Energy & Sustainability Statement

111 Manor Road, Witney, OX28 3UF

PR11012

Date: 27/02/2024



Suite L, The Kidlington Centre, High Street, Kidlington, OX5 2DL



www.erscltd.co.uk

111 Manor Road, Witney, OX28 3UF

Energy & Sustainability Strategy



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Document History

Client: Ifor Rhys Ltd

Project: 111 Manor Road, Witney, OX28 3UF Document title: Energy & Sustainability Strategy

ERS reference: PR11012

Revision	Remarks	Author	Checked	Approved	Date
00		Michael	Riley Dixon	Yes	27/02/2024
		McKinney			



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Executive summary

ERS Consultants Ltd has been appointed to prepare an Energy & Sustainability Statement for the property proposed for 111 Manor Road, Witney, OX28 3UF.

The proposal is for the construction of a new 1-bedroom dwelling. This report will be focusing on implementing careful design and sustainable measures. This is so that the project creates and attractive new residential unit, addressing current housing needs within the local area.

Proposed schedules of accommodation are as follows:

1x 1-bedroom dwelling

Total combined floor area for habitable dwelling: 58.88m²

This energy and sustainability strategy outlines the key measures to be incorporated in the design, in regards to sustainability, carbon emissions, renewable energy and environmental impact of the considered development in accordance and with guidance from the following documents and policies:

- West Oxfordshire District Council (WODC) sustainability standards
- The National Planning Policy Framework (NPPF) July 2021

In line with WODCs sustainability targets, the dwelling would need to have a primary energy usage (DPER) of less than 35.00kWh/m²/year, without any reliance on fossil fuel/gas boilers. The DPER metric will be calculated using Elmhurst's Design SAP 10.2, which is approved software for assessing Part L 2021 compliance. This uses Primary Energy Factors determined in the latest 2021 Building Regulations.

The primary energy metric in SAP 10.2 is new for the 2021 regulations, and is a measure of the energy demand in the property. This energy statement will demonstrate the measures taken in order to ensure that energy demand has been minimalized in the residential development.

The methodology used to determine and reduce the energy demand follows the GLA guidance for energy statements, which uses a Be Lean, Be Clean, Be Green approach. While this approach is not specified for use by WODC, it is the most effective strategy for reducing energy demand in an appropriate manner and uses a holistic approach toward achieving this. The steps are outlined below:



Be Lean – Use less energy

At the be green stage, fabric first measures are emphasised when looking to reduce energy demand.

Emphasis will be put on the buildings fabric performance in order to reduce energy demand. This is because less energy will be lost through the high-performance fabric, hence reducing the demand. Fabric first measures include levels of insulation beyond Building Regulation 2021 requirements, which will help in achieving low air tightness levels, as well as adopting enhanced construction details for the junctions, reducing thermal bridging. High levels of air tightness are also to be targets to reduce heat loss through the fabric further.

Be Clean - Supply energy efficiently

Once demand for energy has been minimised through fabric first measurements, all remaining energy should be supplied as cleanly as possible, using systems with a low primary energy factor and a high efficiency.

When selecting the proposed heating system, it is also imperative to consider carbon dioxide emissions, as all combustion processes can emit oxides of Nitrogen (NOx). Solid or liquid fuelled appliances (such as those using biomass or biodiesel) can also emit Particulate Matter. These pollutants contribute to poor air quality and can have negative impacts on the health of local residents and occupiers of the dwelling. It is important that these impacts are taken into account in determining the heating strategy of a property.

Be Green - Use renewable energy

At this stage of the project, various low-zero carbon and renewable technologies were considered to further the reduction in energy demand. For this development, Solar Photovoltaic Panels are considered a suitable technology that reduces reliance on grid electricity. The main heating system is also to be electric panels with an instantaneous water heating system.

After implementing 3.70kWp of PV on the southeast roof area and 0.7kWp of PV on the northeast roof area with an additional 3.00kWh battery storage at the Be Green stage, **the primary energy demand reduces to 34.87kWh/m²/yr**, thus meeting the sustainability targets set by West Oxfordshire District Council.



Specification Summary

Table 1: Proposed Fabric Specifications								
Fabric Construction and Insulation								
Element Type U-Value								
Ground Floor - Solid 0.12								
External Wall	kternal Wall Cavity Wall 0.17							
Plane Roof	Pitched – insulated at joists	0.10						
Windows	Window	Double glazed, argon filled, 16mm unit with low-e coating; G-Value of 63%; Aluminium frame;						
External Doors	Half Glazed Door	Double glazed, argon filled, 16mm unit with low-e coating; G-Value of 63%; Aluminium frame;	1.20					



Table O. Bronnerd Statem Surgettie attende											
Table 2: Proposed System Specifications											
Space Heating											
Main Heating System	SAP De	fault; Elec	ctric pa	nel heaters							
Heating Controls	Progra	mmer and	d applic	ance therm	ostats						
Secondary Heating	n/a;										
			Wa	ter Heating							
Heat source	Independent; Electric instantaneous at point of use			Cylinder Si	ze	N//	Α	Insulc	ıtion		N/A
WWHRS Instantaneous System 1		n/a		WWHRS Instantane System 2	ous			n,	/a		
Water Use <=125 l/p/d		Yes		Cold Wate Source	r		From Mains				
Shower(s)	Instantaneous electric shower		Rated Pow [kW]	er		9.30					
Bath Count	1 Primary pipework fully insulated;										
Solar Thermal	n/a;										
			V	entilation							
Mechanical Ventilation System	Int	ermittent	extract	fans in wet	room	s;					
Cooling system	n/	a;									
Pressure Test Blower Do	or 5.0	0m³/hm²	@ 50 Pc	a Please note	e ERS c	an prov	ide Air	r Leaka(ge Testi	ing	
				Other							
Detailing (linear thermal bridging junctions – formerly ACDs)	Enhanced construction details used for masonry cavity wall construction and timber frame sections. These details are attached as an appendix to this report, and are to be followed during the construction process with photographic evidence to be supplied as per Appendix B of Part L 2021; Building Alliance Recognised Construction Details; Masonry Cavity Wall Hybrid; 90mm / 0.019W/mK / 0.19W/mK										
Lighting	No. Fittings 20 Power [W] 2 Efficacy [Im/W] 75 Capacity [Im]				y	150					
Tariff and Meters	Standard Smart Electricity Yes Meter Not pro					resent					
PV/Renewables	3.70kWp PV mounted on the Southeast roof; angle of sloped roof;										

Please note: There may be upgrades compared to your original specification to achieve building regulation approval under the relevant Approved Document Part L. Failure to implement these upgrades may result in a Building Regulation Failure at final stage. Please ensure any changes to the specification are made through this office to ensure ongoing compliance.



Introduction

Site & proposal

The site is located at 111 Manor Road, Witney, OX28 3UF.

Proposed development: Construction of 1x 1-bedroom house.

Sitewide Gross Internal Area for the proposed dwelling: 58.88m²

The approximate site location of the proposed development is shown on the site plan Fig.1:

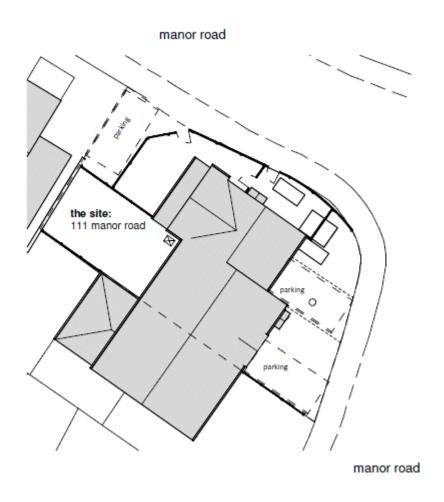


Fig.1 Site Plan



Policy context

This energy and sustainability statement will seek to respond to the energy policies that apply to this dwelling. The most relevant applicable energy policies in the context of the proposed development are presented below.

- West Oxfordshire District Council (WODC) sustainability standards
- The National Planning Policy Framework (NPPF) July 2021

The WODC policy aims for a reduction in Energy Demand, so that the dwelling consumes less than 35.00 kWh/m²/yr. It also stipulates that there is to be no fossil fuels (i.e., gas boilers) in the property.

Calculation methodology

The sections below present the methodology followed in reducing the energy demand for the dwelling.

The methodology employed by the energy and sustainability statement is in line with the GLA's Guidance on preparing energy assessments.

The energy demand is shown by the primary energy metric (DPER) in SAP 10, and is calculated using the primary energy factors in Part L 2021. SAP 10 is the approved compliance software for Part L developed by Elmhurst Energy Systems Ltd.

Baseline:

The buildings baseline uses the same heating system as the as designed counterpart; therefore, in this exercise the baseline models also use an Air Source Heat Pump. The full specification of the baseline can be found in Table 1.1 of the Approved Document L Volume, 2021 Edition.

Be Lean: use less energy

The demand for energy is reduced through a range of passive and active energy efficiency measures; as part of this step the dwelling fabric u-values and glazing have been improved to a high standard. In addition to this suitable heating systems are utilised as per the specifications in Table 2 and 3.

Be Clean: supply energy efficiently

As much of the remaining energy demand is supplied as efficiently as possible in the previous stage. Here, we consider the most highly efficient versions of the selected heating system.

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Energy & Sustainability Strategy



Be Green: use renewable energy

Renewable and low-zero carbon technologies are incorporated to reduce the reliance on grid electricity for the dwelling. The uptake of renewable technologies is based on feasibility and viability considerations, including their compatibility with the energy system determined in the previous step.

The primary energy factors used in all calculations in this document are those used for Part L of the Building Regulations. The relevant factors are reproduced in Table 3 below.

Table 3 Carbon Emission Factors for selected fuel type						
Fuel	Primary energy factor					
Mains Gas	1.130					
Bulk/Bottled LPG	1.141					
Biogas	1.286					
Heating Oil	1.180					
Wood Pellets	1.325					
Grid Electricity	1.501					

^{*} Table extracted from the document SAP Version 10.2 (21-04-2022). Table 12: Fuel prices, emission factors and primary energy factors, Page 189. this can be found in the appendix of the report.



Be Lean – Use less energy

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water, and lighting. The following is a description of the sustainable design methods under the Be Lean umbrella.

Passive design measures

Materials and Waste

A site waste management plan that provides details of waste minimisation, sorting, reuse and recycling procedures is required for all levels in the planning guidance. Sustainable waste management should follow the hierarchy described in BS 5906: Waste management in buildings. Code of practice. This outlines the following principles in decreasing order of desirability:

- Reuse land and buildings wherever feasible and consistent with maintaining and enhancing local character and distinctiveness.
- Reuse and recycle materials that arise through demolition and refurbishment, including the reuse of excavated soil and hardcore within the site.
- Prioritise the use of materials and construction techniques that have smaller ecological and carbon footprints, help to sustain or create good air quality, and improve resilience to a changing climate where appropriate.
- Incorporate green roofs and/or walls into the structure of buildings where technically feasible to improve water management in the built environment, provide space for biodiversity and aid resilience and adaptation to climate change.
- Consider the lifecycle of the building and public spaces, including how they
 can be easily adapted and modified to meet changing social and
 economic needs and how materials can be recycled at the end of their
 lifetime.

Space is provided and appropriately designed to foster greater levels of recycling of domestic waste.



Using Recycled/Recyclable Materials and Sourcing them Responsibly

The following measures will be put in place to minimise environmental impact

Regard for reuse & efficient use of materials: Material efficiency will be a priority for the design team and will be one of the key considerations during detailed design. Potential measures for reducing the material demand and for designing out waste will be explored by all key design team disciplines at each design stage, according to the first stages of the Waste Hierarchy.

Regard will be given to reducing the use of virgin materials, such as ensuring a recycled aggregate of content 10-15% in concrete, for example.

Specifically, the following notes have been made on the durability and recycling potential of project materials:

- Brick in the wall finishes has a long usable life and can be reclaimed / re-used in the future. It can also be recycled although it is a more a down-cycle into rubble material for aggregates.
- Window glass, carpeting, and concrete can also be down-cycled.
- The hard landscaping has many timber elements (seats, benches, fences, the acoustic fence) which is a renewable material and is likely to be FSC certified. It can also be recycled or down-cycled into chipboard / crushed timber.
- Similarly, the use of pre-made sections, such as pre-cast floor slabs in the flatted element will reduce waste and maximise material efficiency. A study by the HSE concluded that waste reductions approaching 70% were possible when compared with traditional techniques.
- The design seeks to use prefabrication for some internal spaces and will be used, subject to the availability of skilled labour and resources within a reasonable distance of the site.



Environmentally conscious materials

- Materials with the lowest environmental impact tend to have only minimal
 processing requirements and contain as many naturally occurring constituents as
 possible. The design team will ensure that 'good practice' is implemented in the
 specification of materials, making conscious decisions to specify more natural
 products and wider environmental impact of the materials will be considered
 when choosing between different options. This could include reviewing
 Environmental Product Declarations.
- Furthermore, efforts will be made to use materials with low/zero Global Warming Potential (GWP), low Ozone Depletion Potential (ODP) and low embodied energy.
- Local and responsible sourcing Transport associated with extracting, processing
 and delivering materials can contribute significantly to their carbon and
 environmental footprint. A robust system of responsible materials sourcing will
 ensure that native materials will be used as a matter of preference, before any
 are sourced internationally. It is reasonable to expect as well that deliveries will
 be made using fuel efficient vehicles.
- The responsible sourcing of materials will be a key consideration in the selection of suppliers, and a sustainable procurement strategy will be produced for the development prior to construction.
- Materials from suppliers who participate in responsible sourcing schemes such as the BRE BES 6001:2008 Responsible Sourcing Standard will be prioritised where economically possible.

Where there are suitable opportunities to recycle a proportion of the material recovered from the existing site it should always be done.



Enhanced U-values

The heat loss of different building fabric elements is dependent upon their U-value. A building with low U-Values provide better levels of insulation and reduced heating demand during the cooler months.

The proposed development will incorporate high levels of insulation and high-performance glazing beyond Part L 2021 targets and notional building specifications, to reduce the demand for space conditioning (heating and/or cooling).

Table 4 demonstrates the improved performance of the proposed building fabric beyond the Building Regulations requirements.

Table 4 Proposed fabric U-Values							
Domestic (U-Values in W/m²k)							
Element	Part L 2021 Building Regulation	Proposed					
Wall	0.26	0.17 (Cavity Wall)					
Floor	0.18	0.12 (Ground Floor)					
Roof	0.16	0.10 (Plane Roof)					
Windows	1.60	1.20					
Doors	1.60	1.20					

These u-values are recommended but may change during the construction stage, to meet site constraints, any worsening of the u-values must ensure compliance and the required energy demand target.



Air tightness improvement

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration.

The proposed development will aim to improve upon the Part L 2021 minimum standards for air tightness by targeting air permeability rates of **5.00m³/m².h** at **50Pa** for the proposed unit.

Reducing the need for artificial lighting

The development has been designed to maximize daylight in all habitable spaces as a way of improving the health and wellbeing of its occupants.

Natural lighting reduces the energy used for artificial lighting and creates a healthier internal environment. Issues to consider include how much of the sky is visible through a window (the more, the better), the dimensions of the interior living/working space and distance from the window, and the proportion of glazed surfaces. The depth of the room is an important factor in determining the amount of natural light received. Naturally dark rooms may be lit naturally through measures such as sun tubes which 'pipe' sunlight from sunny areas to internal areas.

Glare created by natural or artificial light can be uncomfortable for people both inside and outside a building. This can be minimised if considered early in the design process through building layout (e.g., low eaves height) or building design (e.g., blinds, brise soleil screening). If considered together with a lighting strategy this can reduce energy consumption.

All of the habitable areas will benefit from suitable level glazed fenestration to increase the amount of daylight within the internal spaces where possible. This is expected to reduce the need for artificial lighting whilst delivering pleasant, healthy spaces for occupants.



Active design measures

High efficacy & low energy lighting

Where artificial lighting will be needed it will low energy lighting without compensating for luminance, and will accommodate LED.

Water

The sustainability targets require water efficiency in the new development to meet the highest national standard. For residential development, this is defined in the supporting text as the 'optional Building Regulation' for water efficiency in new dwellings, which is 110 litres per day per person.

There are presently no other national standards for non-residential developments than those in the Building Regulations. However, the principle of water efficiency in line with the waste hierarchy applies to all developments. As a result, all developments should seek to reduce demand through efficiency measures, and then meet remaining demand from sustainable sources wherever possible.

For all developments, the submitted information should set out an approach to water management that reduces water usage and waste and priorities demand reduction measures over supply measures.

Reducing water use

Development, whether new construction or change of use and refurbishment, can save water by including measures such as:

- systems for greywater reuse
- aerated washbasin/kitchen taps and shower heads,
- tapered and low-capacity baths,
- sensor and low flush toilets.
- shower timers, and
- water efficient white goods and appliances such as washing machines and dishwashers.

Water use during construction can be reduced through measures including:

- closed loop wheel washers,
- waterless wheel washing using angled steel grids to remove debris,
- high pressure low volume power hoses, recirculating water where possible,
- limiting the water used for flushing building services by stopping it as soon as the flush water turns clear, and
- employing a regime for monitoring water use and water waste.



Choosing the best location for a boiler can reduce water consumption and heat loss. By minimising the length of hot water pipes the volume of water that must be drawn off each time a tap or shower is used can be reduced. Positioning hot water pipes above pipes carrying cold water will reduce heat transfer. Further heat loss can be reduced by insulating the piping.

For all new dwellings, a completed "water efficiency calculator for new dwellings" worksheet that accords with Part G of the building regulations' Approved Documents should be provided prior to occupation. The calculation must demonstrate that the new dwellings will achieve a maximum water usage of 110 litres per person per day.

Rainwater harvesting

Rainwater harvesting is the collection of rainwater directly from a surface it falls on (e.g. a roof). Once collected and stored it can be used for non-potable purposes such as watering gardens, supplying washing machines and flushing toilets, thereby reducing consumption of potable water. Potable water is produced through a purification process and is pumped over large distances, both of which require energy and result in embodied carbon that is not present in water harvested locally. In a residential development, rainwater can be captured for domestic use using water butts connected to a down pipe. Larger systems can use water stored in underground water tanks.

Schemes should be designed to include space for water storage. In residential developments, down pipes should be carefully placed so that water collection and use is convenient for residents.

Greywater re-use

Water that is recycled from bathrooms and kitchens for non-potable uses is known as greywater. Greywater systems must ensure treatment on a regular basis to prevent a build-up of bacteria, and some systems are powered, which entails an energy cost. As a result, greywater reuse is generally less preferable than water use minimisation measures.

Water recycling systems are better suited to new developments rather than retrofitting in existing buildings because of the excavation required for storage tanks and changes needed to the plumbing system, and they are generally more cost effective for new developments and developments of a larger scale.

Recycling systems should be backed up by a mains supply or a sufficiently large reserve storage system to meet higher demands during dry spells. Storage tanks will need an overflow to allow excess water to be released which should be able to flow into a soakaway.



Controls and Monitoring

Advanced lighting and space conditioning controls will be incorporated, specifically:

- For areas of infrequent use, occupant sensors will be fitted for lighting,
 whereas day lit areas will incorporate daylight sensors where appropriate;
- Heating and cooling systems controls will comprise time and temperature controls, both centrally for the whole building, and locally for each space;
- Smart metering to be installed on all new dwellings for adequate monitoring;

Overheating Risk analysis

Passive solar gain refers to the process whereby a building is heated by the sun, either directly from sunlight passing through a window and heating the inside of the building, or indirectly as sunlight warms the external fabric of the building and the heat travels to the interior. The level of passive solar gain can significantly impact upon the quality of a building, how it is used and the energy needed for it to be inhabited comfortably. Passive solar gain can reduce the need for mechanical heating, which in turn reduces energy use and carbon emissions.

Key factors that influence passive solar gain include the physical characteristics of the site, immediate surroundings, orientation of buildings, external design, internal layout and the construction materials used.

Whilst passive solar gain can reduce the carbon emissions associated with heating, if used incorrectly it can lead to overheating, which in turn can lead to the installation of mechanical cooling equipment (e.g. air conditioning). Mechanical cooling increases energy consumption and requires maintenance, resulting in costs and carbon emissions. Mechanical cooling units also produce heat that requires dissipation. The need for mechanical cooling can be avoided or lessened by designing-in passive ventilation and passive cooling measures. Developments should not incorporate mechanical cooling unless passive measures have been fully explored and appraised and proposals that include mechanical cooling should clearly demonstrate that passive measures would not be adequate.

In this project, strategies to mitigate the risk of overheating have been incorporated into the design, meaning that when assessed in the post-planning stage, it is hoped that no further design considerations need to be made in order to comply with Part O 2021.



The following list includes some of the key considerations in the design of new schemes:

- Rooms that are most frequently occupied should benefit from a southerly aspect, but with appropriate measures to avoid overheating.
- Orientation and layout of habitable rooms, and window size and orientation, should be carefully considered in relation to the path of the sun.
- Rooms that include a concentration of heat generating appliances (e.g. kitchens) or are less frequently occupied (e.g. bathrooms) should be located in the cooler part of the building, generally the northern side.
- Deep projections that overshadow windows should be avoided, particularly on south facing elevations. Projections should be sized appropriately so that they provide shading from the sun during the hottest part of the year but allow solar gain in the colder months.
- Where there is a chance that overheating can occur (e.g., due to large expanses of glazing on roofs and south facing elevations), design measures such as roof overhangs, brise soleil, external shuttering, photochromatic and thermochromic glass and a lighter colour palette can help.
- Zonal heating and ventilation systems and controls can be used allowing areas subject to high solar gain to occupy their own temperature control zone. Dynamic controls reduce energy waste.
- Use of materials to build in thermal mass to absorb excess heat during warmer periods and release it slowly during cooler periods (e.g., day/night, summer/winter).
- Buildings should be designed for passive ventilation:
 - cross ventilation with windows located on opposite walls and/or roof mounted turbines or wind cowls that assist with circulation of air by drawing air through windows or top floor openings and
 - o passive stack ventilation (PSV) that uses pressure differences to draw in fresh air from outside to replace rising warm air which is released from the top of the building. A heat exchanger can be placed where the air escapes the building to reduce heat loss.



Be Clean - Supply energy efficiently

The Be Clean stage considers clean energy supply to the building. The following describes the possible systems considered for use in this project. Under the latest GLA guidance, this asks developers to consider Combines heat & power (CHP) and other types of district heating. Neither of these were considered feasible for this project due to size, site constraints, and the overall cost of those systems.

Low Carbon Energy Sources

Combined Heat and Power (CHP)

The presence of a year-round base hot water generation heat load in residential units is favourable to CHP. To date, there are readily available micro gas fired CHP units (such as EC power) on the market. At this stage gas fired CHP will be provisionally incorporated into the development's LZC strategy, however, the carbon reductions due to CHP are extremely sensitive to the system design, unit selection and running time.

CHP (Combined Heat & Power) is a great technology to use, however the system itself needs to run on a 24-hour basis. The heat generated would be exceeding the demand and needs for this site, and would require to have an outlet area which can profit from this excess; however, this development does not have a space that benefit from this; therefore, this option has considered not feasible for this development.

In this project there will be no CHP incorporated so therefore, the Be Clean scenario will not further reduce CO₂ emissions on site for the proposed Site, therefore meaning there are no changes to the carbon reduction to be implemented to the property.

Heat Networks

All new developments should look connect, or be connection ready, where a heat distribution network already exists. The investigation of opportunities should cover all scales and should not be limited to district heating systems.

Where such networks exist and developments should propose to connect to them, the energy statement should set out details showing how connection will occur (a connection strategy). Where such networks exist, and developments do not propose to connect to them, the energy statement must set out clear reasons as to why the connection is not feasible, or why an alternative source of energy would be more sustainable. The development is not currently located within a local heat network, so therefore it is not feasible to use district heating in this project.



Be Green - Use renewable energy

Renewable technologies feasibility study

Methods of generating on-site renewable energy (Green) were assessed, once Lean and Clean measures were considered.

This section provides an overview of the technologies considered, a brief assessment of their feasibility, a proposed mixture of suitable technologies.

The proposed development will benefit from an energy efficient building fabric which will reduce the energy consumption of the proposed development in the first instance.

A range of renewable technologies were subsequently considered including:

- Biomass;
- Ground/water source heat pumps;
- Wind energy;
- Photovoltaic panels, and,
- Solar thermal panels.

In determining the appropriate renewable technology for the site, the following factors were considered:

- CO₂ savings achieved;
- Site constraints;
- Financial benefit
- Any potential visual impacts

Demand profiles

The balance of technologies chosen will depend on the development's energy demand patterns.

Keeping in mind that the space heating energy demand changes according to the season. While hot water energy demand will provide a significant base load throughout the year.

Electrical demand is likely to be moderate throughout the year. Lighting loads will be highest during the evening but will continue at reduced levels throughout the night and during the day.

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Feasibility

At this early stage in the design, it is possible only to outline the likely feasibility of specific technologies. Further descriptions of the LZC technologies below are included in Appendix A.

	Table 5. Renewable an	d Low Ze	ero Carbon T	echnologie	S	
Renewable Technology	Comments	Lifetime (Years)	Maintenance	External Impact	Site Feasibility	Adopted for Site
BIOMASS	Burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location. These however aren't as beneficial to DPER.	20	High	High	2	
PV	PV panels would generate significant energy savings, whilst having minimal impact on the appearance of the building. These are to be incorporated on the south facing roof.	25	Low	Med	10	•
Solar Thermal	Solar thermal array mounted on the roof may contribute to energy reductions, but will reduce the amount of available roof space where Photo voltaic panels are proposed.	25	Low	Med	7	
Heat Pumps	Ground loops requires space, additional time at the beginning of the construction process and very high capital costs. Air source heat pumps were not used for this project.	20	Med	Low	6	
Wind	Due to insufficient open area for installation of a stand-alone wind turbine and planning issues this option has not considered in this development.	25	Med	High	0	



Detailed assessment of Photovoltaic Panels

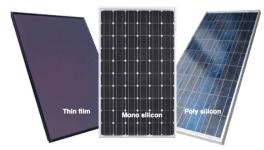


Fig 2. Photovoltaic Panels

Photovoltaic Panel is considered a suitable technology for this development as the development provides an extent of roof space for the installation of PV panels. In addition to this the PV arrays are relatively easy to install when compared to other renewable systems and provide a significant amount of energy savings.

The PV shall comprise of 4.40kWp of sloped roof mounted arrays on the dwelling in addition to 3.00kWh or more of battery storage. Table 6 summarizes the technical data for the proposed PV array. In total, the PV installation would reduce energy demand below the target threshold, to 34.87kWh/m²/yr.

Table 6. Proposed PV Specifications

Photovoltaic Panels						
Module Efficiency	15%					
Tilt	Sloped roof angle					
Array Area (approximately)	~20.00m²					
Total power to be installed	4.40kWp					
Total battery storage to be installed	3.00kWh					
Primary Energy Savings	56.76 kWh/m²/yr					

Be Green CO₂ emissions & savings

After the Be Green Stage, with the electric panels, the high-performance fabric and the PV panels, the energy demand of the building now meets the sustainability targets set by WODC. This means the energy demand is **34.87kWh/m²/yr**, and a total of **0.13kWh/m²/yr** below the target of 35.00 kWh/m²/yr.



Conclusion

Following the implementation of the three-step Energy Hierarchy, the regulated energy demand of the property is **34.87kWh/m²/yr** according to a SAP 10 calculation against Part L standards, using the Primary Energy metric.

Overall, the proposed development at **111 Manor Road**, **Witney**, **OX28 3UF**, has been designed to meet energy policies set out by local and national planning requirements. This demonstrates that the development is committed to reducing energy demand using sustainable design measures and clean energy systems.

The new development will be designed with a high level of insulation and low air permeability to reduce heat loss as much as is practically possible, also the use of low energy lighting and A – Rated White goods are essential for the reduction of energy consumption. The control strategy throughout the proposed site must also be carefully designed to ensure the most economical operation of all equipment.

Measures have also been incorporated into the design in order to mitigate the risk of overheating, however Part O compliance will be assessed in the post planning stage. The passive measures incorporated include external shading devices on areas of large glazing.

To achieve the required energy demand target, electric panels to be provided for the as-built stage. In addition to this, levels of insulation mean the U-Values fall below the minimum notional standards of Part L reduce heat loss and therefore energy demand. After these measures, PV and battery storage is added to achieve the remaining reduction needed for the target.

As per the West Oxfordshire District Councils sustainability targets, residential developments are required to have an energy demand below 35.00 kWh/m²/yr. This development, after Be Lean, Be Clean and Be Green measures are implemented, consumes **34.87kWh/m²/yr**, thus meeting the sustainability targets.

Post construction each building/dwelling is to have suitable testing to be provided to ensure the dwellings satisfy the requirements of this document and building regulation standards at the time of completion. These reports are to be provided as As-Built SAP worksheets, EPC and Air testing, for all conditioned spaces in the development.

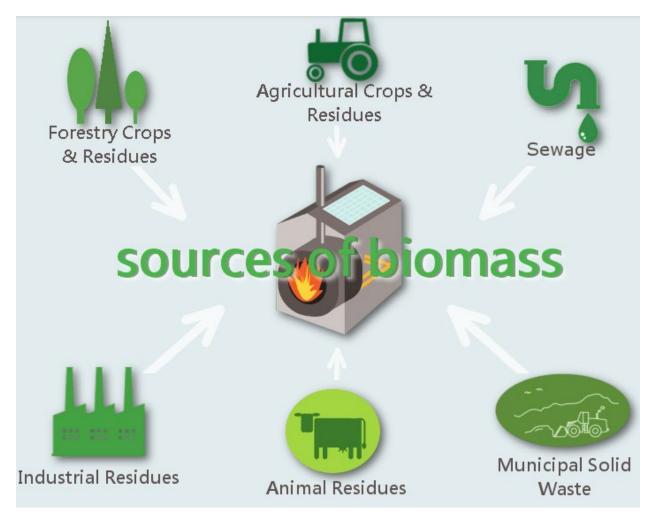


Appendix A - Low or Zero Carbon Energy Sources

Biomass As a fuel

Biomass is a renewable energy source, generated from burning wood, plants and other organic matter, such as manure or household waste. It releases CO₂ when burned, but considerably less than fossil fuels. We consider biomass a renewable energy source, if the plants or other organic materials being burned are replaced.

Biomass is known for its versatility, given it can be used to generate heat, electricity, be used in combined heat and power units and be used as liquid fuel. In domestic settings, it tends to be found in the form of wood-fuelled heating systems.



Geothermal Energy:

Geothermal energy technologies use the heat energy stored in ground; either for direct-use applications: such as using the grounds' heat to defrost a driveway or the indirect use with additional equipment such as a geothermal heat pump. Most commercial installations couple a heat pump with the ground to upgrade the low-

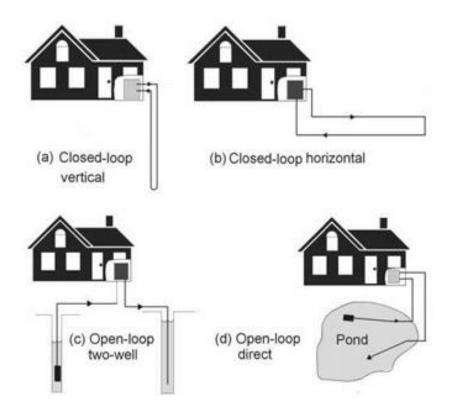


grade heat from the ground or ground water to a higher-grade heat, where it can be used for heating purposes.

The suitability of a ground source system depends heavily on the type of earth coupling heat exchange system used:

Ground source earth coupling options

The right choice of appropriate heat exchanger depends on several factors such as: size of space heating/hot water system, available site area for the heat exchangers, and local ground conditions. Due to the specialist nature of this technology, we recommend that a specialist is employed to size the heat exchangers based on a desktop study of the site's geological conditions – this normally being required in advance of any other contractor appointment.



Vertical Closed Loop System

A frequently used and simple ground source heat exchanger, for a small to medium size project, is a closed loop vertical system. The system comprises of vertically drilled boreholes, usually up to 100 m deep, into which are inserted two polyethylene pipes with a U-shape connector at the base of the hole – effectively providing a flow down to the bottom of the hole and return back up to the surface. All the flow and return loops are connected together across the site - completing the entire heat exchange loop.

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Water is pumped around the loop and is then circulated around the heat pump to achieve the required heat exchange. The distance between boreholes is dependent on ground conditions but is typically a minimum of a 6mx6m grid, to prevent overlapping of the heat exchange process between loops.

Horizontal Closed Loop System

Horizontal closed loop heat exchangers are usually applied to small projects such as individual houses, which usually require a relatively low heat output. Consisting of horizontal trenches 1.5-2m deep, with either straight pipes or 'slinky' coiled pipes, these require significant excavation work and significant site area to achieve appreciable outputs as such are not normally suited to medium to large projects.

Vertical Open Boreholes System

A further option is a vertical open borehole system. The system involves the abstraction and discharge of natural ground water using boreholes; into which pumps are inserted, connected to collapsible pipework. Each borehole pump abstracts ground water, circulates it around the heat pump and then discharges the water back to the ground via an absorbing well, some distance from the original abstraction borehole. The system is capable of providing very high rates of heat exchange for a relatively small number of boreholes, which makes it very efficient in terms of site area required. However, this depends greatly on the availability of ground water, which in turn varies according to location. A major downside of this system is that the extraction of water from deep boreholes via pumps consumes a lot of energy, as the water has to be physically lifted to the surface by the pump – this in effect reduces the carbon emissions saved by this system as a whole.

Ground source heat exchange options in summary:

Vertical loop system - closed boreholes

- moderate heat capacity
- relatively low installation cost

Vertical open system - open boreholes

- high heat capacity
- high running energy
- high installation cost

Horizontal loop system – straight pipes

- low capacity,
- high installation cost
- extensive ground excavation work



Horizontal coiled loop system – 'slinky' pipes

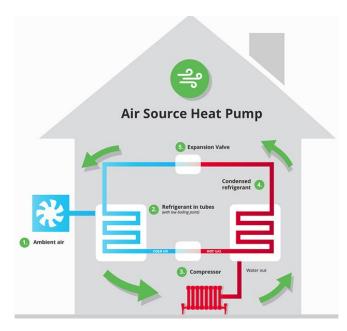
- good capacity
- low installation cost
- extensive ground excavation work

Air Source Heat Pumps

Heat pumps are basically refrigeration units which work in reverse – instead of cooling being produced and heat rejected, the unit produces heat and rejects cooling. Conventional heat pumps use air as the medium to reject this 'coolth' to atmosphere. Ground source units use the ground as a means of improving the unit efficiency because the ground is a constant 11-13 °C at depths of 50m down – this suits the heat pump much better during the coldest weather than the extremes of air temperature. Reversible heat pumps can also be used for cooling; however, this is not being considered further for this project.

A heat pump consumes electrical power to drive the compressor and other ancillary elements. The ratio between total energy input and heat energy output of the heat pump is a measure of its efficiency – usually referred to as 'Coefficient of Performance' - COP. A ground source heat pump has a higher COP than an air-cooled heat pump – this additional energy effectively being the grounds' natural contribution to the system.

