JS LEWIS LTD

Energy and Sustainability Strategy
Land at Foots Farm, Thorpe Road, Clacton on Sea

Revision A

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EXECUTIVE SUMMARY

The applicant is seeking planning permission on the land at Foots Farm, Thorpe Road, Clacton on Sea. This document forms part of a detailed application for 40 dwellings, and the approach has been designed to reflect the climate emergency.

JS Lewis Ltd was instructed by the applicants to develop an energy and sustainability strategy for the proposed development. Its purpose is to help the applicants to deliver a highly sustainable development and respond to planning policy on energy, sustainability, and to address the climate emergency:

- Energy use:
 - o Zero carbon site;
 - Zero fossil fuel site;
 - Efficient fabric and services;
 - Heat pump for each dwelling;
 - Solar PV provision for each dwelling;
 - Electric vehicle charging designed for;
 - Fully connected dwellings;
 - Provision of working from home facilities.
- Siting, orientation, and passive design:
 - o Planned for solar rooftop potential;
 - Dwellings to have high levels of insulation.
- Overheating and adaptation:
 - Cross-ventilation throughout to minimize overheating risks;
 - Appropriate fenestration to be specified at building control stage;
 - Thermal mass to be used to temper internal environments.
- Materials and waste management:
 - o Site waste management plan to be used to promote reuse and recycling;
 - Recycling provision for each dwelling.
- Sustainable and active travel:
 - Cycle storage provided;
 - Access to local amenities in the adjacent shopping village;
 - o Access to Clacton on Sea railway station.
- Design for health and wellbeing:
 - o Access to communal and public open spaces within the site;
 - Private gardens for each dwelling;
 - Cycle storage to be provided.
- Land use and ecology
 - Site of low value;
 - Recommendations made in appraisal document.

As a zero carbon, zero fossil fuel development, the scheme could provide a strong lead for other developments locally to follow. The carbon emissions summary is as follows:



Emissions Summary		
BAU	32.44	tCO2
Energy efficiency	29.20	tCO2
СНР	29.20	tCO2
Renewables	- 0.86	tCO2
Efficiency savings	10%	
CHP savings	0%	
Renewables savings	93%	
Total savings	103%	

Figure 1 - Summary of Carbon Emissions

The scheme has the potential to achieve 100% CO2 emissions savings over and above the current Part L. This compares very favourably with the typical existing home as well as seen below:

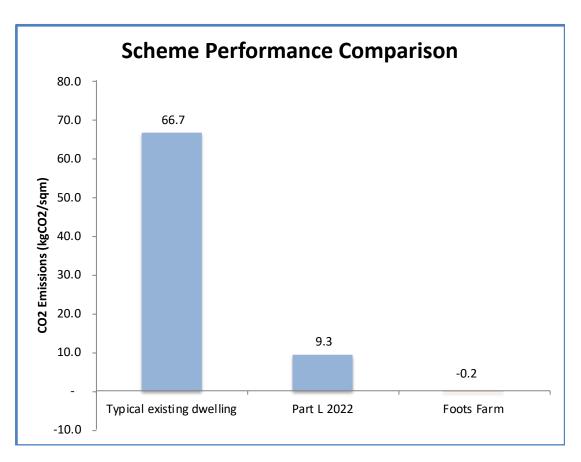


Figure 2 - Comparative Performance



1 INTRODUCTION

1.1 Background

The applicant is seeking planning permission on the land at Foots Farm, Thorpe Road, Clacton on Sea. This document forms part of a detailed application for 40 dwellings, and the approach has been designed to reflect the climate emergency.

JS Lewis Ltd was instructed by the applicants to develop an energy and sustainability strategy for the proposed development. Its purpose is to help the applicants to deliver a highly sustainable development and respond to planning policy on energy, sustainability, and to address the climate emergency. In response to the climate emergency, the applicants have adopted a progressive approach to development with a view to setting a high standard of sustainable development. Key aspects of the development of the site will be achieving zero carbon, zero fossil fuel homes. This document acts as the Renewable Energy Generation Plan sought by policy PPL 10.

1.2 Proposed Development

The proposals are for 40 residential dwellings with associated access, landscaping, drainage, and infrastructure. The site layout is set out below:



Figure 3 - Site Layout

1.3 Scope and Overarching Aims

This report considers the national and local policy framework, the regulatory framework, the climate, and ecological emergencies and aims to set out a strategy for energy, CO2, climate change, biodiversity, and sustainable lifestyle patterns whilst addressing sustainable construction matters. It also considers waste and recycling.



The scheme will deliver 40 zero carbon new build homes and will be a highly sustainable development. The options available for doing so are considered and a recommended strategy is put forward.

This document forms part of the planning application, and as such, the aim is to put in place a strategy that sets out the framework for the delivery of the site. Not all details are fully understood at this stage, so it is important that the strategy as to how the overarching aims are delivered remains flexible.



2 POLICY FRAMEWORK

2.1 National Policy

National Planning Policy Framework (December 2023)

The National Planning Policy Framework sets out a framework for positive growth, making progress in environmental, social and economic areas, and enhancing existing areas. It is a material consideration in planning decisions and reinforces the need for decisions to be determined in accordance with the local plan, unless material considerations indicate otherwise.

The policies throughout the NPPF constitute the government's view of what sustainable development is, and requires the planning process to perform a number of roles:

- 1. An economic role building a strong economy, supporting growth and innovation;
- 2. A social role supporting communities through providing housing supply, a high-quality built environment, and accessible local services;
- 3. An environmental role contributing to natural and built environments, improving biodiversity, using resources prudently, minimizing waste and addressing climate change, including moving to a low carbon economy.

The 2023 National Planning Policy Framework retains a presumption in favour of sustainable development. Section 14 concerns itself with climate change:

158. Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures56. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

159. New development should be planned for in ways that:

- a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and
- b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.
- 162. In determining planning applications, local planning authorities should expect new development to:
- a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
- b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

The NPPF sets out the importance of dealing with climate change, and the use renewable energy. Development should be in sustainable locations to reduce CO2 emissions. It notes the need to align local policies with the national timeline for low carbon buildings.



2.2 Local Policy

Tendring District Council – Local Plan

Policy SP7 - Place Shaping Principles

All new development must meet high standards of urban and architectural design. Development frameworks, masterplans, design codes, and other design guidance documents will be prepared in consultation with stakeholders where they are needed to support this objective. All new development should reflect the following place shaping principles, where applicable:

- Respond positively to local character and context to preserve and enhance the quality of existing places and their environs;
- Provide buildings that exhibit individual architectural quality within well-considered public and private realms;
- Protect and enhance assets of historical or natural value;
- Incorporate biodiversity creation and enhancement measures;
- Create well-connected places that prioritise the needs of pedestrians, cyclists and public
- transport services above use of the private car;
- Provide a mix of land uses, services and densities with well-defined public and private spaces to create sustainable well-designed neighbourhoods;
- Enhance the public realm through additional landscaping, street furniture and other distinctive features that help to create a sense of place;
- Provide streets and spaces that are overlooked and active and promote inclusive access;
- Include parking facilities that are well integrated as part of the overall design and are adaptable if levels of private car ownership fall;
- Provide an integrated and connected network of biodiverse public open space and green and blue infrastructure, thereby helping to alleviate recreational pressure on designated sites;
- Include measures to promote environmental sustainability including addressing energy and water efficiency, and provision of appropriate water and wastewater and flood mitigation measures including the use of open space to provide flora and fauna rich sustainable drainage solutions; and
- Protect the amenity of existing and future residents and users with regard to noise, vibration, smell, loss of light, overbearing and overlooking.

Policy SPL 3 – Sustainable Design

Part A: Design. All new development (including changes of use) should make a positive contribution to the quality of the local environment and protect or enhance local character. The following criteria must be met:

- a. new buildings, alterations and structures are well designed and maintain or enhance local character and distinctiveness;
- b. the development relates well to its site and surroundings particularly in relation to its siting, height, scale, massing, form, design and materials;
- c. the development respects or enhances local landscape character, views, skylines, landmarks, existing street patterns, open spaces and other locally important features;
- d. the design and layout of the development maintains or enhances important existing site features of landscape, ecological, heritage or amenity value; and
- e. boundary treatments and hard and soft landscaping are designed as an integral part of the development reflecting the function and character of the development and its surroundings. The Council will encourage the use of locally distinctive materials and/or locally occurring and characteristic hedge species.



Part B: Practical Requirements. New development (including changes of use) must meet practical requirements. The following criteria must be met:

- a. access to the site is practicable and the highway network will, following any required mitigation, be able to safely accommodate the additional traffic the proposal will generate and not lead to severe traffic impact;
- b. the design and layout of the development maintains and/or provides safe and convenient access for people with mobility impairments;
- c. the development incorporates or provides measures to minimise opportunities for crime and antisocial behaviour;
- d. the applicant/developer can demonstrate how the proposal will minimise the production of greenhouse gases and impact on climate change as per the Building Regulations prevailing at the time and policies and requirements in this plan;
- e. buildings and structures are designed and orientated to ensure adequate daylight, outlook and privacy for future and existing residents;
- f. provision is made for adequate private amenity space, waste storage and recycling facilities, vehicle and cycle parking; and
- g. the development reduces flood risk and integrates sustainable drainage within the development, creating amenity and enhancing biodiversity.
- **Part C: Impacts and Compatibility.** New development (including changes of use) should be compatible with surrounding uses and minimise any adverse environmental impacts. The following criteria must be met:
- a. the development will not have a materially damaging impact on the privacy, daylight or other amenities of occupiers of nearby properties;
- b. the development, including any additional road traffic arising, will not have unacceptable levels of pollution on: air, land, water (including ground water), amenity, health or safety through noise, smell, dust, light, heat, vibration, fumes or other forms of pollution or nuisance;
- c. the health, safety or amenity of any occupants or users of the proposed development will not be materially harmed by any pollution from an existing or committed use; and
- d. all new development should have regard to the most up to date adopted Essex Mineral Local Plan; and
- e. during the construction phase, developers must comply with a 'considerate constructors' scheme' which employs reasonable measures and techniques to minimise and mitigate impacts and disturbance to neighbours and the existing wider community and any damage to public and private property.

All new development (including changes of use), should incorporate climate change adaptation measures and technology from the outset including reduction of emissions, renewable and low carbon energy production, passive design, and through green infrastructure techniques, where appropriate. When considering new development, applicants and developers should avoid adverse impacts upon the environment. Where this is not possible, mitigation measures should be put forward. As a last resort, compensate for adverse environmental impacts. Any measures necessary to meet the above requirements are to be established by the applicant/developer.

This Policy contributes towards achieving Objectives 6, 7 and 8 of this Local Plan.

Policy PPL 5 WATER CONSERVATION, DRAINAGE AND SEWERAGE

All new development must make adequate provision for drainage and sewerage and should include Sustainable Drainage Systems (SuDS) as a means of reducing flood risk, improving water quality, enhancing the Green Infrastructure network and providing amenity and biodiversity benefits. Applicants should explain and justify the reasons for not using SuDS if not included in their proposals, which should



include water inputs and outputs designed to protect and, where possible, enhance the natural environment. New dwellings will be required to incorporate measures to achieve a water consumption rate of not more than 110 litres, per person, per day.

Proposals for development must demonstrate that adequate provision exists, or can be provided in time, for sewage disposal to a public sewer and water recycling centre (sewage treatment works).

Applicants should explain their approach to water conservation, including the potential for the re-use of 'greywater' and rainwater 'capture and use' within their development, to help maintain the supply of drinking water. The Council will require such measures to be implemented in all new development.

Private sewage treatment facilities will not be permitted if there is an accessible public fowl sewer. Where private sewage treatment facilities are the only practical option for sewage disposal, they will only be permitted where there would be no harm to the environment, having regard to preventing pollution of groundwater and any watercourses and odour.

Proposals for agricultural reservoirs may be permitted, subject to a detailed assessment against relevant policies in this Local Plan.

