20.2320	20.2634	20.2717	20.2691	20.2271	19.8924	19.1929	18.6302	(93)
8. Space heat	ing require	ment											
Utiliantion	Jan 0.9907	Feb 0.9576	Mar 0.8704	Apr 0.6835	May 0.4955	Jun 0.3767	Jul 0.2981	Aug 0.3519	Sep 0.5529	Oct 0.8531	Nov 0.9751	Dec 0.9938	(04)
Utilisation Useful gains Ext temp.			8551.9227 5.6000	8976.5665 7.9000			4292.3034 14.9000		5750.0219 12.8000	6359.0064	4977.3705	4125.2204 3.7000	(95)
Heat loss rat	e W							4385.4471		8279.5615			
Space heating	kWh 5654.3540	3636.0740	2198.4030	652.1151	152.0616	0.0000	0.0000	0.0000				5967.1548 23491.7296	
Solar heating	0.0000 contributi	0.0000 on - total	0.0000 per year (}	0.0000 «Wh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Space heating Space heating Space heating	5654.3540 requiremen			652.1151 ution - tota		0.0000 (kWh/year)	0.0000	0.0000	0.0000	1428.8930 (98c)	3802.6741	5967.1548 23491.7296 25.5345	
0- 0													
8c. Space coo													
Calculated fo Ext. temp. Heat loss rat	Jan 3.9000	Feb 4.3000	Mar 5.6000	Apr 7.9000	May 10.7000	Jun 13.2000	Jul 14.9000	Aug 14.8000	Sep 12.8000	Oct 9.7000	Nov 6.6000	Dec 3.7000	
Utilisation Useful loss Total gains	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000		8685.2017 0.9748 8465.9773 17236.2470	0.9847 7185.2432	0.9724 7173.7686	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000	(101) (102)
Space cooling Cooled fracti	kWh 0.0000	0.0000	0.0000	0.0000	0.0000	6314.5942	7012.6236	5263.3934	0.0000	0.0000 cooled area	0.0000	0.0000 0.9728	(104)
Intermittency		ole 10b) 0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	1535.7505	1705.5158	1280.0916	0.0000	0.0000	0.0000	0.0000 4521.3579	
9b. Energy re	quirements												
Fraction of s Fraction of s Fraction of h Factor for co Factor for ch Distribution Efficiency of	pace heat f. eat from control and c. arging metholoss factor secondary/	rom communi mmunity Geo narging met od (Table 4 (Table 12c	ty system thermal-Spa hod (Table c(3)) for v	ace and Wate 4c(3)) for water heatin	er space heat: ng							0.0000 1.0000 1.0000 1.0500 1.0500 1.5000 0.0000	(302) (303a) (305) (305a) (306)
Space heating Space heating	requiremen		0100 (55	686 ST	150					1400 0	2002 5=:	E065 :: -:	(00:
Space heat fr	om Geotherm	al = (98) x			152.0616	0.0000	0.0000	0.0000		1428.8930			(98)
307a Space heating	requiremen	t		1027.0813		0.0000	0.0000	0.0000	0.0000		5989.2117		(207)
Efficiency of Space heating	secondary/	supplementa	ry heating	y system		le 4a or App	0.0000 bendix E) 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(308)
Water heating													,
Annual water	heating req 323.8617	286.1163	303.5289	266.1929	257.5045	231.4840	228.2074	237.6711	240.6946	269.0250	286.7801	320.2665	(64)
Water heat fr 310a	510.0822		1.00 x 1.0 478.0580	05 x 1.50 419.2538	405.5696	364.5873	359.4266	374.3320	379.0940	423.7144	451.6787	504.4197	
Water heating	510.0822		478.0580	419.2538	405.5696	364.5873	359.4266	374.3320	379.0940	423.7144	451.6787	504.4197	
Cooling Syste Space coolin Pumps and Fa	0.0000	ficiency Ra 0.0000 454.4399 99.1490	0.0000 503.1299 89.2727	0.0000 486.8999 65.4050	0.0000 503.1299 50.5207	486.8999	426.3789 503.1299 46.0867		0.0000 486.8999 77.8109	0.0000 503.1299 102.0921	0.0000 486.8999 115.3128	4.0000 0.0000 503.1299 127.0256	(315) (331)
Lighting		ノノ・エヨン ∪		00.7000	JU.J2U/	-11.4/JO	-0.000/	JJ.JUJZ	,,.0103	102.0221	110.0120	141.0430	()
Lighting Electricity g (333a)m	enerated by		dix M) (nec			-558.7076	-562.9648	-654.8727	-765.8378	-932.9504	-837.8009	-739.7350	(333a)