The heat produced by a heat pump is usually used to either provide space heating say to underfloor heating or radiators or the heat is used to generate domestic hot water via a storage vessel.

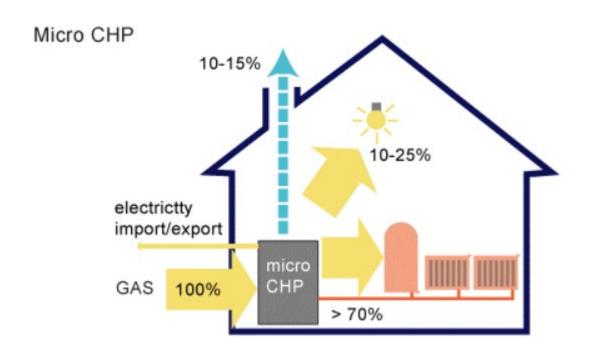




CHP

Combined heat and power (CHP) is a process involving simultaneous generation of heat and electricity, where the heat generated in the process in harnessed via heat recovery equipment. CHP at the large commercial size is now fairly common in premises which have a simultaneous demand for heating and electricity for long periods, such as hospitals, recreational centres and hotels. In addition, small CHP systems are now becoming available for individual houses, group residential units and small non-domestic premises. Compared with using centrally generated electricity supplied via the grid, CHP can offer a more efficient and economic method of supplying energy demand, if installed and operated appropriately, owing to the utilization of heat which is normally rejected to the atmosphere from central generating stations, and by reducing network distribution losses due to local generation and use.

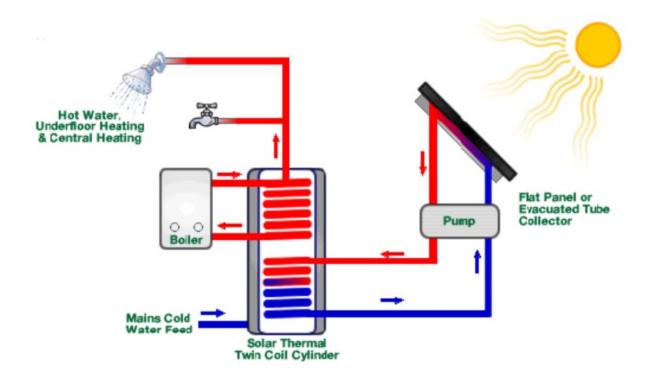
Heat generated will be used for space and water heating, and additional heat storage may be used to lengthen use periods, to assist in warm-up and to improve overall energy efficiency. For overall good energy efficiency, as with all CHP, usage must be heat-demand led. Thus, a sophisticated control system is required and users should be made aware of efficient operating practices.





Solar thermal collectors

Solar thermal collectors (flat plate or evacuated tubes) convert solar thermal energy into heat for hot water generation. These are usually located on a roof-oriented south facing in an ideal slope of 45 degree. Solar collectors properly sized and designed provide approximately 50% of annual hot water demand.





Photovoltaic

Photovoltaic modules convert sunlight directly into DC electricity and can be integrated into buildings. Photovoltaics (PVs) are distinct from other renewable energy technologies since they have no moving parts to be maintained and are silent. PV systems can be incorporated into buildings in various ways: on sloped roofs and flat roofs, in façades, atria and shading devices. Modules can be mounted using frames or they can be fully incorporated into the actual building fabric; for example,



PV roof tiles are now available which can be fitted in place of standard tiles.

Currently, a PV system will cost between £1500 and £2500 per kWp, and frequently part of this cost can be offset owing to the displacement of a conventional cladding material. Costs have fallen significantly since the first systems were installed (1980s) and are predicted to fall further still.

While single crystal silicon remains the most efficient flat plate technology (15–16% conversion efficiency); it also has the least potential for cost reduction. PV cells made from poly-crystalline silicon have become popular as they are less expensive to produce, although they have a slightly lower efficiency.

Thin film modules are constructed by depositing extremely thin layers of photosensitive materials on a low-cost backing such as glass, stainless steel or plastic. As much less semiconductor material is required as for crystalline silicon cells, material costs are potentially much lower. Efficiencies are much lower, around 4–5%, although this can be boosted to 8–10% by depositing two or three layers of thin film material. Thin film production also requires less handling as the films are produced as large, complete modules and not as individual cells that have to be mounted in frames and wired together. Hence, there is the potential for significant cost reductions with volume production.

Since PVs generate DC output, an inverter and other equipment is needed to deliver the power to a building or the grid in an acceptable AC form. The cost of the inverter and these 'Balance of System' (BOS) components can approach 30% of the total cost of a PV system. Hence, simplification and cost reductions in these components over the coming years will also be necessary to make PV systems affordable.



Wind energy

Wind power is the most successful and fastest spreading renewable energy technology in the UK with a number of individual and group installations of varying size, capacity and location. Traditionally, turbines are installed in non-urban areas with a strong trend for large offshore wind farms. In parallel with the design and development of ever-bigger machines, which are deemed to be more efficient and cost-effective, it is being increasingly recognized that smaller devices installed at the point of use, i.e. urban



settings, can play an important role in reducing carbon emissions if they become mainstream.

At present there is a wide range of available off-the-shelf wind products, many manufactured in the UK and EU with proven good performance and durability. The dominant type is horizontal axis wind turbines (HAWT), which are typically ground mounted. Vertical axis wind turbines (VAWT) have limited market presence and there is a trade-off between lower efficiency and potentially higher resistance to extreme conditions. Capacity ranges from 500W to more than 1.5MW, but, for practical purposes and in built-up areas in particular, machines of more than 1kW and below 500kW are likely to be considered.

Wind technology is also currently one of the most cost-effective renewable energy technologies, which is attributable to the large scale of installations reducing the unit output cost. Individual building or community wind projects, although smaller, have the advantage of feeding electricity directly into the building's electricity circuit, thus sparing costly distribution network development and avoiding distribution losses. The downside is the still high capital cost per kW installed for smaller turbines, plus location constraints, such as visual intrusion and noise. The wind regime in urban areas is also a concern owing to higher wind turbulence which reduces the potential electricity output.

In most cases, wind turbines are connected to the electricity grid and all generated energy is used regardless of the building demand fluctuations. The output largely depends on the wind speed and the correlation between the two is a cube function. This means that in short periods of above-average wind speeds the generation increases exponentially. As a result, it is difficult to make precise calculations of the annual output of a turbine, but average figures can provide useful guidance to designers and architects. In reasonably windy areas (average wind speed of 6m/s) the expected output from 1kW installed is about 2500kWh annually.

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The cost per kW installed varies considerably by manufacturer and size of machine with an indicative bracket of £2,500–£5,000. With a lifespan of more than 20 years, wind turbines can save money if design and planning are carried out in a robust way.

Building-integrated wind turbines are starting to be a reality in the UK, but potential projects may face difficulties with obtaining planning permission. There are a few examples now of permitted development rights for certain rooftop turbines in some local councils. A number of horizontal axis devices specifically designed for building integration are now available commercially, having design and reliability parameters relevant to the urban context. Building-mounted vertical axis devices are under development. At present, turbines installed near buildings, as well as community installations for groups of buildings, should be regarded as the larger wind energy source related to buildings, when they contribute to the carbon emissions from these premises using 'private wire' networks. However, the contribution of several building-integrated turbines in a development is likely to become significant in the next few years.



Appendix B-Fuel prices and emission factors

	Standing	Unit Price	Emission Kg CO2	PE Fuel
Gas fuels:	Charge £	p/kWh	p/kWh	Factor Code
mains gas	92	3.64	0.210	1.130 1
bulk LPG	62	6.74	0.241	1.141 2
bottled LPG (for main heating system)		9.46	0.241	1.141 3
bottled LPG (for secondary heating)		11.20	0.241	1.133 5
LPG subject to Special Condition 11F (a)	92	3.64	0.241	1.163 9
biogas (including anaerobic digestion)	62	6.74	0.024	1.286 7
Liquid fuels:				
heating oil		4.94	0.298	1.180 4
bio-liquid HVO from used cooking oil (d)		6.79 6.79	0.036 0.018	1.180 71 1.180 73
bio-liquid FAME from animal/vegetable oils ^(e) B30K (0		5.49	0.214	1.136 75
bioethanol from any biomass source		47	0.105	1.472 76
		7/	0.100	1.4/2 /0
Solid fuels: (g)				
house coal		5.58	0.395	1.064 11
anthracite		4.19	0.395	1.064 15
manufactured smokeless fuel		5.91	0.366	1.261 12
wood logs		5.12	0.028	1.046 20
wood pellets (in bags for secondary heating)		6.91	0.053	1.325 22
wood pellets (bulk supply for main heating)		6.25	0.053	1.325 23
wood chips		3.72	0.023	1.046 21
dual fuel appliance (mineral and wood)		4.77	0.087	1.049 10
Electricity: (a)				
standard tariff	81	16.49	0.136 (s)	1.5010t)
	30			
7-hour tariff (high rate) (h)	7	19.60	0.136 (s)	1.5010t)
7 have haville (lave made)	32	9.40	0.127 (a)	1 501 (4)
7-hour tariff (low rate) (h)		9.40 31	0.136 (s)	1.501 (†)
10-hour tariff (high rate) (">	21	20.54	0.127 (a)	1 501 (4)
10-11001 Idilli (filgiffale) (>	34	20.54	0.136 (s)	1.501 (†)
10-hour tariff (low rate) fib)	0.	12.27	0.136 (a)	1.501 (0
To Floor Fallin (1000 Fallo) lib)		33	0.100 (a)	1.001 (0
18-hour tariff (high rate) (">	26	17.41	0.136 (s)	1.501 (0
To the of team (thight teal of (38	.,	0.100 (5)	1.001 (0
18-hour tariff (low rate) 00		14.17	0.136 (s)	1.501 (†)
		40		
24-hour heating tariff	26	14.04	0.136 (s)	1.501 0)
	35			,
electricity sold to grid, PV		5.59 (0	0.136 (s)	0.501 0)
		60		
electricity sold to grid, other		5.59 ()	0.136 (s)	0.501 0)
		36		04)
electricity, any tariff 0)		N/A	0.136 (s)	1.501 ^{Ot)}
	00.01	39		
Heat networks: (k)	92 0)			
heat from boilers - mains gas		4.44 51	0.210	1.130
heat from boilers - LPG		4.44	0.241	1.141
riedi irom bolleis - LFG		4.44 52	0.241	1.141
heat from boilers - oil (assumes 'gas oil')		4.44	0.335	1.180
		53	0.000	1.100
heat from boilers that can use mineral oil or biodiese	el	4.44	0.335	1.180
		56		
heat from boilers using HVO from used cooking oil		4.44	0.036	1.180

111 Manor Road, Witney, OX28 3UF Energy & Sustainability Strategy



	57		
heat from boilers FAME from animal/vegetable oils (a)	4.44 58	0.018	1.180
heat from boilers - B30D 0)	4.44 55	0.269	1.090
heat from boilers - coal	4.44 54	0.375	1.064
heat from electric heat pump	4.44 41	0.136 (s)	1.501 0)
heat recovered from waste combustion	4.44 42	0.015 0')	0.063
heat from boilers - biomass	4.44 43	0.029	1.037
heat from boilers - biogas (landfill or sewage gas)	4.44 44	0.024	1.286
heat recovered from power station	3.77 45	0.015 0')	0.063
high grade heat recovered from process (Appendix C4.3)	3.77 47	0.011	0.051
low grade heat recovered from process (Appendix C4.4)	3.77 49	0.136 001)	1.501 (001)
heat recovered from geothermal or other natural processes	3.77 46	0.011	0.051
heat from CHP	3.77 48	as above0D	as above0D



Appendix C, D, E, F & G

This appendix contains the following reports used in producing the content of this Energy and Sustainability Statement.

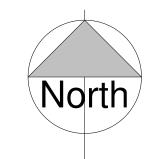
Appendix C – Plan, elevation and section drawings used for SAP Calculation

Appendix D – BREL Worksheets for As-Designed Dwelling (i.e., Be Green Specification)

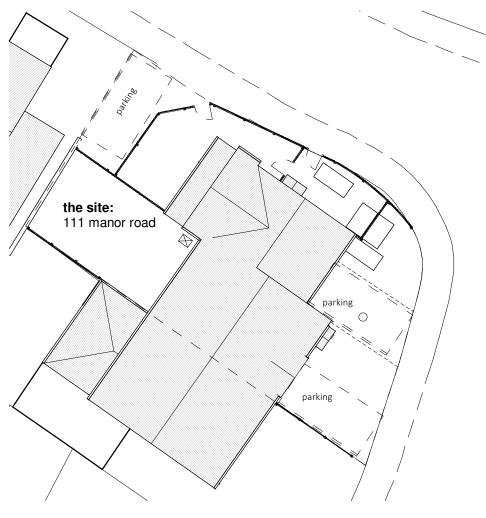
Appendix E – Be Green SAP calculation reports for the As-Designed Dwelling

Appendix F – Be Green PEA showing potential EPC rating using provided specification

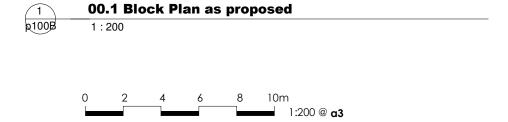
Appendix G – Sample Water calculation showing how to achieve consumption below 110/litres/person/day

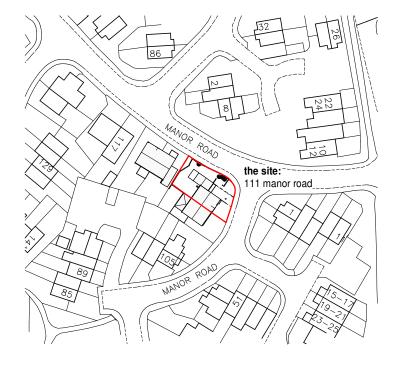






manor road





2 00.0 Location Plan as existing 1:1250

0 100m 1:1250 @ **q3**

Notes

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F	lev	Date	Description
A B		31jan 23feb	amenity space revised amenity space consolidated

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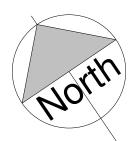
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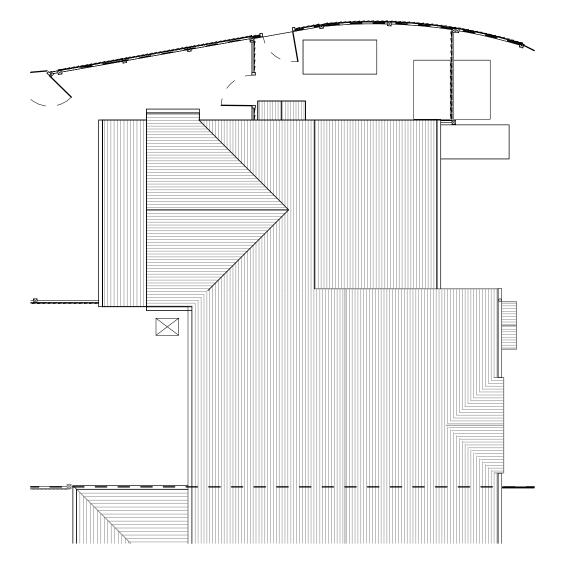
lower barn, 4 blenheim road, horspath, oxford, ox33 1ry

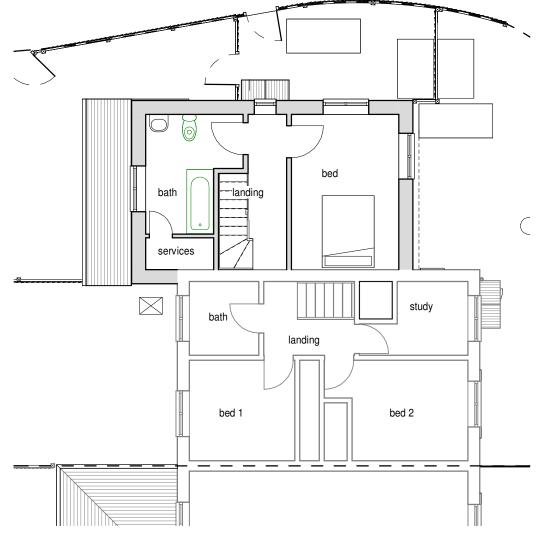
- t **01865 874112**
- e iforrhys@iforrhys.com

client:	Mr Jon Pickering	
job:	Proposed development at 111 Manor Road, Witney, OX28 3UF	
title:	Location & proposed block plan	
status	planning issue	
scale:	As indicated	<u> </u>
date:	february 2024	
no:	2243 p100B	

23/02/2024 12:09:45







04.4 Roof Plan - as proposed

02.4 First Floor plan - as proposed

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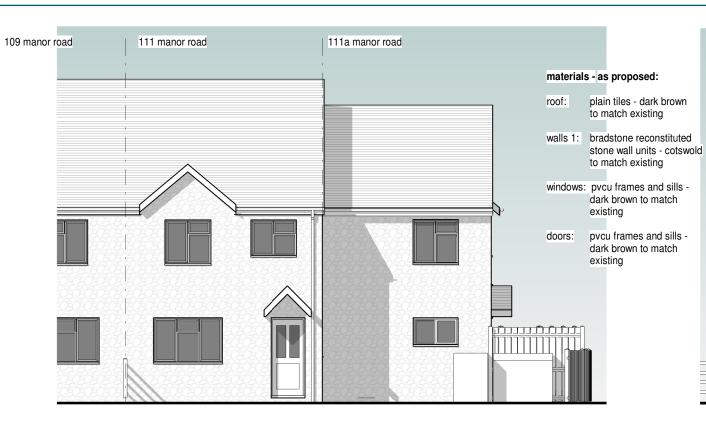
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- t **01865 874112**
- e iforrhys@iforrhys.com

		- 1	
client:	Mr Jon Pickering		
job:	Proposed development at 111 Manor Road, Witney, OX28 3UF		
title:	First Floor and Roof plans - as proposed		
status	planning issue		
scale:	1:100		
date:	february 2024		
no:	2243 p111	23/02/2024 12:17:42	





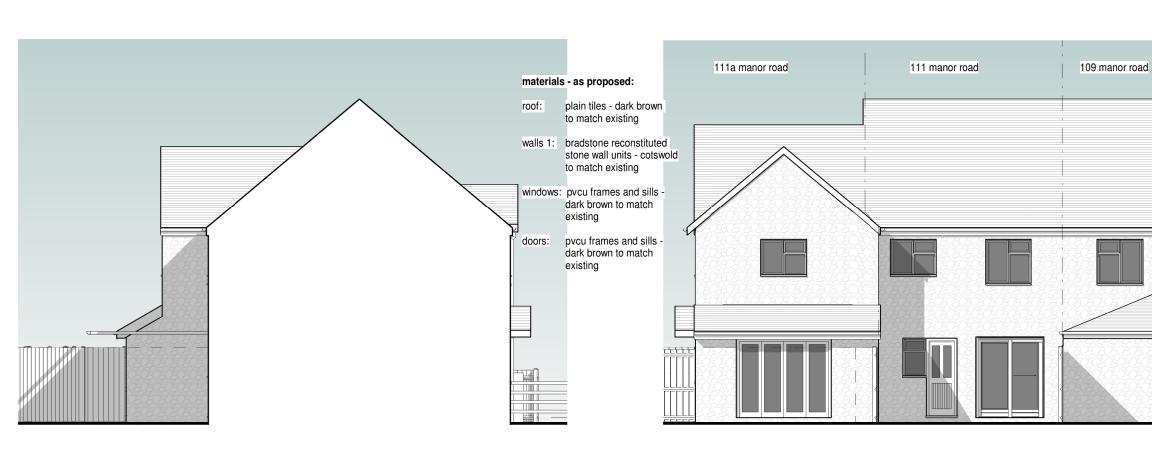
p112

05.4 east elevation - as proposed

1:100

06.4 north elevation - as proposed \p112

1:100



p112

07.4 south elevation - as proposed

1:100

08.4 west elevation - as proposed p112 1:100

1:100 @ **a3**

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Date	Description
	Date

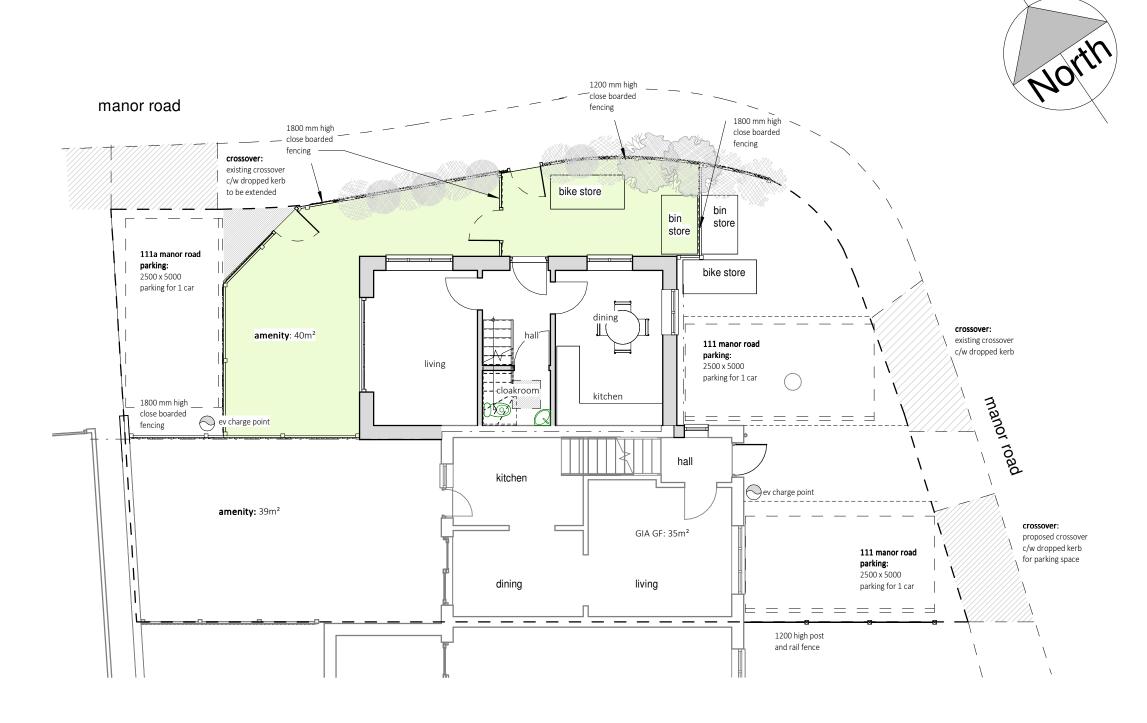
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- t **01865 874112**
- e iforrhys@iforrhys.com

client:	Mr Jon Pickering		
job:	Proposed development at 111 Manor Road, Witney, OX28 3UF		
title:	planning issue 1:100 february 2024 2243 p112		
status	planning issue		
scale:	1:100		
date:	february 2024		
no:	2243 p112		



p110

01.4 Ground floor plan - as proposed

1:100

Notes

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Rev	Date	Description

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- t **01865 874112**
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client:	Mr Jon Pickering	
job:	Proposed development at 111 Manor Road, Witney, OX28 3UF	
title:	Ground floor plan - as proposed	3.36.49
status	planning issue	3:36
scale:	1 : 100	T-
date:	february 2024	20
no:	2243 p110	96/02/2024

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Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Tue 27 Feb 2024 12:33:42

Project Information					
Assessed By	Iraj Maghounaki	Building Type	House, End-terrace		
OCDEA Registration	EES/015723	Assessment Date	2024-02-27		

Dwelling Details						
Assessment Type	As designed	Total Floor Area	59 m ²			
Site Reference	PR11012 - 111 Manor Road	Plot Reference	001 - Be Green			
Address	111 Manor Road, Witney, OX28 3UF					

Client Details	
Name	Ifor Rhys
Company	Ifor Rhys Ltd
Address	Lower Barn, 4 Blenheim Road, Horspath, Oxford, OX33 1RY

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

1a Target emission rate and dwelling emission	ı rate				
Fuel for main heating system	Electricity				
Target carbon dioxide emission rate	13.73 kgCO ₂ /m ²				
Dwelling carbon dioxide emission rate	1.56 kgCO ₂ /m ²	OK			
1b Target primary energy rate and dwelling primary energy					
Target primary energy	72.03 kWh _{PE} /m ²				
Dwelling primary energy	34.87 kWh _{PE} /m ²	OK			
1c Target fabric energy efficiency and dwelling fabric energy efficiency					
Target fabric energy efficiency	42.4 kWh/m²				
Dwelling fabric energy efficiency	36.8 kWh/m ²	OK			

2a Fabric U-values											
Element	Maximum permitted average U-Value [W/m²K]	Dwelling average U-Value [W/m²K]	Element with highest individual U-Value								
External walls	0.26	0.17	Walls (1) (0.17)	OK							
Party walls	0.2	0	Party Wall (1) (0)	N/A							
Curtain walls	1.6	0	N/A	N/A							
Floors	0.18	0.12	Heat Loss Floor 1 (0.12)	OK							
Roofs	0.16	0.1	Roof (1) (0.1)	OK							
Windows, doors, and roof windows	1.6	1.2	Windows (1.2)	OK							
Rooflights	2.2	N/A	N/A	N/A							

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))										
Name	Net area [m ²]	U-Value [W/m ² K]								
Exposed wall: Walls (1)	69.1827	0.17								
Party wall: Party Wall (1)	27.72	0 (!)								
Ground floor: Heat Loss Floor 1, Heat Loss Floor 1	31.38	0.12								
Exposed roof: Roof (1)	31.41	0.1 (!)								

2c Openings (better than typically expected values are flagged with a subsequent (!))											
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]							
Windows, Windows	0.852	South East	0.8	1.2							
Windows, Windows	1.392	South East	0.8	1.2							
Door, HG Door	2.07	North East	N/A	1.2							
Windows, Windows	1.2	North East	0.8	1.2							
Windows, Windows	1.1495	North East	0.8	1.2							
Windows, Windows	0.551	North East	0.8	1.2							
Windows, Windows	2.1004	North East	0.8	1.2							
Windows, Windows	5.225	North West	0.8	1.2							
Windows, Windows	1.1374	North West	0.8	1.2							

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction

Date generated: 2024-02-27 12:33:42

Main element	Junction detail	Source	Psi value	Drawing /
			[W/mK]	reference
External wall	E2: Other lintels (including other	Calculated by person with suitable	0.019 (!)	MHF-100-E2-01
	steel lintels)	expertise		
External wall	E3: Sill	Calculated by person with suitable	0.021 (!)	MHF-100-E3-01
		expertise		
External wall	E4: Jamb	Calculated by person with suitable	0.016 (!)	MHF-100-E4-01
		expertise		
External wall	E5: Ground floor (normal)	Calculated by person with suitable	0.059	MHF-100-E5-12
		expertise		
External wall	E6: Intermediate floor within a	Calculated by person with suitable	0.001 (!)	MHF-100-E6-01
	dwelling	expertise		
External wall	E10: Eaves (insulation at ceiling	Calculated by person with suitable	0.063	MHF-100-E10-0
	level)	expertise		1
External wall	E12: Gable (insulation at ceiling	Calculated by person with suitable	0.041	MHF-100-E12-0
	level)	expertise		1
External wall	E16: Corner (normal)	Calculated by person with suitable	0.037 (!)	MHF-100-E16-0
		expertise		1
External wall	E25: Staggered party wall	Calculated by person with suitable	0.041	MHF-100-E25-0
	between dwellings	expertise		2
Party wall	P1: Ground floor	Calculated by person with suitable	0.043	MPW-P1-12
		expertise		
Party wall	P2: Intermediate floor within a	SAP table default	0 (!)	
	dwelling			
Party wall	P4: Roof (insulation at ceiling	Calculated by person with suitable	0.04	MPW-P4-01
	level)	expertise		

3 Air permeability (better than typically expected values are flagged with a subsequent (!))									
Maximum permitted air permeability at 50Pa	8 m ³ /hm ²								
Dwelling air permeability at 50Pa	5 m ³ /hm ² , Design value	OK							
Air permeability test certificate reference									

4 Space heating								
Main heating system 1: Room heaters - Electricity								
Efficiency	100.0%							
Emitter type								
Flow temperature								
System type	Panel, convector or radiant heaters							
Manufacturer								
Model								
Commissioning								
Secondary heating system: N/A								
Fuel	N/A							
Efficiency	N/A							
Commissioning								

5 Hot water							
Cylinder/store - type: N/A							
Capacity	N/A						
Declared heat loss	N/A						
Primary pipework insulated	N/A						
Manufacturer							
Model							
Commissioning							
Waste water heat recovery system 1 -	type: N/A						
Efficiency							
Manufacturer							
Model							

6 Controls							
Main heating 1 - type: Programmer and appliance thermostats							
Function							
Ecodesign class							
Manufacturer							
Model							

Water heating type: N/A			
Water heating - type: N/A Manufacturer			
Model			
7 Lighting	751 441		
Minimum permitted light source efficacy	75 lm/W		OV
Lowest light source efficacy	75 lm/W		OK
External lights control	N/A		
8 Mechanical ventilation			
System type: N/A			
Maximum permitted specific fan power	N/A		T
Specific fan power	N/A		N/A
Minimum permitted heat recovery	N/A		
efficiency	NI/A		NI/A
Heat recovery efficiency Manufacturer/Model	N/A		N/A
Commissioning			
9 Local generation			
Technology type: Photovoltaic system			
Peak power	3.7 kWp		
Orientation	South East		
Pitch	45°		
Overshading	None or very little		
Manufacturer MCS certificate			
Technology type: Photovoltaic system	(2)		
Peak power	0.7 kWp		
Orientation	North East		
Pitch	45°		
Overshading	None or very little		
Manufacturer			
MCS certificate			
10 Heat maturage			
10 Heat networks N/A			
11 Supporting documentary evidence			
N/A			
12 Declarations			
a. Assessor Declaration			
		ntents of this BREL Compliance Report	
		nformation submitted for this dwelling for	
		and that the supporting documentary	
evidence (SAP Conventions, Appendi			
documentary evidence required) has	been reviewed in the	course of preparing this BREL	
Compliance Report.			
O'man de		A ID:	
Signed:		Assessor ID:	
Namo		Data:	
Name:		Date:	
b. Client Declaration			
N/A			



Property Reference PR11012 - 111 Manor Road										ssued on Da	te	27/02/2024		
Assessment Refe	Assessment Reference 002 - Be Lean							Prop Type R	tef					
Property		11	11, Manor Road,	Witney, Oxford	dshire, OX28 3U	F								
SAP Rating					70 C		DER	8.8	13	TER		13.73		
Environmental					94 A		% DER < TER		,,,			35.69		
CO ₂ Emissions (t/y	year)				0.46		DFEE	36	.81	TFEE		42.39		
Compliance Chec	k				See BREL		% DFEE < TF	EE				13.18		
% DPER < TPER					-27.21		DPER	91	.63	TPER		72.03		
Assessor Details		Mr. Iroi	Maghaupaki							Assos	sor ID	V571-000	24	
Client		-, Ifor R	Maghounaki							Asses	5501 1D	V37 1-000	J I	
SAP 10 WORKSHEET CALCULATION OF E	NERGY RATI			(Version 10	.2, February	2022)		Area	Store	y height		Volume Volume		
Ground floor First floor Total floor area Dwelling volume		à) + (1b) + (1·	c)+(1d)+(1e)	(1n)	5	8.8800		27.5000	(1b) x	2.6000		71.5000	(1b) - (3 (1c) - (3 (4) (5)	
2. Ventilation r	ate										n	n3 per hour		
Number of open of Number of open f Number of chimne Number of flues Number of flues Number of blocke Number of interm Number of passiv Number of fluele	lues ys / flues attached t attached t d chimneys ittent ext e vents	to solid for to other he tract fans	uel boiler eater	ire							0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 3 * 10 = 0 * 10 = 0 * 40 =	0.0000	(6b) (6c) (6d) (6e) (6f) (7a) (7b)	
Infiltration due Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides	thod AP50 e	eys, flues	and fans	= (6a)+(6b)	+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000	/ (5) =	es per hour 0.2043 Yes Blower Door 5.0000 0.4543	(8)	
Shelter factor Infiltration rat		d to inclu	de shelter f	actor					(20) = 1 -	[0.075 x .) = (18) x		0.7000 0.3180	(20)	
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		Oct 4.3000 1.0750	Nov 4.5000 1.1250	Dec 4.7000 1.1750		
Adj infilt rate Effective ac	0.4055	0.3976	0.3896 0.5759	0.3498	0.3419	0.3021 0.5456	0.3021 0.5456	0.2942	0.3180	0.3419	0.3578 0.5640	0.3737 0.5698	(22b)	
3. Heat losses a	nd heat lo	ss parame	ter						ΑχΙ	ı v-	-value	Α×Κ		
HG Door				m2	m2		m2 0700	W/m2K 1.2000	W/F 2.4840	C k	tJ/m2K	kJ/K		
Windows (Uw = 1. Heat Loss Floor External Walls Plane Roof Total net area o	1	elements		84.8600 31.4100	15.6700	13. 31. 69. 31.	6000 3800 1900 4100 6500	1.1450 0.1200 0.1700 0.1000	15.5725 3.7656 11.7623 3.1410	110 110	0.0000 0.0000 0.0000	3451.8000 7610.9000 282.6900	(27) (28a) (29a)	
Fabric heat loss Party Walls GF - Timber FF - Timber Internal Floor Internal Ceiling	, W/K = Su		. ,,			27. 48. 51. 27.		0.0000	= 36.7254 0.0000) 110 9 9 18	0.0000 9.0000 9.0000 9.0000	3049.2000 432.0000 466.5600 495.0000 247.5000	(33) (32) (32c) (32c) (32d)	
Heat capacity Cm Thermal mass par List of Thermal	ameter (TM		TFA) in kJ/m	2K				(28)	(30) + (32)	+ (32a)	.(32e) =	16035.6500 272.3446		
K1 Eleme	ent	(including	other steel	lintels)				1	Length Ps 1.8800 8.3700	0.0190 0.0210	Tot 0.22 0.17	257		