This Policy contributes towards achieving Objectives 8 and 9 of this Local Plan.

Policy PPL 10 RENEWABLE ENERGY GENERATION AND ENERGY EFFICIENCY MEASURES

Proposals for renewable energy schemes will be considered having regard to their scale, impact (including cumulative impact) and the amount of energy which is to be generated.

All development proposals should demonstrate how renewable energy solutions, appropriate to the building(s) site, and location have been included in the scheme and for new buildings, be designed to facilitate the retro-fitting of renewable energy installations.

For residential development proposals involving the creation of one or more dwellings, the Council will expect detailed planning applications to be accompanied by a 'Renewable Energy Generation Plan' (REGP) setting out the measures that will be incorporated into the design, layout and construction aimed at maximising energy efficiency and the use of renewable energy.

Planning permission will only be granted where the applicant can demonstrate that all reasonable renewable energy and energy efficiency measures have been fully considered and, where viable and appropriate, incorporated into the design, layout and construction. The Council will consider the use of planning conditions to ensure the measures are delivered.

Nothing in this policy diminishes or replaces the requirements of Energy Performance Certificates (EPC) and Standard Assessment Procedures (SAP) for constructed buildings and compliance with the relevant building regulations.

This Policy contributes towards achieving Objectives 6 and 9 of this Local Plan.

2.3 Regulatory Framework

The Building Regulations Part L represents the baseline performance for new developments. The new Part L was brought in in June 2022, reflecting the lower emissions of grid electricity. It creates a substantially different regulatory regime for communal heat systems that rely upon gas CHP which will struggle to comply.



2.4 Planning Policy Analysis

The local policy looks to support development that is seeking to address renewable energy and climate change. The applicant shares the Council's aims and has sought to prepare a strategy for the site that seeks not only to reflects this but to exceed the expectations of policy substantially.



3 CREATING A SUSTAINABLE DEVELOPMENT

3.1 Creating A Sense of Community

The proposals are for 40 zero carbon, zero fossil fuel dwellings that are suited to modern lifestyles. Lifestyles have changed substantially in recent times and may continue to do so with our combined response to climate change. The proposed scheme creates good private gardens with opportunities to appreciate the wildlife that colonizes the habitats created as part of the ecological strategy.

3.2 Facilitating Sustainable Lifestyle Choices

3.2.1 Sustainable Travel Choices

Lifestyles have changed substantially since the Covid-19 pandemic, and with the potential for more sustainable modes of living. People have been travelling less, working from home more, and active travel (walking, cycling) has become a larger part of people's lives following the various lockdowns.

In order to provide the opportunity for positive sustainable travel choices to continue, there are measures that the proposals are looking to incorporate. Home working will be further facilitated by the provision of fully connected dwellings with pre-wiring for home office and USB sockets.

The design of the scheme provides a parking strategy that creates the opportunity for occupants to charge electric vehicles ("EVs"). Solar PV is provided meaning that vehicle charging can be even more sustainable. The provision of cycle storage will allow occupants to make active travel choices.

The site will benefit from the local amenities within the Clacton Shopping Village as well as the Clacton railway station. With the level of local facilities and amenities, the advent of grocery deliveries direct to our homes, and the coming of age of working from home, the need for car journeys will be significantly reduced, and those journeys that are required can be undertaken in low emissions electric vehicles that are charged via renewable energy infrastructure.

3.2.2 Active Lifestyles

Secure cycle storage will be provided, allowing those who elect to cycle to be able to integrate that into their life in the development. Some of the local facilities are walkable. The provision of private gardens will create opportunities for occupants to grow their own produce locally, and also foster active, healthy outdoor lifestyles.

3.2.3 Low Carbon Living

Chapter 1 addresses energy performance of the homes themselves. The provision of zero carbon, zero fossil fuel, highly insulated, efficient modern dwellings that integrate renewable energy technology create the base for low carbon living. Active travel, EV charging, and an infrastructure that allows people to work from home successfully creates the opportunity for occupants to address their travel-related emissions in a positive way too.

3.2.4 Bringing in Biodiversity

A Preliminary Ecological Assessment has been undertaken. The assessment found that the site and habitats therein are of limited ecological value. Recommendations include:

Manage light spill via a sensitive lighting strategy;



- Manage clearance works to avoid breeding season;
- Some further assessment work is recommended.

Refer to the Preliminary Ecological Appraisal for further details.

In addition to this, individual gardens can be very good for biodiversity, with an abundance of flowering plants for insects, and potential roosts and foraging for birds and bats. Increasingly, people are managing their gardens for wildlife. Advice and information can be provided to purchasers on how they can garden in a way that helps promote biodiversity through habitat creation, seasonal management techniques, and the provision of appropriate flowering and fruiting plants.

3.3 Managing Water Sustainably

Water conservation in buildings will be driven through the specification of efficient fittings, and the installation of water meters. This will include where appropriate taps with flow restrictors, managed flow rates for showers, and dual flush WCs. Rainwater harvesting through water butts could be provided. The scheme will achieve the 110 litres per person per day expectation in Part G of the Building Regulations.

3.4 Building Sustainably

3.4.1 Materials

Materials would be procured responsibly. The scale of the development means that it would be delivered on a basis that would achieve resource efficient procurement and construction. The design is a traditional approach to the aesthetics and will follow a traditional construction route.

3.4.2 Construction Waste

A Site Waste Management Plan would be prepared at a later stage in the project, which would set out the details of how to segregate and recycle the waste streams that arise on site in line with the waste hierarchy. This could be submitted pursuant to a condition.

3.4.3 Operational Waste

All dwellings will be designed to deal with refuse storage as follows:

- Provision of hard standing for bins;
- Provision of clear flat access between the area and the collection point to the front of the property;
- Option for garden waste provision/collection or home composting area;
- Internal storage should be designed into the plan of each dwelling to facilitate recycling.

3.5 Addressing Air and Light Pollution

A construction management plan will be prepared and could be secured by condition. Air quality would be controlled during the construction phase through the use of measures such as wetting down to reduce dust where required. Greenhouse gas emissions are covered in the earlier sections of this report. Light pollution would be controlled through time and dusk sensor controls on private external lighting within the houses.



3.6 Providing Socio-Economic Sustainability

The scheme will deliver 40 zero carbon, zero fossil fuel homes with their own private gardens. Access to external amenity space became of paramount importance during the pandemic. In addition, the site will provide access to local amenities.

In economic terms, the development will create jobs during the construction process, but also longer term through occupancy. The dwellings will contribute financially through local taxes, but also in this case, provide an example of how low carbon development can be achieved.

Within the wider socio-economic context, if the development can provide an example for others to follow, then it will have a more substantial and wider socio-economic benefit than just at the site-specific level.



4 ADDRESSING THE CLIMATE EMERGENCY

4.1 Climate Change Mitigation

The proposed development will mitigate climate change through a variety of building-related and lifestyle related measures as detailed in this report:

Building Emissions

- Using high levels of insulation and air tightness;
- Using LED lighting throughout;
- Use of heat recovery technology where appropriate;
- Using renewable heat pumps for heating;
- Applying renewable solar PV technology;
- o Avoiding fossil fuel.

Lifestyle Emissions

- Facilitation of sustainable travel choices;
- o Provision of working from home facilities;
- Electric vehicles have been considered in the design;
- Cycle storage and active travel are considered.

This will help to reduce energy use and achieve low carbon emissions for the new-build homes. Other measures will include using low or zero global warming impact insulation materials. The next chapter addresses the approach to energy within buildings in some detail.

4.2 Climate Change Adaptation

Climate change will impact on the new development. Weather patterns will become less predictable – for example rainfall will become more extreme, and summer temperatures are likely to increase. Biodiversity will alter as conditions change. Water management is a key issue in adaptation, as is designing out the requirement for cooling in buildings. Key mitigation measures employed in the development will be:

- Incorporating opportunities for biodiversity as noted previously;
- Designing for cross-ventilation to avoid overheating;
- · Appropriate solar control glazing (g-value) where required;
- Designing appropriate surface water management;
- Harvesting water for irrigation in low rainfall periods via water butts;
- Metering water use to increase awareness of consumption;
- Metering electricity use to increase awareness of energy consumption and energy efficiency.



5 ADDRESSING ENERGY AND CARBON EMISSIONS

5.1 Low Carbon Development

The scheme will deliver a zero-carbon development for the 40 new-build homes on the site. To achieve this, the proposed approach is for the dwellings to use low carbon heat from air source heat pumps and rooftop solar PV. The carbon emissions are determined by energy modeling required for Part L of the Building Regulations using SAP software. This considers the design of the home - its orientation, glazing, insulation levels, thermal losses through any thermal bridges in the fabric, heating technology, lighting demand and efficiency, air tightness, fans and pumps demand, and finally it also considers any onsite electricity generation. The SAP assessment generates an estimate of the heating and electricity demand, and then converts this into CO2 emissions based on the carbon emissions from grid electricity and from the proposed heating fuel (gas, heating oil, electricity etc.). Finally, it assesses how much CO2 any onsite electricity technology would save (e.g., solar PV panels) and subtracts that from the total emissions.

In summary, low carbon, zero fossil fuel development can be achieved by a step-by-step process:

- Design buildings to benefit from passive design principles benefitting from free heating from solar gain whilst providing roof space that is oriented and suited to solar technology;
- 2. Using energy efficiency to minimize heating and electricity demand;
- 3. Avoid fossil fuels;
- 4. Apply low carbon heating technology;
- 5. Recover waste heat where appropriate;
- 6. Use solar panels for renewable electricity generation.

5.2 Energy Efficiency

The new build dwellings will have to address Part L of the Building Regulations as the minimum standard, and as things stand, this sets out a minimum performance for fabric performance overall (the Target Fabric Energy Efficiency standard). It also sets notional target values and backstop standards for individual aspects of building fabric.

The aims for the new Part L, adopted in June 2022, are for higher backstop standards and increased standards for the notional dwelling. There is significant flexibility as to how these standards are applied.

Key aspects of energy efficiency in the new buildings are likely to include:

- Fabric insulation standards;
 - o Construction detailing to reduce unwanted ventilation losses;
 - Demanding wall, floor and roof U-values;
 - Sealing of party walls;
 - Adoption of construction detailing to minimise linear thermal bridging normally caused by penetrations to the insulating layer;
 - Demanding air tightness standards.
- Efficient heating and hot water;
 - Use of high efficiency heating technology;
 - Use of low temperature circulation systems;
 - o Programmable thermostats;
 - Weather compensation controls;
 - Tap flow rates with appropriate controls;
 - Appropriate shower flow rates.
- Electrical efficiency;
 - Use of LED lighting;



- Energy labelled white goods;
- Controls on external lighting to switch automatically when not required;
- Controlled ventilation fan power.
- Considerations for managing behavioural aspects of demand;
- Recovery of waste heat where appropriate.

5.3 Sustainable Heat

5.3.1 Gas CHP and District Heating

Most communal heating schemes relay upon CHP as clean technology that generates electricity whilst also capturing usable heat that is produced in this process. This contrasts with conventional ways of generating electricity where large quantities of heat are simply wasted. In today's coal and gas fired power stations, up to two thirds of the overall energy consumed is lost in this way, often seen as a cloud of steam rising from cooling towers. However, the increase in renewable energy in the UK electricity mix has left the system less reliant upon coal and gas. As a direct result, gas CHP is now not as beneficial in carbon terms. CHP plants generally meet local energy needs; certainly heat, also power and increasingly cooling. As such, it normally also avoids additional efficiency losses of around 7% incurred through transmission and distribution of electricity through the National Grid and local distribution networks – as energy is lost travelling long distances to reach its end user.