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(335a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity) (333b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)			
(334b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Electricity generated by hydro-electric generators (Appendix M) (negative quantity	0.0000 0.0000 cy)	0.0000 0.0000	0.0000 0.0000 (334b)
(335b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Annual totals kWh/year	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000 (335b)
Space heating fuel - community heating			36999.4742 (307)
Space heating fuel - secondary Water heating fuel - community heating			0.0000 (309) 5120.8497 (310)
Efficiency of water heater			0.0000 (311)
Electricity used for heat distribution Space cooling fuel			369.9947 (313) 1130.3395 (321)
Electricity for pumps and fans:			
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.7220)			
mechanical ventilation fans (SFP = 1.7220) Total electricity for the above, kWh/year			5923.9486 (330a) 5923.9486 (331)
Electricity for lighting (calculated in Appendix L)			997.4469 (332)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV generation Wind generation			-9217.2214 (333) 0.0000 (334)
Hydro-electric generation (Appendix N)			0.0000 (335a)
Electricity generated - Micro CHP (Appendix N) Appendix Q - special features			0.0000 (335)
Energy saved or generated Energy used			-0.0000 (336) 0.0000 (337)
Total delivered energy for all uses			40954.8374 (338)
10b. Fuel costs - using BEDF prices (535)			
	Fuel	Fuel price	Fuel cost
Space heating from Geothermal	kWh/year 36999.4742		£/year 1957.2722 (340a)
Space heating total	30333.4742	3.2900	1957.2722 (340)
Total CO2 associated with community systems Space heating - secondary	0.0000	0.0000	0.0000 (473) 0.0000 (341)
Water heating from Geothermal	5120.8497	5.2900	270.8929 (342a)
Water heating total Energy for instantaneous electric shower(s)	0.0000	25.1600	270.8929 (342) 0.0000 (347a)
Space cooling Pumps, fans and electric keep-hot	1130.3395 5923.9486	25.1600 25.1600	284.3934 (348) 1490.4655 (349)
Energy for lighting	997.4469	25.1600	250.9576 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
	-9217 2214	25 1600	-2319 0529
PV Unit electricity used in dwelling PV Unit electricity exported	-9217.2214 0.0000	25.1600 5.8100	-2319.0529 0.0000
PV Unit electricity used in dwelling			
PV Unit electricity used in dwelling PV Unit electricity exported Total			0.0000 -2319.0529 (352)
PV Unit electricity used in dwelling PV Unit electricity exported Total			0.0000 -2319.0529 (352)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost	0.0000		0.0000 -2319.0529 (352)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost	0.0000		0.0000 -2319.0529 (352)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme	0.0000	5.8100 Emission factor	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal	0.0000 Energy kWh/year	5.8100 Emission factor kg CO2/kWh	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme	0.0000	5.8100 Emission factor	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network	0.0000 Energy kWh/year 12573.2310	5.8100 Emission factor kg CO2/kWh 0.0110	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating	0.0000 Energy kWh/year 12573.2310 369.9947	5.8100 Emission factor kg CO2/kWh 0.0110 0.0000	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (376)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Space cooling	0.0000 Energy kWh/year 12573.2310 369.9947	Emission factor kg CO2/kWh 0.0110 0.0000	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 129.2431 (377)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating	0.0000 Energy kWh/year 12573.2310 369.9947	5.8100 Emission factor kg CO2/kWh 0.0110 0.0000	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (376)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies	Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469	5.8100 Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 203.7081 (377) 821.7247 (377) 821.7247 (378) 143.9624 (379)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling	Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 203.7081 (377) 821.7247 (377) 821.7247 (378) 143.9624 (379)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total	Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469	5.8100 Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 (380)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost	Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 203.7081 (376) 129.2431 (377) 821.7247 (378) 143.9624 (379)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total	Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 (380)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total CO2, kg/year	0.0000 Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469 -9217.2214 0.0000	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 (380)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total Total CO2, kg/year	0.0000 Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469 -9217.2214 0.0000	5.8100 Emission factor kg CO2/kWh	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 203.7081 (376) 129.2431 (377) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 (380) -2.3527 (383)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity used in dwelling PV Unit electricity exported Total Total CO2, kg/year 13b. Primary energy - Community heating scheme	0.0000 Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469 -9217.2214 0.0000	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443 0.1411 0.0000	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 203.7081 (377) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 (380) -2.3527 (383) Primary energy kWh/year