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E6 Int E10 Ea E12 Ga E16 Co E25 St P1 Par P2 Par	und floor (ermediate f ves (insula ble (insula rner (norma aggered par ty wall - G ty wall - F ty wall - F s (Sum(L x bridges	loor within tion at certain at certain at certain at certain at certain at the ce	e floor with ation at cei	ngs nin a dwell ling level	.)			17. 16. 9. 8. 15. 10. 5.	1000 9500 0700 8900 6000 0000 0000 5500 8900	0.0160 0.0590 0.0010 0.0630 0.0410 0.0370 0.0410 0.0430 0.0000 0.0400	0.35. 1.05. 0.01. 0.62. 0.35. 0.55. 0.41. 0.23. 0.00. 0.23.	90 61 31 26 50 00 86	
Ventilation he		culated mor	nthly (38)m	= 0.33 × ((25) m × (5)				,		, , , ,		,
(38) m	Jan 28.2072	Feb 28.0525	Mar 27.9009	Apr 27.1888	May 27.0555	Jun 26.4353	Jul 26.4353	Aug 26.3205	Sep 26.6742	Oct 27.0555	Nov 27.3251	Dec 27.6068	(38)
Heat transfer	coeff 69.1777	69.0230	68.8714	68.1593	68.0261	67.4059	67.4059	67.2910	67.6448	68.0261	68.2956	68.5774	
Average = Sum(68.1587	
HLP	Jan 1.1749	Feb 1.1723	Mar 1.1697	Apr 1.1576	May 1.1553	Jun 1.1448	Jul 1.1448	Aug 1.1429	Sep 1.1489	Oct 1.1553	Nov 1.1599	Dec 1.1647	(40)
HLP (average) Days in mont	31	28	31	30	31	30	31	31	30	31	30	1.1576 31	
-													
4. Water heati													
Assumed occupa Hot water usag		showers										1.9498	(42)
Hot water usag	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)
Hot water usag	24.5969	24.2316	23.7172	22.7687	22.0585	21.2710	20.8456	21.3564	21.9126	22.7553	23.7233	24.5138	(42b)
Average daily	34.5979	33.3398	32.0817	30.8236	29.5654	28.3073	28.3073	29.5654	30.8236	32.0817	33.3398	34.5979 54.2578	
incrage darry	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(10)
Daily hot wate		57.5714	55.7989	53.5923	51.6239	49.5783	49.1529	50.9219	52.7361	54.8369	57.0631	59.1116	(44)
Energy conte Energy content	93.7501	81.9809	85.7608	73.3651	69.4957	60.9623	59.4462	63.0519	65.0289	74.4132 Total = Si	81.2968	92.5545 901.1065	
Distribution 1		= 0.15 x (4	15)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage Total storage	loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(10)
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	(56)
Primary 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	
Combi loss Total heat req	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
	79.6876	69.6837	72.8967	62.3604	59.0714	51.8180	50.5293	53.5941	55.2746	63.2512	69.1023	78.6714	
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	(63b)
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	
Output from w/	h 79.6876	69.6837	72.8967	62.3604	59.0714	51.8180	50.5293	53.5941	55.2746	63.2512	69.1023	78.6714	
Electric showe										h/year) = Si		765.9405	
	45.5764	40.6090	44.3434	42.3164 Tot	43.1104 al Energy us	41.1232 sed by insta	42.4940 antaneous el	43.1104 Lectric show	42.3164 ver(s) (kWh	44.3434 /year) = Sur	43.5096 m(64a)m =	45.5764 518.4290	(64a) (64a)
Heat gains fro	m water hea 31.3160	27.5732	29.3100	26.1692	25.5455	23.2353	23.2558	24.1761	24.3977	26.8987	28.1530	31.0619	(65)
5. Internal ga	ins (see Ta	ble 5 and 5	āa)										
Metabolic gain	s (Table 5)	, Watts											
(66) m	116.9878				May 116.9878			Aug 116.9878		Oct 116.9878		Dec 116.9878	(66)
Lighting gains	27.2380	24.1926	19.6747	14.8950	11.1342	9.4000	10.1570	13.2025	17.7203	22.5000	26.2608	27.9951	(67)
Appliances gai	253.9010	256.5357	249.8963	235.7620	217.9198	201.1507	189.9479	187.3132	193.9526	208.0870	225.9291	242.6982	(68)
Cooking gains	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	(69)
Pumps, fans Losses e.g. ev					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Water heating			-77.9919	-77.9919	-77.9919	-77.9919	-77.9919	-77.9919	-77.9919	-77.9919	-77.9919	-77.9919	(71)
Total internal	42.0914		39.3952	36.3461	34.3353	32.2712	31.2578	32.4948	33.8858	36.1541	39.1013	41.7499	(72)
		409.4043	396.6108	374.6476	351.0338	330.4664	319.0072	320.6550	333.2032	354.3856	378.9358	400.0877	(73)
6. Solar gains													
									pp.	3		Co.i.	
[Jan]				m2	Solar flux Table 6a W/m2	Speci	fic data	Specific	data	Acces facto Table	nr.	Gains W	
Nowthoost												10 7041	(75)
Northeast Southeast			5.00	100	11.2829 36.7938 11.2829		0.6300	0.	8000	0.770	00	19.7041 28.7864	(77)
Northwest									8000	0.77	JU	25.0636	(81)
Solar gains													
Total gains	484.4290	349.364U	02/.8808	121.4061	806.5804	809.∠988	109.5914	090.4910	003.9034	519.9415	409./445	401.2824	(04)

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7. Mean interna													
Temperature dur Utilisation fac	ctor for ga	ains for li	ving area,	nil,m (see 1	able 9a)							21.0000	(85)
tau alpha	Jan 64.3899 5.2927	Feb 64.5342 5.3023	Mar 64.6763 5.3118	Apr 65.3520 5.3568	May 65.4800 5.3653	Jun 66.0825 5.4055	Jul 66.0825 5.4055	Aug 66.1953 5.4130	Sep 65.8491 5.3899	Oct 65.4800 5.3653	Nov 65.2216 5.3481	Dec 64.9536 5.3302	
util living are	0.9941	0.9878	0.9667	0.8905	0.7260	0.5246	0.3840	0.4451	0.7169	0.9409	0.9881	0.9954	(86)
MIT Th 2 util rest of ho	19.8593 19.9401	20.0371 19.9423	20.3362 19.9443	20.6994 19.9541	20.9200 19.9559	20.9884 19.9644	20.9982 19.9644	20.9962 19.9660	20.9449 19.9611	20.6292 19.9559	20.1764 19.9522	19.8246 19.9483	
MIT 2 Living area fra	0.9921 18.6335	0.9836 18.8603	0.9553 19.2351	0.8571 19.6709	0.6626 19.8967	0.4436 19.9588	0.2944 19.9639	0.3468 19.9649	0.6297 19.9286 ft.A =	0.9145 19.6050 Living area	0.9833 19.0463	0.9938 18.5955 0.1914	(90)
MIT Temperature adj	18.8681	19.0855	19.4458	19.8677	20.0925	20.1558	20.1619	20.1623	20.1231	19.8011	19.2626	18.8308	
adjusted MIT	18.8681	19.0855	19.4458	19.8677	20.0925	20.1558	20.1619	20.1623	20.1231	19.8011	19.2626	18.8308	(93)
8. Space heatin	ng requirem	ment											
Ext temp.	Jan 0.9891 479.1664 4.3000	Feb 0.9789 537.9806 4.9000	Mar 0.9484 595.5066 6.5000	Apr 0.8540 621.1810 8.9000	May 0.6714 541.5335 11.7000	Jun 0.4589 371.3503 14.6000	Jul 0.3116 239.7887 16.6000	Aug 0.3656 252.4641 16.4000	Sep 0.6443 390.3610 14.1000	Oct 0.9097 472.9845 10.6000	Nov 0.9788 459.7979 7.1000	Dec 0.9914 457.2931 4.2000	(95)
	L007.7907	979.1293	891.5968	747.5529	570.9114	374.4963	240.0933	253.1672	407.4309	625.9130	830.6542	1003.3406	(97)
Space heating k Space heating r Solar heating k	393.2965 requirement	296.4519 - total p	220.2911 er year (kW	90.9878 h/year)	21.8571	0.0000	0.0000	0.0000	0.0000	113.7788	267.0166	406.2593 1809.9392	(98a)
Solar heating &	0.0000 contributio	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	(98b)
	393.2965 requirement		220.2911 ar contribu	90.9878 tion - total	21.8571 per year	0.0000 (kWh/year)	0.0000	0.0000	0.0000	113.7788 (98c)	267.0166	406.2593 1809.9392 30.7395	
9a. Energy requ Fraction of spa Fraction of spa Efficiency of m Efficiency of spa	airements - 	Individua rom seconda rom main sy heating sy heating sy	l heating s ry/suppleme stem(s) stem 1 (in stem 2 (in	ystems, incl ntary system %) %)	uding micr	O-CHP						0.0000 1.0000 100.0000 0.0000 0.0000	(202) (206) (207)
bilicioncy of a	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(200)
Space heating r		296.4519	220.2911	90.9878	21.8571	0.0000	0.0000	0.0000	0.0000	113.7788	267.0166	406.2593	(98)
Space heating e	efficiency 100.0000	(main heat 100.0000	ing system 100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
	393.2965	296.4519	220.2911	90.9878	21.8571	0.0000	0.0000	0.0000	0.0000	113.7788	267.0166	406.2593	(211)
Space heating e	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating f	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)
11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating Water heating r													
Efficiency of w		69.6837 er 100.0000	72.8967	62.3604	59.0714	51.8180	50.5293	53.5941	55.2746 100.0000	63.2512	69.1023	78.6714 100.0000 100.0000	(216)
Fuel for water				62.3604	59.0714	51.8180	50.5293	53.5941	55.2746	63.2512	69.1023	78.6714	
Space cooling f			0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Pumps and Fa Lighting	0.0000 23.8413	0.0000 19.1264	0.0000 17.2212	0.0000 12.6170	0.0000 9.7457	0.0000 7.9623	0.0000 8.8904	0.0000 11.5560	0.0000 15.0101	0.0000 19.6941	0.0000 22.2445	0.0000 24.5039	
Electricity gen (233a)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	(233a)
Electricity gen (234a)m Electricity gen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
(235a)m Electricity use	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 eneration)	0.0000	0.0000	0.0000	0.0000	(235a)
(235c)m Electricity gen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
(233b)m Electricity gen	0.0000 nerated by						0.0000	0.0000	0.0000	0.0000	0.0000		(233b)
(234b)m Electricity gen								0.0000	0.0000	0.0000	0.0000		(234b)
(235b)m Electricity use							0.0000 ve if net ge 0.0000		0.0000	0.0000	0.0000		(235b)
(235d)m Annual totals k Space heating f		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating f Space heating f Space heating f Efficiency of w Water heating f Space cooling f	fuel - mair fuel - seco water heate fuel used	n system 2 ondary										0.0000 0.0000 100.0000 765.9405 0.0000	(213) (215) (219)
Electricity for Total electrici Electricity for	ity for the	e above, kW		ix L)								0.0000 192.4129	
Energy saving/g PV generation Wind generation Hydro-electric	n.			ces M ,N and	l Q)							0.0000 0.0000 0.0000	

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Electricity generated - Micro CHP (Appendix N) Appendix Q - special features Energy saved or generated Energy used Total delivered energy for all uses				0.0000 -0.0000 0.0000 3286.7217	(236) (237)
10a. Fuel costs - using Table 12 prices		Fuel price p/kWh		Fuel cost	
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Pumps, fans and electric keep-hot Energy for lighting Additional standing charges Total energy cost	1809.9392 765.9405 518.4290 0.0000 192.4129	16.4900 16.4900 16.4900 0.0000 16.4900		298.4590 0.0000 126.3036 85.4889 0.0000 31.7289 0.0000 541.9804	(240) (473) (247) (247a) (249) (250) (251)
11a. SAP rating - Individual heating systems Energy cost deflator (Table 12): Energy cost factor (ECF) SAP value SAP rating (Section 12) SAP band		x (256)] / [(4) +	45.0] =	0.3600 1.8783 69.5535 70 C	(257) (258)
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP					
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot Energy for lighting Total CO2, kg/year CO2 emissions per m2 EI value EI rating EI band	Energy kWh/year 1809.9392 765.9405 518.4290 0.0000 192.4129	Emission factor kg CO2/kWh 0.1564 0.1416 0.1391 0.0000 0.1443	kg	Emissions CO2/year 283.1543 0.0000 108.4396 72.1249 391.5939 0.0000 27.7711 491.4900 93.6600 94 A	(261) (373) (264) (264a) (265) (267) (268) (272) (273)
SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY					
1. Overall dwelling characteristics Ground floor First floor Total floor area TFA = (la)+(lb)+(lc)+(ld)+(le)(ln) Dwelling volume 58.8800	Area (m2) 31.3800 (1b) 27.5000 (1c)		(2c) =		(1b) - (3b) (1c) - (3c) (4) (5)
2. Ventilation rate					
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			m3 0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 3 * 10 = 0 * 10 = 0 * 40 =	per hour	(6b) (6c) (6d) (6e) (6f) (7a) (7b)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+ Pressure Test Method Measured/design AP50 Infiltration rate Number of sides sheltered	(7b)+(7c) =	30.0000	Air changes / (5) = Bl	0.2043 Yes ower Door 5.0000 0.4543	(8)
Shelter factor Infiltration rate adjusted to include shelter factor	(20)	$= 1 - [0.075 \times (21) = (18)$		0.7000 0.3180	
Jan Feb Mar Apr May Jun Jul Wind speed 4.3000 4.0000 4.1000 3.8000 3.7000 3.2000 3.1000 Wind factor 1.0750 1.0000 1.0250 0.9500 0.9250 0.8000 0.7750 Adj infilt rate	3.1000	Sep Oct 3.3000 3.5000 0.8250 0.8750	Nov 3.4000 0.8500	Dec 3.8000 0.9500	

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0.3021 (22b) 0.5456 (25) Effective ac 0.5584 0.5506 0.5433 0.5324 0.5304 0.5304 0.5365 3. Heat losses and heat loss parameter A x U W/K 2.4840 Gross Openings NetArea U-value K-value m2 2.0700 Windows (Uw = 1.20) 13.6000 1.1450 15.5725 3451.8000 (28a) 7610.9000 (29a) 282.6900 (30) Heat Loss Floor 1 External Walls 31.3800 69.1900 0.1200 0.1700 3.7656 110.0000 110.0000 31.4100 Plane Roof 31.4100 3.1410 Total net area of external elements Aum(A, m2) 147.6500 (31) (26)...(30) + (32) = Fabric heat loss, W/K = Sum (A x U)
Party Walls 36.7254 27.7200 GF - Timber FF - Timber 48.0000 9.0000 432.0000 466.5600 (32c) (32c) 51.8400 Heat capacity Cm = Sum(A \times k) Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K List of Thermal Bridges $(28) \dots (30) + (32) + (32a) \dots (32e) =$ 16035.6500 (34) Psi-value K1 Element Length $\ensuremath{\mathtt{E2}}$ Other lintels (including other steel lintels) $\ensuremath{\mathtt{E3}}$ Sill 11.8800 0.0190 0.0210 0.2257 0.1758 0.3536 E4 Jamb 0.0160 E5 Ground floor (normal) E6 Intermediate floor within a dwelling E10 Eaves (insulation at ceiling level) E12 Gable (insulation at ceiling level) 17.9500 0.0590 1.0590 16.0700 0.0010 0.0161 9.8900 0.0410 0.3526 E16 Corner (normal) 15.0000 0.0370 0.5550 E16 Corner (normal) E25 Staggered party wall between dwellings P1 Party wall - Ground floor P2 Party wall - Intermediate floor within a dwelling P4 Party wall - Roof (insulation at ceiling level) 0.0410 0.4100 0.0000 0.0000 5.8900 0.0400 0.2356 Thermal bridges (Sum(L x Psi) calculated using Appendix K) Point Thermal bridges
Total fabric heat loss 4.2451 (36) 0.0000 40.9705 (37) (33) + (36) + (36a) Nov 25.9943 Oct 26.0999 Dec 26.4353 (38) Heat transfer coeff 68.0261 Average = Sum(39)m / 12 67.4059 (39) 67.2113 67 6448 67 7688 67 4059 67 2910 66 7627 66 6662 66 6662 66 8622 67 0705 66.9648 Feb Mar Jun Jul Nov May 1.1429 Sep 1.1356 1.1448 (40) 1.1415 1.1553 1.1489 1.1510 1.1448 1.1339 1.1322 1.1322 1.1391 1.1373 31 31 30 31 31 31 31 Days in mont 31 4. Water heating energy requirements (kWh/year) Assumed occupancy 1.9498 (42) water usage for mixer showers 0.0000 0.0000 0.0000 0.0000 (42a) 0.0000 Hot water usage for baths 24.2316 23.7172 22.7687 22.0585 21.2710 20.8456 21.3564 21.9126 22.7553 23.7233 24.5138 (42b) 24.5969 Hot water usage for other uses 34.5979 33.3398 28.3073 34.5979 (42c) 54.2578 (43) Average daily hot water use (litres/day) Jul Daily hot water use 59.1948 57.5714 55.7989 53.5923 51.6239 49.1529 52.7361 54.8369 57.0631 59.1116 (44) 50.9219 Energy conte 93.7501 81.9809 81 Energy content (annual) Distribution loss (46)m = 0.15 x (45)m 85 7608 73 3651 69 4957 60 9623 63 0519 65 0289 74 4132 81 2968 92.5545 (45) 901.1065 0.0000 0.0000 0.0000 (46) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Water storage loss: Total storage loss 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56) If cylinder contains dedicated solar 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 (57) Primary loss 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (59) 0.0000 (61) Combi loss 0.0000 0.0000 0.0000 Total heat required for water heating calculated for each month 69.6837 0.0000 0.0000 62.3604 0.0000 0.0000 59.0714 51.8180 50 5293 53.5941 63 2512 69.1023 78.6714 (62) 0.0000 (63a) 0.0000 (63b) WWHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 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 0.0000 0.0000 (63c FGHRS
Output from w/h 0.0000 0.0000 0.0000 0.0000 0.0000 79.6876 69.6837 72.8967 62.3604 59.0714 63.2512 51.8180 50.5293 53.5941 69.1023 Total per year (kWh/year) = Sum(64)m = 765 9405 (64) Electric shower(s) 44.3434 Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 518.4290 (64a) Heat gains from water heating, kWh/month 31.3160 27.5732 29 29.3100 26 1692 23.2353 23 2558 24 1761 31.0619 (65) 5. Internal gains (see Table 5 and 5a) Metabolic gains (Table 5), Watts
 Metabolic gains (Table 5), Watts
 Jan
 Feb
 Mar
 Apr
 May
 Jun

 (66)m
 116.9878
 116.9878
 116.9878
 116.9878
 116.9878
 116.9878
 1

 Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
 27.2380
 24.1926
 19.6747
 14.8950
 11.1342
 9.4000

 Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table
 253.9010
 256.5357
 249.8963
 235.7620
 217.9198
 201.1507
 1
 Aug 116.9878 116.9878 116.9878 116.9878 116.9878 116.9878 (66) 10.1570 13.2025 17 7203 22 5000 26 2608 27.9951 (67) 189.9479 187.3132 193.9526 208.0870 225.9291 242.6982 (68)

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Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal	48.6486 0.0000 vaporation (1 -77.9919 gains (Table 42.0914 gains 410.8749	48.6486 0.0000 negative va -77.9919 e 5) 41.0315	48.6486 0.0000 alues) (Tabl -77.9919 39.3952 396.6108	48.6486 0.0000 Le 5) -77.9919 36.3461 374.6476	48.6486 0.0000 -77.9919 34.3353 351.0338	48.6486 0.0000 -77.9919 32.2712 330.4664	48.6486 0.0000 -77.9919 31.2578 319.0072	48.6486 0.0000 -77.9919 32.4948 320.6550	48.6486 0.0000 -77.9919 33.8858 333.2032	48.6486 0.0000 -77.9919 36.1541 354.3856	48.6486 0.0000 -77.9919 39.1013 378.9358	48.6486 0.0000 -77.9919 41.7499 400.0877	(70) (71) (72)
6. Solar gains													
[Jan]				rea m2	Solar flux Table 6a W/m2	Speci:	g fic data Table 6b	Specific or Tab		Acces facto Table 6	or	Gains W	
Northeast Southeast Northwest			5.00 2.24 6.30	100 500	13.7947 43.3860 13.7947		0.6300 0.6300 0.6300	0 0 0	.8000 .8000 .8000	0.770 0.770 0.770	0.0	24.0906 33.9439 30.6432	(77)
Solar gains Total gains	88.6777 499.5526	153.4036 562.8079	244.0691 640.6799	381.0722 755.7197	473.7274 824.7612	536.0524 866.5188	488.1841 807.1914	410.6421 731.2971	302.4448 635.6480	183.4207 537.8063	107.9860 486.9218	74.1111 474.1988	
7. Mean intern	nal temperati	ure (heatir	ng season)										
Temperature du Utilisation fa		ins for liv	ving area, r			Th1 (C)						21.0000	(85)
tau alpha	Jan 65.4800 5.3653	Feb 65.8491 5.3899	Mar 65.7286 5.3819	Apr 66.0825 5.4055	May 66.1953 5.4130	Jun 66.7191 5.4479	Jul 66.8157 5.4544	Aug 66.8157 5.4544	Sep 66.6198 5.4413	Oct 66.4129 5.4275	Nov 66.5177 5.4345	Dec 66.0825 5.4055	
util living ar	0.9927	0.9852	0.9584	0.8613	0.6736	0.4364	0.3135	0.3547	0.6455	0.9212	0.9842	0.9944	(86)
MIT Th 2	19.9356 19.9559	20.1138 19.9611	20.4194 19.9594	20.7656 19.9644	20.9491 19.9660	20.9959 19.9733	20.9995 19.9746	20.9990 19.9746	20.9700 19.9719	20.7014 19.9690	20.2647 19.9705	19.8982 19.9644	
util rest of h	0.9902	0.9802	0.9444	0.8220	0.6060	0.3592	0.2291	0.2619	0.5538	0.8876	0.9778	0.9925	(89)
MIT 2 Living area fr MIT	18.7422 faction 18.9706	18.9712 19.1899	19.3487 19.5536	19.7512	19.9310	19.9716	19.9745	19.9744	19.9562 fLA = 20.1502	19.6975 Living area 19.8896	19.1709 a / (4) = 19.3803	18.7010 0.1914 18.9301	(91)
Temperature ad adjusted MIT		19.1899	19.5536	19.9454	20.1259	20.1676	20.1707	20.1705	20.1502	19.8896	19.3803	0.0000	
8. Space heati													
Utilisation Useful gains Ext temp.	Jan 0.9869 493.0017 4.5000	Feb 0.9752 548.8520 5.1000	Mar 0.9376 600.7199 6.9000	Apr 0.8212 620.6110 9.3000	May 0.6169 508.8233 12.3000	Jun 0.3739 324.0039 15.3000	Jul 0.2453 197.9736 17.2000	Aug 0.2797 204.5564 17.1000	Sep 0.5704 362.5744 14.6000	Oct 0.8845 475.6763 11.0000	Nov 0.9728 473.7009 7.4000	Dec 0.9897 469.3022 4.4000	(95)
Heat loss rate	984.3811	953.1061	857.5201	717.5602	526.6100	324.9768	198.0438	204.6985	371.1012	596.2331	802.2557	979.4167	(97)
Space heating Space heating	365.5863 requirement		191.0594 er year (kWh	69.8034 n/year)	13.2333	0.0000	0.0000	0.0000	0.0000	89.6943	236.5595	379.5252 1617.1201	(98a)
Solar heating	0.0000	0.0000 n - total p	0.0000 per year (kW	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	kWh 365.5863 requirement	271.6588	191.0594	69.8034	13.2333 per year	0.0000 (kWh/year)	0.0000	0.0000	0.0000	89.6943 (98c)	236.5595	379.5252 1617.1201 27.4647	
9a. Energy red	quirements -	Individua	l heating sy	stems, incl	luding micr	O-CHP							
Fraction of sp Fraction of sp Efficiency of Efficiency of Efficiency of	pace heat from ace heat from main space hace heat from main space heat from main space heat heat from the heat fro	om secondar om main sys heating sys heating sys	ry/supplemer stem(s) stem 1 (in 9 stem 2 (in 9	ntary system 8) 8)								0.0000 1.0000 100.0000 0.0000 0.0000	(202) (206) (207)
Space heating	Jan requirement	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating	365.5863 efficiency	271.6588 (main heat:	ing system 1		13.2333	0.0000	0.0000	0.0000	0.0000	89.6943	236.5595	379.5252	
Space heating	fuel (main)	heating sys		100.0000	13.2333	0.0000	0.0000	0.0000	0.0000	100.0000 89.6943	100.0000 236.5595	100.0000	
Space heating	365.5863 efficiency 0.0000				0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	379.5252 0.0000	
Space heating				0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating	fuel (second 0.0000	dary) 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating Water heating	requirement.												
Efficiency of	79.6876	69.6837	72.8967	62.3604	59.0714	51.8180	50.5293	53.5941	55.2746	63.2512	69.1023	78.6714 100.0000	(216)
(217)m Fuel for water	100.0000 heating, ki	100.0000 Wh/month	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	
Space cooling (221)m	79.6876 fuel require 0.0000	69.6837 ement 0.0000	72.8967	0.0000	0.0000	51.8180	0.0000	0.0000	0.0000	0.0000	0.0000	78.6714	
Pumps and Fa Lighting	0.0000 23.8413	0.0000 19.1264	0.0000 17.2212	0.0000 12.6170	0.0000 9.7457	0.0000 0.0000 7.9623	0.0000 8.8904	0.0000 11.5560	0.0000 15.0101	0.0000 19.6941	0.0000	0.0000	(231)
Electricity ge (233a)m	0.0000	PVs (Append 0.0000	dix M) (nega 0.0000	ative quanti 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)

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Electricity generated by wind turbines (234a)m 0.0000 0.0000	(Appendix M) (negative qua 0.0000 0.0000 0.000		0 0.0000	0.0000 0.0	000 0.0000	0.0000 (234a
Electricity generated by hydro-electric		negative quantity)			000 0.0000	
Electricity used or net electricity gen (235c)m 0.0000 0.0000	erated by micro-CHP (Appen	dix N) (negative if net	generation)		000 0.0000	
Electricity generated by PVs (Appendix					000 0.0000	
Electricity generated by wind turbines		ntity)			0.0000	
Electricity generated by hydro-electric (235b)m 0.0000 0.0000	generators (Appendix M) (negative quantity)			000 0.0000	
Electricity used or net electricity gen	erated by micro-CHP (Appen	dix N) (negative if net	generation)			
(235d)m 0.0000 0.0000 Annual totals kWh/year	0.0000 0.0000 0.00	0.0000 0.000	0.0000	0.0000 0.0	0.0000	
Space heating fuel - main system 1 Space heating fuel - main system 2						1617.1201 (211) 0.0000 (213)
Space heating fuel - secondary Efficiency of water heater						0.0000 (215) 100.0000
Water heating fuel used Space cooling fuel						765.9405 (219) 0.0000 (221)
Electricity for pumps and fans: Total electricity for the above, kWh/ye Electricity for lighting (calculated in						0.0000 (231) 192.4129 (232)
Energy saving/generation technologies (Appendices M ,N and Q)					
PV generation Wind generation						0.0000 (233) 0.0000 (234)
Hydro-electric generation (Appendix N) Electricity generated - Micro CHP (Appe	endix N)					0.0000 (235a 0.0000 (235)
Appendix Q - special features Energy saved or generated						-0.0000 (236)
Energy used Total delivered energy for all uses						0.0000 (237) 3093.9026 (238)
10a. Fuel costs - using BEDF prices (53	6)					
			Fuel	Fuel pr		Fuel cost
Space heating - main system 1			kWh/year 1617.1201	p/ 25.1		£/year 406.8674 (240)
Total CO2 associated with community sys Water heating (other fuel)	tems		765.9405	25.1	600	0.0000 (473) 192.7106 (247)
Energy for instantaneous electric showe Pumps, fans and electric keep-hot	r(s)		518.4290 0.0000	25.1 0.0		130.4367 (247a 0.0000 (249)
Energy for lighting Additional standing charges			192.4129	25.1	600	48.4111 (250) 0.0000 (251)
Total energy cost						778.4259 (255)
12a. Carbon dioxide emissions - Individ	ual heating systems includ	ing micro-CHP				
			Energy kWh/year	Emission fac	kWh !	Emissions kg CO2/year
Space heating - main system 1 Total CO2 associated with community sys	tems		1617.1201	0.1		253.7982 (261) 0.0000 (373)
Water heating (other fuel) Energy for instantaneous electric showe	r(s)		765.9405 518.4290	0.1 0.1	416 391	108.4396 (264) 72.1249 (264a
Space and water heating Pumps, fans and electric keep-hot			0.0000		000	362.2378 (265) 0.0000 (267)
Energy for lighting Total CO2, kg/year			192.4129	0.1	443	27.7711 (268) 462.1339 (272)
13a. Primary energy - Individual heatin	g systems including micro-	CHP				
Space heating - main system 1	tomo			Primary energy fac kg CO2/ 1.5		mary energy kWh/year 2556.6981 (275)
Total CO2 associated with community sys Water heating (other fuel)			Energy F kWh/year 1617.1201 765.9405	kg CO2/ 1.5 1.5	kWh 810 235	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278)
Total CO2 associated with community sys Water heating (other fuel) Energy for instantaneous electric showe Space and water heating			Energy F kWh/year 1617.1201 765.9405 518.4290	kg CO2/ 1.5 1.5 1.5	kWh 810 235 143	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278) 785.0748 (278a 3723.6336 (279)
Total CO2 associated with community sys Water heating (other fuel) Energy for instantaneous electric showe Space and water heating Pumps, fans and electric keep-hot Energy for lighting			Energy F kWh/year 1617.1201 765.9405	kg CO2/ 1.5 1.5 1.5	kWh 810 235 143	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278) 785.0748 (278- 3723.6336 (279) 0.0000 (281) 295.1294 (282)
Total CO2 associated with community sys Water heating (other fuel) Energy for instantaneous electric showe Space and water heating Pumps, fans and electric keep-hot			Energy F kWh/year 1617.1201 765.9405 518.4290 0.0000	kg co2/ 1.5 1.5 1.5	kWh 810 235 143	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278) 785.0748 (278a 3723.6336 (279) 0.0000 (281)
Total CO2 associated with community sys Water heating (other fuel) Energy for instantaneous electric showe Space and water heating Pumps, fans and electric keep-hot Energy for lighting	r(s)		Energy F kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129	kg co2/ 1.5 1.5 1.5	kWh 810 235 143	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278) 785.0748 (278- 3723.6336 (279) 0.0000 (281) 295.1294 (282)
Total CO2 associated with community sys Water heating (other fuel) Energy for instantaneous electric showe Space and water heating Pumps, fans and electric keep-hot Energy for lighting Total Primary energy kWh/year SAP 10 EPC IMPROVEMENTS	r(s)		Energy F kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129	kg co2/ 1.5 1.5 1.5	kWh 810 235 143	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278) 785.0748 (278- 3723.6336 (279) 0.0000 (281) 295.1294 (282)
Total CO2 associated with community sys Water heating (other fuel) Energy for instantaneous electric showe Space and water heating Pumps, fans and electric keep-hot Energy for lighting Total Primary energy kWh/year SAP 10 EPC IMPROVEMENTS 002 - Be Lean	r(s)		Energy F kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129	kg co2/ 1.5 1.5 1.5	kWh 810 235 143	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278) 785.0748 (278- 3723.6336 (279) 0.0000 (281) 295.1294 (282)
Total CO2 associated with community sys Water heating (other fuel) Energy for instantaneous electric showe Space and water heating Pumps, fans and electric keep-hot Energy for lighting Total Primary energy kWh/year SAP 10 EPC IMPROVEMENTS	r(s)		Energy F kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129	kg co2/ 1.5 1.5 1.5	kWh 810 235 143	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278) 785.0748 (278- 3723.6336 (279) 0.0000 (281) 295.1294 (282)
Total CO2 associated with community sys Water heating (other fuel) Energy for instantaneous electric showe Space and water heating Pumps, fans and electric keep-hot Energy for lighting Total Primary energy kWh/year SAP 10 EPC IMPROVEMENTS OU2 - Be Lean Current energy efficiency rating: Current environmental impact rating: N Solar water heating	r(s)	C 70 A 94 Recommended	Energy F kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129	kg co2/ 1.5 1.5 1.5	kWh 810 235 143	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278) 785.0748 (278- 3723.6336 (279) 0.0000 (281) 295.1294 (282)
Total CO2 associated with community sys Water heating (other fuel) Energy for instantaneous electric showe Space and water heating Pumps, fans and electric keep-hot Energy for lighting Total Primary energy kWh/year SAP 10 EPC IMPROVEMENTS O02 - Be Lean Current energy efficiency rating: Current environmental impact rating:	r(s)	C 70 A 94	Energy F kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129	kg co2/ 1.5 1.5 1.5	kWh 810 235 143	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278) 785.0748 (278- 3723.6336 (279) 0.0000 (281) 295.1294 (282)
Total CO2 associated with community sys Water heating (other fuel) Energy for instantaneous electric showe Space and water heating Pumps, fans and electric keep-hot Energy for lighting Total Primary energy kWh/year SAP 10 EPC IMPROVEMENTS OU2 - Be Lean Current energy efficiency rating: Current environmental impact rating: N Solar water heating U Solar photovoltaic panels V2 Wind turbine Recommended measures:	r(s)	C 70 A 94 Recommended Recommended Not applicable e CO2 change	Energy F kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129	kg co2/ 1.5 1.5 1.5	kWh 810 235 143	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278) 785.0748 (278- 3723.6336 (279) 0.0000 (281) 295.1294 (282)
Total CO2 associated with community sys Water heating (other fuel) Energy for instantaneous electric showe Space and water heating Pumps, fans and electric keep-hot Energy for lighting Total Primary energy kWh/year SAP 10 EPC IMPROVEMENTS OU2 - Be Lean Current energy efficiency rating: Current environmental impact rating: N Solar water heating U Solar photovoltaic panels V2 Wind turbine	r(s)	C 70 A 94 Recommended Recommended Not applicable	Energy F kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129	kg co2/ 1.5 1.5 1.5	kWh 810 235 143	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278) 785.0748 (278- 3723.6336 (279) 0.0000 (281) 295.1294 (282)
Total CO2 associated with community sys Water heating (other fuel) Energy for instantaneous electric showe Space and water heating Pumps, fans and electric keep-hot Energy for lighting Total Primary energy kWh/year SAP 10 EPC IMPROVEMENTS Current energy efficiency rating: Current environmental impact rating: N Solar water heating U Solar photovoltaic panels V2 Wind turbine Recommended measures: N Solar water heating	SAP change Cost chang + 2.8 - £ 84 + 10.3 -£ 271	C 70 A 94 Recommended Recommended Not applicable e C02 change -43 kg (9.3%) -241 kg (57.5%) Energy Environme	Energy F kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129	kg co2/ 1.5 1.5 1.5	kWh 810 235 143	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278) 785.0748 (278- 3723.6336 (279) 0.0000 (281) 295.1294 (282)
Total CO2 associated with community sys Water heating (other fuel) Energy for instantaneous electric showe Space and water heating Pumps, fans and electric keep-hot Energy for lighting Total Primary energy kWh/year SAP 10 EPC IMPROVEMENTS Current energy efficiency rating: Current environmental impact rating: N Solar water heating U Solar photovoltaic panels V2 Wind turbine Recommended measures: N Solar water heating	SAP change Cost chang + 2.8 -£ 84 + 10.3 -£ 271 Typical annual savings	C 70 A 94 Recommended Recommended Not applicable e CO2 change -43 kg (9.3%) -241 kg (57.5%)	Energy F kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129	kg co2/ 1.5 1.5 1.5	kWh 810 235 143	kWh/year 2556.6981 (275) 0.0000 (473) 1166.9355 (278) 785.0748 (278- 3723.6336 (279) 0.0000 (281) 295.1294 (282)