CHP in new property developments tends to be relatively small-scale compared with industrial CHP, even when installed in large developments. Heat distribution infrastructure is required to distribute the heat from the plant room to the buildings. Heat is lost in the distribution process – this was previously expected to be in the order of 5% of the gross heat output, although more recent analysis has led the Standard Assessment Procedure 10 (SAP 10) to assume losses of 50%, or 20% if the scheme is designed to CIBSE guidance that is under development. Parasitic pumping energy requirements are typically approximated as 1% of the gross heat output. Each building/dwelling requires a heat exchanger and heat metering facility. There are a number of very minor incentives for CHP, but to date, there has been no major support scheme for CHP. The incentives that are potentially relevant to CHP within new property developments are as follows:

- Exemption from the Climate Change Levy for all fuels in, and all electricity out;
- · Eligibility for enhanced capital allowances;
- Business rates exemption.

The costs for CHP are defined by the density of the development and the value of the heat sold and electricity produced compared with the fuel purchased to run it. The proposed scheme is very low density in CHP terms and would not support the expense of an installed heat network. Further, the relatively low value heat that is generated combined with high running costs means that it would run at a loss operationally irrespective of the capital cost implications. Finally, the new regulatory regime will make compliance with gas CHP very challenging.

CHP is not financially viable, nor technically feasible, and is not recommended.

5.3.2 Biomass and Related Technologies

Any technologies that rely on a communal heat network are not financially viable on the site due to the reasons set out above for gas CHP. This includes biomass CHP, biomass heating, and biogas from anaerobic digestion.

Biomass and biogas are not financially viable and are not recommended.



5.3.3 Solar Thermal

Solar thermal on a plot-by-plot basis may have some application on the site. Typically, it is a more expensive means of reducing CO2 than solar photo-voltaics and competes directly for space with it. As a result, it often is less preferable than solar PV.

Solar PV is preferable as a rooftop solar technology at this stage.

5.3.4 Heat Pump Technology

The market for heat pump solutions in new build property is expanding quickly due to the rapid decline in grid electricity CO2 emissions. The significant expansion of renewable energy on the UK network has quartered the related carbon emissions over the last 10 years. As a result, interest in electric based-heating technology for new build is rapidly increasing. Employing heat pump technology is a realistic option for the development as a means to providing low carbon heat that decouples the need for fossil-fuel based systems. The more likely approach would be for individual air-source heat pumps for individual dwellings. Currently ground source options represent a substantial cost per dwelling, either on a communal or an individual basis.

Individual plot-by-plot air source heat pumps for heating and hot water provision are a key option for the development to provide low carbon heat.

5.4 Sustainable Electricity

5.4.1 Solar Photo-Voltaics

Solar PV has the greatest potential as an onsite renewable electricity technology. The current approach is to focus any solar PV as on-plot building-mounted provision. PV is best when oriented South but can still provide material contributions to CO2 reductions at other orientations. For zero carbon, the provision is estimated to be approximately 182kWp.

Solar PV will be provided for onsite renewable electricity generation to help achieve the zerocarbon ambition.

5.4.2 Wind and Hydro

Small-scale wind within the proximity of buildings performs very poorly and is therefore more costly per tonne of carbon than any other solution analysed in this report. Therefore, it is not technically or financially viable. Large-scale wind is not viable on the site technically, and there is no opportunity for hydro power.

Wind and hydro are not technically or financially viable and therefore not recommended.

5.5 Proposed Approach

The applicant will achieve zero carbon, zero fossil-fuel new build homes that can provide a good example for others to follow. The approach as to how low carbon is achieved needs to be flexible to address the realities of what may happen in the market as this will affect deliverability. Achieving this requires renewable heat from heat pumps combined with demanding fabric and technologies including solar PV.

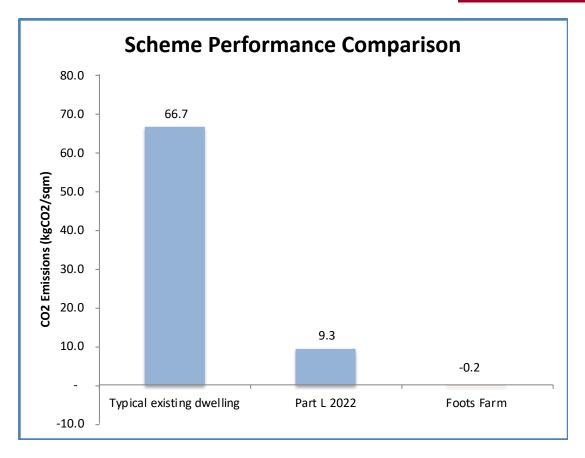


Figure 4 - Comparative Performance

The carbon emissions are summarised as follows:

Emissions Summary		
BAU	32.44	tCO2
Energy efficiency	29.20	tCO2
CHP	29.20	tCO2
Renewables	- 0.86	tCO2
Efficiency savings	10%	
CHP savings	0%	
Renewables savings	93%	
Total savings	103%	

Figure 5 - Carbon Emissions Summary

The development's zero carbon, zero fossil-fuel approach to the new build homes represents a significant advance in building CO2 emissions standards, taking seriously the need to address the Climate Emergency. It looks to provide a strong lead for other developments in the locality, saving nearly 100% emissions over and above the current regulations.



6 CONCLUSION

6.1 Proposals

The applicant is seeking planning permission on the land at Foots Farm, Thorpe Road, Clacton on Sea. This document forms part of a detailed application for 40 dwellings, and the approach has been designed to reflect the climate emergency.

JS Lewis Ltd was instructed by the applicants to develop an energy and sustainability strategy for the proposed development. Its purpose is to help the applicants to deliver a highly sustainable development and respond to planning policy on energy, sustainability, and to address the climate emergency.

In response to the climate emergency, the applicants have adopted a progressive approach to development with a view to setting a high standard of sustainable development. Key aspects of the development of the site will be achieving low carbon, fossil fuel free homes.

6.2 Zero Carbon Development

This report seeks to set out a strategy for the proposed development to follow. The applicant's aim is to achieve a sustainable community with zero carbon new build dwellings - a standard that is far better than typical existing dwellings in the locality, and substantially exceeds the brand-new regulatory aims (Part L). As a zero carbon development, the scheme could provide a strong lead for other developments locally to follow.

6.3 Sustainable Development

The scheme comprehensively addresses and exceeds the Council's own ambitions as set out in their adopted policy framework:

- Energy use:
 - Zero carbon site;
 - Zero fossil fuel site;
 - Efficient fabric and services;
 - Heat pump for each dwelling;
 - Solar PV provision for each dwelling;
 - Electric vehicle charging designed for;
 - Fully connected dwellings;
 - Provision of working from home facilities.
- Siting, orientation, and passive design:
 - Planned for solar rooftop potential;
 - Dwellings to have high levels of insulation.
- Overheating and adaptation:
 - o Cross-ventilation throughout to minimize overheating risks;
 - Appropriate fenestration to be specified at building control stage;
 - Thermal mass to be used to temper internal environments.
- Materials and waste management:
 - Site waste management plan to be used to promote reuse and recycling;
 - o Recycling provision for each dwelling.
- Sustainable and active travel:
 - Cycle storage provided;
 - Access to local amenities in the adjacent shopping village;
 - Access to Clacton on Sea railway station.



- Design for health and wellbeing:
 - o Access to communal and public open spaces within the site;
 - Private gardens for each dwelling;
 - o Cycle storage to be provided.
- Land use and ecology
 - Site of low value;
 - Recommendations made in appraisal document.

As a zero carbon, zero fossil fuel development, the scheme could provide a strong lead for other developments locally to follow.

6.4 Statement of Policy Compliance

The local policy requirements on energy and carbon are to be achieved and substantially exceeded. This report demonstrates that the proposed scheme has the potential to achieve standards well in excess of the local policy requirements. The scheme therefore has addressed policy, and can be considered to be highly sustainable, policy-compliant, and actually to out-perform adopted policy.



APPENDIX - EXAMPLE SAP CALCULATIONS



Property Reference Assessment Refe			pe A - Semi pe A					Prop Type Ref		ssued on D pe A - Semi		19/01/2024	
Property		Тур	pe A - Semi, A	A, Clacton, -									
SAP Rating					95 A		DER	-0.55		TER		10.36	
Environmental					101 A		% DER < TER					105.31	
CO ₂ Emissions (t/	year)				-0.11		DFEE	38.47		TFE	3	41.68	
Compliance Chec	k				See BREL		% DFEE < TFE	EE				7.68	
% DPER < TPER					66.69		DPER	18.48		TPE	R	55.49	
Assessor Details		Mr. Jona	than Lewis							Asse	essor ID	AZ32-000	01
Client													
SAP 10 WORKSHEET CALCULATION OF I	DWELLING E	MISSIONS FO				2022)							
1. Overall dwell Ground floor Total floor area Dwelling volume)+(1d)+(1e	·)(ln)	6	7.8000			lb) x				(1b) - (3b)
2. Ventilation											mi	3 per hour	
Number of open of Number of open in Number of chimne Number of flues Number of flues Number of intern Number of passiv Number of fluele	flues eys / flues attached attached ed chimneys mittent ex ye vents	to solid fur to other he s tract fans	el boiler	fire							0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 20 = 0 * 35 = 0 * 20 = 0 * 10 = 0 * 10 = 0 * 40 =	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(6b) (6c) (6d) (6e) (6f) (7a) (7b)
Infiltration due	to chimn	evs flues	and fans	= (6a)+(6b)	1+(6a)+(6d)+(6e)+(6f)+((6a) + (7a) + (7	7h) + (7c) =		0 0000	Air changes 0 / (5) =		
Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides	ethod AP50			(32)		, (, -,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					Yes lower Door 3.0000 0.1500	(17)
Shelter factor Infiltration rat	ce adjuste	d to include	e shelter	factor				(20) = 1 - (21		x (19)] = x (20) =	0.8500 0.1275	
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000		May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000		Dec 4.7000	
Wind factor Adj infilt rate			1.2250		1.0750	0.9500	0.9500	0.9250	1.0000	1.0750		1.1750	
Effective ac	0.1626 0.5132	0.1594 0.5127	0.1562 0.5122		0.1371 0.5094	0.1211 0.5073	0.1211 0.5073		0.1275 0.5081	0.1371 0.5094		0.1498 0.5112	
3. Heat losses a	and heat le	oss paramet	er						7. v. T		Z volue	7 V	
Element Windows (Uw = 1.	20)			Gross m2	Openings m2		:Area m2 :1000	U-value W/m2K 1.1450	A x U W/K 11.5649		K-value kJ/m2K	A x K kJ/K	
Solid Door Heatloss Floor I External Wall 1 External Roof 1 Total net area of Fabric heat loss	L of externa	l elements :	Aum(A, m2)	69.0000 67.8000	12.2000	2. 67. 56. 67.	1000 8000 8000 8000 6000	1.2000 0.1300 0.1700 0.1200 30) + (32) =	2.5200 8.8140 9.6560 8.1360				(26) (28a) (29a) (30) (31) (33)
E3 Sill E4 Jamb E5 Grour E10 Eave E16 Corr E17 Corr	Bridges ent c lintels nd floor (es (insula ner (norma ner (inver	(including one of the control of the	other stee ling level nal area c ings	el lintels) .) (reater than	external are	a)		8. 8. 24. 23. 27. 12.		i-value 0.0280 0.0390 0.0100 0.0500 0.0780 0.0430 0.0000 0.0340	Tot: 0.22- 0.31: 0.24- 1.16: 2.12: 0.53' 0.000	40 20 00 50 94 75	