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total Total CO2, kg/year 13b. Primary energy - Community heating scheme Efficiency of heat source Geothermal	Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469 -9217.2214 0.0000	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443 0.1411 0.0000 Primary energy factor kg CO2/kWh	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 129.2431 (377) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 (380) -2.3527 (383) Primary energy kWh/year 335.0000 (467a)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost	Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469 -9217.2214 0.0000	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443 0.1411 0.0000 Primary energy factor kg CO2/kWh 0.0510	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 203.7081 (377) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 (380) -2.3527 (383) Primary energy kWh/year 335.0000 (467a) 563.2676 (467) 663.2676 (467)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity used in dwelling PV Unit electricity exported Total Total CO2, kg/year 13b. Primary energy - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal	Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469 -9217.2214 0.0000 Energy kWh/year 12573.2310	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443 0.1411 0.0000 Primary energy factor kg CO2/kWh 0.0510	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 203.7081 (377) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 0.0000 -1300.9910 (380) -2.3527 (383) Primary energy kWh/year 335.0000 (467a) 563.2756 (467)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost	Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469 -9217.2214 0.0000 Energy kWh/year 12573.2310 369.9947	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443 0.1411 0.0000 Primary energy factor kg CO2/kWh 0.0510 0.0000	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 (380) -2.3527 (383) Primary energy kWh/year 335.0000 (467a) 563.2756 (467) 663.2674 (472) 0.0310 (486) 1304.5022 (473) 1304.5022 (473)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme 12c. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total Total CO2, kg/year Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot	Energy kWh/year 12573.2310 369.9947 130.3395 5923.9486 997.4469 -9217.2214 0.0000 Energy kWh/year 12573.2310 369.9947 130.3395 5923.9486	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443 0.1411 0.0000 Primary energy factor kg CO2/kWh 0.0510 0.0000 1.4214 1.5128	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 203.7081 (377) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 (380) -2.3527 (383) Primary energy kWh/year 335.0000 (467a) 563.2756 (467) 663.2674 (472) 0.0310 (486) 1304.5022 (473) 1304.5022 (476) 1606.6408 (477) 8961.7495 (478)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost 12b. Carbon dioxide emissions - Community heating scheme 12c. Carbon dioxide emissions - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity used in dwelling PV Unit electricity exported Total Total CO2, kg/year 13b. Primary energy - Community heating scheme Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling	Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469 -9217.2214 0.0000 Energy kWh/year 12573.2310 369.9947 1130.3395	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443 0.1411 0.0000 Primary energy factor kg CO2/kWh 0.0510 0.0000 1.4214 1.5128	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 203.7081 (377) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 (380) -2.3527 (383) Primary energy kWh/year 335.0000 (467a) 563.2756 (467) 663.2674 (472) 0.0310 (486) 1304.5022 (473) 1304.5022 (476) 1606.6408 (477) 8961.7495 (478)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost	Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469 Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443 0.1411 0.0000 Primary energy factor kg CO2/kWh 0.0510 0.0000 1.4214 1.5128 1.5338	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 203.7081 (377) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 (380) -2.3527 (383) Primary energy kWh/year 335.0000 (467a) 563.2756 (467) 663.2674 (472) 0.0310 (486) 1304.5022 (473) 1304.5022 (476) 1606.6408 (477) 8961.7495 (478) 1529.9174 (479)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost	Energy kWh/year 12573.2310 369.9947 130.3395 5923.9486 997.4469 -9217.2214 0.0000 Energy kWh/year 12573.2310 369.9947 130.3395 5923.9486	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443 0.1411 0.0000 Primary energy factor kg CO2/kWh 0.0510 0.0000 1.4214 1.5128 1.5338	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 203.7081 (377) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 0.0000 -2.3527 (383) Primary energy kWh/year 335.0000 (467a) 563.2756 (467) 663.2674 (472) 0.0310 (486) 1304.5022 (473) 1304.5022 (473) 1304.5022 (476) 1606.6408 (477) 8961.7495 (478) 1529.9174 (479) -14028.6550 0.0000
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost Total energy cost Total energy cost Total energy of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total Total CO2, kg/year Efficiency of heat source Geothermal Space and Water heating from Geothermal Electrical energy for heat distribution (space & water) Overall CO2 factor for heat network Total CO2 associated with community systems Space and water heating Space cooling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies Ev Unit electricity used in dwelling	Energy kWh/year 12573.2310 369.9947 1130.3395 5923.9486 997.4469 -9217.2214 0.0000 12573.2310 369.9947 1130.3395 5923.9486 997.4469 -9217.2214	Emission factor kg CO2/kWh 0.0110 0.0000 0.1143 0.1387 0.1443 0.1411 0.0000 Primary energy factor kg CO2/kWh 0.0510 0.0000 1.4214 1.5128 1.5338	0.0000 -2319.0529 (352) 2036.9287 (355) Emissions kg CO2/year 335.0000 (367) 121.4908 (367) 65.4026 (372) 0.0048 (386) 203.7081 (373) 203.7081 (373) 203.7081 (377) 821.7247 (378) 143.9624 (379) -1300.9910 0.0000 -1300.9910 0.0000 -1300.9910 (380) -2.3527 (383) Primary energy kWh/year 335.0000 (467a) 563.2756 (467) 663.2674 (472) 0.0310 (486) 1304.5022 (473) 1304.5022 (476) 1606.6408 (477) 8961.7495 (478) 1529.9174 (479)

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APPENDIX F – DESIGN EPC

Date: 01/02/24 Revision: 001

Ref: 6750-CBC-GC-RP-S-002-P01

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Predicted Energy Assessment



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

House, Detached 01/02/2024 Sushil Pathak 920 m²

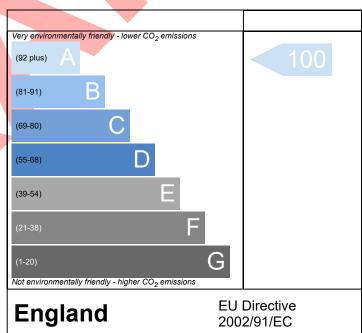
This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

Very energy efficient - lower running costs (92 plus) A (81-91) B (69-80) C (55-68) (1-20) F Not energy efficient - higher running costs England EU Directive 2002/91/EC

The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO₂) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

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