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Solar photovoltaic panels

Total Savings 4.09 kg/m² 4.82 kg/m² в 83 A 97 Potential energy efficiency rating: A 97 Potential environmental impact rating: Fuel prices for cost data on this page from database revision number 536 TEST (31 Jan 2024) Recommendation texts revision number 6.1 (11 Jun 2019) Typical heating and lighting costs of this home (per year, Thames Valley): $\begin{array}{ccc} \text{Current} & \text{Potential} & \text{Savi} \\ \text{Electricity} & \text{£778} & \text{£694} & \text{£84} \end{array}$ Space heating Water heating Lighting £.407 £427 -f.20 £48 £0 £271 Generated (PV) -£271 -£0 £423 Total cost of uses £778 £423 £355 15 kWh/m² 0.2 tonnes 3 kg/m² 44 kWh/m² Delivered energy Carbon dioxide emissions CO2 emissions per m² Primary energy 53 kWh/m² 37 kWh/m² 0.3 tonnes 5 kg/m² 38 kWh/m² 0.5 tonnes 8 kg/m² 82 kWh/m² SAP 10 WORKSHEET FOR New Build (As Designed) (Ver CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING 1. Overall dwelling characteristics Volume (m3) 75.3120 (1b) - (3b) 71.5000 (1c) - (3c) Storey height Volume (m2) 31.3800 (1b) 27.5000 (1c) (m) 2.4000 (2b) 2.6000 (2c) Ground floor
First floor
Total floor area TFA = (la)+(lb)+(lc)+(ld)+(le)...(ln)
Dwelling volume 58.8800 $(3a) + (3b) + (3c) + (3d) + (3e) \dots (3n) =$ 146.8120 (5) 2. Ventilation rate m3 per hour 0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 3 * 10 = 0 * 10 = 0 * 40 = 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 0.0000 (6a) 0.0000 (6b) 0.0000 (6c) 0.0000 (6d) 0.0000 (6e) 0.0000 30.0000 0.0000 (6f) (7a) (7b) 0.0000 (7c) Air changes per hour 30.0000 / (5) = 0.2043 Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 0.2043 (8) Pressure test Pressure Test Method Measured/design AP50 Yes Tes Blower Door 5.0000 (17) 0.4543 (18) 4 (19) Infiltration rate Number of sides sheltered $- [0.075 \times (19)] = (21) = (18) \times (20) =$ (20) = 1Infiltration rate adjusted to include shelter factor 0.3180 (21) Aug 3.7000 0.9250 Sep 4.0000 May 4.3000 Jun 3.8000 Oct 4.3000 4.7000 (22) 1.1750 (22a) 5.1000 5.0000 4.4000 4.5000 Wind speed 4.9000 3.8000 Wind factor Adj infilt rate 1.2750 1.2250 1.1000 1.0750 0.9500 0.9500 1.0000 1.0750 1.1250 0.3419 Effective ac 0.5822 0.5790 0.5640 0.5698 (25) 3. Heat losses and heat loss parameter Openings m2 Element Gross NetArea II-value K-value W/m2K 1.2000 1.1450 2.0700 HG Door Windows (Uw = 1.20) 2.4840 15.5725 13.6000 3.7656 11.7623 3.1410 3451.8000 (28a) 7610.9000 (29a) 282.6900 (30) 31.3800 69.1900 31.4100 0.1200 0.1700 0.1000 110.0000 110.0000 9.0000 Heat Loss Floor 1 External Walls Plane Roof 31.4100 Total net area of external elements Aum(A, m2) 147.6500 (31)Fabric heat loss, W/K = Sum (A x U)
Party Walls
GF - Timber
FF - Timber (26)...(30) + (32) = 36.7254 27.7200 48.0000 110.0000 3049.2000 9.0000 432.0000 (32c) 466.5600 (32c) 51.8400 9.0000 18.0000 495.0000 (32d) 247.5000 (32e) Heat capacity Cm = Sum(A x k) Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K List of Thermal Bridges K1 Element (28)...(30) + (32) + (32a)...(32e) = 16035.6500 (34)272.3446 (35) Psi-value Length

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E3 Sill E4 Jamb E5 Grou E6 Inte E10 Eav E12 Gab E16 Cor E25 Sta P1 Part	nnd floor (remediate f res (insula res (insula) res (insula) res (insula)	loor within tion at cei tion at cei 1) ty wall bet round floor ntermediate oof (insula	a dwelling ling level) ling level) ween dwelli floor with tion at cei	ngs in a dwell ling level)			8. 22. 17. 16. 9. 8. 15. 10. 5.	8880 3700 1000 9500 0700 8900 6000 0000 0000 5500 8900	0.0190 0.0210 0.0160 0.0590 0.0010 0.0630 0.0410 0.0370 0.0410 0.0430 0.0000 0.0400	0.22; 0.17; 0.35; 1.05; 0.01; 0.62; 0.35; 0.55; 0.41; 0.23; 0.00; 0.23; (36a) = + (36a) =	58 36 90 51 31 226 50 00	
Ventilation hea	nt loss cal Jan	culated mon	thly (38)m Mar	= 0.33 x (25)m x (5) May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m Heat transfer o	28.2072 coeff 69.1777	28.0525 69.0230	27.9009 68.8714	27.1888 68.1593	27.0555 68.0261	26.4353 67.4059	26.4353 67.4059	26.3205 67.2910	26.6742	27.0555 68.0261	27.3251 68.2956	27.6068 68.5774	
Average = Sum(3	39)m / 12 =											68.1587	(33)
HLP HLP (average)	Jan 1.1749	Feb 1.1723	Mar 1.1697	Apr 1.1576	May 1.1553	Jun 1.1448	Jul 1.1448	Aug 1.1429	Sep 1.1489	Oct 1.1553	Nov 1.1599	Dec 1.1647 1.1576	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	
4. Water heatin	ng energy r	equirements	(kWh/year)										
Assumed occupan Hot water usage	e for mixer		0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.9498	
Hot water usage	0.0000 for baths 24.5969	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 24.5138	
Hot water usage			32.0817	30.8236	29.5654	28.3073	28.3073	29.5654	30.8236	32.0817	33.3398	34.5979	
Average daily h			-									54.2578	(43)
Daily hot water	Jan : use 59.1948	Feb 57.5714	Mar 55.7989	Apr 53.5923	May 51.6239	Jun 49.5783	Jul 49.1529	Aug 50.9219	Sep 52.7361	Oct 54.8369	Nov 57.0631	Dec 59.1116	(44)
Energy conte Energy content	93.7501	81.9809	85.7608	73.3651	69.4957	60.9623	59.4462	63.0519	65.0289	74.4132	81.2968 um(45)m =	92.5545 901.1065	
Distribution lo	0.0000	= 0.15 x (4 0.0000	5)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage 1 Total storage 1		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 con	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	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	
Total heat requ	79.6876 0.0000	69.6837 0.0000	72.8967 0.0000	62.3604 0.0000	59.0714	51.8180 0.0000	50.5293	53.5941 0.0000	55.2746 0.0000	63.2512 0.0000	69.1023 0.0000	78.6714 0.0000	
PV diverter Aperture area of Zero-loss colle Collector linea Collector 2nd of Collector loop Incidence angle Overshading fac Overall heat lo Heat loss coeff Dedicated solar Effective solar Reference volum Storage tank co Heat delivered Heat delivered Solar input Solar input Solar input	ector effic er heat los prider heat efficiency e modifier etor ess coeffic ficient of estorage v evolume en en prection c to hot wat to space h	iency s coefficie loss coeffi ient of sys collector l olume oefficient er eating	cient tem oop	-0.0000	-0.0000 -54.3327	-0.0000 -48.4954	-0.0000	-0.0000 -47.0973	-0.0000	-0.0000 -27.7755	-0.0000 -4.5001	-0.0000 3.0000 0.8000 1.8000 0.0000 0.9000 1.0000 0.8000 6.5000 3.9667 75.0000 225.0000 1.3161 381.3293 0.0000 381.3293 -0.0000	(H1) (H2) (H3) (H4) (H5) (H6) (H6) (H11) (H11) (H12) (H14) (H15) (H16) (H24) (H29)
FGHRS Output from w/h			0.0000			0.0000						0.0000	
Electric shower	79.6876	52.4299	29.1872	12.4559	4.7387	3.3226	2.5707		14.9726 er year (kW	35.4757 h/year) = S	64.6022 um(64)m =	78.6714 384.6112	
	45.5764			42.3164 Tot		41.1232 used by insta	42.4940 antaneous e	43.1104 lectric show		44.3434 /year) = Su		45.5764 518.4290	
Heat gains from		ting, kWh/m 27.5732		26.1692	25.5455	23.2353	23.2558	24.1761	24.3977	26.8987	28.1530	31.0619	(65)
5. Internal gains	ins (see Ta (Table 5) Jan	ble 5 and 5 , Watts Feb	a) Mar	 Apr	May		Jul	Aug	Sep 116.9878	Oct 116.9878	Nov 116.9878	Dec 116.9878	(66)
Lighting gains	(calculate 27.2380	d in Append 24.1926	ix L, equat 19.6747	ion L9 or 14.8950	L9a), also 11.1342	see Table 5 9.4000	10.1570	13.2025	17.7203	22.5000	26.2608	27.9951	
	253.9010	256.5357	249.8963	235.7620	217.9198	201.1507	189.9479	187.3132	193.9526	208.0870	225.9291	242.6982	(68)
Cooking gains (Pumps, fans		48.6486 0.0000					48.6486 0.0000	48.6486 0.0000	48.6486	48.6486	48.6486 0.0000	48.6486	
Losses e.g. eva	aporation (negative va	lues) (Tabl	e 5)			-77.9919			-77.9919		-77.9919	
Water heating g	gains (Tabl 42.0914			36.3461	34.3353	32.2712	31.2578	32.4948	33.8858	36.1541	39.1013	41.7499	
Total internal		409.4043	396.6108	374.6476	351.0338	330.4664	319.0072	320.6550	333.2032	354.3856	378.9358	400.0877	(73)

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[Jan]			λ,	rea	Solar flux		ď		FF	Acces	s	Gains	
				m2	Table 6a W/m2	Speci or	fic data Table 6b	Specific or Tab		facto Table 6	r	W	
Northeast Southeast Northwest			5.00 2.20 6.30	000 100 500	11.2829 36.7938 11.2829		0.6300 0.6300 0.6300	0 0 0	.8000 .8000 .8000	0.770 0.770 0.770	0	19.7041 28.7864 25.0636	(77)
Solar gains Total gains					455.5466 806.5804					165.5559 519.9415	90.8087 469.7445	61.1947 461.2824	
7. Mean inter	nal temperat	ture (heati	ng season)										
Temperature d Utilisation f	during heating	ng periods :	in the livi	ng area fro	m Table 9, T							21.0000	(85)
tau	Jan 64.3899	Feb 64.5342	Mar 64.6763	Apr 65.3520	May 65.4800	Jun 66.0825	Jul 66.0825	Aug 66.1953	Sep 65.8491	Oct 65.4800	Nov 65.2216	Dec 64.9536	
alpha util living a		5.3023	5.3118	5.3568	5.3653	5.4055	5.4055	5.4130	5.3899	5.3653	5.3481	5.3302	
MIT	0.9941	0.9878	0.9667	0.8905	0.7260	0.5246	0.3840	0.4451	0.7169	0.9409	0.9881	0.9954 19.8246	
Th 2 util rest of	19.9401	19.9423	19.9443	19.9541	19.9559	19.9644	19.9644	19.9660	19.9611	19.9559	19.9522	19.9483	
MIT 2	0.9921 18.6335	0.9836 18.8603	0.9553 19.2351	0.8571 19.6709	0.6626 19.8967	0.4436 19.9588	0.2944 19.9639	0.3468 19.9649	0.6297 19.9286	0.9145 19.6050	0.9833 19.0463	0.9938 18.5955	(90)
Living area f MIT Temperature a	18.8681	19.0855	19.4458	19.8677	20.0925	20.1558	20.1619	20.1623	1LA = 20.1231	Living area 19.8011	19.2626	0.1914 18.8308 0.0000	(92)
adjusted MIT		19.0855	19.4458	19.8677	20.0925	20.1558	20.1619	20.1623	20.1231	19.8011	19.2626	18.8308	
8. Space heat	ing requirer	ment											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation Useful gains		0.9789 537.9806	0.9484 595.5066	0.8540	0.6714 541.5335	0.4589	0.3116	0.3656	0.6443	0.9097 472.9845	0.9788 459.7979	0.9914 457.2931	(95)
Ext temp. Heat loss rat	4.3000 te W 1007.7907	4.9000 979.1293	6.5000 891.5968	8.9000 747.5529	11.7000 570.9114	14.6000 374.4963	16.6000 240.0933	16.4000 253.1672	14.1000 407.4309	10.6000 625.9130	7.1000 830.6542	4.2000	
Space heating	y kWh 393.2965	296.4519	220.2911	90.9878	21.8571	0.0000	0.0000	0.0000	0.0000	113.7788	267.0166	406.2593	(98a)
Space heating Solar heating		-0.0000	er year (kWl -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	1809.9392 -0.0000	
Solar heating Space heating	contribution				0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating Space heating	requirement	296.4519 t after sola		90.9878	21.8571	0.0000	0.0000	0.0000	0.0000	113.7788	267.0166	406.2593 1809.9392	
space nearing	per mz			LION - COCA	i per year '	(KMII/ YCCL)				(98c)	/ (4) =	30.7395	
		To dividuo								(98c)	/ (4) =		
9a. Energy re	equirements		l heating s	ystems, inc	luding micro)-CHP				(98c)	/ (4) =		(99)
9a. Energy re Fraction of s Fraction of s Efficiency of	equirements - space heat fi space heat fr main space	rom seconda: rom main sy: heating sy: heating sy:	l heating syry/supplements stem(s) stem 1 (in stem 2 (in stem 2 (in stem 2 (in stem 3 (i	ystems, incontary syste	luding micro)-CHP				(98c)	/ (4) =	0.0000 1.0000 100.0000 0.0000	(201) (202) (206) (207)
Pa. Energy re Fraction of s Fraction of s Efficiency of Efficiency of	equirements - space heat fr space heat fr main space main space secondary/s	rom seconda: rom main sy: heating sy: heating sy: supplementa: Feb	l heating syry/supplements stem(s) stem 1 (in stem 2 (in stem 2 (in stem 2 (in stem 3 (i	ystems, incontary syste	luding micro)-CHP	Jul	Aug	Sep	(98c) Oct	/ (4) =	0.0000 1.0000 100.0000	(201) (202) (206) (207)
Pa. Energy re Fraction of s Fraction of s Fraction of s Fficiency of Fficiency of	equirements - space heat fi pace heat fi main space main space secondary/s Jan requirement 393,2965	rom seconda: rom main sy: heating sy: heating sy: supplementa: Feb t	l heating syry/supplements tem(s) stem 1 (in stem 2 (in	/stems, incontrary systems, incontrary systems, incontrary system, incontrary system, incompared and incompared	luding micro)-СНР	Jul 0.0000	Aug 0.0000	Sep 0.0000			0.0000 1.0000 100.0000 0.0000 0.0000	(201) (202) (206) (207) (208)
Paction of s Fraction of s Efficiency of Efficiency of Efficiency of Space heating	equirements space heat fi fmain space fmain space f secondary/s Jan frequirement 393,2965 gefficiency 100.0000	rom seconda: rom main sy: heating sy: heating sy: supplementa: Feb t 296.4519 (main heat: 100.0000	l heating syry/supplements stem (s) stem 1 (in stem 2 (ystems, incontary syste (a) (b) (c) (c) (d) (d) (d) (d) (d) (d) (d) (d) (d) (d	.luding micro m (Table 11)	Jun		=		Oct	Nov	0.0000 1.0000 100.0000 0.0000 0.0000	(201) (202) (206) (207) (208)
Da. Energy re Fraction of s Fraction of s Efficiency of Efficiency of Efficiency of Efficiency of Epace heating Epace heating	equirements epace heat fi main space f main space secondary/s Jan grequirement 393,2965 gefficiency 100.0000 g 100.0000 g 393,2965	rom seconda: rom main sy: heating sy: heating sy: supplementa: Feb t 296.4519 (main heat: 100.0000 heating sy: 296.4519	l heating syry/supplements tem (s) stem 1 (in stem 2 (in stem 2 (in stem 2 20.2911 ing system 100.0000 stem) 220.2911	ystems, incontary syste (b) (b) (c) (c) (d) (d) (d) (d) (d) (d) (d) (d) (d) (d	Lluding micro mm (Table 11) May 21.8571	Jun 0.0000	0.0000 0.0000 0.0000	0.0000	0.0000	Oct 113.7788	Nov 267.0166	0.0000 1.0000 0.0000 0.0000 0.0000 Dec 406.2593	(201) (202) (206) (207) (208) (98)
Pace heating	quirements pace heat fi main space main space main space secondary/s Jan grequirement 393.2965 gefficiency 100.0000 g fuel (main 393.2965 gefficiency 0.0000 g fuel (main	rom seconda: rom main sy: heating sy: heating sy: supplementa: Feb t 296.4519 (main heat: 100.0000 heating sy: (main heat: 0.0000 heating sy:	l heating sy- ry/supplement stem(s) stem 1 (in stem 2 (/stems, inc ttary syste (b) (b) (b) system, % Apr 90.9878 (1) 100.0000 90.9878 (2) 0.0000	May 21.8571 100.0000 21.8571 0.0000	Jun 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	Oct 113.7788 100.0000 113.7788 0.0000	Nov 267.0166 100.0000 267.0166 0.0000	0.0000 1.0000 0.0000 0.0000 0.0000 Dec 406.2593 100.0000 406.2593	(201) (202) (206) (207) (208) (98) (210) (211)
9a. Energy re Fraction of s Fraction of s Efficiency of Efficiency of Efficiency of Space heating Space heating Space heating	ppace heat fi main space f main space f main space f main space f main space f secondary/s Jan g requirement 393.2965 g efficiency 100.0000 f tuel (main 393.2965 g efficiency 0.0000 f mul (main 0.0000 f tuel (main 0.0000 f tuel (main f tuel (secondary)	rom seconda: rom main sy: heating sy: heating sy: supplementa: Feb t 296.4519 (main heat: 100.0000 heating sy: 0.0000 heating sy: 0.0000 heating sy: 0.0000	l heating syry/supplemerstem(s) stem 1 (in stem 2 (in s	/stems, incontary systems, incontary systems, incontary system, incontary systems, inc	May 21.8571 100.0000 21.8571 0.0000 0.0000	Jun 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	Oct 113.7788 100.0000 113.7788 0.0000 0.0000	Nov 267.0166 100.0000 267.0166 0.0000 0.0000	0.0000 1.0000 0.0000 0.0000 0.0000 Dec 406.2593 100.0000 406.2593 0.0000	(201) (202) (206) (207) (208) (98) (210) (211) (212) (213)
9a. Energy re Fraction of s Fraction of s Efficiency of Efficiency of Efficiency of Efficiency of Space heating Space heating Space heating Space heating	pace heat framents - pace framents -	rom seconda: rom main sy: heating sy: heating sy: supplementa: 296.4519 (main heat: 100.0000 heating sy: 0.0000 heating sy:	l heating sy- ry/supplement stem(s) stem 1 (in stem 2 (/stems, inc ttary syste (b) (b) (b) system, % Apr 90.9878 (1) 100.0000 90.9878 (2) 0.0000	May 21.8571 100.0000 21.8571 0.0000	Jun 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	Oct 113.7788 100.0000 113.7788 0.0000	Nov 267.0166 100.0000 267.0166 0.0000	0.0000 1.0000 0.0000 0.0000 0.0000 Dec 406.2593 100.0000 406.2593	(201) (202) (206) (207) (208) (98) (210) (211) (212) (213)
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Pace heating Space cooling (217)m Fuel for wate Space cooling (221)m Pumps and Fa Lighting Electricity G (233a)m Electricity G Electricity	propriements - propri	rom seconda: rom main sy: heating sy: heating sy: supplementa: Feb t 296.4519 (main heat: 100.0000 heating sy: 296.4519 (main heat: 0.0000 heating sy: 0.0000 teating sy: 0.00000 teating sy: 0.0000 teating sy: 0.00000	1 heating sy- ry/supplement stem(s) stem 1 (in stem 2 (/stems, incontary systems, incon	May 21.8571 100.0000 21.8571 0.0000 0.0000 4.7387 100.0000 4.7387 0.0000 6.7945 9.7457 ity) -89.5272	Jun 0.0000 0.0000 0.0000 0.0000 0.0000 3.3226 100.0000 6.5753 7.9623 -80.6280	0.0000 0.0000 0.0000 0.0000 0.0000 2.5707 100.0000 2.5707 0.0000 6.7945 8.8904	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 6.4968 100.0000 6.7945 11.5560	0.0000 0.0000 0.0000 0.0000 0.0000 14.9726 100.0000 14.9726 0.0000 6.5753 15.0101	Oct 113.7788 100.0000 113.7788 0.0000 0.0000 35.4757 100.0000 35.4757 0.0000 6.7945 19.6941	Nov 267.0166 100.0000 267.0166 0.0000 0.0000 64.6022 100.0000 64.6022 0.0000 6.5753 22.2445 -43.1437	0.0000 1.0000 1.0000 0.0000 0.0000 Dec 406.2593 0.0000 0.0000 0.0000 78.6714 0.0000 78.6714 0.0000 6.7945 24.5039 -33.1738	(201) (202) (206) (207) (208) (211) (212) (213) (215) (64) (216) (217) (219) (221) (231) (232) (233a
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Pace heating Space cooling (217)m Fuel for wate Space cooling (2211)m Fuel for wate Space cooling (2213)m Electricity g (233a)m Electricity g (234a)m Electricity g Electricity g Electricity g	pquirements - ppace heat fi ppace heat fi ppace heat fi main space fi main space fi main space fi main space fi secondary/s Jan fi requirement 333.2965 fi ficiency 100.0000 fi fuel (main 0.0000 fi fuel (main 0.0000 fi fuel (secon 79.6876 fi water heate 100.0000 fi fuel require 79.6876 fi fuel require 100.0000 fi fill require 23.8413 generated by -38.7399 generated by 0.0000 figure fill fill fill fill generated by 0.0000 fill fill generated by 0.0000	rom seconda: rom main sy: heating sy: heating sy: seating sy: seating sy: seating sy: feating sy: seating sy: 296.4519 (main heat: 100.0000 heating sy: 0.0000 heating sy: 0.0000 to seating sy: 100.0000 heating sy: 100.0000 he	1 heating syry/supplemers stem(s) stem 1 (in stem 2 (in	//stems, incontary systems, inco	May 21.8571 100.0000 21.8571 0.0000 0.0000 4.7387 100.0000 4.7387 100.0000 6.7945 9.7457 ity) -89.5272 tive quantit 0.0000 dix M) (nega	Jun 0.0000 0.0000 0.0000 0.0000 0.0000 3.3226 100.0000 6.5753 7.9623 -80.6280 EY) 0.0000 ative quant 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 2.5707 100.0000 6.7945 8.8904 -79.8957 0.0000 ity)	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 6.4968 100.0000 6.7945 11.5560 -75.7654 0.0000 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 14.9726 100.0000 14.9726 0.0000 6.5753 15.0101	Oct 113.7788 100.0000 113.7788 0.0000 0.0000 35.4757 100.0000 35.4757 0.0000 6.7945 19.6941	Nov 267.0166 100.0000 267.0166 0.0000 0.0000 64.6022 100.0000 64.6022 0.0000 6.5753 22.2445 -43.1437	0.0000 1.0000 1.0000 0.0000 0.0000 Dec 406.2593 0.0000 0.0000 0.0000 78.6714 0.0000 78.6714 0.0000 6.7945 24.5039 -33.1738	(201) (202) (206) (207) (208) (210) (211) (212) (213) (215) (217) (219) (231) (232) (233a (234a (235a
9a. Energy re Praction of s Fraction of s Fraction of s Efficiency of Efficiency of Efficiency of Efficiency of Efficiency of Space heating Space heating Space heating Space heating Fraction of Efficiency of Carried to the second of Electricity of Electricity of Carried to the second of Electricity of	guirements	rom seconda: rom main sy: heating sy: heating sy: supplementa: Feb t 296.4519 (main heat: 100.0000 heating sy: 296.4519 (main heat: 0.0000 heating sy: 0.0000 t 52.4299 er 100.0000 kWh/month 52.4299 er 100.0000 kWh/month 752.4299 er 0.0000 heating sy: 0.0000 color of the sy: 0.0000 hy (Appen: 0.0000 hy (Appen: 0.0000 PVS (Appen: -26.1099	1 heating sy- ry/supplements tem(s) stem 1 (in stem 2 (in stem) 200.000 stem) 200.2911 ing system 2 (in stem 2	/stems, inco- trary systems, inco- trary systems, inco- trary systems, inco- polystem, inco- p	May 21.8571 100.0000 21.8571 0.0000 0.0000 4.7387 100.0000 4.7387 100.0000 4.7387 100.0000 dixy) -89.5272 tive quantit 0.0000 dix M) (nega 0.0000 (IP (Appendix 0.0000) 1-146.1556	Jun 0.0000 0.0000 0.0000 0.0000 0.0000 3.3226 100.0000 6.5753 7.9623 -80.6280 EY) 0.0000 tive quant 0.0000 N) (negatir 0.0000 -151.0857	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 2.5707 100.0000 6.7945 8.8904 -79.8957 0.0000 ity) 0.0000 ve if net ge 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 6.4968 100.0000 6.7945 11.5560 -75.7654 0.0000 0.0000 eneration) 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 14.9726 100.0000 6.5753 15.0101 -67.8455 0.0000 0.0000	Oct 113.7788 100.0000 113.7788 0.0000 0.0000 35.4757 100.0000 35.4757 0.0000 6.7945 19.6941 -62.9424 0.0000 0.0000	Nov 267.0166 100.0000 267.0166 0.0000 0.0000 64.6022 100.0000 6.5753 22.2445 -43.1437 0.0000 0.0000	0.0000 1.0000 1.0000 0.0000 0.0000 Dec 406.2593 0.0000 0.0000 0.0000 78.6714 0.0000 6.7945 24.5039 -33.1738 0.0000 0.0000	(201) (202) (206) (207) (208) (210) (211) (212) (213) (215) (64) (216) (217) (219) (221) (233a (235a (235a (235a
9a. Energy re	Jan grequirements	rom seconda: rom main sy: heating sy: heating sy: supplementa: Feb t 296.4519 (main heat: 100.0000 heating sy: 296.4519 (main heat: 0.0000 ndary) 0.0000 t 52.4299 er 100.0000 kWh/month 52.4299 rement 0.0000 heating sy: 0.0000 cletricity 0.0000 bydro-elect 0.0000 slectricity 0.0000 slectricity 0.0000 pVs (Appene-26.1099) wind turbin 0.0000 slectricity 0.0000 pVs (Appene-26.1099) wind turbin 0.0000	1 heating sy- ry/supplements tem(s) stem 1 (in stem 2 (in stem 2 (in stem 2) (in stem 3) (in stem 3) (in system 3) (in system 3) (in system 2) (in system 3) (in system 2) (in system 3) (in system 3) (in system 3) (in system 4)	/stems, inco- trary syste (s)	May 21.8571 100.0000 21.8571 0.0000 0.0000 4.7387 100.0000 4.7387 100.0000 4.7387 100.0000 4.7387 0.0000 6.7945 9.7457 ity) -89.5272 tive quantit 0.0000 (IP (Appendix 0.0000) (IP (Appendix 0.000) (IP (Appendix 0.0000) (IP (Appendix 0.000) (IP (Appendix 0.0000) (IP (Appendix 0.000) (IP	Jun 0.0000 0.0000 0.0000 0.0000 0.0000 3.3226 100.0000 3.3226 0.0000 6.5753 7.9623 -80.6280 EY) 0.0000 witive quant 0.0000 N) (negati- 0.0000 -151.0857	0.0000 0.0000 0.0000 0.0000 0.0000 2.5707 100.0000 6.7945 8.8904 -79.8957 0.0000 ity) 0.0000 ve if net gr 0.0000 -148.7558	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 6.4968 100.0000 6.7945 11.5560 -75.7654 0.0000 0.0000 eneration) 0.0000	0.0000 0.0000 0.0000 0.0000 0.0000 14.9726 100.0000 6.5753 15.0101 -67.8455 0.0000 0.0000	Oct 113.7788 100.0000 113.7788 0.0000 0.0000 35.4757 100.0000 6.7945 19.6941 -62.9424 0.0000 0.0000	Nov 267.0166 100.0000 267.0166 0.0000 0.0000 64.6022 100.0000 64.6022 0.0000 6.5753 22.2445 -43.1437 0.0000 0.0000	0.0000 1.0000 1.0000 0.0000 0.0000 Dec 406.2593 100.0000 0.0000 0.0000 78.6714 100.0000 6.7945 24.5039 -33.1738 0.0000 0.0000	(201) (202) (203) (204) (211) (212) (213) (215) (64) (216) (217) (219) (231) (232) (233a (235a (235a (235a (235a (235a

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Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if ne (235d)m 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.000000	0.0000	0.0000 0.0000 0.00	1809.9392 (211) 0.0000 (213) 0.0000 (213) 0.0000 (215) 100.0000 384.6112 (219) 0.0000 (221) 80.0000 (231) 192.4129 (232) -1727.2394 (233) 0.0000 (234) 0.0000 (235a) 0.0000 (235b) -0.0000 (236) 0.0000 (237) 1258.1530 (238)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Pumps, fans and electric keep-hot Pump for solar water heating Energy for lighting Additional standing charges Energy saving/generation technologies		Fuel price p/kWh 16.4900 16.4900 0.0000 16.4900 16.4900 16.4900	Fuel cost £/year 298.4590 (240) 0.0000 (473) 63.4224 (247) 85.4889 (247a) 0.0000 (249) 13.1920 (249) 31.7289 (250) 0.0000 (251)
PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost	-802.8063 -924.4331	16.4900 5.5900	-132.3828 -51.6758 -184.0586 (252) 308.2326 (255)
11a. SAP rating - Individual heating systems Energy cost deflator (Table 12): Energy cost factor (ECF) SAP value SAP rating (Section 12) SAP band		55) x (256)] / [(4) + 45.0] =	0.3600 (256) = 1.0682 (257) 82.6846 83 (258) B
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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 CO2 emissions per m2 EI rating EI rating EI band	Energy kWh/year 1809.9392 384.6112 518.4290 80.0000 192.4129 -802.8063 -924.4331	Emission factor kg CO2/kWh 0.1564 0.1531 0.1391 0.1387 0.1443 0.1355	Emissions kg CO2/year 283.1543 (261) 0.0000 (373) 58.8916 (264) 72.1249 (264a) 342.0459 (265) 11.0970 (267) 27.7711 (268) -108.7898 -113.2324 -222.0222 (269) 231.0167 (272) 3.9200 (273) 97.0200 97 (274) A
SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 1. Overall dwelling characteristics Ground floor First floor Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)(1n) 58.8800 Dwelling volume	Area (m2) 31.3800 (127.5000 (137.500	Storey height (m) 1b) x 2.4000 (2b) 1c) x 2.6000 (2c))+(3b)+(3c)+(3d)+(3e)(3n)	(4)

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2. Ventilation	rate												
Number of open Number of open Number of chimm Number of flues Number of flues Number of inter Number of passi Number of fluel	flues eys / flues s attached s attached ed chimney mittent ex ve vents	to solid fur to other he s tract fans	el boiler	ire							m 0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 3 * 10 = 0 * 10 = 0 * 40 =	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 30.0000 0.0000	(6b) (6c) (6d) (6e) (6f) (7a) (7b)
Infiltration du Pressure test Pressure Test M Measured/design Infiltration ra Number of sides	Method AP50		and fans	= (6a)+(6b)	+(6c)+(6d)+	(6e)+(6f)+	(6g)+(7a)+(7b)+(7c) =		30.0000		0.2043 Yes lower Door 5.0000 0.4543	(8)
Shelter factor Infiltration ra	ite adjuste	d to includ	e shelter f	actor					(20) = 1 - (21	[0.075 x .) = (18) x		0.7000 0.3180	
Wind speed	Jan 4.3000	Feb 4.0000	Mar 4.1000	Apr 3.8000	May 3.7000	Jun 3.2000	Jul 3.1000	Aug 3.1000	Sep 3.3000	Oct 3.5000	Nov 3.4000	Dec 3.8000	
Wind factor Adj infilt rate	0.3419	0.3180	0.3260	0.9500	0.9250	0.8000	0.7750	0.7750	0.8250	0.8750	0.8500	0.9500	(22b)
Effective ac	0.5584	0.5506	0.5531	0.5456	0.5433	0.5324	0.5304	0.5304	0.5344	0.5387	0.5365	0.5456	(25)
3. Heat losses	and heat 1	oss paramet	er										
Element		-		Gross	Openings	Net	 :Area	U-value	Axt		value	AxK	
HG Door Windows (Uw = 1	.20)			m2	m2	2.	m2 .0700 .6000	W/m2K 1.2000 1.1450	W/F 2.4840 15.5725)	J/m2K	kJ/K	(26a) (27)
Heat Loss Floor External Walls Plane Roof	: 1			84.8600 31.4100	15.6700	69.	.3800 .1900 .4100	0.1200 0.1700 0.1000	3.7656 11.7623 3.1410	3 110	.0000	3451.8000 7610.9000 282.6900	(29a)
Total net area Fabric heat los Party Walls							.6500 (26)(3	30) + (32) 0.0000		l	.0000	3049.2000	(31) (33)
GF - Timber FF - Timber Internal Floor Internal Ceilin	ıg					48. 51. 27.	.0000 .8400 .5000	0.0000	0.0000	9 9 18	.0000	432.0000 466.5600 495.0000 247.5000	(32c) (32c) (32d)
Heat capacity C Thermal mass pa			FA) in kJ/m	2K				(28).	(30) + (32)	+ (32a)	.(32e) =	16035.6500 272.3446	
List of Thermal K1 Elem E2 Othe E3 Sill E4 Jamb E5 Grou E6 Inte E10 Eav E12 Gab E16 Cor E25 Sta P1 Part P2 Part	Bridges Hent Fr lintels Ind floor (Fres (insula Fres (i	normal) loor within tion at cei tion at cei tion at cei ty wall bet round floor ntermediate oof (insula	a dwelling ling level) ling level) ween dwelli floor with tion at cei	lintels) ngs in a dwelli ling level)	-			11 8 22 17 16 9 8 15 10 5 5	ength Ps .8800 .3700 .1000 .9500 .0700 .8900 .6000 .0000 .0000 .5500 .8900	si-value 0.0190 0.0210 0.0160 0.0590 0.0010 0.0630 0.0410 0.0370 0.0410 0.0430 0.0000 0.0400	Tot 0.22 0.17 0.35 1.05 0.01 0.62 0.35 0.55 0.41 0.23	al 577 588 336 90 61 331 226 50 000 886	
Point Thermal b	ridges	ror, dardar	acca acting	npponain n					(33	3) + (36) +	(36a) = (36a) =	0.0000 40.9705	
Ventilation hea	t loss cal Jan 27.0555	culated mon Feb 26.6742	thly (38)m Mar 26.7983	= 0.33 x (2 Apr 26.4353	5)m x (5) May 26.3205	Jun 25.7921	Jul 25.6957	Aug 25.6957	Sep 25.8917	Oct 26.0999	Nov 25.9943	Dec 26.4353	(38)
Heat transfer of Average = Sum(3	68.0261	67.6448	67.7688	67.4059	67.2910	66.7627	66.6662	66.6662	66.8622	67.0705	66.9648	67.4059 67.2113	
HLP	Jan 1.1553	Feb 1.1489	Mar 1.1510	Apr 1.1448	May 1.1429	Jun 1.1339	Jul 1.1322	Aug 1.1322	Sep 1.1356	Oct 1.1391	Nov 1.1373	Dec 1.1448	(40)
HLP (average) Days in mont	31	28	31	30	31	30	31	31	30	31	30	1.1415 31	
4. Water heatin	ng energy r ncy e for mixer	equirements	(kWh/year)									1.9498	
Hot water usage	0.0000 for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Hot water usage	34.5979	33.3398	23.7172 32.0817	22.7687	22.0585	21.2710	20.8456	21.3564	21.9126	22.7553	23.7233	24.5138 34.5979	(42c)
Average daily h	ot water u	se (litres/	day)								Nov	54.2578	
Daily hot water	Jan use 59.1948	Feb 57.5714	Mar 55.7989	Apr 53.5923	May 51.6239	Jun 49.5783	Jul 49.1529	Aug 50.9219	Sep 52.7361	Oct 54.8369	Nov 57.0631	Dec 59.1116	(44)
Energy conte Energy content	93.7501 (annual)	81.9809	85.7608	73.3651	69.4957	60.9623	59.4462	63.0519	65.0289	74.4132 Total = Su	81.2968	92.5545 901.1065	
Distribution lo	0.0000 .oss:	0.15 x (4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Total storage 1 If cylinder con	0.0000	0.0000 cated solar	0.0000 storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