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Point Thermal Total fabric h									(33) + (36)	(36a) = + (36a) =	0.0000 45.4688	
Ventilation he	at loss cal	lculated mos	nthly (38)m Mar	= 0.33 x Apr	(25) m x (5) May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38) m Heat transfer	28.7066	28.6779	28.6498	28.5176		28.3778	28.3778	28.3565	28.4221	28.4929	28.5429	28.5952	(38)
Average = Sum (74.1754 (39) m / 12 =	74.1467	74.1185	73.9864	73.9617	73.8466	73.8466	73.8253	73.8909	73.9617	74.0117	74.0640 73.9863	
HLP	Jan 1.0940	Feb 1.0936	Mar 1.0932	Apr 1.0912	May 1.0909	Jun 1.0892	Jul 1.0892	Aug 1.0889	Sep 1.0898	Oct 1.0909	Nov 1.0916	Dec 1.0924	(40)
HLP (average) Days in mont	31	28	31	30		30	31	31	30	31	30	1.0912	
4. Water heati	ng energy n	requirement	s (kWh/year)									
Assumed occupa Hot water usag	incy											2.1916	(42)
Hot water usag	0.0000 ge for baths	0.0000 s	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usag			67.7621	65.0522		60.7730	59.5577	61.0171	62.6062	65.0138	67.7796	70.0380	
Average daily	37.0737 hot water u	35.7255 use (litres	34.3774 /day)	33.0293	31.6811	30.3330	30.3330	31.6811	33.0293	34.3774	35.7255	37.0737 98.8599	
Daily hot wate	Jan er use	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte Energy content	107.3493 170.0150 (annual)	149.4580	102.1396 156.9847	98.0815 134.2687		91.1060 112.0255	89.8907 108.7150	92.6983 114.7798	95.6355 117.9281	99.3912 134.8730 Total = S	103.5051 147.4620 um(45)m =	107.1117 167.7110 1641.7108	(45)
Distribution 1	25.5022	= 0.15 x (22.4187	45)m 23.5477	20.1403	19.1235	16.8038	16.3073	17.2170	17.6892	20.2309	22.1193	25.1566	(46)
Water storage Store volume a) If manufac		ared loss f	actor is kn	own (kWh/	dav):							170.0000 1.6000	
Temperature Enter (49) or	factor from	m Table 2b										0.7800 1.2480	(49)
Total storage	38.6880	34.9440	38.6880	37.4400	38.6880	37.4400	38.6880	38.6880	37.4400	38.6880	37.4400	38.6880	(56)
If cylinder co	38.6880	34.9440 49.5488	r storage 38.6880 54.8576	37.4400 53.0880		37.4400 22.5120	38.6880 23.2624	38.6880 23.2624	37.4400 22.5120	38.6880 54.8576	37.4400 53.0880	38.6880	
Primary loss Combi loss Total heat req	54.8576 0.0000 mired for w	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	54.8576 0.0000	
WWHRS	263.5606	233.9508	250.5303	224.7967		171.9775 0.0000	170.6654	176.7302 0.0000	177.8801 0.0000	228.4186	237.9900	261.2566 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	(63c)
FGHRS Output from w/	0.0000 h 263.5606	0.0000	0.0000	0.0000	0.0000 221.0357	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 261.2566	
12Total per ye			230.3303	224.7307	221.0337	171.9773	170.0034			1h/year) = S		2618.7924	
Electric showe		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Heat gains fro		ating, kWh/n 117.2890	month 127.0339		tal Energy us		antaneous e 85.7081	lectric sho 87.7246		/year) = Su 119.6817		0.0000	
	131.3003	117.2090	127.0339	117.0007	117.2269	85.2101	03.7001	07.7240	87.1727	119.001/	121.4333	130.6004	(63)
5. Internal ga	ins (see Ta	able 5 and											
Metabolic gain	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m Lighting gains	(calculate	ed in Appen	dix L, equa	tion L9 or	109.5776 L9a), also s 102.5781	see Table 5				109.5776			
Appliances gai	ns (calcula	ated in App	endix L, eq	uation L13		lso see Tab	le 5						
Cooking gains	(calculated	d in Append	ix L, equat	ion L15 or 33.9578	L15a), also 33.9578	see Table 33.9578	5 33.9578			33.9578	33.9578	33.9578	
Pumps, fans Losses e.g. ev	aporation	0.0000 (negative v	0.0000 alues) (Tab	le 5)	0.0000			0.0000		0.0000			
Water heating	gains (Tabl	le 5)			-87.6621 157.5631			117.9094		160.8626		-87.6621 175.5382	
Total internal	gains				480.8989								
6. Solar gains													
[Jan]				rea m2	Solar flux Table 6a W/m2	Speci	g fic data	Specific	FF	Acce	ss	Gains W	
										Table	6d	**	
North East West			5.9 2.9	000	10.6334 19.6403 19.6403		0.6300 0.6300	0	= 0 0 0	0.77 0.77 0.77		4.2246 35.4137 17.4067	(76)
Solar gains Total gains	57.0450	111.4014	183.8852	270.2134	333.8352	343.1305	326.0891	278.1591	214.4050 644.0990	132.2177 608.9763	71.0725 572.5731	46.9588 564.5808	(83) (84)
7. Mean intern													
Temperature du												21.0000	(85)
Utilisation fa			ving area, : Mar			Jun	Jul	Aug	Sep	Oct	Nov	Dec	

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tau 25.39 alpha 2.69		25.4097 2.6940	25.4551 2.6970	25.4636 2.6976	25.5033 2.7002	25.5033 2.7002	25.5107 2.7007	25.4880 2.6992	25.4636 2.6976	25.4464 2.6964	25.4285 2.6952	
util living area 0.92		0.8610	0.7806	0.6653	0.5350	0.4094	0.4491	0.6399	0.8082	0.8968	0.9314	(86)
Living 20.12		20.2983	20.4353	20.5474	20.6153	20.6439	20.6391	20.5845	20.4467	20.2638	20.1078	(00)
Non living 18.94 24 / 16	79 19.0337	19.1658	19.3335	19.4638	19.5381	19.5640	19.5608	19.5086	19.3513	19.1266	18.9296	
24 / 9	3 0 28 0	0	0	0	0	0	0	0	0	0	0	
MIT 20.55 Th 2 20.00	16 20.1921	20.2983	20.4353 20.0080	20.5474 20.0083	20.6153	20.6439	20.6391	20.5845	20.4467 20.0083	20.2638	20.2326 20.0071	
util rest of house 0.91		0.8427	0.7514	0.6205	0.4695	0.3264	0.3646	0.5776	0.7762	0.8814	0.9222	
MIT 2 19.58 Living area fraction	40 19.0337	19.1658	19.3335	19.4638	19.5381	19.5640	19.5608	19.5086 fLA =	19.3513 Living area	19.1266 a / (4) =	19.1237 0.4867	,
MIT 20.05 Temperature adjustmen		19.7170	19.8698	19.9912	20.0624	20.0896	20.0856	20.0323	19.8845	19.6801	19.6635 0.0000	(92)
adjusted MIT 20.05	49 19.5976	19.7170	19.8698	19.9912	20.0624	20.0896	20.0856	20.0323	19.8845	19.6801	19.6635	(93)
8. Space heating requ												
											_	
Jan Utilisation 0.91		Mar 0.8368	Apr 0.7470	May 0.6197	Jun 0.4732	Jul 0.3334	Aug 0.3714	Sep 0.5792	Oct 0.7717	Nov 0.8756	Dec 0.9187	
Useful gains 535.23 Ext temp. 4.30		587.5840 6.5000	577.4830 8.9000	504.8526 11.7000	367.0103 14.6000	247.8674 16.6000	258.5687 16.4000	373.0692 14.1000	469.9733 10.6000	501.3387 7.1000	518.6749 4.2000	
	92 1089.7747	979.6257	811.6126	613.2327	403.3829	257.6954	272.0923	438.3427	686.6945	931.0718	1145.2852	(97)
Space heating kWh 471.24 Space heating require	80 347.2155		168.5733	80.6348	0.0000	0.0000	0.0000	0.0000	161.2405	309.4079	466.1981 2296.1970	(98a)
Solar heating kWh		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(99h)
Solar heating contrib				0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(900)
	80 347.2155			80.6348	0.0000 (kWh/year)	0.0000	0.0000	0.0000	161.2405	309.4079	466.1981 2296.1970	(98c)
Space heating per m2	41001 00		22011 20242	. per year	(11111) 1001)				(98c)	/ (4) =	33.8672	(99)
9a. Energy requiremen												
Fraction of space hea											0.0000	(201)
Fraction of space hea Efficiency of main sp	t from main sy	ystem(s)									1.0000 265.2639	
Efficiency of main sp Efficiency of seconda	ace heating sy	ystem 2 (in	%)								0.0000	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	80 347.2155			80.6348	0.0000	0.0000	0.0000	0.0000	161.2405	309.4079	466.1981	(98)
Space heating efficie 265.26	39 265.2639	265.2639	1) 265.2639	265.2639	0.0000	0.0000	0.0000	0.0000	265.2639	265.2639	265.2639	(210)
Space heating fuel (m 177.65	25 130.8943	109.9580	63.5493	30.3980	0.0000	0.0000	0.0000	0.0000	60.7849	116.6415	175.7488	(211)
Space heating efficie	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 fuel (m 0.00 Space heating fuel (s	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
0.00		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 require	ment											
	06 233.9508	250.5303	224.7967	221.0357	171.9775	170.6654	176.7302	177.8801	228.4186	237.9900	261.2566 163.6200	
	00 163.6200	163.6200	163.6200	163.6200	163.6200	163.6200	163.6200	163.6200	163.6200	163.6200	163.6200	
	09 142.9842	153.1172	137.3895	135.0909	105.1079	104.3060	108.0126	108.7154	139.6031	145.4529	159.6728	(219)
(221)m 0.00 Pumps and Fa 0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Lighting 20.26 Electricity generated	31 16.2558	14.6365	10.7234	8.2830	6.7673	7.5561	9.8217	12.7574	16.7383	18.9059	20.8263	
(233a)m -59.74 Electricity generated	49 -86.5651	-126.9438	-140.6700	-146.8376		-123.7346	-118.2364	-105.9644	-96.7424	-65.6930	-51.1871	(233a)
(234a)m 0.00 Electricity generated		ctric genera	0.0000 tors (Append	0.0000 lix M) (neg	0.0000 ative quant	0.0000 ity)	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
(235a)m 0.00 Electricity used or n	00 0.0000 et electricity	0.0000 y generated	0.0000 by micro-CHF	0.0000 (Appendix	0.0000 N) (negati	0.0000 ve if net g		0.0000	0.0000	0.0000		(235a)
(235c)m 0.00 Electricity generated	by PVs (Apper	ndix M) (neg			0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235c)
Electricity generated		ines (Append	ix M) (negat	ive quanti	ty)				-99.0663	-39.7151	-22.0046	
(234b)m 0.00 Electricity generated	by hydro-elec						0.0000	0.0000	0.0000	0.0000		(234b)
(235b)m 0.00 Electricity used or n	et electricity	y generated !						0.0000	0.0000	0.0000		(235b)
(235d)m 0.00 Annual totals kWh/yea	r	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235d)
Space heating fuel - Space heating fuel -	main system 2										865.6273 0.0000	(213)
Space heating fuel - Efficiency of water h	eater										0.0000 163.6200	
Water heating fuel us Space cooling fuel	eu										1600.5332	
Electricity for pumps		ah /was∽									0 0000	(221)
Total electricity for Electricity for light			ix L)								0.0000 163.5347	
Energy saving/generat PV generation	ion technologi	ies (Appendi	ces M ,N and	i Q)							-3293.3975	(233)
Wind generation Hydro-electric genera	tion (Annendis	× N)									0.0000	(234)
Electricity generated											0.0000	