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Primary loss Combi loss Total heat requ	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	0.0000 0.0000 0.0000	0.0000 0.0000 0.0000	(59)
WWHRS PV diverter Aperture area o	79.6876 0.0000 -0.0000 of solar co	69.6837 0.0000 -0.0000 ollector	72.8967 0.0000 -0.0000		59.0714 0.0000 -0.0000	51.8180 0.0000 -0.0000	50.5293 0.0000 -0.0000	53.5941 0.0000 -0.0000	55.2746 0.0000 -0.0000	63.2512 0.0000 -0.0000	69.1023 0.0000 -0.0000	78.6714 0.0000 -0.0000 3.0000	(63a) (63b) (H1)
Zero-loss collector lines Collector 2nd collector loop	ar heat los order heat	ss coefficie loss coeff:										0.8000 1.8000 0.0000 0.9000	(H3) (H4)
Incidence angle Overshading fac Overall heat lo	e modifier ctor oss coeffic	cient of sy:										1.0000 0.8000 6.5000	(H6) (H8) (H10)
Heat loss coeff Dedicated solar Effective solar Reference volum	r storage v r volume		loop									3.9667 75.0000 75.0000 225.0000	(H12) (H14)
Storage tank co Heat delivered Heat delivered Solar input	to hot wat	er										1.3161 413.6494 0.0000 413.6494	(H24)
Solar input FGHRS	0.0000	-20.6577 0.0000	-45.9094 0.0000	-52.1103 0.0000	-55.0764 0.0000	-50.4873 0.0000	-49.2184 0.0000	-49.1179 0.0000	-43.1568 0.0000	-31.7314 0.0000	-10.5836 0.0000	-0.0000	
Output from w/h	74.0874	49.0260	26.9873	10.2501	3.9950	1.3307	1.3108	4.4762 Total pe	12.1178 er year (kW	31.5198 h/year) = Si	58.5186 um(64)m =	78.6714 352.2911	
Electric shower	r(s) 45.5764	40.6090	44.3434	42.3164	43.1104	41.1232	42.4940	43.1104	42.3164	44.3434	43.5096	45.5764	
Heat gains from		ating, kWh/r 27.5732		26.1692	25.5455	23.2353	23.2558	24.1761	24.3977	26.8987	28.1530	518.4290 31.0619	
5. Internal gai	ins (see Ta	able 5 and 5	5a)										
Metabolic gains	s (Table 5)		Mar			Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	116.9878 (calculate	116.9878 ed in Append	116.9878 dix L, equa	116.9878 tion L9 or	116.9878 L9a), also	116.9878 see Table 5	116.9878	116.9878	116.9878	116.9878	116.9878	116.9878	
Appliances gair		ated in Appe		uation L13				13.2025 187.3132	17.7203 193.9526	22.5000	26.2608	27.9951 242.6982	
Cooking gains ((calculated	d in Append:		ion L15 or				48.6486	48.6486	48.6486	48.6486	48.6486	
Pumps, fans Losses e.g. eva					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Water heating o	gains (Tabl			-77.9919 36.3461	-77.9919 34.3353	-77.9919 32.2712	-77.9919 31.2578	-77.9919 32.4948	-77.9919 33.8858	-77.9919 36.1541	-77.9919 39.1013	-77.9919 41.7499	
Total internal	gains	409.4043		374.6476	351.0338	330.4664	319.0072	320.6550	333.2032	354.3856	378.9358	400.0877	
6. Solar gains													
6. Solar gains									P.P.	haaa		Caina	
6. Solar gains [Jan]			A	 rea m2	Solar flux Table 6a W/m2	Speci or	g fic data Table 6b	Specific	FF data le 6c	Acce: facto Table	or	Gains W	
6. Solar gains [Jan] Northeast			A 5.0	rea m2	Solar flux Table 6a W/m2	Speci or '	g fic data Table 6b	Specific or Tab	data le 6c	facto Table 0	or 6d 00	W 24.0906	(75)
6. Solar gains			A 5.0 2.2 6.3	rea m2 000 400 600	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947	Speci or	gfic data Table 6b 0.6300 0.6300 0.6300	Specific or Tab	data le 6c	facto Table	or 6d 00 00	W	(75) (77)
6. Solar gains [Jan] Northeast Southeast Northwest Solar gains		153.4036	A 5.0 2.2 6.3	rea m2 000 400 600	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947	Speci or	gfic data Table 6b 0.6300 0.6300 0.6300	Specific or Tab	data le 6c .8000 .8000	facto Table (0.770 0.770	or 6d 00 00	24.0906 33.9439 30.6432	(75) (77) (81)
6. Solar gains [Jan] Northeast Southeast Northwest Solar gains	88.6777 499.5526	153.4036 562.8079	5.0 2.2 6.3 244.0691 640.6799	rea m2 000 400 600 381.0722 755.7197	Solar flux Table 6a 13.7947 43.3860 13.7947 473.7274 824.7612	Speci or ' 	fic data Table 6b 0.6300 0.6300 0.6300 488.1841 807.1914	Specific or Tab: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	data le 6c .8000 .8000 .8000	factor Table (0.770 0.770 0.770 183.4207	or 6d 00 00 00 107.9860	24.0906 33.9439 30.6432	(75) (77) (81)
6. Solar gains [Jan] Northeast Southeast Northwest Solar gains Total gains 7. Mean interna	88.6777 499.5526 al temperat	153.4036 562.8079	5.0 2.2 6.3 244.0691 640.6799	rea m2 000 400 600	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612	Speci or '	fic data Table 6b 0.6300 0.6300 0.6300 488.1841 807.1914	Specific or Tab: 0 0 0 0 410.6421 731.2971	data le 6c .8000 .8000 .8000	factor Table (0.770 0.770 0.770 183.4207	or 6d 00 00 00 107.9860	W 24.0906 33.9439 30.6432 74.1111 474.1988	(75) (77) (81) (83) (84)
6. Solar gains [Jan] Northeast Southeast Northwest Solar gains Total gains	88.6777 499.5526 al temperat	153.4036 562.8079 Lure (heating periods:	244.0691 640.6799	rea m2 000 400 600 381.0722 755.7197	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612	Speci or '	gfic data Table 6b 	Specific or Tab: 0 0 0 0 410.6421 731.2971	data Le 6c .8000 .8000 .8000 .8000 302.4448 635.6480	factor Table (0.77) 0.77(0.77) 183.4207 537.8063	or 6d 00 00 00 107.9860	24.0906 33.9439 30.6432	(75) (77) (81) (83) (84)
6. Solar gains [Jan] Northeast Southeast Northwest Solar gains Total gains 7. Mean interna Temperature dur Untilisation fact tau alpha	88.6777 499.5526 al temperataring heatir tror for gar Jan 65.4800 5.3653	153.4036 562.8079 ure (heating periods:	244.0691 640.6799	rea m2 000 400 600 381.0722 755.7197	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612 mm Table 9, 17 Table 9a) May 66.1953	Speci or or 5 536.0524 866.5188 Th1 (C) Jun 66.7191	fic data Table 6b 0.6300 0.6300 0.6300 488.1841 807.1914	Specific or Tab: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	data Le 6c .8000 .8000 .8000 .8000 302.4448 635.6480	factor Table (0.77) 0.77(0.77) 183.4207 537.8063	or 6d 00 00 00 107.9860 486.9218	W 24.0906 33.9439 30.6432 74.1111 474.1988	(75) (77) (81) (83) (84)
6. Solar gains [Jan] Northeast Southeast Northwest Solar gains Total gains 7. Mean interna Temperature dur Utilisation factau	88.6777 499.5526 al temperataring heatir tror for gar Jan 65.4800 5.3653	153.4036 562.8079 re (heating periods: periods: ins for liver Feber 65.8491	244.0691 640.6799 in the livi ving area, Mar 65.7286	rea m2 000 400 381.0722 755.7197 ng area fronil,m (see Apr 66.0825	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612 m Table 9a) May 66.1953 5.4130	Speci or or 5 536.0524 866.5188 Th1 (C) Jun 66.7191	fic data Table 6b 0.6300 0.6300 0.6300 488.1841 807.1914	Specific or Tab: 0 0 0 0 410.6421 731.2971 Aug 66.8157	data Le 6c .8000	factor Table (0.77) 0.77(0.77) 183.4207 537.8063	00 00 00 00 107.9860 486.9218	24.0906 33.9439 30.6432 74.1111 474.1988 21.0000 Dec 66.0825	(75) (77) (81) (83) (84)
6. Solar gains [Jan] Northeast Southeast Northwest Solar gains Total gains 7. Mean internation factors Temperature dur Utilisation factors tau alpha util living are	88.6777 499.5526 all temperat ring heatir ttor for ge Jan 65.4800 5.3653 ea 0.9927 19.9356 19.9559	153.4036 562.8079 cure (heating periods: sins for liv Feb 65.8491 5.3899	244.0691 640.6799 ng season) in the livi ving area, Mar 65.7286 5.3819	rea m2 000 400 600 381.0722 755.7197 ang area froil, m (see Apr Apr 66.0825 5.4055	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612 m Table 9, 5 Table 9a) May 66.1953 5.4130 0.6736	Speci or 536.0524 866.5188 Th1 (C) Jun 66.7191 5.4479	gfic data Pable 6b 0.6300 0.6300 0.6300 488.1841 807.1914 Jul 66.8157 5.4544	Specific or Tab: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	data Le 6c .8000 .8000 .8000 302.4448 635.6480 Sep 66.6198 5.4413	factor Table (0.77) 0.77(0.77) 183.4207 537.8063	Nov 66.5177 5.4345	24.0906 33.9439 30.6432 74.1111 474.1988 21.0000 Dec 66.0825 5.4055	(75) (77) (81) (83) (84) (85)
6. Solar gains [Jan] Northeast Southeast Northwest Total gains 7. Mean internation factor of the second	88.6777 499.5526 al temperation for garage Jan 65.4800 5.3653 aa 0.9927 19.9356 19.9559 ouse 0.9902	153.4036 562.8079 	244.0691 640.6799 10 season) 10 the livitying area, 10 Mar 65.7286 5.3819 0.9584 20.4194 19.9594 0.9444	rea m2 000 400 381.0722 755.7197 ang area frc nil,m (see Apr 66.0825 5.4055 0.8613 20.7656 19.9644 0.8220	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612 mm Table 9a, 7 Table 9a) May 66.1953 5.4130 0.6736 20.9491 19.9660 0.6060	Speci or or 5 536.0524 866.5188 Th1 (C) Jun 66.7191 5.4479 0.4364 20.9959 19.9733 0.3592	Jul 66.8157 5.4544 0.3135 20.9995 19.9746 0.2291	Aug 66.8157 5.4544 0.3547 20.9990 19.9746 0.2619	data le 6c .8000 .80	factor Table (0.77) 0.77) 0.77) 183.4207 537.8063 Oct 66.4129 5.4275 0.9212 20.7014 19.9690 0.8876	Nov 66.5177 5.4345 0.9842 20.2647 19.9705 0.9778	24.0906 33.9439 30.6432 74.1111 474.1988 21.0000 Dec 66.0825 5.4055 0.9944 19.8982 19.9644 0.9925	(75) (77) (81) (83) (84) (85) (86) (87) (88) (89)
6. Solar gains [Jan] Northeast Southeast Northwest Solar gains Total gains 7. Mean internation fact tau alpha util living are MIT Th 2 util rest of ho MIT 2 Living area fra MIT	88.6777 499.5526 al temperat ring heatir ttor for ge Jan 65.4800 5.3653 aa 0.9927 19.9559 ouse 0.9902 18.7422 action 18.9706	153.4036 562.8079 	244.0691 640.6799 ng season) in the livi wing area, Mar 65.7286 5.3819 0.9584 20.4194 19.9594	rea m2 000 400 600 381.0722 755.7197 mg area fronil,m (sec Apr 66.0825 5.4055 0.8613 20.7656 19.9644	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612 mm Table 9, 7 Table 9a) May 66.1953 5.4130 0.6736 20.9491 19.9660	Speci or 536.0524 866.5188 Th1 (C) Jun 66.7191 5.4479 0.4364 20.9959 19.9733	Jul 66.8157 5.4544 0.3135 20.9995 19.9746	Aug 66.8157 5.4544 0.3547 20.9990 19.9746	data Le 6c .8000 .8000 .8000 .8000 302.4448 635.6480 Sep 66.6198 5.4413 0.6455 20.9700 19.9719 0.5538 19.9562 flA =	0.77(0.77(0.77(0.77(0.77(0.77(183.4207 537.8063	Nov 66.5177 5.4345 0.9842 20.2647 19.9705 0.9778 19.1709	24.0906 33.9439 30.6432 74.1111 474.1988 21.0000 Dec 66.0825 5.4055 0.9944 19.8982 19.9644 0.9925 18.7010 0.1914 18.9301	(75) (77) (81) (83) (84) (85) (86) (87) (88) (89) (90) (90)
6. Solar gains [Jan] Northeast Southeast Northwest Total gains 7. Mean interna Temperature dur Utilisation fact tau alpha util living are MIT Th 2 util rest of ho	88.6777 499.5526 all temperat ring heatir tor for go Jan 65.4800 5.3653 aa 0.9927 19.9356 19.9559 puse 0.9902 18.7422 action 18.9706 justment	153.4036 562.8079 Eure (heating periods: sins for liver Feb 15.8491 5.3899 0.9852 20.1138 19.9611 0.9802 18.9712	244.0691 640.6799 ng season) in the livi ving area, Mar 65.7286 5.3819 0.9584 20.4194 19.9594 0.9444 19.3487	rea m2 000 400 600 381.0722 755.7197 ang area frc nil,m (see Apr 66.0825 5.4055 0.8613 20.7656 19.9644 0.8220 19.7512	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612 m Table 9a) May 66.1953 5.4130 0.6736 20.9491 19.9660 0.6060 19.9310	Speci or	Jul 66.8157 5.4544 0.3135 20.9995 19.9745	Aug 66.8157 5.4544 0.3547 20.9990 19.9746 0.2619 19.9744	data Le 6c .8000 .8000 .8000 .8000 302.4448 635.6480 Sep 66.6198 5.4413 0.6455 20.9700 19.9719 0.5538 19.9562 fLA = 20.1502	Oct 66.4129 5.4275 0.9212 20.7014 19.9690 0.8876 19.6975 Living area	Nov 66.5177 5.4345 0.9842 20.2647 19.9705 0.9778 19.1709	24.0906 33.9439 30.6432 74.1111 474.1988 21.0000 Dec 66.0825 5.4055 0.9944 19.8982 19.9644 0.9925 18.7010 0.1914	(75) (77) (81) (83) (84) (85) (86) (87) (88) (89) (90) (90) (90) (91) (92)
6. Solar gains [Jan] Northeast Southeast Northwest Total gains 7. Mean internation factor Temperature dur Utilisation factor tau alpha util living are MIT Th 2 util rest of ho MIT 2 Living area fra MIT Temperature adj adjusted MIT	88.6777 499.5526 al temperat ring heatir rtor for ga Jan 65.4800 5.3653 aa 0.9927 19.9559 buse 0.9902 18.7422 action 18.9706	153.4036 562.8079 	244.0691 640.6799 10 season) 10 the living area, Mar 65.7286 5.3819 0.9584 20.4194 19.9594 0.9444 19.3487 19.5536	rea m2 000 400 600 381.0722 755.7197 ang area fro nil,m (see Apr 66.0825 5.4055 0.8613 20.7656 19.9644 0.8220 19.7512 19.9454	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612 mm Table 9a, Table 9a) May 66.1953 5.4130 0.6736 20.9491 19.9660 0.6060 19.9310 20.1259 20.1259	Speci or or section or	Jul 66.8157 5.4544 0.3135 20.9995 19.9745 20.1707 20.1707	Aug 66.8157 5.4544 0.3547 20.9990 19.9744 20.1705 20.1705	data Le 6c .8000 .8000 .8000 .8000 302.4448 635.6480 Sep 66.6198 5.4413 0.6455 20.9700 19.9719 0.5538 19.9562 fLA = 20.1502	Oct 66.4129 5.4275 0.9212 20.7014 19.9690 0.8876 19.6875 Living area 19.8896	Nov 66.5177 5.4345 0.9842 20.2647 19.9705 0.9778 19.1709 a / (4) = 19.3803	24.0906 33.9439 30.6432 74.1111 474.1988 21.0000 Dec 66.0825 5.4055 0.9944 19.8982 19.9644 0.9925 18.7010 0.1914 18.9301 0.0000	(75) (77) (81) (83) (84) (85) (86) (87) (88) (89) (90) (90) (90) (91) (92)
6. Solar gains [Jan] Northeast Southeast Northwest Solar gains Total gains 7. Mean interna Temperature dur Utilisation fact tau alpha util living are MIT Th 2 util rest of ho MIT 2 Living area fra MIT Temperature adj	88.6777 499.5526 al temperat- ring heatir ctor for ga Jan 65.4800 5.3653 a 0.9927 19.9559 ouse 0.9902 18.7422 action 18.9706 justment 18.9706	153.4036 562.8079 Eure (heating periods: sins for limple for limp	244.0691 640.6799 10 season) 10 the livity ving area, Mar 65.7286 5.3819 0.9584 20.4194 19.9594 0.9444 19.3487 19.5536	rea m2 000 400 381.0722 755.7197 ang area frc nil,m (see Apr 66.0825 5.4055 0.8613 20.7656 19.9644 0.8220 19.7512 19.9454	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612 mm Table 9a) May 66.1953 5.4130 0.6736 20.9491 19.9660 0.6060 19.9310 20.1259 20.1259	Speci or or o	Jul 66.8157 5.4544 0.3135 20.9995 19.9746 0.2291 19.9745 20.1707	Aug 66.8157 5.4544 0.3547 20.9990 19.9744 20.1705 20.1705	data Le 6c .8000 .8000 .8000 .8000 302.4448 635.6480 Sep 66.6198 5.4413 0.6455 20.9700 19.9719 0.5538 19.9562 fLA = 20.1502	Oct 66.4129 5.4275 0.9212 20.7014 19.9690 0.8876 19.6875 Living area 19.8896	Nov 66.5177 5.4345 0.9842 20.2647 19.9705 0.9778 19.1709 a / (4) = 19.3803	24.0906 33.9439 30.6432 74.1111 474.1988 21.0000 Dec 66.0825 5.4055 0.9944 19.8982 19.9644 0.9925 18.7010 0.1914 18.9301 0.0000	(75) (77) (81) (83) (84) (85) (86) (87) (88) (89) (90) (90) (90) (91) (92)
6. Solar gains [Jan] Northeast Southeast Northwest Solar gains Total gains 7. Mean internation factor of the solution of t	88.6777 499.5526 al temperation for gargan desired for for gargan desired for gargan des	153.4036 562.8079 Eure (heating periods: sins for liver	244.0691 640.6799 1640.6799 1640.6799 165.7286 5.3819 0.9584 20.4194 19.9594 0.9444 19.3487 19.5536	rea m2 000 400 381.0722 755.7197 ng area frc nil,m (see Apr 66.0825 5.4055 0.8613 20.7656 19.9644 0.8220 19.7512 19.9454	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612 mm Table 9, 7 Table 9a) May 66.1953 5.4130 0.6736 20.9491 19.9660 0.6060 19.9310 20.1259 20.1259	Speci or or o	Jul 66.8157 5.4544 0.3135 20.9995 19.9746 0.2291 19.9745 20.1707	Aug 66.8157 5.4544 0.3547 20.9990 19.9746 20.1705 20.1705	data le 6c .8000 .8000 .8000 .8000 302.4448 635.6480 Sep 66.6198 5.4413 0.6455 20.9700 19.9719 0.5538 19.9562 fLA = 20.1502 20.1502	factor Table 0 0.77% 0.7	Nov 66.5177 5.4345 0.9842 20.2647 19.9705 0.9778 19.1709 a / (4) = 19.3803	24.0906 33.9439 30.6432 74.1111 474.1988 21.0000 Dec 66.0825 5.4055 0.9944 19.8982 19.9644 0.9925 18.7010 0.1914 18.9301 0.0000 18.9301	(75) (77) (81) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93)
G. Solar gains [Jan] Northeast Southeast Northwest Solar gains Total gains 7. Mean internation Temperature dur Utilisation fact tau alpha util living are MIT Th 2 util rest of ho MIT 2 Living area from MIT Temperature adj adjusted MIT 8. Space heatin Utilisation Useful gains	88.6777 499.5526 al temperation peating heating for for gar Jan 65.4800 5.3653 as 0.9927 19.9559 pouse 0.9902 18.7422 action 18.9706 justment 18.9706	153.4036 562.8079 Eure (heating periods: sins for liver periods: sins for liv	244.0691 640.6799 ng season) in the livi ving area, Mar 65.7286 5.3819 0.9584 20.4194 19.9594 0.9444 19.3487 19.5536 19.5536	rea m2 000 400 600 381.0722 755.7197 ang area frc ni1,m (see Apr 66.0825 5.4055 0.8613 20.7656 19.9644 0.8220 19.7512 19.9454 19.9454	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612 mm Table 9a, 7 Table 9a) May 66.1953 5.4130 0.6736 20.9491 19.9660 0.6060 19.9310 20.1259 20.1259	Speci or	Jul 66.8157 5.4544 0.3135 20.9995 19.9745 20.1707 Jul 0.2453 197.9735	Aug 66.8157 5.4544 0.3547 20.9990 19.9744 20.1705 20.1705	data Le 6c .8000 .8000 .8000 .8000 .8000 302.4448 635.6480 Sep 66.6198 5.4413 0.6455 20.9700 19.9719 0.5538 19.9562 fLA = 20.1502 20.1502 Sep 0.5704 362.5744	factor Table (10.77) (Nov 66.5177 5.4345 0.9842 20.2647 19.3803 19.3803	24.0906 33.9439 30.6432 74.1111 474.1988 21.0000 Dec 66.0825 5.4055 0.9944 19.8982 19.9644 0.9925 18.7010 0.1914 18.9301 0.0000 18.9301	(75) (77) (81) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93)
G. Solar gains [Jan] Northeast Southeast Northwest Total gains 7. Mean internation of the solution of the	88.6777 499.5526 al temperat ring heatir ctor for ge Jan 65.4800 5.3653 aa 0.9927 19.9356 19.9559 ouse 0.9902 18.7422 action 18.9706 justment 18.9706 Jan 0.9869 493.0017 4.5000 W	153.4036 562.8079 Eure (heating periods: sins for liver periods: sins for liv	244.0691 640.6799 10 season) in the livitying area, Mar 65.7286 5.3819 0.9584 20.4194 19.9594 0.9444 19.3487 19.5536 19.5536	rea m2 000 400 600 381.0722 755.7197 ng area frc ni1,m (see Apr 66.0825 5.4055 0.8613 20.7656 19.9644 0.8220 19.7512 19.9454 19.9454	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612 m Table 9a) May 66.1953 5.4130 0.6736 20.9491 19.9660 0.6060 19.9310 20.1259 20.1259	Speci or	Jul 66.8157 5.4544 0.3135 20.9995 19.9745 20.1707	Aug 66.8157 5.4544 0.3547 20.9990 19.9746 20.1705 20.1705	data le 6c	Gattable (1) 0.77(1) 0	Nov 0.0942 20.2647 19.3803 19.3803 Nov 0.9728	24.0906 33.9439 30.6432 74.1111 474.1988 21.0000 Dec 66.0825 5.4055 0.9944 19.8982 19.9644 0.9925 18.7010 0.1914 18.9301 0.0000 18.9301	(75) (77) (81) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93)
G. Solar gains [Jan] Northeast Southeast Northwest Solar gains Total gains 7. Mean internation fact tau alpha util living are MIT Th 2 util rest of ho MIT 2 Living area fra MIT Temperature adj adjusted MIT 8. Space heatin Utilisation Useful gains Ext temp. Heat loss rate Space heating	88.6777 499.5526 al temperat ring heatir ctor for ga Jan 65.4800 5.3653 aa 0.9927 19.9356 19.9559 ouse 0.9902 18.7422 action 18.9706 justment 18.9706 Jan 0.9869 493.0017 4.5000 W 984.3811 kWh 365.5863	153.4036 562.8079 Eure (heating periods: sins for liver feb 65.8491 5.3899 0.9852 20.1138 19.9611 0.9802 18.9712 19.1899 19.1899 19.1899 19.1899 19.1899 19.1899	244.0691 640.6799 244.0691 640.6799 in the liviting area, Mar 65.7286 5.3819 0.9584 20.4194 19.9594 0.9444 19.3487 19.5536 19.5536 Mar 0.9376 600.7199 6.9000 857.5201	rea m2 000 400 600 381.0722 755.7197 ang area frc nil,m (see Apr 66.0825 5.4055 0.8613 20.7656 19.9644 0.8220 19.7512 19.9454 19.9454 Apr 0.8212 620.6110 9.3000 717.5602 69.8034	Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612 m Table 9a) May 66.1953 5.4130 0.6736 20.9491 19.9660 0.6060 19.9310 20.1259 20.1259	Speci or	Jul 66.8157 5.4544 0.3135 20.9995 19.9746 0.2291 19.9745 20.1707 Jul 0.2453 197.9736 17.2000	Aug 66.8157 5.4544 0.3547 20.9990 19.9746 0.2619 19.9744 20.1705 20.1705	data le 6c	Oct 66.4129 5.4275 0.9212 20.7014 19.9690 0.8876 19.8896 19.8896	Nov 66,5177 5,4345 0,9842 20,2647 19,9705 19,1709 a / (4) = 19,3803 19,3803 Nov 0,9728 473,7009 7,4000	24.0906 33.9439 30.6432 74.1111 474.1988 21.0000 Dec 66.0825 5.4055 0.9944 19.8982 19.9644 0.9925 18.7010 0.1914 18.9301 0.0000 18.9301	(75) (77) (81) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97)

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Solar heating kWh -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution Space heating kWh	n - total p	er year (kV	Wh/year)								0.0000	
	271.6588 after sola		69.8034	13.2333	0.0000 (kWh/vear)	0.0000	0.0000	0.0000	89.6943	236.5595	379.5252 1617.1201	(98c)
Space heating per m2				1	(, 1,				(98c)	/ (4) =	27.4647	(99)
9a. Energy requirements -												
											0.0000	(001)
Fraction of space heat fr Fraction of space heat fr	om main sys	tem(s)		n (Table II)						0.0000 1.0000	(202)
Efficiency of main space Efficiency of main space	heating sys	tem 2 (in %	ß)								0.0000	(207)
Efficiency of secondary/s	upplementar	y heating s	system, %								0.0000	(208)
Jan Space heating requirement	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
365.5863 Space heating efficiency	271.6588 (main heati		69.8034 L)	13.2333	0.0000	0.0000	0.0000	0.0000	89.6943	236.5595	379.5252	(98)
100.0000 Space heating fuel (main	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
	271.6588	191.0594	69.8034	13.2333	0.0000	0.0000	0.0000	0.0000	89.6943	236.5595	379.5252	(211)
0.0000 Space heating fuel (main	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
0.0000 Space heating fuel (secon	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating												
Water heating requirement 74.0874	49.0260	26.9873	10.2501	3.9950	1.3307	1.3108	4.4762	12.1178	31.5198	58.5186	78.6714	
Efficiency of water heate (217)m 100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	
Fuel for water heating, k	49.0260	26.9873	10.2501	3.9950	1.3307	1.3108	4.4762	12.1178	31.5198	58.5186	78.6714	(219)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Pumps and Fa 6.7945 Lighting 23.8413	6.1370 19.1264	6.7945 17.2212	6.5753 12.6170	6.7945 9.7457	6.5753 7.9623	6.7945 8.8904	6.7945 11.5560	6.5753 15.0101	6.7945 19.6941	6.5753 22.2445	6.7945 24.5039	
Electricity generated by (233a)m -45.0179	PVs (Append -60.7683				-83.8822	-82.0935	-78.8316	-70.9524	-65.8330	-48.9737	-38.8940	(233a)
Electricity generated by (234a)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	(234a)
Electricity generated by (235a)m 0.0000	hydro-elect 0.0000	ric generat 0.0000	ors (Append 0.0000	dix M) (neg 0.0000	ative quant 0.0000	ity) 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net e (235c)m 0.0000	electricity 0.0000	generated b	oy micro-CHE 0.0000	(Appendix 0.0000		ve if net g	eneration) 0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by (233b)m -15.0531	PVs (Append -29.9000	ix M) (nega -63.4380	ative quanti -112.2692	ity) -152.6982	-172.2593	-162.3919	-139.7660	-100.1209	-51.2849	-21.2319	-11.6553	(233b)
Electricity generated by (234b)m 0.0000	wind turbin					0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by (235b)m 0.0000						ity) 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Electricity used or net e (235d)m 0.0000								0.0000	0.0000	0.0000	0.0000	
Annual totals kWh/year Space heating fuel - main		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1617.1201	
Space heating fuel - main Space heating fuel - seco	system 2										0.0000	(213)
Efficiency of water heate Water heating fuel used											100.0000 352.2911	
Space cooling fuel											0.0000	
Electricity for pumps and											00 0000	(220)
pump for solar water h Total electricity for the	above, kWh										80.0000	(231)
Electricity for lighting											192.4129	(232)
Energy saving/generation PV generation	technologie	s (Appendio	ces M ,N and	1 Q)							-1871.9557	
Wind generation Hydro-electric generation											0.0000	(235a)
Electricity generated - M Appendix Q - special feat	ures	ppendix N)									0.0000	
Energy saved or generated Energy used											-0.0000 0.0000	(237)
Total delivered energy fo	r all uses										888.2974	(238)
10a. Fuel costs - using B	EDF prices	(536)										
							Fuel		Fuel price		Fuel cost	
Space heating - main syst	em 1						kWh/year 1617.1201		p/kWh 25.1600		£/year 406.8674	
Total CO2 associated with Water heating (other fuel	community	systems					352.2911		25.1600		0.0000 88.6364	(473) (247)
Energy for instantaneous Pumps, fans and electric	electric sh	ower(s)					518.4290		25.1600 0.0000		130.4367	(247a)
Pump for solar water heat Energy for lighting							80.0000 192.4129		25.1600 25.1600		20.1280	(249)
Additional standing charg	res										0.0000	
Energy saving/generation PV Unit electricity used							-839.8869		25.1600		-211.3156	
PV Unit electricity expor							-1032.0687		5.8100		-59.9632 -271.2787	
Total energy cost											423.2009	
12a. Carbon dioxide emiss	ions - Indi	vidual heat	ing systems	s including	micro-CHP							
							Energy	Emiss	ion factor		Emissions	

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Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot Energy for lighting	kWh/year 1617.1201 352.2911 518.4290 80.0000 192.4129	kg CO2/kWh 0.1569 0.1541 0.1391 0.1387 0.1443	kg CO2/year 253.7982 (261) 0.0000 (373) 54.2739 (264) 72.1249 (264a) 308.0721 (265) 11.0970 (267) 27.7711 (268)
Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total Total CO2, kg/year	-839.8869 -1032.0687	0.1359	-114.1248 -126.7810 -240.9058 (269) 178.1594 (272)
13a. Primary energy - Individual heating systems including micro-CHP			
Construction and suction 1	kWh/year	kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot Energy for lighting			

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Property Referenc	e	PF	R11012 - 111 Ma	anor Road						ssued on Da	te	27/02/2024	
Assessment Refer	ence	00	1 - Be Green					Prop Type R	tef				
Property		11	1, Manor Road,	Witney, Oxford	dshire, OX28 3U	F							
SAP Rating					91 B		DER	1.5	56	TER		13.73	
Environmental					99 A		% DER < TER		, , , , , , , , , , , , , , , , , , ,			88.64	
CO ₂ Emissions (t/y	ear)				0		DFEE	36	.81	TFEE		42.39	
Compliance Check					See BREL		% DFEE < TFI					13.18	
% DPER < TPER					51.59		DPER	34	.87	TPER		72.03	
Assessor Details		NA. 11.	4								sor ID	V571-000	24
Client		-, Ifor Rh	Maghounaki							Asses	SSOF ID	V571-000	JT
SAP 10 WORKSHEET CALCULATION OF E			esigned)	(Version 10	.2, February	2022)							
1. Overall dwell Ground floor First floor Total floor area Dwelling volume			:)+(1d)+(1e)	(1n)	5	8.8800		27.5000	(1b) x	2.6000	(2b) = (2c) =	71.5000	(1b) - (3 (1c) - (3 (4)
2. Ventilation r 2. Ventilation r 2. Number of open c Number of open f Number of flues Number of flues Number of interm Number of passiv Number of fluesiv	himneys lues ys / flues attached t attached t d chimneys ittent ext	to solid fu to other he tract fans	el boiler	ire							0 * 80 = 0 * 20 = 3 * 10 = 0 * 10 = 0 * 20 =	0.0000	(6a) (6b) (6c) (6d) (6e) (6f) (7a) (7b)
Infiltration due Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides	thod AP50	eys, flues	and fans	= (6a)+(6b)	+ (6c) + (6d) + (6e)+(6f)+(6g)+(7a)+(′	7b)+(7c) =		30.0000	/ (5) =	es per hour 0.2043 Yes Blower Door 5.0000 0.4543	(8)
Shelter factor Infiltration rat	e adjusted	d to includ	le shelter f	actor					(20) = 1 - (21)	[0.075 x .) = (18) x		0.7000 0.3180	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(00:
Wind speed Wind factor	5.1000 1.2750	5.0000 1.2500	4.9000 1.2250	4.4000 1.1000	4.3000 1.0750	3.8000 0.9500	3.8000 0.9500	3.7000 0.9250		4.3000 1.0750	4.5000 1.1250	4.7000 1.1750	
Adj infilt rate Effective ac	0.4055 0.5822	0.3976 0.5790	0.3896 0.5759	0.3498 0.5612	0.3419 0.5584	0.3021 0.5456	0.3021 0.5456	0.2942 0.5433		0.3419 0.5584	0.3578 0.5640	0.3737 0.5698	
3. Heat losses a Element	nd heat lo	ss paramet	er						ΑχΙ		-value	Α×Κ	
HG Door				m2	m2		m2 0700	W/m2K 1.2000	W/F 2.4840	C k	J/m2K	kJ/K	
Windows (Uw = 1. Heat Loss Floor External Walls Plane Roof Total net area o Fabric heat loss Party Walls GF - Timber FF - Timber Internal Floor Internal Ceiling	1 f external			84.8600 31.4100	15.6700	13. 31. 69. 31. 147. 27. 48. 51. 27.	6000 3800 1900 4100 6500	1.1450 0.1200 0.1700 0.1000 30) + (32) 0.0000	15.5725 3.7656 11.7623 3.1410	110 110 110 110 110 110	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	3451.8000 7610.9000 282.6900 3049.2000 432.0000 466.5600 495.0000 247.5000	(27) (28a) (29a) (30) (31) (33) (32) (32c) (32c) (32c) (32d)
Heat capacity Cm Thermal mass par List of Thermal K1 Eleme E2 Other E3 Sill	ameter (TM Bridges nt	MP = Cm / T	FA) in kJ/m					1	(30) + (32) Length Ps 1.8800 8.3700	+ (32a)	Tot 0.22 0.17	272.3446 :al 257	