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ppendix Q - spe nergy saved or nergy used otal delivered	generated										-0.0000 0.0000 -663.7023	(237)
2a. Carbon diox						micro-CHP	 					
pace heating - otal CO2 associ ater heating (c	main syste	em 1					Energy kWh/year 865.6273	kc	on factor (CO2/kWh 0.1552 0.1416		Emissions kg CO2/year 134.3508 0.0000 226.5669 360.9177	(261) (373) (264)
mps, fans and mergy for light		keep-hot					0.0000 163.5347		0.0000 0.1443		0.0000 23.6031	
Energy saving/g 7 Unit electric 7 Unit electric otal otal CO2, kg/ye PC Dwelling Car	city used i city export ear	in dwelling ced					1247.6747 2045.7228		0.1354 0.1235		-168.8770 -252.6999 -421.5769 -37.0561 -0.5500	(269) (272)
Ja. Primary ene							 					
pace heating -	main syste	em 1							gy factor CO2/kWh 1.5746		imary energy kWh/year 1363.0093 0.0000	(275)
ater heating (co bace and water umps, fans and	other fuel) heating						0.0000		1.5235		2438.3752 3801.3846	(279)
mps, fans and ergy for light		reeh-uor					163.5347		1.5338		0.0000 250.8350	
Energy saving/g 7 Unit electric 7 Unit electric otal	city used i city export nergy kWh/y	in dwelling ed year					1247.6747 2045.7228		1.5003 0.4533		-1871.8977 -927.3104 -2799.2081 1253.0115 18.4800	(283) (286)
welling Primary	I FOR New E	Build (As D	esigned)	(Version 1			 					
welling Primary AP 10 WORKSHEET ALCULATION OF 1	F FOR New F PARGET EMIS	Build (As D	esigned)	(Version 1	0.2, Februa:	ry 2022)	 Area (m2)		y height (m) 2.5000		Volume (m3) 169.500	(1b) -
velling Primary AP 10 WORKSHEET ALCULATION OF T Overall dwell cound floor	FOR New F PARGET EMIS	Build (As D	esigned)	(Version 1	0.2, Februa:	ry 2022)	 Area (m2) 67.8000		(m) 2.5000	(2b) =	(m3) 169.5000	(4)
Pelling Primary Pello WORKSHEET LCULATION OF T Overall dwell cound floor stal floor area relling volume	FOR New F FARGET EMIS ling charac	Build (As D	esigned)	(Version 1	0.2, Februa:	ry 2022)	 Area (m2) 67.8000	(1b) x	(m) 2.5000	(2b) =)(3n) =	(m3) 169.5000 169.5000	(4)
Pelling Primary AP 10 WORKSHEET LCULATION OF T Overall dwell cound floor tal floor area relling volume	r FOR New F TARGET EMIS ling charac	Build (As D	esigned)	(Version 1	0.2, Februa:	ry 2022)	 Area (m2) 67.8000	(1b) x	(m) 2.5000	(2b) =)(3n) =	(m3) 169.5000	(4)
P10 WORKSHEET LCULATION OF T Overall dwell ound floor tal floor area elling volume Ventilation r wher of open c mber of open f mber of flues mber of flues mber of blocke mber of interm mber of passiv	r FOR New F TARGET EMIS TARGET EMIS Ing charac a TFA = (la trace thimneys flues bys / flues attached t attached t attached t attached t attached t chimneys inttent ext	suild (As DissIONS) tteristics a)+(lb)+(lc) s attached to solid furce other here cract fans	esigned))+(ld)+(le) to closed fel boiler	(Version 1	0.2, Februa:	ry 2022)	 Area (m2) 67.8000	(1b) x	(m) 2.5000	(2b) =)(3n) =	(m3) 169.5000 169.5000 m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 20.0000 0.0000	(6a) (6b) (6c) (6d) (6e) (6f) (7a) (7b)
P10 WORKSHEET P10 WORKSHEET LCULATION OF T Overall dwell ound floor tal floor area elling volume Wentilation r wher of open c mber of chimne mber of flues mber of flues mber of flues mber of flues filtration due essure test essure design	rFOR New F FOR New F	Build (As Dissions) cteristics a)+(lb)+(lc) s attached to solid function them is stract fans cres	esigned))+(ld)+(le) to closed fel boiler ater	(Version 1	0.2, Februa:	67.8000	Area (m2) 67.8000	(1b) x 3a)+(3b)+(3c)+	(m) 2.5000 (3d)+(3e)	(2b) = 0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 20 = 2 * 10 = 0 * 10 = 0 * 40 = Air chanc 0 / (5) =	(m3) 169.5000 169.5000 m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 20.0000 0.0000	(6a) (6b) (6c) (6d) (6e) (6f) (7a) (7b) (7c) (8)
P 10 WORKSHEET P 10 WORKSHEET LCULATION OF T Overall dwell ound floor tal floor area elling volume Ventilation r mber of open c mber of fopen f mber of flues mber of flues mber of flues mber of flues filtration due essure Test Me assured/design filtration rat mber of sides	r FOR New F FARGET EMISTERS FARGET EMISTERS FARGET EMISTERS FARGET EMISTERS FARGET EMISTERS FARGET F	Build (As Dissions) cteristics a)+(lb)+(lc) s attached to solid function them is stract fans cres	esigned))+(ld)+(le) to closed fel boiler ater	(Version 1	0.2, Februa:	67.8000	Area (m2) 67.8000	(1b) x 3a)+(3b)+(3c)+	(m) 2.5000 (3d) + (3e)	(2b) = 0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 2 * 10 = 0 * 10 = 0 * 40 = Air chanc 0 / (5) =	(m3) 169.5000 169.5000 169.5000 m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 9es per hour 0.1180 Yes Blower Door 5.0000 0.3680 2	(6a) (6b) (6c) (6d) (6e) (6f) (7a) (7b) (7c) (8)
Pelling Primary Pelling Primary Pello WORKSHEET LCULATION OF T Overall dwell Cound floor Stal floor area Pelling volume Ventilation r Comber of open of Stal floor area Pelling volume Wentilation r Stal floor area Pelling volume Imber of open of Stal floor area Pelling volume Comber of open of Stal floor area Pelling volume Comber of open of Stal floor area Pelling volume Comber of open of Stal floor area Pelling volume Comber of open of Stal floor area Pelling volume Comber of open of Stal floor area Pelling volume Comber of open of Stal floor area Pelling volume Comber of open of Stal floor area Pelling volume Comber of open of Stal floor area Pelling volume Comber of open of Stal floor area Pelling volume Comber of open of Stal floor area Pelling volume Comber of open of Stal floor area Pelling volume Ventilation of open of Stal floor area Pelling volume Comber of open of Stal floor area Pelling volume Ventilation of Stal floor area Pelling v	r FOR New F F FARGET EMIS ling charac a TFA = (la rate chimneys flues eys / flues attached t attached t attached ted chimneys mittent ext ve vents ess gas fir e to chimne ethod AP50 te sheltered	s attached to solid fur to other hes cract fans	to closed fel boiler ater	(Version 1	0.2, Februa:	67.8000	Area (m2) 67.8000	(1b) x 3a) + (3b) + (3c) +	(m) 2.5000 (3d) + (3e) 20.0000	(2b) = 0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 2 * 10 = 0 * 10 = 0 * 40 = Air chanc 0 / (5) =	(m3) 169.5000 169.5000 m3 per hour 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 0.0000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.000000	(6a) (6b) (6c) (6d) (6c) (6d) (7a) (7b) (7c) (8) (17) (18) (19) (20)
welling Primary AP 10 WORKSHEET ALCULATION OF I	rate chimneys flues sys / flues attached t	s attached to solid fur to other hes cract fans	to closed fel boiler ater	(Version 1	0.2, Februa:	67.8000	Area (m2) 67.8000	(20) = 1 - (21) Sep 4.0000	(m) 2.5000 (3d) + (3e) 20.0000	(2b) = 0 * 80 = 0 * 20 = 0 * 20 = 0 * 20 = 0 * 20 = 0 * 30 = 0 * 40 = Air chang 0 / (5) = x (19)] = x (20) = Nov 4.5000	(m3) 169.5000 169.5000 169.5000 m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.3080 2 0.8500 0.3128 Dec 0.4.7000	(6a) (6b) (6c) (6d) (6e) (6f) (7a) (7b) (7c) (8) (17) (18) (19) (20) (21)

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3. Heat losses and heat loss parameter



The Property State 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	 Element			Gross	Opening	s Net	 :Area	U-value	Ах	II F	(-value	Α×Κ	
Marchen 1.0	TER Opaque door					2 2.	m2 .1000	W/m2K 1.0000	W 2.10	/K 00			(26)
Secretary of the property of t	Heatloss Floor 1	Jw = 1.20)				67	.8000	0.1300	8.81	40			(28a)
Company Comp	External Roof 1	outomol element	o 7 mm (7 m2)		12.200	67.	.8000						(30)
The content of the						204		30) + (32) =	= 40.16	09			
The			TFA) in kJ/	m2K								100.0000	(35)
Section Sect	K1 Element	-	g other stee	l lintels)									
Explanation of the state of the	E4 Jamb							24	.0000	0.0500	1.20	00	
Company Comp	E10 Eaves	(insulation at c	eiling level)				27	.3000	0.0600	1.63	80	
Commonweign	E17 Corner	(inverted - int		reater than	external a	rea)		5	.0000	-0.0900	-0.45	00	
Company Comp	Thermal bridges (Su	um(L x Psi) calc		Appendix K	.)			, and the second		0.0000		8.3410	
									(33) + (36)	+ (36a) =	48.5019	(37)
	Já	an Feb	Mar	Apr	May								(20)
Table Tabl	Heat transfer coeff	£											
1.1955 1.1999 1.1864 1.1767 1.1745 1.1643 1.1643 1.1624 1.1624 1.1624 1.1745 1.1793 1			60.3736	79.7604	79.0310	70.9390	76.9390	70.0107	79.2037	79.0310	79.9320		
### A Matter heating energy requirements (DBM/year) 4. Matter heating energy requirements (DBM/year) 5. Assumed accompancy 5. Assumed accompancy 6. Marker uses for mixer showers 6. Double vater uses 6. Double v													(40)
Assumed occupancy Assumed occup	HLP (average) Days in mont	31 28	31	30	31	30	31	31	30	31	30		
Assumed occupancy Assumed occup													
Assumed occupancy Assumed occup													
Note that truspects Formisser showers 1,0000 0,00													
Both water usage for baths of 2,2716 69,2219 67,7621 65,022 61,0231 60,7730 59,557 61,0171 62,6062 65,0138 67,7736 70,0380 (422)	Assumed occupancy Hot water usage for	r mixer showers										2.1916	(42)
Hot water usage for other use. (litter/day) 31,0233 31,631 30,333 31,681 30,333 31,681 30,023 31,377 35,725 37,0737 (42) Wherage daily hot water use (litter/day) 31,023 34,077 35,725 37,0737 (42) While water use and the property of th	Hot water usage for	r baths			0.0000	0.0000		0.0000	0.0000				
Warrage daily hot water use [litres/day]	Hot water usage for	r other uses											
Baily hot water use 107.3493				33.0293	31.6811	30.3330	30.3330	31.6811	33.0293	34.3774	35.7255		
107.3493 104,9574 102,1396 98.0815 94.7042 91.1060 89.8907 92.6983 95.6355 99.3912 103.5051 107.1117 (44) Emergy content (amnual) 107.0150 104,450 156,9347 134.2697 127.4901 112.0255 108.7150 114.7799 117.0251			Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Referency content (annual)	107.	.3493 104.9574											
Water storage loss: Store volume a) If manufacturer declared loss factor is known (kWh/day):	Distribution loss	(46) m = 0.15 x											
a) If manufacturer declared loss factor is known (kWh/day):	Water storage loss:		23.5477	20.1403	19.1235	16.8038	16.3073	17.2170	17.6892	20.2309	22.1193		
Enter (49) or (54) in (55) Total storage loss 25.1153	a) If manufactures			own (kWh/d	ay):							1.5003	(48)
Teyliner contains dedicated solar storage	Enter (49) or (54)												
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 22.5120 23.2624 22.5120 23.2624 (9) Combi loss 0.0000 0.0000	25.			24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
Total heat required for water heating calculated for each month 218.3927 193.1540 205.3624 181.0858 175.8678 158.8426 157.0927 163.1575 164.7453 183.2507 194.2791 216.0887 (62) WWHEN	Primary loss 23.	.2624 21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
WWHES 0.0000 0.0	Total heat required	d for water heat	ing calculat	ed for each	month								
Solar input 0.0000 0.00	WWHRS 0.	.0000 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
Dutput from w/h 218.3927 193.1540 205.3624 181.0858 175.8678 158.8426 157.0927 163.1575 164.7453 183.2507 194.2791 216.0887 (64) 12Total per year (kWh/year) = Sum(64)m = 2211.3193 (64) 2211 (64) 221 (64) 221 (64) 221 (64) 221 (64) 22 (64) 22 (64) 22 (64) 22 (64) 22 (64) 23 (64) 24 (65) 25 (66) 26 (66) 27 (66) 28 (66) 28	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	(63c)
2211 (64) 2211 (61) 2211 (61) 2211 (61) 2211 (61) 2211 (61) 2211 (61) 2211 (61) 2211	Output from w/h								164.7453				
0.000 0.000		kWh/year)						Total p	er year (kW	h/year) = 8	Sum (64) m =		
Heat gains from water heating, kWh/month 95.2321 84.6516 90.8996 82.0980 81.0926 74.7022 74.8499 76.865 76.6648 83.5474 86.4848 94.4661 (65) 5. Internal gains (see Table 5 and 5a) Metabolic gains (Table 5), Watts Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (66) 109.5776 109.		.0000 0.0000	0.0000										
5. Internal gains (see Table 5 and 5a) Metabolic gains (Table 5), Watts Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (19).5776 109.57						-				_			
5. Internal gains (see Table 5 and 5a) Metabolic gains (Table 5), Watts Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (66) m 109.5776													(,
Metabolic gains (Table 5), Watts Jan Feb Mar Jan Jul													
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 109.5776 (66) Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 102.5781 113.5686 102.5781 105.9973 102.5781 105.9													
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 102.5781 13.5686 102.5781 105.9973 102.5781 105.9973 102.5781 105.9973 102.5781 105.9973 102.5781 105.9973 102.5781 105.9973 102.5781 105.9973 102.5781 105.9973 102.5781 (67) Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 192.1089 194.1024 189.0789 178.3844 164.8845 152.1965 143.7201 141.7267 146.7502 157.4447 170.9446 183.6325 (68) Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 33.9578 3	Ja	an Feb	Mar 109 5776	Apr 109 5776	May 109 5776	Jun 109 5776		Aug 109 5776					(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 192.1089 194.1024 189.0789 178.3844 164.8845 152.1965 143.7201 141.7267 146.7502 157.4447 170.9446 183.6325 (68) Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 33.9578	Lighting gains (cal	lculated in Appe	ndix L, equa	tion L9 or	L9a), also	see Table 5							
33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 33.9578 (69) Pumps, fans 3.000 3.000 3.000 3.000 0.000 0.000 0.000 0.000 3.000 3.000 3.000 (70) Losses e.g. evaporation (negative values) (Table 5) -87.6621	Appliances gains (c	calculated in Ap .1089 194.1024	pendix L, eq 189.0789	178.3844	or L13a), a 164.8845	lso see Tab: 152.1965	le 5 143.7201						
Losses e.g. evaporation (negative values) (Table 5) -87.6621 -87.6621 -87.6621 -87.6621 -87.6621 -87.6621 -87.6621 -87.6621 -87.6621 -87.6621 -87.6621 -87.6621 -87.6621 (71) Water heating gains (Table 5) 128.0002 125.9696 122.1768 114.0251 108.9954 103.7530 100.6047 103.3151 106.4789 112.2949 120.1178 126.9705 (72) Total internal gains	Cooking gains (calc	culated in Appen .9578 33.9578	dix L, equat 33.9578	ion L15 or 33.9578	L15a), also 33.9578	see Table 5	33.9578	33.9578	33.9578	33.9578	33.9578	33.9578	(69)
Water heating gains (Table 5) 128.0002 125.9696 122.1768 114.0251 108.9954 103.7530 100.6047 103.3151 106.4789 112.2949 120.1178 126.9705 (72) Total internal gains	Losses e.g. evapora	ation (negative	values) (Tab	le 5)									
Total internal gains	Water heating gains	s (Table 5)											
101,000 101,000	Total internal gair	ns											
	101.	. = =											/

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[Jan]					or '		Specific or Tab		Acces facto Table 6	r			
North East West			1.30 5.90 2.90	000 000			0.6300 0.6300 0.6300	0	.7000 .7000 .7000	0.770 0.770 0.770	0	4.2246 35.4137 17.4067	(76)
Solar gains Total gains	57.0450 538.6055	111.4014 603.9152	183.8852 656.5922	270.2134 727.4934	333.8352 769.1665	343.1305 760.9506	326.0891 728.8653	278.1591 681.6522	214.4050 629.5047	132.2177 563.4086	71.0725 527.0054	46.9588 519.0132	
7. Mean inter													
Temperature d Utilisation f	luring heatin	ng periods	in the livi	ng area fro	m Table 9, T							21.0000	(85)
tau	Jan 23.2747	Feb 23.3245	Mar 23.3735	Apr 23.6065	May 23.6506	Jun 23.8581	Jul 23.8581	Aug 23.8969	Sep 23.7777	Oct 23.6506	Nov 23.5615	Dec 23.4691	
alpha util living a	2.5516 rea 0.9402	2.5550 0.9192	2.5582 0.8849	2.5738 0.8130	2.5767 0.7066	2.5905 0.5637	2.5905 0.4372	2.5931 0.4778	2.5852 0.6684	2.5767 0.8416	2.5708 0.9169	2.5646 0.9450	(86)
MIT	18.4964	18.7910	19.2567	19.8857	20.4123	20.7717	20.9142	20.8897	20.6242	19.9442	19.1304	18.4500	
Th 2 util rest of	19.9252	19.9273	19.9293	19.9387	19.9404	19.9487	19.9487	19.9502	19.9455	19.9404	19.9369	19.9332	
MIT 2	0.9316 17.0258	0.9078 17.3961	0.8682 17.9791	0.7850 18.7549	0.6611 19.3753	0.4938 19.7702	0.3455 19.9007	0.3854 19.8845	0.6038 19.6275	0.8117 18.8442	0.9033 17.8352	0.9371 16.9720	(90)
Living area f	17.7416	18.0750	18.6009	19.3053	19.8800	20.2576	20.3940	20.3738	fLA = 20.1126	Living area 19.3796	/ (4) = 18.4656	0.4867	
Temperature a adjusted MIT		18.0750	18.6009	19.3053	19.8800	20.2576	20.3940	20.3738	20.1126	19.3796	18.4656	0.0000 17.6914	(93)
8. Space heat		ment											
Utilisation Useful gains Ext temp.	Jan 0.9085 489.2971 4.3000	Feb 0.8826 532.9863 4.9000	Mar 0.8427 553.3209 6.5000	Apr 0.7659 557.1865 8.9000	May 0.6583 506.3493 11.7000	Jun 0.5154 392.1841 14.6000	Jul 0.3857 281.1225 16.6000	Aug 0.4242 289.1810 16.4000	Sep 0.6149 387.0845 14.1000	Oct 0.7931 446.8116 10.6000	Nov 0.8792 463.3223 7.1000	Dec 0.9148 474.7965 4.2000	(95)
Heat loss rat	1087.6629	1063.8157	975.0402	830.1402	651.3898	446.6088	299.4942	313.1775	476.2356	699.1318	908.4823	1082.6478	(97)
		356.7173		196.5267 h/year)	107.9102	0.0000	0.0000	0.0000	0.0000	187.7262	320.5152	452.2414 2380.5804	(98a)
Space heating Space heating	requirement	c cocar p						0.0000	0.0000	0.0000	0.0000	0 0000	(98b)
	requirement kWh 0.0000	0.0000	0.0000 per year (ki	0.0000 Wh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating Solar heating	requirement kWh 0.0000 contribution kWh 445.1842 requirement	0.0000 on - total p	per year (kī 313.7592	Wh/year) 196.5267	107.9102	0.0000	0.0000	0.0000	0.0000	187.7262	320.5152		
Space heating Solar heating Solar heating Space heating Space heating Space heating 9a. Energy re-	requirement kWh 0.0000 contribution kWh 445.1842 requirement per m2	0.0000 on - total p 356.7173 t after sola	ger year (ki 313.7592 ar contribut	Wh/year) 196.5267 tion - tota	107.9102 1 per year (0.0000 kWh/year)	0.0000	0.0000		187.7262	320.5152	0.0000 452.2414 2380.5804 35.1118	(99)
Space heating Solar heating Solar heating Space heating Space heating Space heating Pace heating Fraction of simple fraction of	requirement 0.0000 contribution kWh 445.1842 requirement per m2 quirements	0.0000 on - total p 356.7173 t after sole	313.7592 ar contribut 1 heating stry/supplementstem(s) stem 1 (in the stem 2 (in	196.5267 tion - tota ystems, inctary syste	107.9102 1 per year (0.0000 kWh/year)	0.0000	0.0000		187.7262	320.5152	0.0000 452.2414 2380.5804	(201) (202) (206) (207)
Space heating Solar heating Solar heating Space heating Space heating Space heating 9a. Energy re- Fraction of s Fraction of s Efficiency of Efficiency of	requirement 0.0000 contribution (kWh 445.1842 requirement per m2 quirements	0.0000 on - total p 356.7173 t after sola - Individual	313.7592 ar contribut 1 heating stry/supplementstem(s) stem 1 (in the stem 2 (in	196.5267 tion - tota ystems, inctary syste	107.9102 1 per year (0.0000 kWh/year)	0.0000	0.0000		187.7262	320.5152	0.0000 452.2414 2380.5804 35.1118 0.0000 1.0000 92.3000 0.0000	(201) (202) (206) (207)
Space heating Solar heating Solar heating Space heating Space heating Space heating Pace heating Space heating Fraction of simple from the service of sefficiency of sefficiency of sefficiency of space heating	requirement 0.0000 (contribution kWh 445.1842 requirement per m2 requirements requirements requirements requirements requirements requirement yeace heat fine pace heat fine pace heat fine pace is main space secondary/s Jan requirement 445.1842	0.0000 on - total p 356.7173 t after sola - Individua:	313.7592 ar contribut 1 heating sy ry/supplementstem (s) stem 1 (in stem 2 (in stem 3 (in stem 2 (in stem 3	196.5267 196.5267 tion - tota 	107.9102 l per year (luding micro	0.0000 kWh/year) 	0.0000	0.0000	0.0000	187.7262 (98c)	320.5152	0.0000 452.2414 2380.5804 35.1118 0.0000 1.0000 92.3000 0.0000 Dec	(201) (202) (206) (207) (208)
Space heating Solar heating Solar heating Space heating Space heating Space heating Pace heating Space heating Fraction of simple fraction of simp	requirement 0.0000 contribution (kWh 445.1842 requirement (per m2) pace heat fi pace is secondary/: Jan requirement 445.1842 refficiency 92.3000 fuel (main	0.0000 on - total p 356.7173 t after sola - Individual	313.7592 ar contribut 1 heating sy ry/supplement stem (s) stem 1 (in stem 2	196.5267 tion - tota 196.5267 tion - tota ystems, inc ntary syste %) %) system, % Apr 196.5267 1) 92.3000	107.9102 1 per year (10ding micro m (Table 11) May 107.9102 92.3000	0.0000 kWh/year) CHP 	Jul 0.0000 0.0000	0.0000 Aug 0.0000 0.0000	0.0000 Sep 0.0000 0.0000	187.7262 (98c) Oct 187.7262 92.3000	320.5152 / (4) = Nov 320.5152 92.3000	0.0000 452.2414 2380.5804 35.1118 0.0000 1.0000 92.3000 0.0000 Dec 452.2414 92.3000	(99) (201) (202) (206) (207) (208) (98)
Space heating Solar heating Solar heating Space heating Space heating Space heating Pa. Energy re Fraction of s; Efficiency of Efficiency of Efficiency of Space heating Space heating	requirement 0.0000 (contribution kWh 445.1842 requirement per m2 quirements	0.0000 on - total p 356.7173 t after sola - Individual	313.7592 ar contribut 1 heating sistem(s) stem 1 (in stem 2 (in stem 2 (in stem 3 (in s	196.5267 tion - tota ystems, inc ntary syste %) %) system, % Apr 196.5267 1) 92.3000 212.9217 2)	107.9102 1 per year (100.0000000000000000000000000000000000	0.0000 kWh/year) CHP Jun 0.0000 0.0000	Jul 0.0000 0.0000 0.0000	Aug 0.0000 0.0000 0.0000	Sep 0.0000 0.0000 0.0000	187.7262 (98c) Oct 187.7262 92.3000 203.3870	320.5152 / (4) = Nov 320.5152 92.3000 347.2538	0.0000 452.2414 2380.5804 35.1118 0.0000 1.0000 92.3000 0.0000 Dec 452.2414 92.3000 489.9690	(99) (201) (202) (206) (207) (208) (98) (210) (211)
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Space heating Solar heating Solar heating Solar heating Space heating Space heating Space heating Space heating Pa. Energy re- Fraction of s. Fraction of s. Efficiency of Efficiency of Efficiency of Efficiency of Efficiency of Space heating Efficiency of (217)m Fuel for wate Space cooling (221)m Pumps and Fa Lighting Electricity g. (233a)m Electricity g. (235a)m Electricity g. (235a)m Electricity g. (235a)m Electricity g. (233b)m Electricity g. Electric	requirement (kWh 0.0000 (contribution (kWh 445.1842 requirement (per m2) (contribution (per	0.0000 on - total p 356.7173 t after sold 356.7173 t after sold control p 10.000 heating sy, supplemental 22.3000 heating sy, 386.4760 (main heat: 92.3000 heating sy, 0.0000 heating sy, 386.4760 (main heat: 92.3000 heating sy, 10.0000 hydro-electicity 0.0000 PVs (Appendiction of the sy, 10.0000 hydro-electicity 0.0000 hydro-electicity	313.7592 ar contribut 313.7592 ar contribut 1 heating sy	## 196.5267 tion - tota 196.5267 tion - tota ystems, inc tary syste ## 196.5267 1) 92.3000 212.9217 2) 0.0000 0.0000 181.0858 84.2437 214.9548 0.0000 7.0685 511.2794 ative quant -98.7932 ix M) (nega 0.0000 tors (Appen 0.0000 cors (Appen 0.0000 py micro-CH 0.0000 py micro-CH 0.0000 politive quant -270.8544 ix M) (nega	107.9102 1 per year (luding micro- m (Table 11) May 107.9102 92.3000 116.9124 0.0000 0.0000 175.8678 82.9988 211.8920 0.0000 7.3041 8.7125 ity) -101.1507 tive quantit 0.0000 dix M) (nega 0.0000 p (Appendix 0.0000 ity) -352.3869	0.0000 kWh/year) Jun 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 158.8426 79.8000 199.0509 0.0000 7.0685 7.1182 -92.6137 y) 0.0000 tive quant 0.0000 N) (negati 0.0000 n) (negati 0.0000 -351.9734 y)	Jul 0.0000 0.0000 0.0000 0.0000 0.0000 157.0927 79.8000 196.8580 0.0000 7.3041 7.9478 -91.4955 0.0000 ity) 0.0000 ve if net ge 0.0000 -347.7731	Aug 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 163.1575 79.8000 204.4581 0.0000 7.3041 10.3309 -88.9346 0.0000 0.0000 eneration) 0.00000 -296.9682	Sep 0.0000 0.0000 0.0000 0.0000 0.0000 164.7453 79.8000 206.4477 0.0000 7.0685 13.4188 -83.7428 0.0000 0.0000 0.0000 -221.1257	0ct 187.7262 92.3000 203.3870 0.0000 0.0000 183.2507 84.1140 217.8600 0.0000 7.3041 17.6062 -76.4341 0.0000 0.0000 0.0000 -133.6562	Nov 320.5152 / (4) = Nov 320.5152 92.3000 347.2538 0.0000 0.0000 194.2791 85.1747 228.0948 0.0000 7.0685 19.8862 -56.4469 0.0000 0.0000 0.0000 -61.1425	0.0000 452.2414 2380.5804 35.1118 0.0000 1.0000 92.3000 0.0000 Dec 452.2414 92.3000 489.9690 0.0000 0.0000 216.0887 79.8000 85.6758 252.2167 0.0000 7.3041 21.9061 -46.3270 0.0000 0.0000 0.0000	(201) (202) (202) (206) (207) (208) (210) (211) (212) (213) (215) (215) (221) (232) (233a (234a (235a (235c (233b)
Space heating Solar heating Solar heating Solar heating Space heating Space heating Space heating Pa. Energy re Fraction of si Fraction of si Fraction of si Friction of si Fraction of si	requirement (kWh 0.0000 (contribution (kWh 445.1842 requirement (per m2 definition Jan requirement 445.1842 (efficiency 92.3000 (fuel (main 482.3231 efficiency 92.3000 (fuel (main 218.3927 (afficiency 218.3927 (affici	0.0000 on - total y 356.7173 t after sold 356.7173 t after sold command system command system teating system teating system 356.7173 (main heat: 92.3000 heating system 0.0000 heating system 0.0000 heating system 0.0000 teating system 0.0000 heating system 0.0000 heating system 0.0000 teating system 0.0000 heating system 0.0000 hydro-elect 0.0000	313.7592 ar contribut 313.7592 ar contribut 1 heating system: system (s) stem 1 (in system) stem 2 (in system) 339.9341 ing system: 0.0000 stem) 205.3624 85.0073 241.5821 0.0000 7.3041 15.3954 dix M) (negging system) 0.0000 cric generated to 0.0000 generated 1 0.0000 generated 2 0.0000 generated 3 0.0000 generated 4 0.0000 generated 4 0.0000 generated 5 0.0000 generated 6 0.0000 generated 1 0.0000 generated 1 0.0000 generated 1 0.0000 generated 1 0.0000 generated 2 0.0000 generated 3 0.0000 generated 4 0.0000 generated 6 0.0000 generated 6 0.0000	## 196.5267 tion - tota 196.5267 tion - tota ystems, inc ttary syste ## 196.5267 1) 92.3000 212.9217 2) 0.0000 0.0000 181.0858 84.2437 214.9548 0.0000 7.0685 11.2794 ative quant -98.7932 ix M) (nega 0.0000 tors (Appen 0.0000 ymicro-CH 0.0000 ymicro-CH 0.0000 op micro-CH 0.0000 ative quant -270.8544 ix M) (nega 0.0000 ative quant -270.8544 ix M) (nega 0.0000	107.9102 1 per year (107.9102 1 per year (107.9102 107.	0.0000 kWh/year) Jun 0.0000 0.0000 0.0000 0.0000 0.0000 158.8426 79.8000 199.0509 0.0000 7.0685 7.1182 -92.6137 y) 0.0000 tive quant 0.0000 N) (negati 0.0000 -351.9734 y) 0.0000	Jul 0.0000 0.0000 0.0000 0.0000 0.0000 157.0927 79.8000 196.8580 0.0000 7.3041 7.9478 -91.4955 0.0000 ity) 0.0000 ve if net gr 0.0000 -347.7731 0.0000	Aug 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 163.1575 79.8000 204.4581 0.0000 7.3041 10.3309 -88.9346 0.0000 0.0000 eneration) 0.0000	Sep 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 164.7453 79.8000 206.4477 0.0000 7.0685 13.4188 -83.7428 0.0000 0.0000	0ct 187.7262 92.3000 203.3870 0.0000 0.0000 183.2507 84.1140 217.8600 0.0000 7.3041 17.6062 -76.4341 0.0000 0.0000	320.5152 / (4) = Nov 320.5152 92.3000 347.2538 0.0000 0.0000 194.2791 85.1747 228.0948 0.0000 7.0685 19.8862 -56.4469 0.0000 0.0000 0.0000	0.0000 452.2414 2380.5804 35.1118 0.0000 1.0000 0.0000 0.0000 0.0000 452.2414 92.3000 489.9690 0.0000 0.0000 0.0000 216.0887 79.8000 85.6758 252.2167 0.0000 7.3041 21.9061 -46.3270 0.0000 0.0000	(99) (201) (202) (206) (207) (208) (98) (210) (211) (212) (213) (215) (64) (221) (221) (233) (233a (235a (233b (233b (234b)