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E6 Int E10 Ea E12 Ga E16 Co E25 St P1 Par P2 Par	und floor (ermediate fives (insulable (insularner (normaggered party wall - Gty wall - Fits (Sum(L x bridges	loor within tion at cell tion a	e floor with ation at cei	ngs nin a dwell ling level	.)			17. 16. 9. 8. 15. 10. 5.	1000 9500 9700 8900 6000 0000 0000 5500 8900	0.0160 0.0590 0.0010 0.0630 0.0410 0.0370 0.0410 0.0430 0.0000 0.0400	0.35: 1.05: 0.01: 0.62: 0.35: 0.41: 0.23: 0.00: 0.23:	90 61 31 26 50 00 86	
Ventilation he		culated mor	nthly (38)m	= 0.33 × (25)m x (5)								
(38) m	Jan 28.2072	Feb 28.0525	Mar 27.9009	Apr 27.1888	May 27.0555	Jun 26.4353	Jul 26.4353	Aug 26.3205	Sep 26.6742	Oct 27.0555	Nov 27.3251	Dec 27.6068	(38)
Heat transfer	coeff 69.1777	69.0230	68.8714	68.1593	68.0261	67.4059	67.4059	67.2910	67.6448	68.0261	68.2956	68.5774	
Average = Sum(:										68.1587	
HLP	Jan 1.1749	Feb 1.1723	Mar 1.1697	Apr 1.1576	May 1.1553	Jun 1.1448	Jul 1.1448	Aug 1.1429	Sep 1.1489	Oct 1.1553	Nov 1.1599	Dec 1.1647	(40)
HLP (average) Days in mont	31	28	31	30	31	30	31	31	30	31	30	1.1576 31	
-													
4. Water heati													
Assumed occupa Hot water usag	ncy											1.9498	(42)
Hot water usag	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)
Hot water usag	24.5969	24.2316	23.7172	22.7687	22.0585	21.2710	20.8456	21.3564	21.9126	22.7553	23.7233	24.5138	(42b)
Average daily	34.5979	33.3398	32.0817	30.8236	29.5654	28.3073	28.3073	29.5654	30.8236	32.0817	33.3398	34.5979 54.2578	
Average daily	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(43)
Daily hot wate		57.5714	55.7989	53.5923	51.6239	49.5783	49.1529	50.9219	52.7361	54.8369	57.0631	59.1116	(44)
Energy conte Energy content	93.7501	81.9809	85.7608	73.3651	69.4957	60.9623	59.4462	63.0519	65.0289	74.4132 Total = Si	81.2968	92.5545 901.1065	
Distribution 1		= 0.15 x (4	15)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage Total storage	loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(40)
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	(56)
-	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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Total heat req	79.6876	69.6837	72.8967	62.3604	59.0714	51.8180	50.5293	53.5941	55.2746	63.2512	69.1023	78.6714	
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	(63b)
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	
Output from w/	n 79.6876	69.6837	72.8967	62.3604	59.0714	51.8180	50.5293	53.5941	55.2746	63.2512	69.1023	78.6714	
Electric showe		40 6000	44 2424	10 2164	42 1104	41 1000	40 4040			h/year) = Si		765.9405	
	45.5764	40.6090	44.3434	42.3164 Tot	43.1104 al Energy us	41.1232 sed by insta	42.4940 antaneous el	43.1104 Lectric show	42.3164 ver(s) (kWh	44.3434 /year) = Sur	43.5096 m(64a)m =	45.5764 518.4290	
Heat gains fro	31.3160	27.5732	29.3100	26.1692	25.5455	23.2353	23.2558	24.1761	24.3977	26.8987	28.1530	31.0619	(65)
5. Internal ga	ins (see Ta	ble 5 and 5	āa)										
Metabolic gain	s (Table 5)	, Watts											
(66) m	116.9878				May 116.9878			Aug 116.9878		Oct 116.9878		Dec 116.9878	(66)
Lighting gains	27.2380	24.1926	19.6747	14.8950	11.1342	9.4000	10.1570	13.2025	17.7203	22.5000	26.2608	27.9951	(67)
Appliances gai	253.9010	256.5357	249.8963	235.7620	217.9198	201.1507	189.9479	187.3132	193.9526	208.0870	225.9291	242.6982	(68)
Cooking gains	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	48.6486	
Pumps, fans Losses e.g. ev	aporation (negative va	alues) (Tabl	.e 5)	0.0000					0.0000	0.0000	0.0000	
Water heating	gains (Tabl	.e 5)			-77.9919								
Total internal	gains				34.3353							41.7499	
	410.8749	409.4043	396.6108	374.6476	351.0338	330.4664	319.0072	320.6550	333.2032	354.3856	378.9358	400.0877	(73)
6. Solar gains													
[Jan]			Д	rea	Solar flux		a		FF	Acces	38	Gains	
[0411]				m2	Solar flux Table 6a W/m2	Specia	fic data Table 6b	Specific or Tabl	data e 60	facto Table	nr.	W	
Northeast												19.7041	(75)
Southeast Northwest			2.24	100	11.2829 36.7938 11.2829		0.6300	0.	8000	0.77	00	28.7864 25.0636	(77)
Northwest										0.77		23.0030	(U1)
Solar gains Total gains													
gains					0.0001								/

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7. Mean interna													
Temperature dur Utilisation fac	ctor for ga	ains for li	ving area,	nil,m (see 1	Table 9a)				_			21.0000	(85)
tau alpha	Jan 64.3899 5.2927	Feb 64.5342 5.3023	Mar 64.6763 5.3118	Apr 65.3520 5.3568	May 65.4800 5.3653	Jun 66.0825 5.4055	Jul 66.0825 5.4055	Aug 66.1953 5.4130	Sep 65.8491 5.3899	Oct 65.4800 5.3653	Nov 65.2216 5.3481	Dec 64.9536 5.3302	
util living are	0.9941	0.9878	0.9667	0.8905	0.7260	0.5246	0.3840	0.4451	0.7169	0.9409	0.9881	0.9954	(86)
MIT Th 2 util rest of ho	19.8593 19.9401	20.0371 19.9423	20.3362 19.9443	20.6994 19.9541	20.9200 19.9559	20.9884 19.9644	20.9982 19.9644	20.9962 19.9660	20.9449 19.9611	20.6292 19.9559	20.1764 19.9522	19.8246 19.9483	
MIT 2 Living area fra	0.9921 18.6335	0.9836 18.8603	0.9553 19.2351	0.8571 19.6709	0.6626 19.8967	0.4436 19.9588	0.2944 19.9639	0.3468 19.9649	0.6297 19.9286 ftA =	0.9145 19.6050 Living area	0.9833 19.0463	0.9938 18.5955 0.1914	(90)
MIT Temperature adj	18.8681	19.0855	19.4458	19.8677	20.0925	20.1558	20.1619	20.1623	20.1231	19.8011	19.2626	18.8308	
adjusted MIT	18.8681	19.0855	19.4458	19.8677	20.0925	20.1558	20.1619	20.1623	20.1231	19.8011	19.2626	18.8308	(93)
8. Space heatin	ng requirem	ment											
Utilisation Useful gains Ext temp.	Jan 0.9891 479.1664 4.3000	Feb 0.9789 537.9806 4.9000	Mar 0.9484 595.5066 6.5000	Apr 0.8540 621.1810 8.9000	May 0.6714 541.5335 11.7000	Jun 0.4589 371.3503 14.6000	Jul 0.3116 239.7887 16.6000	Aug 0.3656 252.4641 16.4000	Sep 0.6443 390.3610 14.1000	Oct 0.9097 472.9845 10.6000	Nov 0.9788 459.7979 7.1000	Dec 0.9914 457.2931 4.2000	(95)
	L007.7907	979.1293	891.5968	747.5529	570.9114	374.4963	240.0933	253.1672	407.4309	625.9130	830.6542	1003.3406	(97)
Space heating r	393.2965 requirement	296.4519 - total p	220.2911 er year (kW	90.9878 h/year)	21.8571	0.0000	0.0000	0.0000	0.0000	113.7788	267.0166	406.2593 1809.9392	(98a)
Solar heating k	0.0000 contributio	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	(98b)
Space heating r Space heating r Space heating p	393.2965 requirement		220.2911 ar contribu	90.9878 tion - total	21.8571 L per year	0.0000 (kWh/year)	0.0000	0.0000	0.0000	113.7788 (98c)	267.0166	406.2593 1809.9392 30.7395	
9a. Energy requ	uirements -	- Individua	l heating s	ystems, incl	luding micr	O-CHP							
Fraction of spa Fraction of spa Efficiency of m Efficiency of s	ace heat fr ace heat fr main space main space	rom seconda rom main sy heating sy heating sy	ry/suppleme stem(s) stem 1 (in stem 2 (in	ntary system %) %)								0.0000 1.0000 100.0000 0.0000 0.0000	(202) (206) (207)
Space heating r	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	393.2965	296.4519	220.2911	90.9878	21.8571	0.0000	0.0000	0.0000	0.0000	113.7788	267.0166	406.2593	(98)
	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
	393.2965	296.4519	220.2911	90.9878	21.8571	0.0000	0.0000	0.0000	0.0000	113.7788	267.0166	406.2593	(211)
Space heating f				0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating f	0.0000 fuel (secor 0.0000	0.0000 ndary) 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Water heating	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 r	requirement 79.6876	69.6837	72.8967	62.3604	59.0714	51.8180	50.5293	53.5941	55.2746	63.2512	69.1023	78.6714	(64)
	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	
Fuel for water	79.6876	69.6837	72.8967	62.3604	59.0714	51.8180	50.5293	53.5941	55.2746	63.2512	69.1023	78.6714	(219)
Space cooling f (221)m Pumps and Fa Lighting	0.0000 0.0000 23.8413	0.0000 0.0000 19.1264	0.0000 0.0000 17.2212	0.0000 0.0000 12.6170	0.0000 0.0000 9.7457	0.0000 0.0000 7.9623	0.0000 0.0000 8.8904	0.0000 0.0000 11.5560	0.0000 0.0000 15.0101	0.0000 0.0000 19.6941	0.0000 0.0000 22.2445	0.0000 0.0000 24.5039	(231)
Electricity gen	nerated by	PVs (Appen	dix M) (neg		ity)						-93.9751	-70.8440	
Electricity gen (234a)m	nerated by 0.0000	wind turbi 0.0000	nes (Append 0.0000	ix M) (negat 0.0000	ive quanti 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity gen (235a)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	(235a)
Electricity use (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	N) (negati 0.0000	ve if net g 0.0000	eneration) 0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
	-11.5914	-32.1321	-84.2040	-169.0132	-267.6395		-280.3311	-225.1544	-151.6766	-63.1875	-18.6275	-8.4801	(233b)
Electricity gen (234b)m Electricity gen	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
(235b)m Electricity use	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 eneration)	0.0000	0.0000	0.0000	0.0000	(235b)
(235d)m Annual totals k	0.0000	0.0000	0.0000		0.0000		0.0000		0.0000	0.0000	0.0000	0.0000	(235d)
Space heating f Space heating f Space heating f Efficiency of w Water heating f Space cooling f	fuel - mair fuel - seco water heate fuel used	n system 2 ondary										1809.9392 0.0000 0.0000 100.0000 765.9405 0.0000	(213) (215) (219)
Electricity for Total electrici Electricity for	ity for the	e above, kW		ix L)								0.0000 192.4129	
Energy saving/g PV generation Wind generation Hydro-electric	n.			ces M ,N and	d Q)							-3350.6715 0.0000 0.0000	

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Electricity generated - Micro CHP (Appendix N) Appendix Q - special features Energy saved or generated Energy used Total delivered energy for all uses				0.0000 -0.0000 0.0000 -63.9498	(236) (237)
10a. Fuel costs - using Table 12 prices Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Pumps, fans and electric keep-hot Energy for lighting Additional standing charges Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total		p/kWh 16.4900 16.4900 0.0000 16.4900		Fuel cost £/year 298.4590 0.0000 126.3036 85.4889 0.0000 31.7289 0.0000	(240) (473) (247) (247a) (249) (250) (251)
Total energy cost Total energy cost 11a. SAP rating - Individual heating systems Energy cost deflator (Table 12): Energy cost factor (ECF) SAP value SAP rating (Section 12) SAP band		(255) x (256)] / [(4) +	- 45.0] =	0.3600 0.5670 90.8091	(255) (256) (257) (258)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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 CO2 emissions per m2 EI value EI rating EI band		Emission factor kg CO2/kWh 0.1564 0.1416 0.1391 0.0000 0.1443		Emissions kg CO2/year 283.1543 0.0000 108.4396 72.1249 391.5939 0.0000 27.7711 -237.8500 -190.7349 -428.5849 62.9050 1.0700 99.1886 99	(261) (373) (264) (264) (264a) (265) (267) (268) (269) (272) (273) (274)
SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 1. Overall dwelling characteristics Ground floor First floor Total floor area TFA = (la)+(lb)+(lc)+(ld)+(le)(ln) 58.8800 Dwelling volume	Area (m2) 31.3800 27.5000	(m)	(2b) = (2c) =		(1c) - (3c) (4)
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 Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a) Pressure test Pressure Test Method Measured/design AP50 Infiltration rate		30.0000	0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 20 = 0 * 20 = 3 * 10 = 0 * 30 = 0 * 40 = 0 *	0.0000 0.0000 0.0000 0.0000 0.0000 30.0000 0.0000 0.0000	(6b) (6c) (6d) (6e) (6f) (7a) (7b) (7c) (8)

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Number of sides	sheltered											4	(19)
Shelter factor	Difference								(20) = 1 -	[0.075 x	(19)] =	0.7000	
Infiltration rat	te adjusted	d to includ	e shelter f	actor					(2:	L) = (18) x	(20) =	0.3180	(21)
Wind speed Wind factor Adj infilt rate	Jan 4.3000 1.0750	Feb 4.0000 1.0000	Mar 4.1000 1.0250	Apr 3.8000 0.9500	May 3.7000 0.9250	Jun 3.2000 0.8000	Jul 3.1000 0.7750	Aug 3.1000 0.7750	Sep 3.3000 0.8250	Oct 3.5000 0.8750	Nov 3.4000 0.8500	Dec 3.8000 0.9500	
Effective ac	0.3419 0.5584	0.3180 0.5506	0.3260 0.5531	0.3021 0.5456	0.2942 0.5433	0.2544	0.2465	0.2465	0.2624	0.2783 0.5387	0.2703 0.5365	0.3021 0.5456	
arreceive de	0.0001	0.0000	0.0001	0.0100	0.0100	0.0321	0.0001	0.0001	0.0011	0.0007	0.0000	0.0100	(23)
3. Heat losses a													
Element				Gross m2	Openings m2	Net	:Area m2	U-value W/m2K	A x t W/I		value J/m2K	A x K kJ/K	
HG Door Windows (Uw = 1	.20)			IIIZ	IIIZ	2.	0700	1.2000	2.4840 15.572)	0 / IIIZIX	KO/I	(26a) (27)
Heat Loss Floor External Walls Plane Roof Total net area	1	l elements		84.8600 31.4100	15.6700	31. 69. 31.	3800 1900 4100 6500	0.1200 0.1700 0.1000	3.7650 11.7623 3.1410	5 110 3 110	.0000	3451.8000 7610.9000 282.6900	(28a) (29a)
Fabric heat los: Party Walls			,					0.0000 = 0.0000	= 36.725 0.000		.0000	3049.2000	(33)
GF - Timber FF - Timber Internal Floor Internal Ceiling	g					51. 27.	0000 8400 5000 5000			9 18	.0000 .0000 .0000	432.0000 466.5600 495.0000 247.5000	(32c) (32d)
Heat capacity Cr Thermal mass par			FA) in k.T/m	2 K				(28).	(30) + (32)	+ (32a)	.(32e) =	16035.6500	
List of Thermal	Bridges	nr - Cm / 1	raj ili ko/m	210				Le	ength Pa	si-value	Tot		(33)
E3 Sill E4 Jamb E5 Groun E6 Inte: E10 Eav E12 Gab. E16 Corn E25 Stac	nd floor (no find flo	loor within tion at cei tion at cei 1) ty wall bet round floor	a dwelling ling level) ling level) ween dwelli	ngs				8 22 17 16 9 8 15 10	.8800 .3700 .1000 .9500 .0700 .8900 .6000 .0000 .0000	0.0190 0.0210 0.0160 0.0590 0.0010 0.0630 0.0410 0.0370 0.0410	0.22 0.17 0.35 1.05 0.01 0.62 0.35 0.55 0.41	58 336 90 61 31 226 550 000 886	
	y wall - Ro	oof (insula	tion at cei		g				.8900 .8900	0.0000	0.00		(26)
Point Thermal b: Total fabric hea	ridges	rsi) caicui	aced using	Appendix K)					(3:	3) + (36) +	(36a) = (36a) =	0.0000 40.9705	
Ventilation heat	t loss cald Jan 27.0555	culated mon Feb 26.6742	thly (38)m Mar 26.7983	= 0.33 x (25 Apr 26.4353)m x (5) May 26.3205	Jun 25.7921	Jul 25.6957	Aug 25.6957	Sep 25.8917	Oct 26.0999	Nov 25.9943	Dec 26.4353	(38)
Heat transfer co	68.0261	67.6448	67.7688	67.4059	67.2910	66.7627	66.6662	66.6662	66.8622	67.0705	66.9648	67.4059	(39)
Average = Sum(3	9)m / 12 = Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	67.2113 Dec	
HLP (average)	1.1553	1.1489	1.1510	1.1448	1.1429	1.1339	1.1322	1.1322	1.1356	1.1391	1.1373	1.1448	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	
4. Water heating	g energy re	equirements	(kWh/year)										
Assumed occupand	су											1.9498	(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)
Hot water usage			23.7172	22.7687	22.0585	21.2710	20.8456	21.3564	21.9126	22.7553	23.7233	24.5138	
Average daily ho	34.5979 ot water us	33.3398 se (litres/	32.0817 day)	30.8236	29.5654	28.3073	28.3073	29.5654	30.8236	32.0817	33.3398	34.5979 54.2578	
Daily hot water	Jan use	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte Energy content	59.1948 93.7501 (annual)	57.5714 81.9809	55.7989 85.7608	53.5923 73.3651	51.6239 69.4957	49.5783 60.9623	49.1529 59.4462	50.9219 63.0519	52.7361 65.0289	54.8369 74.4132 Total = Su	57.0631 81.2968 m(45)m =	59.1116 92.5545 901.1065	
Distribution los Water storage lo	0.0000	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 lo	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 cont	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 requi	0.0000 0.0000 ired for 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	0.0000	0.0000	0.0000	
WWHRS	79.6876 0.0000	69.6837 0.0000	72.8967 0.0000	62.3604	59.0714	51.8180 0.0000	50.5293	53.5941 0.0000	55.2746 0.0000	63.2512 0.0000	69.1023 0.0000	78.6714 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	-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/h		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Flactric charge	79.6876	69.6837	72.8967	62.3604	59.0714	51.8180	50.5293	53.5941 Total pe	55.2746 er year (kWh,	63.2512 'year) = Su	69.1023 m(64)m =	78.6714 765.9405	
Electric shower	(s) 45.5764	40.6090	44.3434	42.3164 Total	43.1104 Energy use	41.1232 ed by insta	42.4940 antaneous el	43.1104 ectric show	42.3164 wer(s) (kWh/	44.3434 /ear) = Sum	43.5096 (64a)m =	45.5764 518.4290	
Heat gains from	water head 31.3160	ting, kWh/m 27.5732	onth 29.3100	26.1692	25.5455	23.2353	23.2558	24.1761	24.3977	26.8987	28.1530	31.0619	

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5. Internal ga	ins (see Ta	able 5 and 5											
(66) m	116.9878					Jun 116.9878	Jul 116.9878	Aug 116.9878	Sep 116.9878	Oct 116.9878	Nov 116.9878	Dec 116.9878	(66)
Lighting gains	27.2380	24.1926	19.6747	14.8950	11.1342	9.4000	10.1570	13.2025	17.7203	22.5000	26.2608	27.9951	(67)
Appliances gai Cooking gains	253.9010	256.5357	249.8963	235.7620	217.9198	201.1507	189.9479	187.3132	193.9526	208.0870	225.9291	242.6982	(68)
Pumps, fans	48.6486	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	
Losses e.g. ev	aporation		alues) (Tabl		-77.9919	-77.9919	-77.9919	-77.9919	-77.9919	-77.9919	-77.9919	-77.9919	
Water heating			39.3952	36.3461	34.3353	32.2712	31.2578	32.4948	33.8858	36.1541	39.1013	41.7499	
Total internal		409.4043	396.6108	374.6476	351.0338	330.4664	319.0072	320.6550	333.2032	354.3856	378.9358	400.0877	(73)
6. Solar gains													
[Jan]					Solar flux		g		FF	Acces	ss	Gains	
				m2	Table 6a W/m2	Specif	fic data Table 6b	Specific or Tab	data le 6c	facto Table 6	r	W	
Northeast			5.00	000	13.7947	7	0.6300	0	.8000	0.770		24.0906	
Northwest			2.24 6.36	600	43.3860 13.7947	7	0.6300 0.6300	0	.8000 .8000	0.770		33.9439 30.6432	
	88.6777 499.5526		244.0691 640.6799			536.0524 866.5188				183.4207 537.8063	107.9860 486.9218	74.1111 474.1988	
TOTAL GAINS	499.3320	302.0079	040.0799	733.7197	024.7012	000.3100	007.1914	731.2371	033.0400	337.0003	400.9210	474.1300	(04)
7. Mean intern		tura (haatir											
Temperature du												21.0000	(85)
Utilisation fa						Jun	Jul	Aug	Sep	Oct	Nov	Dec	(00)
tau alpha	65.4800 5.3653	65.8491 5.3899	65.7286 5.3819	66.0825 5.4055	66.1953 5.4130	66.7191 5.4479	66.8157 5.4544	66.8157 5.4544	66.6198 5.4413	66.4129 5.4275	66.5177 5.4345	66.0825 5.4055	
util living ar	ea 0.9927	0.9852	0.9584	0.8613	0.6736	0.4364	0.3135	0.3547	0.6455	0.9212	0.9842	0.9944	(86)
MIT Th 2	19.9356 19.9559	20.1138 19.9611	20.4194 19.9594	20.7656 19.9644	20.9491	20.9959 19.9733	20.9995 19.9746	20.9990 19.9746	20.9700 19.9719	20.7014 19.9690	20.2647	19.8982 19.9644	
util rest of h		0.9802	0.9444	0.8220	0.6060	0.3592	0.2291	0.2619	0.5538	0.8876	0.9778	0.9925	
MIT 2 Living area fr	18.7422	18.9712	19.3487	19.7512	19.9310	19.9716	19.9745	19.9744	19.9562	19.6975 Living area	19.1709	18.7010 0.1914	(90)
MIT Temperature ad	18.9706 justment	19.1899	19.5536	19.9454	20.1259	20.1676	20.1707	20.1705	20.1502	19.8896	19.3803	18.9301 0.0000	
adjusted MIT	18.9706	19.1899	19.5536	19.9454	20.1259	20.1676	20.1707	20.1705	20.1502	19.8896	19.3803	18.9301	(93)
8. Space heati													
Utilisation	Jan 0.9869	Feb 0.9752	Mar 0.9376	Apr 0.8212	May 0.6169	Jun 0.3739	Jul 0.2453	Aug 0.2797	Sep 0.5704	Oct 0.8845	Nov 0.9728	Dec 0.9897	(94)
Useful gains			600.7199	620.6110	508.8233	324.0039 15.3000	197.9736 17.2000	204.5564	362.5744 14.6000	475.6763 11.0000	473.7009 7.4000		(95)
Heat loss rate	W	953.1061			526.6100	324.9768	198.0438	204.6985	371.1012	596.2331	802.2557	979.4167	
Space heating	365.5863	271.6588		69.8034	13.2333	0.0000	0.0000	0.0000	0.0000	89.6943	236.5595	379.5252	
Space heating Solar heating	kWh											1617.1201	
Solar heating Space heating		0.0000 on - total p	0.0000 per year (kW	0.0000 Wh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Space heating	365.5863	271.6588 t after sola			13.2333 L per year	0.0000 (kWh/year)	0.0000	0.0000	0.0000	89.6943	236.5595	379.5252 1617.1201	(98c)
Space heating	per m2									(98c)	/ (4) =		(99)
9a. Energy req													
Fraction of sp Fraction of sp Efficiency of Efficiency of	ace heat f: main space main space	rom main sys heating sys heating sys	stem(s) stem 1 (in 8 stem 2 (in 8	%) %)	n (Table 11	-)						0.0000 1.0000 100.0000 0.0000	(202) (206) (207)
Efficiency of					Marz	Tun	.Tu 1	Aug	Son	Oct	Nove	0.0000	(∠∪8)
Space heating		Feb t 271.6588	Mar 191.0594	Apr 69.8034	May 13.2333	Jun 0.0000	Jul 0.0000	Aug 0.0000	Sep 0.0000	Oct 89.6943	Nov 236.5595	Dec 379.5252	(98)
Space heating	efficiency		ing system 1	1)	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	
Space heating	fuel (main		stem)	69.8034	13.2333	0.0000	0.0000	0.0000	0.0000	89.6943	236.5595	379.5252	
Space heating	efficiency 0.0000	(main heati	ing system 2 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating	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)
Space heating	fuel (secon 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating Water heating	requirement 79.6876		72.8967	62.3604	59.0714	51.8180	50.5293	53.5941	55.2746	63.2512	69.1023	78.6714	(64)

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Efficiency of water heater			1	00.000	(216)
(217)m 100.0000 100.0000 100.0000 100.0000 100.0000 100.0000 100.0000 100.0000 100.0000	000 100.0000	100.0000 100.0000	100.0000 1	00.000	(217)
79.6876 69.6837 72.8967 62.3604 59.0714 51.8180 50.5	293 53.5941	55.2746 63.2512	69.1023	78.6714	(219)
Space cooling fuel requirement (221)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	(221)
Pumps and Fa 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00 Lighting 23.8413 19.1264 17.2212 12.6170 9.7457 7.9623 8.8	000 0.0000 904 11.5560	0.0000 0.0000 15.0101 19.6941	0.0000 22.2445	0.0000 24.5039	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m -97.5399 -134.5214 -191.2178 -202.1662 -192.3996 -174.5076 -171.8				83.6782	
Electricity generated by wind turbines (Appendix M) (negative quantity)					
(234a)m 0.0000 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	(234a)
(235a)m 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.000	000 0.0000 et generation)	0.0000 0.0000	0.0000	0.0000	(235a)
(235c)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00	0.0000	0.0000 0.0000	0.0000	0.0000	(235c)
(233b)m -16.2899 -37.9695 -93.3574 -192.5159 -282.4439 -331.0353 -309.7	153 -257.9355	-174.2717 -76.3642	-25.7088 -	12.0343	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		0.0000 0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if no (235d)m 0.0000 0.0000 0.0000 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			
Space heating fuel - main system 1 Space heating fuel - main system 2			16	0.0000	(213)
Space heating fuel - secondary Efficiency of water heater			1	0.0000	(215)
Water heating fuel used Space cooling fuel				65.9405	
				0.0000	(221)
Electricity for pumps and fans: Total electricity for the above, kWh/year				0.0000	
Electricity for lighting (calculated in Appendix L)			1	92.4129	(232)
Energy saving/generation technologies (Appendices M ,N and Q) PV generation			-36	36.6311	(233)
Wind generation				0.0000	(234)
Hydro-electric generation (Appendix N) Electricity generated - Micro CHP (Appendix N)				0.0000	
Appendix Q - special features Energy saved or generated				-0.0000	(236)
Energy used Total delivered energy for all uses			-5	0.0000	
2-					
10a. Fuel costs - using BEDF prices (536)					
	Fuel	Fuel price		el cost	
Space heating - main system 1	kWh/year 1617.1201	p/kWh 25.1600	4	£/year 06.8674	
Total CO2 associated with community systems Water heating (other fuel)	765.9405	25.1600		0.0000	
Energy for instantaneous electric shower(s) Pumps, fans and electric keep-hot	518.4290 0.0000	25.1600 0.0000	1	30.4367	(247a)
Energy for lighting	192.4129	25.1600		48.4111	(250)
Additional standing charges				0.0000	(251)
Energy saving/generation technologies PV Unit electricity used in dwelling	-1826.9894	25.1600	-4	59.6705	
PV Unit electricity exported Total	-1809.6416	5.8100		05.1402	(252)
Total energy cost				13.6152	
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP					
	Energy	Emission factor		issions	
Space heating - main system 1			kg C	02/year 53.7982	
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel)	Energy kWh/year 1617.1201 765.9405	kg CO2/kWh 0.1569 0.1416	kg C 2 1	02/year 53.7982 0.0000 08.4396	(373) (264)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating	Energy kWh/year 1617.1201 765.9405 518.4290	kg CO2/kWh 0.1569 0.1416 0.1391	kg C 2 1	02/year 53.7982 0.0000 08.4396 72.1249	(373) (264) (264a) (265)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s)	Energy kWh/year 1617.1201 765.9405	kg CO2/kWh 0.1569 0.1416 0.1391 0.0000	kg C 2 1 3	02/year 53.7982 0.0000 08.4396 72.1249	(373) (264) (264a) (265) (267)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot	Energy kWh/year 1617.1201 765.9405 518.4290 0.0000	kg CO2/kWh 0.1569 0.1416 0.1391 0.0000	kg C 2 1 3	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000	(373) (264) (264a) (265) (267)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot Energy for lighting	Energy kWh/year 1617.1201 765.9405 518.4290 0.0000	kg CO2/kWh 0.1569 0.1416 0.1391 0.0000 0.1443	kg C 2 1 3 32	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000	(373) (264) (264a) (265) (267)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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 1617.1201 765.9405 518.4290 0.0000 192.4129	kg CO2/kWh 0.1569 0.1416 0.1391 0.0000 0.1443	kg C 2 1 3 -2 -2 -4	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000 27.7711 48.7787 16.6300 65.4087	(373) (264) (264a) (265) (267) (268)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported	Energy kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129	kg CO2/kWh 0.1569 0.1416 0.1391 0.0000 0.1443	kg C 2 1 3 -2 -2 -4	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000 27.7711	(373) (264) (264a) (265) (267) (268)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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	Energy kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129 -1826.9894 -1809.6416	kg CO2/kWh 0.1569 0.1416 0.1391 0.0000 0.1443	kg C 2 1 3 -2 -2 -4	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000 27.7711 48.7787 16.6300 65.4087	(373) (264) (264a) (265) (267) (268)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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	Energy kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129 -1826.9894 -1809.6416	kg CO2/kWh 0.1569 0.1416 0.1391 0.0000 0.1443	kg C 2 1 3 -2 -2 -4	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000 27.7711 48.7787 16.6300 65.4087	(373) (264) (264a) (265) (267) (268)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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	Energy kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129 -1826.9894 -1809.6416	kg CO2/kwh 0.1569 0.1416 0.1391 0.0000 0.1443 0.1362 0.1197	kg C 2 1 1 3 3 -2 -2 -4	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000 27.7711 48.7787 16.6300 65.4087 -3.2747	(373) (264) (264a) (265) (267) (268)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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 13a. Primary energy - Individual heating systems including micro-CHP Space heating - main system 1	Energy kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129 -1826.9894 -1809.6416	kg CO2/kWh 0.1569 0.1416 0.1391 0.0000 0.1443 0.1362 0.1197 Primary energy factor kg CO2/kWh	kg C 2 1 3 -2 -2 -4 Primary 25	02/year 53.792 0.0000 08.4396 72.1249 62.2378 0.0000 27.7711 48.7787 16.6300 65.4087 -3.2747	(373) (264) (264a) (265) (267) (268) (269) (272)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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 13a. Primary energy - Individual heating systems including micro-CHP	Energy kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129 -1826.9894 -1809.6416	kg CO2/kWh 0.1569 0.1416 0.1391 0.0000 0.1443 0.1362 0.1197 Primary energy factor kg CO2/kWh 1.5810	kg C 2 1 1 3 3 -2 -2 -4 Primary k 25	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000 27.7711 48.7787 16.6300 65.4087 -3.2747	(373) (264) (264a) (265) (267) (268) (269) (272)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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 Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s)	Energy kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129 -1826.9894 -1809.6416	kg CO2/kWh 0.1569 0.1416 0.1391 0.0000 0.1443 0.1362 0.1197 Primary energy factor kg CO2/kWh 1.5810 1.5235	kg C 2 1 1 3 3 -2 -2 -4 Primary k 25 11 7	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000 27.7711 48.7787 16.6300 65.4087 -3.2747	(273) (264) (264a) (265) (267) (268) (269) (272) (272) (275) (473) (278) (278a)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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 Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot	Energy kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129 -1826.9894 -1809.6416 Energy kWh/year 1617.1201 765.9405 518.4290 0.0000	kg CO2/kwh 0.1569 0.1416 0.1391 0.0000 0.1443 0.1362 0.1197 Primary energy factor kg CO2/kwh 1.5810 1.5235 1.5143 0.0000	Primary k 25	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000 27.7711 48.7787 16.6300 65.4087 -3.2747	(273) (264) (264a) (265) (267) (268) (269) (272) (272) (273) (278) (278a) (279) (281)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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 Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot Energy for lighting	Energy kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129 -1826.9894 -1809.6416 Energy kWh/year 1617.1201 765.9405 518.4290	kg CO2/kWh 0.1569 0.1416 0.1391 0.0000 0.1443 0.1362 0.1197 Primary energy factor kg CO2/kWh 1.5810 1.5235 1.5143 0.0000	Primary k 25	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000 27.7711 48.7787 16.6300 65.4087 -3.2747	(273) (264) (264a) (265) (267) (268) (269) (272) (272) (273) (278) (278a) (279) (281)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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 Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot Energy saving/generation technologies FV Unit electricity used in dwelling Energy saving/generation technologies FV Unit electricity used in dwelling	Energy kWh/year 1617.1201 765.9405 18.4290 0.0000 192.4129 Energy kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129 -1826.9894	kg CO2/kWh 0.1569 0.1416 0.1391 0.0000 0.1443 0.1362 0.1197 Primary energy factor kg CO2/kWh 1.5810 1.5235 1.5143 0.0000 1.5338	Rg C 2 1 1 3 3 -2 -2 -4 Primary k 25 11 7 37 2 -27	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000 27.7711 48.7787 16.6300 65.4087 -3.2747	(273) (264) (264a) (265) (267) (268) (269) (272) (272) (273) (278) (278a) (279) (281)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies FV Unit electricity used in dwelling PV Unit electricity exported Total Total CO2, kg/year Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total	Energy kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129 -1826.9894 -1809.6416 Energy kWh/year 1617.1201 765.9405 518.4290 0.0000	Rg CO2/kwh 0.1569 0.1416 0.1391 0.0000 0.1443 0.1362 0.1197 Primary energy factor kg CO2/kwh 1.5810 1.5235 1.5143 0.0000 1.5338	Primary k 25 11 7 37 2 -27 -7 -35	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000 27.7711 48.7787 16.6300 65.4087 -3.2747 -3.2747 -3.2747 -3.2747 -4.6300 65.4087 -3.2747 -3.2747 -3.2747 -4.6300 66.935 85.0748 23.6336 0.0000 66.935 95.1294 -4.6375 94.5494 41.1869	(273) (264) (264a) (265) (267) (268) (269) (272) (272) (275) (473) (278) (278) (278) (278) (278) (282)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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 Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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	Energy kWh/year 1617.1201 765.9405 18.4290 0.0000 192.4129 Energy kWh/year 1617.1201 765.9405 518.4290 0.0000 192.4129 -1826.9894	kg CO2/kWh 0.1569 0.1416 0.1391 0.0000 0.1443 0.1362 0.1197 Primary energy factor kg CO2/kWh 1.5810 1.5235 1.5143 0.0000 1.5338	Primary k 25 11 7 37 2 -27 -7 -35	02/year 53.7982 0.0000 08.4396 72.1249 62.2378 0.0000 27.7711 48.7787 16.6300 65.4277 -3.2747	(273) (264) (264a) (265) (267) (268) (269) (272) (272) (275) (473) (278) (278) (278) (278) (278) (282)