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(235d)m 0.00 Annual totals kWh/yea Space heating fuel -	r main system 1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 2579.1770	(211)
Space heating fuel - Space heating fuel - Efficiency of water h	secondary										0.0000 0.0000 79.8000	
Water heating fuel us Space cooling fuel											2654.6147	
Electricity for pumps Total electricity for Electricity for light	the above, kWh/		L)								86.0000 172.0137	
Energy saving/generat PV generation Wind generation Hydro-electric genera Electricity generated Appendix Q - special	tion (Appendix N - Micro CHP (Ap	I)	s M ,N and	Q)							-3351.1849 0.0000 0.0000 0.0000	(234) (235a)
Energy saved or gener Energy used Total delivered energ	ated										-0.0000 0.0000 2140.6206	(237)
12a. Carbon dioxide e												
							Energy		on factor		Emissions	
Space heating - main	system 1						kWh/year 2579.1770	k	g CO2/kWh 0.2100	k	g CO2/year 541.6272	(261)
Total CO2 associated	with community s	ystems									0.0000	(373)
Water heating (other Space and water heati							2654.6147		0.2100		557.4691 1099.0963	
Pumps, fans and elect							86.0000		0.1387		11.9293	(267)
Energy for lighting							172.0137		0.1443		24.8269	(268)
Energy saving/genera		:S					-952.5976		0.1360		-129.5625	
PV Unit electricity u PV Unit electricity e							-952.5976		0.1266		-303.6063	
Total Total CO2, kg/year											-433.1687 702.6837	
EPC Target Carbon Dic	xide Emission Ra	te (TER)									10.3600	
13a. Primary energy -												
							Energy Pr	imary ener		Prim	ary energy	
Space heating - main	system 1						kWh/year 2579.1770	k	g CO2/kWh 1.1300		kWh/year 2914.4701	(275)
Total CO2 associated	with community s	ystems									0.0000	(473)
Water heating (other Space and water heati							2654.6147		1.1300		2999.7146 5914.1846	
Pumps, fans and elect Energy for lighting	ric keep-hot						86.0000 172.0137		1.5128 1.5338		130.1008 263.8404	
Energy saving/genera		s										
PV Unit electricity u PV Unit electricity e							-952.5976 -2398.5873		1.5027		-1431.5121 -1114.5169	
Total									0.101/		-2546.0290	
Total Primary energy Target Primary Energy											3762.0968 55.4900	
3 1	- , ,											