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SAP 10 EPC IMPRO	OVEMENTS															
001 - Be Green																
Current energy e							B 91 A 99									
N Solar water h U Solar photovo V2 Wind turbine		ls						ended y installed plicable								
Recommended meas N Solar water h			SAP chane + 2.1	ge Cost -£	change 59	е	CO2 chan	ge (1278.7%)								
			Typical	annual sa	vings			Environmenta cy impact	1							
Recommended meas Solar water heat		Total Savings	£59 £59		0.71 kg		A 93	A 100								
Potential energy Potential enviro							A 93	A 100								
Fuel prices for Recommendation t					on numb	ber 5	36 TEST (31 Jan 2024)								
Typical heating	and lighti	ng costs of th	nis home (pe		Thames		ey): Saving									
Electricity Space heating			£778	£694		£84 -£20	,									
Water heating Lighting Generated (PV)	ı		£407 £323 £48 -£565	£219 £48 -£540		£104 £0 -£25										
Total cost of Total cost of	uses		£213 £213	£154 £154			£59 £59									
Delivered ener Carbon dioxide CO2 emissions	e emissions		-9 kWh/m ² -0.0 tonne: -0 kg/m ²	s -0.0	kWh/m² tonnes g/m²	s	6 kWh/m ² 0.0 tonne 1 kg/m ²	s								
Primary energy	7		21 kWh/m²	15 k	:Wh/m²		6 kWh/m²									
SAP 10 WORKSHEET CALCULATION OF E	ENERGY RATI		ED DWELLING													
1. Overall dwell									Area		torey	heiaht			Volume	
Ground floor First floor Total floor area Dwelling volume	a TFA = (1a)+(1b)+(1c)+(1	ld)+(1e)	(1n)		5	8.8800		(m2) 31.3800 27.5000	(1b) x	:	(m) 2.4000 2.6000	(2c)	= =	(m3) 75.3120	(1b) - (3k (1c) - (3c (4) (5)
2. Ventilation r	rate															
Number of open of													0 * 80	=	0.0000	(6a)
Number of open f Number of chimne Number of flues	flues eys / flues												0 * 20 0 * 10 0 * 20	=	0.0000 0.0000 0.0000	(6c)
Number of flues Number of blocke Number of interm	attached t ed chimneys	o other heater											0 * 35 0 * 20 3 * 10	= =	0.0000	(6e) (6f)
Number of interm Number of passiv Number of fluels	e vents												0 * 10 0 * 40	=	30.0000 0.0000 0.0000	(7b)
Infiltration due	e to chimne	ys, flues and	fans = (6a)+(6b)+	(6c)+(6	6d)+(6e)+(6f)+	(6g) + (7a) + (7)	b)+(7c) =			30.000	Air ch		per hour 0.2043	(8)
Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides	AP50 te													Blo	Yes ower Door 5.0000 0.4543	(17)
Shelter factor Infiltration rat		to include sh	nelter facto	or						(20) = 1			x (19)] x (20)		0.7000 0.3180	(20)
Wind speed	Jan 5.1000	5.0000	1.9000	Apr 4.4000	May 4.300	00	Jun 3.8000	Jul 3.8000	Aug 3.7000		0	Oct 4.3000		000	Dec 4.7000	
Wind factor Adj infilt rate	1.2750 0.4055			1.1000 0.3498	0.34		0.9500	0.9500	0.9250			1.0750 0.3419			1.1750	
Effective ac	0.5822			0.5612	0.558		0.5456	0.5456	0.2942			0.5584	0.5		0.5698	

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Element				Gross m2	Openings m2		Area m2	U-value W/m2K	A x U		value J/m2K	A x K kJ/K	
HG Door Windows (Uw =	1.20)			1112	1112	2.	0700	1.2000	2.4840 15.572	0	.07 111211	K07 K	(26 (27
Heat Loss Floo External Walls Plane Roof	r 1			84.8600 31.4100	15.6700	31. 69.	3800 1900 4100	0.1200 0.1700 0.1000	3.7656 11.7623 3.1410	3 110	.0000	3451.8000 7610.9000 282.6900	(28 (29
Total net area Fabric heat lo				31.1100		147.	6500	30) + (32) =				202.0300	(31
Party Walls GF - Timber						48.	7200 0000	0.0000	0.000	9	.0000	3049.2000	(32
FF - Timber Internal Floor Internal Ceili						27.	8400 5000 5000			18	.0000	466.5600 495.0000 247.5000	(32
Heat capacity Thermal mass p	arameter (T		PFA) in kJ/m	2K				(28)	.(30) + (32)) + (32a)	.(32e) = 1	.6035.6500 272.3446	
E3 Sil E4 Jam E5 Gro E6 Int E10 Ea E12 Ga E16 Co E25 St P1 Par	ment ier lintels l the lintels bund floor (cermediate f twes (insula ble (insula arner (norma taggered par	normal) loor within tion at cei tion at cei 1) ty wall bet round floor	iling level) :ween dwelli	ngs	ng			11. 8. 22. 17. 16. 9. 8. 15.	ngth P: 8800 3700 1000 9500 0700 8900 6000 0000 0000 5500 8900	si-value 0.0190 0.0210 0.0160 0.0590 0.0630 0.0410 0.0370 0.0410 0.0430 0.0430 0.0430	Tota 0.225 0.179 0.353 1.059 0.016 0.623 0.352 0.555 0.410	57 58 86 90 51 81 86 60	
P4 Par Thermal bridge	ty wall - R es (Sum(L x	oof (insula	ation at cei	ling level)				5.	8900	0.0400	0.235	4.2451	
Point Thermal Total fabric h									(3:	3) + (36) +	(36a) = (36a) =	0.0000 40.9705	
Ventilation he	at loss cal Jan 28.2072	culated mon Feb 28.0525	nthly (38)m Mar 27.9009	= 0.33 x (2 Apr 27.1888	5)m x (5) May 27.0555	Jun 26.4353	Jul 26.4353	Aug 26.3205	Sep 26.6742	Oct 27.0555	Nov 27.3251	Dec	/20
Heat transfer Average = Sum(coeff 69.1777	69.0230	68.8714	68.1593	68.0261	67.4059	67.4059	67.2910	67.6448	68.0261	68.2956	27.6068 68.5774 68.1587	(39)
HLP	Jan 1.1749	Feb 1.1723	Mar 1.1697	Apr 1.1576	May 1.1553	Jun 1.1448	Jul 1.1448	Aug 1.1429	Sep 1.1489	Oct 1.1553	Nov 1.1599	Dec 1.1647	
HLP (average) Days in mont	31	28	31	30	31	30	31	31	30	31	30	1.1576	
Hot water usag Hot water usag	0.0000 ge for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Hot water usag	24.5969 ge for other 34.5979	24.2316 uses 33.3398	23.7172 32.0817	22.7687 30.8236	22.0585	21.2710	20.8456	21.3564	21.9126	22.7553	23.7233	24.5138 34.5979	
Average daily	hot water u	se (litres/ Feb	/day) Mar	Anr	May	Jun	Jul	Aug	Sep	Oct	Nov	54.2578 Dec	(43
Daily hot wate		57.5714	55.7989	Apr 53.5923	May 51.6239	49.5783	49.1529	50.9219	52.7361	54.8369	57.0631	59.1116	(44
Energy conte Energy content Distribution l	93.7501 (annual)	81.9809 - 0.15 v. (4	85.7608	73.3651	69.4957	60.9623	59.4462	63.0519	65.0289	74.4132 Total = Su	81.2968 m(45)m =	92.5545 901.1065	
Water storage	0.0000 loss:	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 If cylinder co	0.0000	0.0000 cated solar	0.0000 r storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56
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	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	(59
Total heat req				d for each 62.3604		51.8180	50.5293	53.5941	55.2746	63.2512	69.1023	78.6714	
WWHRS PV diverter Aperture area Zero-loss coll Collector line Collector 2nd	0.0000 -0.0000 of solar co ector effic ar heat los order heat efficiency	0.0000 -0.0000 llector iency s coefficie loss coeffi	0.0000 -0.0000 ent icient	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 -0.0000 3.0000 0.8000 0.0000 0.9000 1.0000 0.8000 6.5000 3.9667 75.0000	(63 (63 (H1 (H2 (H3 (H4 (H5 (H6 (H8 (H1 (H1
Incidence angl Overshading fa Overall heat l Heat loss coef Dedicated sola Reference volu Storage tank of Heat delivered Solar input	oss coeffic fficient of ir storage v ir volume ime correction c it to hot wat it to space h	collector 1 olume oefficient er eating	Loop									75.0000 225.0000 1.3161 381.3293 0.0000 381.3293	(H1 (H1 (H2 (H2
Collector loop Incidence angl Overshading fa Overall heat leat loss coef Dedicated sola Reference volu Storage tank c Heat delivered Heat delivered Solar input FGHRS Output from w/	coss coefficitions of the storage varieties of the storage varieties of the storage varieties of the storage of	collector l olume oefficient er		-49.9045 0.0000	-54.3327 0.0000	-48.4954 0.0000	-47.9586 0.0000	-47.0973 0.0000	-40.3020 0.0000	-27.7755 0.0000	-4.5001 0.0000	225.0000 1.3161 381.3293 0.0000	(H1 (H1 (H2 (H2
Incidence angi Overshading fa Overall heat 1 Heat loss coef Dedicated sola Effective sola Reference volu Storage tank of Heat delivered Solar input Solar input FGHRS Output from w/	oss coeffic efficient of rr storage v er volume mme correction c et to hot wat et to space h -0.0000 0.0000 h 79.6876	collector 1 olume oefficient er eating -17.2539	-43.7094					0.0000 6.4968		0.0000 35.4757	0.0000	225.0000 1.3161 381.3293 0.0000 381.3293 -0.0000	(H1 (H2 (H2 (H2 (63 (63
Incidence angi Overshading fa Overshl heat 1 Heat loss coef Dedicated sola Effective sola Reference volu Storage tank c Heat delivered Solar input Solar input FGHRS	oss coeffic fficient of fr storage v r volume ume correction c i to hot wat i to space h 79.6876 er(s) 45.5764	collector 1 olume coefficient er eating -17.2539 0.0000 52.4299 40.6090	-43.7094 0.0000 29.1872 44.3434	0.0000 12.4559 42.3164	0.0000	0.0000 3.3226 41.1232	0.0000 2.5707 42.4940	0.0000 6.4968 Total pe	0.0000 14.9726 r year (kWh, 42.3164	0.0000 35.4757 /year) = Su 44.3434	0.0000 64.6022 m(64)m = 43.5096	225.0000 1.3161 381.3293 0.0000 381.3293 -0.0000 0.0000	(H1 (H1 (H2 (H2 (63 (63 (64 (64

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5. Internal ga	ins (see Ta	able 5 and 5											
Metabolic gain													
(66) m	116.9878					Jun 116.9878		Aug 116.9878	Sep 116.9878	Oct 116.9878	Nov 116.9878	Dec 116.9878	(66)
Lighting gains	27.2380	24.1926	19.6747	14.8950	11.1342	9.4000	10.1570	13.2025	17.7203	22.5000	26.2608	27.9951	(67)
Appliances gai Cooking gains	253.9010	256.5357	249.8963	235.7620	217.9198	201.1507	189.9479	187.3132	193.9526	208.0870	225.9291	242.6982	(68)
Pumps, fans	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	48.6486 0.0000	
Losses e.g. ev	aporation (alues) (Tab				-77.9919	-77.9919	-77.9919	-77.9919	-77.9919	-77.9919	
Water heating	gains (Tabl	Le 5)	39.3952	36.3461	34.3353	32.2712	31.2578	32.4948	33.8858	36.1541	39.1013	41.7499	
Total internal		409.4043	396.6108	374.6476	351.0338	330.4664	319.0072	320.6550	333.2032	354.3856	378.9358	400.0877	(73)
6. Solar gains													
[Jan]				 rea	Solar flux		g		FF	Acces	3.5	Gains	
loani				m2	Table 6a W/m2	Speci:	fic data Table 6b	Specific or Tab		facto Table 6	or	W	
Northeast			5.0	000	11.2829		0.6300	0	.8000	0.770		19.7041	
Northwest			2.2 6.3	500	36.7938 11.2829		0.6300 0.6300	0	.8000 .8000	0.770		28.7864 25.0636	
						478.8324					90.8087	61.1947	
Total gains	484.4290	549.5640	627.8808	727.4061	806.5804	809.2988	769.5914	690.4910	605.9034	519.9415	469.7445	461.2824	(84)
7. Mean intern												01 0000	(05)
Temperature du Utilisation fa	ring heatin ctor for ga Jan	ng periods 1 ains for liv Feb	in the livii ving area, i Mar	ng area from nil,m (see ! Apr	m Table 9, Table 9a) May	Jun	Jul	Aug	Sep	Oct	Nov	21.0000 Dec	(85)
tau alpha	64.3899 5.2927	64.5342	64.6763 5.3118	65.3520 5.3568	65.4800 5.3653	66.0825 5.4055	66.0825 5.4055	66.1953 5.4130	65.8491 5.3899	65.4800 5.3653	65.2216 5.3481	64.9536 5.3302	
util living ar	ea 0.9941	0.9878	0.9667	0.8905	0.7260	0.5246	0.3840	0.4451	0.7169	0.9409	0.9881	0.9954	(86)
MIT	19.8593	20.0371	20.3362	20.6994	20.9200	20.9884	20.9982	20.9962	20.9449	20.6292	20.1764	19.8246	
Th 2 util rest of h		19.9423	19.9443	19.9541	19.9559	19.9644	19.9644	19.9660	19.9611	19.9559	19.9522	19.9483	
MIT 2 Living area fr	0.9921 18.6335	0.9836 18.8603	19.2351	19.6709	0.6626 19.8967	0.4436 19.9588	0.2944 19.9639	0.3468 19.9649	19.9286	19.6050 Living area	0.9833	0.9938 18.5955 0.1914	(90)
MIT Temperature ad	18.8681	19.0855	19.4458	19.8677	20.0925	20.1558	20.1619	20.1623	20.1231	19.8011	19.2626	18.8308	
	18.8681	19.0855	19.4458	19.8677	20.0925	20.1558	20.1619	20.1623	20.1231	19.8011	19.2626	18.8308	(93)
8. Space heati	ng requirem	nent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation Useful gains			0.9484 595.5066	0.8540 621.1810	0.6714 541.5335	0.4589 371.3503	0.3116 239.7887	0.3656 252.4641	0.6443 390.3610	0.9097 472.9845	0.9788 459.7979	0.9914 457.2931	
Heat loss rate	W		6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Space heating	kWh	979.1293			570.9114	374.4963	240.0933	253.1672	407.4309	625.9130		1003.3406	
Space heating Solar heating	requirement	296.4519 - total pe		90.9878 n/year)	21.8571	0.0000	0.0000	0.0000	0.0000	113.7788	267.0166	406.2593 1809.9392	(98a)
Solar heating	-0.0000 contributio	-0.0000 on - total p		-0.0000 Wh/year)	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 0.0000	(98b)
Space heating Space heating	393.2965	296.4519				0.0000 (kWh/yoar)	0.0000	0.0000	0.0000	113.7788	267.0166	406.2593 1809.9392	(98c)
Space heating		. diter sole	ir contribu	LION - LOCA.	r per year	(kwii/year)				(98c)	/ (4) =	30.7395	(99)
9a. Energy req	uirements -	- Individual	heating s	ystems, inc	luding micr	o-CHP							
Fraction of sp Fraction of sp	ace heat fr	om secondar	y/suppleme									0.0000	
Efficiency of Efficiency of Efficiency of	main space main space	heating sys	stem 1 (in stem 2 (in s	₹)								100.0000 0.0000 0.0000	(206) (207)
TITIOTOMOY OF	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(200)
Space heating	requirement 393.2965	296.4519	220.2911	90.9878	21.8571	0.0000	0.0000	0.0000	0.0000	113.7788	267.0166	406.2593	(98)
Space heating	efficiency 100.0000	(main heati	ng system 100.0000		100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	
Space heating	393.2965	296.4519	220.2911	90.9878	21.8571	0.0000	0.0000	0.0000	0.0000	113.7788	267.0166	406.2593	(211)
Space heating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating Water heating	requirement	:											

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79.6876 52.4299 29.1872 12.4559 4.7387 3.3226 2.570° Efficiency of water heater	7 6.4968	14.9726	35.4757	64.6022	78.6714 100.0000	
(217)m 100.0000 100.0000 100.0000 100.0000 100.0000 100.0000 100.0000 Fuel for water heating, kWh/month	0 100.0000	100.0000	100.0000	100.0000		
79.6876 52.4299 29.1872 12.4559 4.7387 3.3226 2.570° Space cooling fuel requirement	7 6.4968	14.9726	35.4757	64.6022	78.6714	(219)
(221)m 0.0000 0.	5 6.7945	6.5753	0.0000 6.7945 19.6941	0.0000 6.5753 22.2445	6.7945	(231)
(233a)m -83.3379 -126.3045 -184.8373 -189.8696 -172.8546 -148.2168 -147.1995	5 -145.9481	-138.5405	-138.2812	-94.0218	-70.8994	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)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	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000			0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net (235c)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000			0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m -11.5159 -32.5383 -87.9447 -180.2188 -289.1956 -308.2699 -302.2998	8 -243.3714	-162.6858	-65.3147	-18.5808	-8.4247	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)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	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000			0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net (235d)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000			0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year Space heating fuel - main system 1					1809.9392	
Space heating fuel - main system 2 Space heating fuel - secondary					0.0000	
Efficiency of water heater Water heating fuel used					100.0000 384.6112	
Space cooling fuel					0.0000	(221)
Electricity for pumps and fans: pump for solar water heating					80.0000	
Total electricity for the above, kWh/year Electricity for lighting (calculated in Appendix L)					80.0000 192.4129	
Energy saving/generation technologies (Appendices M ,N and Q)						
PV generation Wind generation					-3350.6715 0.0000	(234)
Hydro-electric generation (Appendix N) Electricity generated - Micro CHP (Appendix N)					0.0000	
Appendix Q - special features Energy saved or generated					-0.0000	
Energy used Total delivered energy for all uses					0.0000 -365.2791	
10a. Fuel costs - using Table 12 prices			Duel main		Decil cost	
Chase besting wein quotem 1	Fuel kWh/year 1809.9392		Fuel price p/kWh 16.4900		Fuel cost £/year	(240)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel)	384.6112		16.4900		298.4590 0.0000 63.4224	(473)
Energy for instantaneous electric shower(s) Pumps, fans and electric keep-hot	518.4290		16.4900		85.4889 0.0000	(247a)
Pump for solar water heating Energy for lighting	80.0000 192.4129		16.4900 16.4900		13.1920 31.7289	(249)
Additional standing charges	172.1127		10.1300		0.0000	
Energy saving/generation technologies PV Unit electricity used in dwelling	-1640.3110		16.4900		-270.4873	
PV Unit electricity exported Total	-1710.3605		5.5900		-95.6092 -366.0964	(252)
Total energy cost					126.1948	(255)
11a. SAP rating - Individual heating systems						
Energy cost deflator (Table 12): Energy cost factor (ECF)	[(255) x (256	5)] / [(4) +	45.0] =	0.3600 0.4373	
SAP value SAP rating (Section 12)					92.9108 93	(258)
SAP band					A	
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP					Emissions	
	Energy	Emiss	ion factor			
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP Space heating - main system 1		Emiss	ion factor kg CO2/kWh 0.1564		kg CO2/year 283.1543	
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel)	Energy kWh/year 1809.9392 384.6112	Emiss	kg CO2/kWh 0.1564 0.1531		283.1543 0.0000 58.8916	(373) (264)
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating	Energy kWh/year 1809.9392 384.6112 518.4290	Emiss	kg CO2/kWh 0.1564 0.1531 0.1391		283.1543 0.0000 58.8916 72.1249 342.0459	(373) (264) (264a) (265)
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s)	Energy kWh/year 1809.9392 384.6112	Emiss	kg CO2/kWh 0.1564 0.1531		283.1543 0.0000 58.8916 72.1249	(373) (264) (264a) (265) (267)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies	Energy kWh/year 1809.9392 384.6112 518.4290 80.0000 192.4129	Emiss	kg CO2/kWh 0.1564 0.1531 0.1391 0.1387 0.1443		283.1543 0.0000 58.8916 72.1249 342.0459 11.0970 27.7711	(373) (264) (264a) (265) (267)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported	Energy kWh/year 1809.9392 384.6112 518.4290	Emiss	kg CO2/kWh 0.1564 0.1531 0.1391 0.1387		283.1543 0.0000 58.8916 72.1249 342.0459 11.0970 27.7711 -223.9745 -203.5399	(373) (264) (264a) (265) (267) (268)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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	Energy kWh/year 1809.9392 384.6112 518.4290 80.0000 192.4129	Emiss	kg CO2/kWh 0.1564 0.1531 0.1391 0.1387 0.1443		283.1543 0.0000 58.8916 72.1249 342.0459 11.0970 27.7711 -223.9745 -203.5399 -427.5143 25.5246	(373) (264) (264a) (265) (267) (268) (269) (272)
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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 CO2 emissions per m2 EI value	Energy kWh/year 1809.9392 384.6112 518.4290 80.0000 192.4129	Emiss	kg CO2/kWh 0.1564 0.1531 0.1391 0.1387 0.1443		283.1543 0.0000 58.8916 72.1249 342.0459 11.0970 27.7711 -223.9745 -203.5399 -427.55143 25.5246 0.4300 99.6707	(373) (264) (264a) (265) (267) (268) (269) (272) (273)
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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 CO2 emissions per m2	Energy kWh/year 1809.9392 384.6112 518.4290 80.0000 192.4129	Emiss	kg CO2/kWh 0.1564 0.1531 0.1391 0.1387 0.1443		283.1543 0.0000 58.8916 72.1249 342.0459 11.0970 27.7711 -223.9745 -203.5399 -427.55143 25.5246 0.4300 99.6707	(373) (264) (264a) (265) (267) (268) (269) (272)

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 1. Overall dwelling characteristics Storey height Volume Area (m3) 75.3120 (1b) - (3b) 71.5000 (1c) - (3c) (m2) (m) 2.4000 (2b) 2.6000 (2c) 27.5000 (1c) First floor Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)58.8800 (4) Dwelling volume $(3a) + (3b) + (3c) + (3d) + (3e) \dots (3n) =$ 146.8120 (5) 2. Ventilation rate m3 per hour 0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 3 * 10 = 0 * 10 = 0.0000 (6a) 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 0.0000 (6b) 0.0000 (6c) 0.0000 (6d) 0.0000 (6e) (6f) (7a) (7b) Number of blocked chimneys Number of intermittent extract fans 0.0000 30.0000 0 * 10 = 0 * 40 = Number of passive vents Number of flueless gas fires 0.0000 (7c) Air changes per hour 30.0000 / (5) = 0.2043 (8)Pressure test Pressure Test Method Yes Blower Door 5.0000 (17) 0.4543 (18) Measured/design AP50 Infiltration rate Number of sides sheltered 4 (19) $(20) = 1 - [0.075 \times (19)] = (21) = (18) \times (20) =$ 0.7000 (20) 0.3180 (21) Infiltration rate adjusted to include shelter factor May 3.7000 0.9250 Sep 3.3000 0.8250 Jun 4.3000 4.0000 3.8000 3.1000 0.7750 3.5000 3.4000 3.8000 (22) 0.9500 (22a) Wind speed Wind factor 3.1000 1.0750 1.0000 1.0250 0.8000 Adj infilt rate 0.3419 0.3180 Effective ac 0.5584 0.5506 0.5531 0.5456 0.5433 0.5324 0.5304 0.5304 0.5344 0.5387 0.5365 0.5456 (25) 3. Heat losses and heat loss parameter A x U W/K 2.4840 15.5725 3.7656 Element U-value K-value m2 2.0700 13.6000 HG Door Windows (Uw = 1.20) 31.3800 69.1900 31.4100 3451.8000 (28a) 7610.9000 (29a) 282.6900 (30) Heat Loss Floor 1 0.1200 110.0000 External Walls Plane Roof 84 8600 110.0000 Total net area of external elements Aum (A, m2) 147.6500 (26)...(30) + (32) = Fabric heat loss, W/K = Sum (A x U) 36.7254 (33) (33) 3049.2000 (32) 432.0000 (32c) 466.5600 (32c) 495.0000 (32d) 247.5000 (32e) Party Walls GF - Timber FF - Timber 27.7200 48.0000 110.0000 9.0000 51.8400 27.5000 Internal Floor Internal Ceiling 18 0000 Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16035.6500 (34)Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K List of Thermal Bridges 272 3446 (35) Psi-value K1 Element
E2 Other lintels (including other steel lintels) 11.8800 0.0190 0.0210 0.2257 0.1758 E3 Sill 8.3700 E3 Sill
E4 Jamb
E5 Ground floor (normal)
E6 Intermediate floor within a dwelling
E10 Eaves (insulation at ceiling level)
E12 Gable (insulation at ceiling level) 1.0590 17.9500 0.0590 16.0700 0.0010 0.0161 9.8900 0.6231 0.3526 0.5550 0.0630 E12 Gable (insulation at ceiling level)
E16 Corner (normal)
E25 Staggered party wall between dwellings
Pl Party wall - Ground floor
P2 Party wall - Intermediate floor within a dwelling
P4 Party wall - Roof (insulation at ceiling level)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Point Thermal bridges
Total fabric heat loss 15.0000 0.0370 10.0000 0.0410 0.4100 5.5500 0.0430 0.2386 5.8900 0.0400 0.2356 4.2451 (36) (36a) =(33) + (36) + (36a) 40.9705 (37) 26.4353 (38) Heat transfer coeff 67.6448 67.4059 (39) 67.2113 68.0261 Average = Sum(39)m / 12 67.7688 67.4059 67.2910 66.7627 66.6662 66.6662 66.8622 67.0705 66.9648 May 1.1429 Jul Aug 1.1322 Sep 1.1356 1.1448 1.1448 (40) 1.1415 1.1553 1.1489 1.1510 1.1339 1.1322 1.1391 1.1373 31 30

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Days in mont



4. Water heati													
Assumed occupa	ncy											1.9498	(42)
Hot water usag	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)
Hot water usag	24.5969	24.2316	23.7172	22.7687	22.0585	21.2710	20.8456	21.3564	21.9126	22.7553	23.7233	24.5138	(42b)
Average daily	34.5979	33.3398	32.0817 /day)	30.8236	29.5654	28.3073	28.3073	29.5654	30.8236	32.0817	33.3398	34.5979 54.2578	
Daily hot wate	Jan r use	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte Energy content	59.1948 93.7501 (annual)	57.5714 81.9809	55.7989 85.7608	53.5923 73.3651	51.6239 69.4957	49.5783 60.9623	49.1529 59.4462	50.9219 63.0519	52.7361 65.0289	54.8369 74.4132 Total = Su	57.0631 81.2968 um(45)m =	59.1116 92.5545 901.1065	
Distribution 1	0.0000 loss:	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 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	(56)
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	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	(59)
Total heat req	uired for w 79.6876 0.0000	vater heati 69.6837 0.0000	ng calculate 72.8967 0.0000	ed for each 62.3604 0.0000	59.0714 0.0000	51.8180 0.0000	50.5293	53.5941 0.0000	55.2746 0.0000	63.2512 0.0000	69.1023 0.0000	78.6714 0.0000	
PV diverter Aperture area Zero-loss coll Collector line Collector 2nd Collector loop Incidence angl	-0.0000 of solar co ector efficient heat los order heat efficiency	-0.0000 ollector ciency ss coefficients to the coefficients coefficien	-0.0000 ent	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 3.0000 0.8000 1.8000 0.0000 0.9000	(63b) (H1) (H2) (H3) (H4) (H5)
Overshading fa Overall heat 1 Heat loss coef Dedicated sola Effective sola Reference volu Storage tank c Heat delivered	ctor oss coeffic ficient of r storage v r volume me correction o	collector :	loop									0.8000 6.5000 3.9667 75.0000 75.0000 225.0000 1.3161 413.6494	(H8) (H10) (H11) (H12) (H14) (H15) (H16)
Heat delivered	-	_	45 0004	-52.1103	-55.0764	-50.4873	40 2104	40 1170	-43.1568	21 7214	10 5026	0.0000	
Solar input FGHRS Output from w/	-5.6002 0.0000	-20.6577 0.0000	-45.9094 0.0000	0.0000	0.0000	0.0000	-49.2184 0.0000	-49.1179 0.0000	0.0000	-31.7314 0.0000	-10.5836 0.0000	-0.0000 0.0000	
-	74.0874	49.0260	26.9873	10.2501	3.9950	1.3307	1.3108	4.4762 Total pe	12.1178 er year (kW	31.5198 n/year) = Su	58.5186 um(64)m =	78.6714 352.2911	
Electric showe	r(s) 45.5764	40.6090	44.3434	42.3164 Tot	43.1104 al Energy us	41.1232 sed by insta	42.4940 antaneous e	43.1104 lectric show	42.3164 ver(s) (kWh	44.3434 /year) = Sum	43.5096 n(64a)m =	45.5764 518.4290	
Heat gains fro	m water hea 31.3160	ating, kWh/r 27.5732	month 29.3100	26.1692	25.5455	23.2353	23.2558	24.1761	24.3977	26.8987	28.1530	31.0619	(65)
				20.1032	20.0400	23.2333	23.2330	24.1701	24.3911	20.0307	20.1330	31.0013	, ,
									24.3911	20.0307	20.1330	31.0013	, ,
5. Internal ga	ins (see Ta	able 5 and !	5a)						24.3511	20.0907	20.1330	31.0013	,
5. Internal ga	ins (see Ta	able 5 and 5	5a) Mar	 Apr	May	Jun	Jul	 Aug	Sep	Oct	Nov	Dec	
5. Internal ga	ins (see Ta	able 5 and 9 , Watts Feb 116.9878 ed in Append	5a) Mar 116.9878 dix L, equat	Apr 116.9878 tion L9 or	May 116.9878 L9a), also s	Jun 116.9878	Jul 116.9878	Aug 116.9878	Sep 116.9878	Oct 116.9878	Nov 116.9878	Dec 116.9878	(66)
5. Internal ga 	ins (see Ta	able 5 and 5 , Watts Feb 116.9878 ed in Appen 24.1926 ated in Appe	Mar 116.9878 dix L, equat 19.6747 endix L, eq	Apr 116.9878 tion L9 or 14.8950 uation L13	May 116.9878 L9a), also s 11.1342	Jun 116.9878 see Table 5 9.4000 so see Tab	Jul 116.9878 10.1570 le 5	 Aug	Sep	Oct	Nov	Dec	(66) (67)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains	ins (see Ta (Table 5) Jan 116.9878 (calculate 27.2380 ns (calcula 253.9010 (calculated 48.6486	able 5 and : , Watts Feb 116.9878 ed in Appen 24.1926 atted in App 256.5357 d in Append 48.6486	Mar 116.9878 dix L, equat 19.6747 endix L, eq 249.8963 ix L, equat: 48.6486	Apr 116.9878 tion L9 or 14.8950 lation L13 235.7620 ion L15 or 48.6486	May 116.9878 L9a), also s 11.1342 or L13a), al 217.9198 L15a), also 48.6486	Jun 116.9878 see Table 5 9.4000 so see Table 201.1507 see Table 4 48.6486	Jul 116.9878 10.1570 le 5 189.9479 5	Aug 116.9878 13.2025 187.3132 48.6486	Sep 116.9878 17.7203 193.9526 48.6486	Oct 116.9878 22.5000 208.0870 48.6486	Nov 116.9878 26.2608 225.9291 48.6486	Dec 116.9878 27.9951 242.6982 48.6486	(66) (67) (68) (69)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai	ins (see Table 5) Jan 116.9878 (calculate 27.2380 ns (calculate 253.9010 (calculate 48.6486 0.0000 appration	hble 5 and 1. Watts Feb 116.9878 d in Appen. 24.1926 ated in Appe. 48.6486 0.0000 (negative v.	Mar 116.9878 dix L, equat 19.6747 endix L, eq 249.8963 ix L, equati 48.6486 0.0000 alues) (Tabl	Apr 116.9878 tion L9 or 14.8950 Jation L13 235.7620 ion L15 or 48.6486 0.0000 le 5)	May 116.9878 L9a), also s 11.1342 or L13a), al 217.9198 L15a), also 48.6486 0.0000	Jun 116.9878 see Table 5 9.4000 so see Table 201.1507 see Table 9 48.6486 0.0000	Jul 116.9878 10.1570 le 5 189.9479 5 48.6486 0.0000	Aug 116.9878 13.2025 187.3132 48.6486 0.0000	Sep 116.9878 17.7203 193.9526 48.6486 0.0000	Oct 116.9878 22.5000 208.0870 48.6486 0.0000	Nov 116.9878 26.2608 225.9291 48.6486 0.0000	Dec 116.9878 27.9951 242.6982 48.6486 0.0000	(66) (67) (68) (69) (70)
5. Internal ga- Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans	ins (see Ta	, Watts Feb 116.9878 ed in Appenc 24.1926 sted in Append 48.6486 0.0000 (negative v77.9919	Mar 116.9878 dix L, equat 19.6747 endix L, equat 249.8963 ix L, equat: 48.6486 0.0000 alues) (Tabi	Apr 116.9878 tion 19 or 14.8950 ation L13 235.7620 ion L15 or 48.6486 0.0000 le 5) -77.9919	May 116.9878 L9a), also s 11.1342 or L13a), al 217.9198 L15a), also 48.6486 0.0000	Jun 116.9878 see Table 5 9.4000 so see Table 201.1507 see Table 9 48.6486 0.0000	Jul 116.9878 10.1570 le 5 189.9479 5 48.6486 0.0000	Aug 116.9878 13.2025 187.3132 48.6486 0.0000	Sep 116.9878 17.7203 193.9526 48.6486 0.0000	Oct 116.9878 22.5000 208.0870 48.6486 0.0000	Nov 116.9878 26.2608 225.9291 48.6486 0.0000	Dec 116.9878 27.9951 242.6982 48.6486 0.0000	(66) (67) (68) (69) (70) (71)
5. Internal gan Metabolic gains (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev	ins (see Ta	, Watts Feb 116.9878 ed in Append 24.1926 sted in Append 256.5357 d in Append 48.6486 0.0000 (negative v77.9919 Le 5) 41.0315	Mar 116.9878 dix L, equat 19.6747 endix L, equat 249.8963 ix L, equat: 48.6486 0.0000 alues) (Tab) -77.9919 39.3952	Apr 116.9878 1100 L9 or 14.8950 1ation L13 235.7620 ion L15 or 48.6486 0.0000 le 5) -77.9919	May 116.9878 L9a), also s 11.1342 or L13a), al 217.9198 L15a), also 48.6486 0.0000	Jun 116.9878 see Table 5 9.4000 so see Table 2011.1507 see Table 48.6486 0.0000 -77.9919 32.2712	Jul 116.9878 10.1570 le 5 189.9479 5 48.6486 0.0000 -77.9919 31.2578	Aug 116.9878 13.2025 187.3132 48.6486 0.0000 -77.9919 32.4948	Sep 116.9878 17.7203 193.9526 48.6486 0.0000 -77.9919 33.8858	Oct 116.9878 22.5000 208.0870 48.6486 0.0000	Nov 116.9878 26.2608 225.9291 48.6486 0.0000 -77.9919 39.1013	Dec 116.9878 27.9951 242.6982 48.6486 0.0000	(66) (67) (68) (69) (70) (71) (72)
5. Internal gan Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal	ins (see Ta s (Table 5) Jan 116.9878 (calculate 27.2380 ns (calculate 253.9010 (calculatec 48.6486 0.0000 aporation (-77.9919 gains (Tabl 42.0914 gains 410.8749	able 5 and 1 Feb 116.9878 d in Appen 24.1926 ated in Appen 256.5357 in Appendia 48.6486 0.0000 (negative v77.9919 le 5) 41.0315	Mar 116.9878 dix L, equat 19.6747 endix L, equ 249.8963 ix L, equati 48.6486 0.0000 alues) (Tabi -77.9919 39.3952	Apr 116.9878 tion L9 or 14.8950 action L13 235.7620 ion L15 or 48.6486 0.0000 le 5) -77.9919 36.3461	May 116.9878 19a), also s 11.1342 or L13a), al 217.9198 L15a), also 48.6486 0.0000 -77.9919 34.3353 351.0338	Jun 116.9878 see Table 5 9.4000 so see Table 201.1507 see Table 4 48.6486 0.0000 -77.9919 32.2712 330.4664	Jul 116.9878 10.1570 le 5 189.9479 5 48.6486 0.0000 -77.9919 31.2578 319.0072	Aug 116.9878 13.2025 187.3132 48.6486 0.0000 -77.9919 32.4948 320.6550	Sep 116.9878 17.7203 193.9526 48.6486 0.0000 -77.9919 33.8858	Oct 116.9878 22.5000 208.0870 48.6486 0.0000 -77.9919 36.1541	Nov 116.9878 26.2608 225.9291 48.6486 0.0000 -77.9919 39.1013	Dec 116.9878 27.9951 242.6982 48.6486 0.0000 -77.9919 41.7499	(66) (67) (68) (69) (70) (71) (72)
5. Internal gan Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev	ins (see Ta	watts Feb 116.9878 ed in Appen 24.1926 sted in Appen 256.5357 d in Append 48.6486 0.0000 (negative v77.9919 e 5) 41.0315	Mar 116.9878 dix L, equat 19.6747 endix L, equat 249.8963 ix L, equat: 48.6486 0.0000 alues) (Tabi -77.9919 39.3952 396.6108	Apr 116.9878 tion L9 or 14.8950 ation L13 235.7620 ion L15 or 48.6486 0.0000 le 5) -77.9919 36.3461 374.6476	May 116.9878 L9a), also s 11.1342 or L13a), al 217.9198 L15a), also 48.6486 0.0000 -77.9919 34.3353 351.0338	Jun 116.9878 see Table 5 9.4000 so see Table 201.1507 see Table 9 48.6486 0.0000 -77.9919 32.2712 330.4664	Jul 116.9878 10.1570 1e 5 189.9479 5 48.6486 0.0000 -77.9919 31.2578 319.0072	Aug 116.9878 13.2025 187.3132 48.6486 0.0000 -77.9919 32.4948 320.6550	Sep 116.9878 17.7203 193.9526 48.6486 0.0000 -77.9919 33.8858	Oct 116.9878 22.5000 208.0870 48.6486 0.0000 -77.9919 36.1541	Nov 116.9878 26.2608 225.9291 48.6486 0.0000 -77.9919 39.1013	Dec 116.9878 27.9951 242.6982 48.6486 0.0000 -77.9919 41.7499	(66) (67) (68) (69) (70) (71) (72)
5. Internal gan Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal	ins (see Ta- s (Table 5) Jan 116.9878 16(calculate 27.2380 ns (calculate 253.9010 (calculate 48.6486 0.0000 aporation -77.9919 gains (Tabl 42.0914 gains 410.8749	watts Feb 116.9878 24.1926 24.1926 256.5357 d in Append: 48.6486 0.0000 (negative v77.9919 1.0315 409.4043	Mar 116.9878 dix L, equat 19.6747 endix L, equat 249.8963 ix L, equat: 48.6486 0.0000 alues) (Tabi -77.9919 39.3952 396.6108	Apr 116.9878 tion L9 or 14.8950 lation L13 235.7620 ion L15 or 48.6486 0.0000 le 5) -77.9919 36.3461 374.6476	May 116.9878 L9a), also s 11.1342 or L13a), also 48.6486 0.0000 -77.9919 34.3353 351.0338	Jun 116.9878 see Table 5 9.4000 so see Table 201.1507 see Table 4 48.6486 0.0000 -77.9919 32.2712 330.4664	Jul 116.9878 10.1570 le 5 189.9479 5 48.6486 0.0000 -77.9919 31.2578 319.0072	Aug 116.9878 13.2025 187.3132 48.6486 0.0000 -77.9919 32.4948 320.6550	Sep 116.9878 17.7203 193.9526 48.6486 0.0000 -77.9919 33.8858 333.2032	Oct 116.9878 22.5000 208.0870 48.6486 0.0000 -77.9919 36.1541 354.3856	Nov 116.9878 26.2608 225.9291 48.6486 0.0000 -77.9919 39.1013 378.9358	Dec 116.9878 27.9951 242.6982 48.6486 0.0000 -77.9919 41.7499	(66) (67) (68) (69) (70) (71) (72)
5. Internal game Metabolic gains (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 6. Solar gains [Jan]	ins (see Ta- s (Table 5) Jan 116.9878 (calculate 27.2380 ns (calculate 253.9010 (calculate 48.6486 0.0000 aporation -77.9919 gains (Tabl) 42.0914 gains 410.8749	able 5 and 9 , Watts Feb 116.9878 ed in Append 24.1926 sted in Append 256.5357 in Append 48.6486 0.0000 (negative v77.9919 le 5) 41.0315 409.4043	Mar 116.9878 dix L, equat 19.6747 endix L, equat 48.6486 0.0000 alues) (Tabl) -77.9919 39.3952 396.6108 An 5.00 2.24 6.36	Apr 116.9878 116.9878 14.8950 14.8950 14.8950 100 115 or 48.6486 0.0000 1e 5) -77.9919 36.3461 374.6476	May 116.9878 L9a), also s 11.1342 or L13a), also 48.6486 0.0000 -77.9919 34.3353 351.0338 Solar flux Table 6a W/m2 13.7947 43.3860 13.7947	Jun 116.9878 see Table 5 9.4000 so see Tab. 201.1507 see Table 6 48.6486 0.0000 -77.9919 32.2712 330.4664 Speci: or 9	Jul 116.9878 10.1570 les 189.9479 5 48.6486 0.0000 -77.9919 31.2578 319.0072 fic data Table 6b 0.6300 0.6300 0.6300	Aug 116.9878 13.2025 187.3132 48.6486 0.0000 -77.9919 32.4948 320.6550 Specific or Tab:	Sep 116.9878 17.7203 193.9526 48.6486 0.0000 -77.9919 33.8858 333.2032	Oct 116.9878 22.5000 208.0870 48.6486 0.0000 -77.9919 36.1541 354.3856	Nov 116.9878 26.2608 225.9291 48.6486 0.0000 -77.9919 39.1013 378.9358	Dec 116.9878 27.9951 242.6982 48.6486 0.0000 -77.9919 41.7499 400.0877	(66) (67) (68) (69) (70) (71) (72) (73)
5. Internal gan Metabolic gains (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 6. Solar gains [Jan] Northeast Southeast Northwest	ins (see Ta	Jable 5 and 9 , Watts Feb 116.9878 ed in Append 24.1926 sted in Append 48.6486 0.0000 (negative v77.9919 de 5) 41.0315 409.4043	Mar 116.9878 dix L, equat 19.6747 endix L, equat 249.8963 ix L, equat: 48.6486 0.0000 alues) (Tab) -77.9919 39.3952 396.6108 An 5.00 2.24 6.36	Apr 116.9878 tion L9 or 14.8950 lation L13 235.7620 ion L15 or 48.6486 0.0000 le 5) -77.9919 36.3461 374.6476	May 116.9878 L9a), also s 11.1342 or L13a), also 48.6486 0.0000 -77.9919 34.3353 351.0338 Solar flux Table 6a W/m2 13.7947 43.3860 13.7947	Jun 116.9878 186 Table 5 9.4000 .so see Table 2011.1507 see Table 6 48.6486 0.0000 -77.9919 32.2712 330.4664 Specicor 9	Jul 116.9878 10.1570 le 5 189.9479 5 48.6486 0.0000 -77.9919 31.2578 319.0072 fic data Table 6b 0.6300 0.6300 0.6300	Aug 116.9878 13.2025 187.3132 48.6486 0.0000 -77.9919 32.4948 320.6550 Specific or Tab:	Sep 116.9878 17.7203 193.9526 48.6486 0.0000 -77.9919 33.8858 333.2032 FF data e 6c 8000 8000 8000	Oct 116.9878 22.5000 208.0870 48.6486 0.0000 -77.9919 36.1541 354.3856 Acces facto Table 6	Nov 116.9878 26.2608 225.9291 48.6486 0.0000 -77.9919 39.1013 378.9358	Dec 116.9878 27.9951 242.6982 48.6486 0.0000 -77.9919 41.7499 400.0877 Gains W 24.0906 33.9439 30.6432	(66) (67) (68) (69) (70) (71) (72) (73) (75) (77) (81)
5. Internal gan Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 6. Solar gains [Jan] Northeast Northeast Northwest	ins (see Ta	Jable 5 and 9 , Watts Feb 116.9878 ed in Append 24.1926 sted in Append 48.6486 0.0000 (negative v77.9919 de 5) 41.0315 409.4043	Mar 116.9878 dix L, equat 19.6747 endix L, equat 249.8963 ix L, equat: 48.6486 0.0000 alues) (Tab) -77.9919 39.3952 396.6108 An 5.00 2.24 6.36	Apr 116.9878 tion L9 or 14.8950 lation L13 235.7620 ion L15 or 48.6486 0.0000 le 5) -77.9919 36.3461 374.6476	May 116.9878 L9a), also s 11.1342 or L13a), also 48.6486 0.0000 -77.9919 34.3353 351.0338 Solar flux Table 6a W/m2 13.7947 43.3860 13.7947	Jun 116.9878 186 Table 5 9.4000 .so see Table 2011.1507 see Table 6 48.6486 0.0000 -77.9919 32.2712 330.4664 Specicor 9	Jul 116.9878 10.1570 le 5 189.9479 5 48.6486 0.0000 -77.9919 31.2578 319.0072 fic data Table 6b 0.6300 0.6300 0.6300	Aug 116.9878 13.2025 187.3132 48.6486 0.0000 -77.9919 32.4948 320.6550 Specific or Tab:	Sep 116.9878 17.7203 193.9526 48.6486 0.0000 -77.9919 33.8858 333.2032 FF data e 6c 8000 8000 8000	Oct 116.9878 22.5000 208.0870 48.6486 0.0000 -77.9919 36.1541 354.3856 Acces facto Table 6	Nov 116.9878 26.2608 225.9291 48.6486 0.0000 -77.9919 39.1013 378.9358	Dec 116.9878 27.9951 242.6982 48.6486 0.0000 -77.9919 41.7499 400.0877 Gains W 24.0906 33.9439 30.6432	(66) (67) (68) (69) (70) (71) (72) (73) (75) (77) (81)
5. Internal gan Metabolic gains (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 6. Solar gains [Jan] Northeast Southeast Northwest Solar gains Total gains	ins (see Ta- s (Table 5) Jan 116.9878 (calculate 27.2380 ns (calculate 253.9010 (calculate 48.6486 0.0000 aporation -77.9919 gains (Tabl) 42.0914 gains 410.8749	able 5 and 9 , Watts Feb 116.9878 ed in Append 24.1926 sted in Append 48.6486 0.0000 (negative v77.9919 14.0315 409.4043	Mar 116.9878 dix L, equat 19.6747 endix L, equat 48.6486 0.0000 alues) (Tab) -77.9919 39.3952 396.6108 An 5.00 2.24 6.36 244.0691 640.6799	Apr 116.9878 tion 19 or 14.8950 lation L13 235.7620 ion L15 or 48.6486 0.0000 le 5) -77.9919 36.3461 374.6476	May 116.9878 L9a), also s 11.1342 or L13a), also s 11.1342 or L13a), also s 48.6486 0.0000 -77.9919 34.3353 351.0338 Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612	Jun 116.9878 see Table 5 9.4000 so see Table 201.1507 see Table 48.6486 0.0000 -77.9919 32.2712 330.4664 Speci: or 5	Jul 116.9878 10.1570 1e 5 189.9479 5 48.6486 0.0000 -77.9919 31.2578 319.0072 fic data Table 6b 0.6300 0.6300 0.6300 488.1841 807.1914	Aug 116.9878 13.2025 187.3132 48.6486 0.0000 -77.9919 32.4948 320.6550 Specific or Tab:	Sep 116.9878 17.7203 193.9526 48.6486 0.0000 -77.9919 33.8858 333.2032 FF data e 6c 8000 8000 8000	Oct 116.9878 22.5000 208.0870 48.6486 0.0000 -77.9919 36.1541 354.3856 Acces facto Table 6	Nov 116.9878 26.2608 225.9291 48.6486 0.0000 -77.9919 39.1013 378.9358	Dec 116.9878 27.9951 242.6982 48.6486 0.0000 -77.9919 41.7499 400.0877 Gains W 24.0906 33.9439 30.6432	(66) (67) (68) (69) (70) (71) (72) (73) (75) (77) (81)
5. Internal gan Metabolic gains (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 6. Solar gains [Jan] Northeast Southeast Northwest Solar gains Total gains Total gains Total gains	ins (see Ta	### A	Mar 116.9878 dix L, equati 19.6747 endix L, equati 249.8963 ix L, equati 48.6486 0.0000 alues) (Tab) -77.9919 39.3952 396.6108 An 5.00 2.24 6.36 244.0691 640.6799	Apr 116.9878 tion L9 or 14.8950 lation L13 235.7620 ion L15 or 48.6486 0.0000 le 5) -77.9919 36.3461 374.6476	May 116.9878 L9a), also s 11.1342 or L13a), also 217.9198 L15a), also 48.6486 0.0000 -77.9919 34.3353 351.0338 Solar flux Table 6a W/m2 13.7947 473.7274 824.7612	Jun 116,9878 lee Table 5 9.4000 so see Table 5 0.0000 -77.9919 32.2712 330.4664 Specimor 5 36.0524 866.5188	Jul 116.9878 10.1570 1e 5 189.9479 5 48.6486 0.0000 -77.9919 31.2578 319.0072 gfic data Fable 6b 0.6300 0.6300 0.6300 0.6300 488.1841 807.1914	Aug 116.9878 13.2025 187.3132 48.6486 0.0000 -77.9919 32.4948 320.6550 Specific or Tab:	Sep 116.9878 17.7203 193.9526 48.6486 0.0000 -77.9919 33.8858 333.2032 FF data e 6c 8000 8000 8000	Oct 116.9878 22.5000 208.0870 48.6486 0.0000 -77.9919 36.1541 354.3856 Acces facto Table 6	Nov 116.9878 26.2608 225.9291 48.6486 0.0000 -77.9919 39.1013 378.9358	Dec 116.9878 27.9951 242.6982 48.6486 0.0000 -77.9919 41.7499 400.0877 Gains W 24.0906 33.9439 30.6432	(66) (67) (68) (69) (70) (71) (72) (73) (75) (77) (81) (83) (84)
5. Internal gan Metabolic gains (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 6. Solar gains [Jan] Northeast Southeast Northwest Solar gains Total gains Total gains 7. Mean intern Temperature du Utilisation fa	ins (see Ta- s (Table 5) Jan 116.9878 (calculate 27.2380 ns (calculate 253.9010 (calculate 48.6486 0.0000 aporation -77.9919 gains (Tabl) 42.0914 gains 410.8749	153.4036 562.8079 able 5 and 1.5 peb 116.9878 dd in Append 24.1926 ted in Append 48.6486 0.0000 (negative v77.9919 te 5) 41.0315 409.4043	Mar 116,9878 dix L, equat 19.6747 endix L, equat 48.6486 0.0000 alues) (Tab) -77.9919 39.3952 396.6108 An 5.00 2.22 6.36 244.0691 640.6799 in the living area, r Mar	Apr 116.9878 110.9878 110.19 or 14.8950 1325.7620 100.115 or 48.6486 0.0000 18.5) -77.9919 36.3461 374.6476	May 116.9878 L9a), also s 11.1342 or L13a), al 13 217.9198 L15a), also o 48.6486 0.0000 -77.9919 34.3353 351.0338 Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612	Jun 110,9878 120 Table 5 9,4000 So see Table 2011.507 See Table 48.6486 0.0000 -77.9919 32.2712 330.4664 Speci: or 536.0524 866.5188	Jul 116.9878 10.1570 les 189.9479 5 48.6486 0.0000 -77.9919 31.2578 319.0072 fic data Table 6b 0.6300 0.6300 0.6300 0.6300 488.1841 807.1914	Aug 116.9878 13.2025 187.3132 48.6486 0.0000 -77.9919 32.4948 320.6550 Specific or Tab: 0 0 0 10.6421 731.2971	Sep 116.9878 17.7203 193.9526 48.6486 0.0000 -77.9919 33.8858 333.2032 FF data e 6c 8000 8000 302.4448 635.6480	Oct 116.9878 22.5000 208.0870 48.6486 0.0000 -77.9919 36.1541 354.3856 Acces factc Table 6 0.770 0.770 183.4207 537.8063	Nov 116.9878 26.2608 225.9291 48.6486 0.0000 -77.9919 39.1013 378.9358	Dec 116.9878 27.9951 242.6982 48.6486 0.0000 -77.9919 41.7499 400.0877 Gains W 24.0906 33.9439 30.6432 74.1111 474.1988	(66) (67) (68) (69) (70) (71) (72) (73) (75) (77) (81) (83) (84)
5. Internal gan Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Losses e.g. ev Water heating Total internal 6. Solar gains [Jan] Northeast Northeast Northwest Temperature du Utilisation fa	ins (see Ta- s (Table 5) Jan 116.9878 (calculate 27.2380 ns (calculate 253.9010 (calculate 48.6486 0.0000 aporation -77.9919 gains (Tabl) 42.0914 gains 410.8749 88.6777 499.5526	153.4036 152.8079 153.4036 156.8079 16.8186 17.8186 18.8186	Mar 116.9878 dix L, equat 19.6747 endix L, equat 249.8963 ix L, equati 48.6486 0.0000 alues) (Tabl -77.9919 39.3952 396.6108 An 5.00 2.24 6.36 244.0691 640.6799 in the livir ving area, r Mar 65.7286	Apr 116.9878 tion L9 or 14.8950 ation L15 or 48.6486 0.0000 le 5) -77.9919 36.3461 374.6476	May 116.9878 19a), also s 11.1342 or L13a), al 217.9198 L15a), also 48.6486 0.0000 -77.9919 34.3353 351.0338 Solar flux Table 6a W/m2 13.7947 473.7274 824.7612 om Table 9, T Table 9a)	Jun 116.9878 120.115.07 120.115.0	Jul 116.9878 10.1570 1e 5 189.9479 5 48.6486 0.0000 -77.9919 31.2578 319.0072 fic data Pable 6b 0.6300 0.6300 0.6300 488.1841 807.1914	Aug 116.9878 13.2025 187.3132 48.6486 0.0000 -77.9919 32.4948 320.6550 Specific or Tab:	Sep 116.9878 17.7203 193.9526 48.6486 0.0000 -77.9919 33.8858 333.2032 FF data e. 6c 8000 8000 8000 302.4448 635.6480	Oct 116.9878 22.5000 208.0870 48.6486 0.0000 -77.9919 36.1541 354.3856 Acces factor Table 6 0.770 0.770 183.4207 537.8063	Nov 116.9878 26.2608 225.9291 48.6486 0.0000 -77.9919 39.1013 378.9358	Dec 116.9878 27.9951 242.6982 48.6486 0.0000 -77.9919 41.7499 400.0877 Gains W 24.0906 33.9439 30.6432 74.1111 474.1988	(66) (67) (68) (69) (70) (71) (72) (73) (75) (77) (81) (83) (84)
5. Internal gander Metabolic gains (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal for the following gains [Jan] Northeast Southeast Northwest Total gains	ins (see Ta	153.4036 562.8079 15.3899 0.9852	Mar 116.9878 dix L, equat 19.6747 endix L, equat 48.6486 0.0000 alues) (Tab) -77.9919 39.3952 396.6108 An 5.00 2.24 6.36 244.0691 640.6799 in the livin ving area, r Mar 65.7286 5.3819 0.9584	Apr 116.9878 110.19 or 14.8950 141.8950	May 116.9878 L9a), also s 11.1342 or L13a), al 217.9198 L15a), also s 48.6486 0.0000 -77.9919 34.3353 351.0338 Solar flux Table 6a W/m2 13.7947 43.3860 13.7947 473.7274 824.7612 mm Table 9, T Table 9a) May 66.1953	Jun 110,9878 120,19878 120,19878 120,19878 120,11507 120	Jul 116.9878 10.1570 les 189.9479 5 48.6486 0.0000 -77.9919 31.2578 319.0072 fic data Table 6b 0.6300 0.6300 0.6300 0.6300 488.1841 807.1914 Jul 66.8157 5.4544 0.3135	Aug 116.9878 13.2025 187.3132 48.6486 0.0000 -77.9919 32.4948 320.6550 Specific or Tab: 410.6421 731.2971 Aug 66.8157 5.4544 0.3547	Sep 116.9878 17.7203 193.9526 48.6486 0.0000 -77.9919 33.8858 333.2032 FF data e 6c 8000 8000 302.4448 635.6480	Oct 116.9878 22.5000 208.0870 48.6486 0.0000 -77.9919 36.1541 354.3856 Acces factc Table 6 0.770 0.770 183.4207 537.8063	Nov 116.9878 26.2608 225.9291 48.6486 0.0000 -77.9919 39.1013 378.9358 ssr id 100 107.9860 486.9218	Dec 116.9878 27.9951 242.6982 48.6486 0.0000 -77.9919 41.7499 400.0877 Gains W 24.0906 33.9439 30.6432 74.1111 474.1988	(66) (67) (68) (69) (70) (71) (72) (73) (75) (77) (81) (83) (84)

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util rest of house 0.9902	0.9802	0.9444	0.8220	0.6060	0.3592	0.2291	0.2619	0.5538	0.8876	0.9778	0.9925	
MIT 2 18.7422 Living area fraction	18.9712	19.3487	19.7512	19.9310	19.9716	19.9745	19.9744		19.6975 Living area		18.7010 0.1914	(91)
MIT 18.9706 Temperature adjustment adjusted MIT 18.9706	19.1899	19.5536 19.5536	19.9454	20.1259	20.1676	20.1707	20.1705	20.1502	19.8896	19.3803	18.9301 0.0000 18.9301	
adjusted MII 10.9700	19.1099	19.3330	19.9404	20.1239	20.1070	20.1707	20.1703	20.1302	19.0090	19.3003	10.9301	(93)
8. Space heating require												
Jan Utilisation 0.9869	Feb 0.9752	Mar 0.9376	Apr 0.8212	May 0.6169	Jun 0.3739	Jul 0.2453	Aug 0.2797	Sep 0.5704	Oct 0.8845	Nov 0.9728	Dec 0.9897	(94)
Useful gains 493.0017 Ext temp. 4.5000	548.8520 5.1000	600.7199 6.9000	620.6110 9.3000	508.8233 12.3000	324.0039 15.3000	197.9736 17.2000	204.5564 17.1000	362.5744 14.6000	475.6763 11.0000	473.7009 7.4000	469.3022 4.4000	
	953.1061	857.5201	717.5602	526.6100	324.9768	198.0438	204.6985	371.1012	596.2331	802.2557	979.4167	(97)
Space heating kWh 365.5863 Space heating requiremen		191.0594	69.8034 h/year)	13.2333	0.0000	0.0000	0.0000	0.0000	89.6943	236.5595	379.5252 1617.1201	(98a)
Solar heating kWh -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution Space heating kWh			Wh/year) 69.8034	13.2333	0.0000	0.0000	0.0000	0.0000	89.6943	236.5595	0.0000	(000)
Space heating requirement Space heating per m2	271.6588 t after sol					0.0000	0.0000	0.0000		236.5595	379.5252 1617.1201 27.4647	
opace meating per mi									(300)	, , (-,	27.1017	(22)
9a. Energy requirements Fraction of space heat f											0.0000	(201)
Fraction of space heat f Efficiency of main space	rom main sy	stem(s)		(labic ii	.,						1.0000	(202)
Efficiency of main space Efficiency of secondary/											0.0000	
Jan Space heating requiremen	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	271.6588		69.8034 1)	13.2333	0.0000	0.0000	0.0000	0.0000	89.6943	236.5595	379.5252	(98)
100.0000 Space heating fuel (main	100.0000 heating sy	100.0000 stem)	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	
Space heating efficiency		ing system		13.2333	0.0000	0.0000	0.0000	0.0000	89.6943	236.5595	379.5252	
0.0000 Space heating fuel (main 0.0000		0.0000 stem 2) 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating fuel (second 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Water heating												
Water heating requirement 74.0874 Efficiency of water heat	49.0260	26.9873	10.2501	3.9950	1.3307	1.3108	4.4762	12.1178	31.5198	58.5186	78.6714 100.0000	
(217)m 100.0000 Fuel for water heating,	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	
74.0874 Space cooling fuel requi		26.9873	10.2501	3.9950	1.3307	1.3108	4.4762	12.1178	31.5198	58.5186	78.6714	
(221)m 0.0000 Pumps and Fa 6.7945 Lighting 23.8413	0.0000 6.1370 19.1264	0.0000 6.7945 17.2212	0.0000 6.5753 12.6170	0.0000 6.7945 9.7457	0.0000 6.5753 7.9623	0.0000 6.7945 8.8904	0.0000 6.7945 11.5560	0.0000 6.5753 15.0101	0.0000 6.7945 19.6941	0.0000 6.5753 22.2445	0.0000 6.7945 24.5039	(231)
Electricity generated by (233a)m -97.5591	PVs (Appen	dix M) (neg	ative quanti	ty)								
Electricity generated by (234a)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	(234a)
Electricity generated by (235a)m 0.0000 Electricity used or net	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
(235c)m 0.0000 Electricity generated by	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
	-38.6186	-97.9501 nes (Append	-206.3137	-305.7301 ive quanti	ty)	-333.9371	-279.0699	-187.6614	-79.5590	-25.8391	-11.9537	(233b)
(234b)m 0.0000 Electricity generated by	hydro-elec				ative quant:		0.0000	0.0000	0.0000	0.0000	0.0000	
(235b) m 0.0000 Electricity used or net (235d) m 0.0000			0.0000 by micro-CHP 0.0000	0.0000 (Appendix 0.0000	N) (negati	0.0000 ve if net g 0.0000	0.0000 eneration) 0.0000	0.0000	0.0000	0.0000	0.0000	
Annual totals kWh/year Space heating fuel - mai:		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1617.1201	
Space heating fuel - mai Space heating fuel - sec	ondary										0.0000	
Efficiency of water heat Water heating fuel used Space cooling fuel	er										100.0000 352.2911 0.0000	
Electricity for pumps and	d fans:										0.0000	(221)
pump for solar water ! Total electricity for the	heating e above, kW										80.0000 80.0000	(231)
Electricity for lighting Energy saving/generation				0)							192.4129	(232)
PV generation Wind generation	cecimorogi	es (Appendi	ces m , m and	. 2)							-3636.6311 0.0000	
Hydro-electric generation Electricity generated - 1	Micro CHP (0.0000	(235a)
Appendix Q - special fea Energy saved or generate											-0.0000	
Energy used Total delivered energy f	or all uses										0.0000 -876.3779	
10a. Fuel costs - using	BEDF prices	(536)										
							Fuel		Fuel price		Fuel cost	

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Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Pumps, fans and electric keep-hot Pump for solar water heating Energy for lighting Additional standing charges	kWh/year 1617.1201 352.2911 518.4290 0.0000 80.0000 192.4129	p/kWh 25.1600 25.1600 25.1600 0.0000 25.1600 25.1600	£/year 406.8674 (240) 0.0000 (473) 88.6364 (247) 130.4367 (247a) 0.0000 (249) 20.1280 (249) 48.4111 (250) 0.0000 (251)
Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total Total energy cost	-1696.6122 -1940.0188	25.1600 5.8100	-426.8676 -112.7151 -539.5827 (252) 154.8969 (255)
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP			
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating 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	Energy kWh/year 1617.1201 352.2911 518.4290 80.0000 192.4129 -1696.6122 -1940.0188	Emission factor kg CO2/kWh 0.1569 0.1541 0.1391 0.1387 0.1443	Emissions kg CO2/year 253.7982 (261) 0.0000 (373) 54.2739 (264) 72.1249 (264a) 308.0721 (265) 11.0970 (267) 27.7711 (268) -232.6685 -231.5466 -464.2151 (269) -45.1499 (272)
13a. Primary energy - Individual heating systems including micro-CHP			
Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Energy for instantaneous electric shower(s) Space and water heating Pumps, fans and electric keep-hot Energy for lighting		imary energy factor kg CO2/kWh 1.5810 1.5701 1.5143 1.5128 1.5338	Primary energy kWh/year 2556.6981 (275) 0.0000 (473) 553.1417 (278) 785.0748 (278a) 3109.8398 (279) 121.0240 (281) 295.1294 (282)
Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total Total Primary energy kWh/year	-1696.6122 -1940.0188	1.5070 0.4377	-2556.8181 -849.2291 -3406.0472 (283) 905.0208 (286)

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Predicted Energy Assessment



111, Manor Road, Witney, Oxfordshire, OX28 3UF

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

House, End-Terrace 27/02/2024 Iraj Maghounaki 58.88 m²

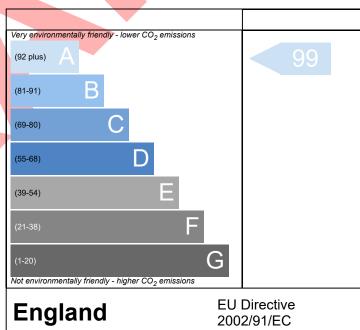
This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance 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) D (21-38) F (1-20) G Not energy efficient - higher running costs England 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 (CO₂) emissions. The higher the rating the less impact it has on the environment.

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breglobal

Job no: Date: Assessor name: PR11012 27/02/2024 Iraj Maghounaki

Registration no:

BRE400012

Development name:

Appendix G

BRE Global 2008. BRE Certification is a registered trademark owned by BRE Global and may not be used without BRE Global's written permission.

Permission is given for this tool to be copied without infringement of copyright for use only on projects where a Code for Sustainable Homes assessment is carried out. Whilst every care is taken in preparing the Wat 1 assessment tool, BREG cannot accept responsibility for any inaccuracies or for consequential loss incurred as a result of such inaccuracies arising through the use of the Wat 1 tool.

PRINTING: before printing please make sure that in "Page Setup" you have selected the page to be as "Landscape" and that the Scale has been set up to 70% (maximum)

WATER EFFICI	ENCY CALCU	ILATOR	FOR	IEW DV	VELLIN	GS - (B	ASIC C	ALCUL	ATOR)													
	House Type:	Type 1		Type 2		Type 3		Type 4		Type 5		Type 6		Type 7		Type 8		Type 9		Type 10		
	Description:		Sample for 111 Manor Road																			
Installation Type	Unit of measure	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	
Is a dual or single flush WC specified?		Dual																				
wc	Full flush volume	6	8.76		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
	Part flush volume	3	8.88		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Taps (excluding kitchen and external taps)	Flow rate (litres / minute)	6	11.06		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Are both a Bath &	Bath & Shower																					
Bath	Capacity to overflow	155	17.05		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Shower	Flow rate (litres / minute)	8	34.96		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Kitchen sink taps	Flow rate (litres / minute)	6	13.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Has a wash	No																					
Washing Machine	Litres / kg	7	17.16		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Has a dishwashe	No																					
Dishwasher	Litres / place setting	0.9	4.50		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Has a waste disposal unit been specified?		No	0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
Water Softener	Litres / person / day		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
		lated Use	115.4		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Normalisat			0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91	
Code for	Total Consumption Mandatory level		105.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Sustainable Homes			Level 3/4		•		•		•		•		-		•		•		•		-	
Building Regulations 17.K	External use		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0	
	Total Consumption		110.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
	17.K Compliance?		Yes		-		-		-		-		-		-		-		-		-	

(BASIC CALC.)