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Property Reference Assessment Refe			pe B					Prop Type Ref		ssued on D		19/01/2024	
Property		Тур	pe A - Semi, A	A, Clacton, -									
SAP Rating					94 A		DER	-0.21		TER		9.96	
Environmental					100 A		% DER < TER					102.11	
CO ₂ Emissions (t/					-0.1		DFEE	41.60		TFE	E	45.06	
Compliance Chec	k				See BREL		% DFEE < TFE	E				7.68	
% DPER < TPER					63.80		DPER	19.36	i	TPE	R	53.48	
Assessor Details		Mr. Jona	than Lewis							Asse	essor ID	AZ32-000)1
SAP 10 WORKSHEET													
1. Overall dwell	Ling chara	cteristics											
Ground floor Total floor area Dwelling volume	a TFA = (1	a)+(1b)+(1c)+(1d)+(1e	e)(1n)	8	2.0000			Store 1b) x)+(3b)+(3c)-		(2b) =	Volume (m3) 205.0000 205.0000	(1b) - (3b (4) (5)
2. Ventilation n													
Number of open of Number of open f Number of chimme Number of flues Number of flues Number of block Number of intern Number of passif Number of fluele	flues eys / flues attached attached ed chimneys mittent ex ye vents	to solid fu to other he s tract fans	el boiler	fire							0 * 80 = 0 * 20 = 0 * 10 = 0 * 35 = 0 * 20 = 0 * 10 = 0 * 10 = 0 * 10 = 0 * 40 = 0 *	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(6b) (6c) (6d) (6e) (6f) (7a) (7b)
Infiltration due	to chimn	evs. flues	and fans	= (6a) + (6b)	ı + (6c) + (6d) + (6e)+(6f)+	(6g) + (7a) + (7	7b) + (7c) =		0 0000	Air change: 0 / (5) =		
Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides	ethod AP50			(32,1(32,		, - (,,,,,, -	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					Yes lower Door 3.0000 0.1500	(17)
Shelter factor Infiltration rat	ce adjuste	d to includ	e shelter	factor				(20) = 1 - (2)		x (19)] = x (20) =	0.8500 0.1275	
Wind speed Wind factor Adj infilt rate	Jan 5.1000 1.2750		Mar 4.9000 1.2250		May 4.3000 1.0750	Jun 3.8000 0.9500	Jul 3.8000 0.9500	Aug 3.7000 0.9250	Sep 4.0000 1.0000	Oct 4.3000 1.0750		Dec 4.7000 1.1750	
Effective ac	0.1626 0.5132	0.1594 0.5127	0.1562 0.5122		0.1371 0.5094	0.1211 0.5073	0.1211 0.5073		0.1275 0.5081	0.1371 0.5094		0.1498 0.5112	
3. Heat losses a	and heat le	oss paramet	er										
Element				Gross m2	Openings m2		:Area m2	U-value W/m2K	A x U W/I	ζ	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1. Solid Door Heatloss Floor 1 External Wall 1 External Roof 1 Total net area of Fabric heat loss	L of externa	l elements um (A x U)	Aum(A, m2)	96.5000 82.0000	18.1000	2. 82. 78. 82.	1000 0000 4000 0000 5000	1.1450 1.2000 0.1300 0.1700 0.1200 30) + (32) =	18.320 2.520 10.660 13.328 9.840)))			(27) (26) (28a) (29a) (30) (31) (33)
E3 Sill E4 Jamb E5 Grour E10 Eave E16 Corr E17 Corr	Bridges ent c lintels nd floor (es (insula ner (norma ner (inver	(including normal) tion at cei 1) ted - inter tween dwell	other stee ling level nal area q ings	el lintels)	external are	a)		12. 12. 29. 34. 34. 12.		si-value 0.0280 0.0390 0.0100 0.0500 0.0780 0.0430 0.0000 0.0340	Tot. 0.33 0.46 0.29 1.70 2.65 0.53 0.00 0.00	60 80 00 00 20 75	

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21.0000 (85)

Point Thermal h									,	33) + (36)	(36a) =	0.0000 60.6521	
Ventilation hea	at loss cal												(37)
(38) m	Jan 34.7189	Feb 34.6842	Mar 34.6501	Apr 34.4903	May 34.4604	Jun 34.3213	Jul 34.3213	Aug 34.2955	Sep 34.3749	Oct 34.4604	Nov 34.5209	Dec 34.5842	(38)
Heat transfer of Average = Sum(3	95.3710	95.3363	95.3023	95.1425	95.1126	94.9734	94.9734	94.9476	95.0270	95.1126	95.1730	95.2363 95.1423	
HLP	Jan 1.1631	Feb 1.1626	Mar 1.1622	Apr 1.1603	May 1.1599	Jun 1.1582	Jul 1.1582	Aug 1.1579	Sep 1.1589	Oct 1.1599	Nov 1.1606	Dec 1.1614	(40)
HLP (average) Days in mont	31	28	31	30	31	30	31	31	30	31	30	1.1603	(40)
4. Water heating	ng energy i	requirement	s (kWh/year)									
Assumed occupar	ncy											2.4997	(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			73.5304	70.5898	68.3879	65.9463	64.6275	66.2112	67.9356	70.5481	73.5493	76.0000	
Average daily h	40.2296 not water i	38.7667 use (litres	37.3038 /day)	35.8409	34.3780	32.9151	32.9151	34.3780	35.8409	37.3038	38.7667	40.2296 107.2753	
Daily hot water	Jan r use	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte Energy content	116.4874 184.4875	113.8919 162.1806	110.8342 170.3480	106.4307 145.6983	102.7659 138.3427	98.8615 121.5617	97.5426 117.9694	100.5892 124.5505	103.7765 127.9668	107.8519 146.3540 Total = S	112.3160 160.0147 um(45)m =	116.2296 181.9874 1781.4615	
Distribution lo	27.6731	= 0.15 x (24.3271		21.8547	20.7514	18.2343	17.6954	18.6826	19.1950	21.9531	24.0022	27.2981	(46)
Water storage : Store volume a) If manufact		arod loss f	actor is kn	own /kWh/d	lasz) •							170.0000	
Temperature : Enter (49) or	factor from (54) in (55	n Table 2b	actor is kii	OWII (KWII/O	ay):							0.7800	(49)
Total storage : If cylinder cor	38.6880	34.9440	38.6880	37.4400	38.6880	37.4400	38.6880	38.6880	37.4400	38.6880	37.4400	38.6880	(56)
Primary loss	38.6880 54.8576	34.9440 49.5488	38.6880 54.8576	37.4400 53.0880	38.6880 54.8576	37.4400 22.5120	38.6880 23.2624	38.6880 23.2624	37.4400 22.5120	38.6880 54.8576	37.4400 53.0880	38.6880 54.8576	
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	
WWHRS	278.0331 0.0000	246.6734 0.0000	0.0000	236.2263 0.0000	231.8883	181.5137 0.0000	179.9198 0.0000	186.5009 0.0000	187.9188 0.0000	239.8996	250.5427 0.0000	275.5330 0.0000	(63a)
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 0.0000	(63c)
FGHRS Output from w/h	0.0000 n 278.0331	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 250.5427	0.0000 275.5330	
12Total per yea	ar (kWh/yea		203.0330	230.2203	231.0003	101.3137	173.3130			h/year) = S		2758.5431	
Electric shower	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 /year) = Su	0.0000 m(64a)m =	0.0000	
Heat gains from			month 131.4772		120.8354	88.3809	88.7851	90.9734	90.5106	_	125.6273	135.3473	
5. Internal gas	ins (see Ta	able 5 and											
Metabolic gains (66)m	Jan	Feb	Mar 124 9857	Apr	May	Jun 124 9857	Jul 124 9857	Aug	Sep	Oct 124.9857	Nov 124 9857	Dec 124 9857	(66)
Lighting gains	(calculate	ed in Appen	dix L, equa	tion L9 or		see Table 5		113.8740	117.6698	113.8740	117.6698	113.8740	
Appliances gair	ns (calcula	ated in App	endix L, eq	uation L13		lso see Tab	le 5	164.9365	170.7828	183.2286		213.7052	
Cooking gains Pumps, fans	(calculated 35.4986	d in Append 35.4986	ix L, equat 35.4986	ion L15 or 35.4986	L15a), also 35.4986	see Table 35.4986	5 35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	(69)
Losses e.g. eva	aporation	(negative v	alues) (Tab	le 5)						0.0000	0.0000	0.0000	
Water heating o	gains (Tab:	Le 5)			-99.9886			-99.9886		-99.9886	-99.9886		
Total internal	gains				162.4132					165.9935 523.5919		181.9184 569.9933	
	300.9731	333.2324	371.1290	333.0340	320.0030	470.0377	400.9011	401.3023	474.0374	323.3919	331.3072	309.9933	(73)
6. Solar gains													
[Jan]			A	rea m2	Solar flux Table 6a	Speci	g fic data	Specific	FF data	Acce fact Table	ss or	Gains W	
 North												9.4241	(74)
East South			3.6	000 000	19.6403 46.7521		0.6300	0	.7000 .7000	0.77 0.77 0.77 0.77	00 00	21.6084	(76)
West			8.8	000	19.6403		0.6300	0	.7000	0.77	00	52.8204	
Solar gains Total gains													
7. Mean interna													

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Temperature during heating periods in the living area from Table 9, Th1 (C) Utilisation factor for gains for living area, ni1,m (see Table 9a)



	Jan 23.8833	Feb 23.8920	Mar 23.9006	Apr 23.9407	May 23.9482	Jun 23.9833	Jul 23.9833	Aug 23.9898	Sep 23.9698	Oct 23.9482	Nov 23.9330	Dec 23.9171	
tau alpha	2.5922	2.5928	2.5934	2.5960	2.5965	2.5989	2.5989	2.5993	2.5980	2.5965	2.5955	2.5945	
util living a	0.9348	0.9083	0.8644	0.7785	0.6584	0.5250	0.4027	0.4460	0.6412	0.8188	0.9081	0.9407	(86)
Living Non living	20.0505 18.8060	20.1306 18.9062	20.2520 19.0572	20.4039 19.2428	20.5259 19.3841	20.5991 19.4635	20.6293 19.4906	20.6236 19.4869	20.5630 19.4295	20.4066 19.2513	20.2025	20.0327 18.7848	
24 / 16 24 / 9	0 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	
16 / 9 MIT	28 20.5143	0 20.1306	0 20.2520	0 20.4039	0 20.5259	0 20.5991	0 20.6293	0 20.6236	20.5630	20.4066	0 20.2025	10 20.1680	
Th 2 util rest of	19.9497	19.9500	19.9503	19.9519	19.9522	19.9536	19.9536	19.9538	19.9530	19.9522	19.9516	19.9510	
MIT 2	0.9257 19.4937	0.8959 18.9062	0.8458 19.0572	0.7482 19.2428	0.6116 19.3841	0.4571 19.4635	0.3165 19.4906	0.3577 19.4869	0.5763 19.4295	0.7866 19.2513	0.8935 18.9999	0.9324 18.9950	
Living area f	raction 19.8795	19.3691	19.5089	19.6818	19.8157	19.8928	19.9211	19.9166		Living area		0.3780 19.4384	(91)
Temperature a		19.3691	19.5089	19.6818	19.8157	19.8928	19.9211	19.9166	19.8580	19.6881	19.4545	0.0000 19.4384	
8. Space heat													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation Useful gains	0.9250 624.2510	0.8880 686.6895	0.8370 721.8392	0.7396 721.9132	0.6050 634.1021	0.4528 457.9659	0.3137 303.6717	0.3544 317.2961	0.5699 462.8009	0.7775 571.7865	0.8855 591.4024	0.9278 600.9033	
Ext temp. Heat loss rat		4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Space heating	1485.8371 kWh		1239.7781		771.9096	502.6742	315.4156	333.8967	547.1655			1451.2498	(97)
Space heating		465.5219 - total p	385.3466 er year (kW	218.8009 h/year)	102.5287	0.0000	0.0000	0.0000	0.0000	217.6954	420.7790	632.6578 3084.3503	(98a)
Solar 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	(98b)
Solar heating Space heating	kWh											0.0000	
Space heating	requirement			218.8009 tion - total		0.0000 (kWh/year)	0.0000	0.0000	0.0000	217.6954	420.7790	632.6578 3084.3503	
Space heating	per m2									(98c)	/ (4) =	37.6140	(99)
9a. Energy re	quirements -	- Individua	l heating s	ystems, incl	uding micr	co-CHP							
Fraction of s	pace heat fi	rom seconda:	ry/suppleme									0.0000	
Fraction of s	main space	heating sy	stem 1 (in									1.0000	(206)
Efficiency of Efficiency of												0.0000	
Conne hosting	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating	641.0200	465.5219	385.3466		102.5287	0.0000	0.0000	0.0000	0.0000	217.6954	420.7790	632.6578	(98)
Space heating	263.4972	263.4972	263.4972		263.4972	0.0000	0.0000	0.0000	0.0000	263.4972	263.4972	263.4972	(210)
Space heating	243.2739	176.6705	146.2431	83.0373	38.9107	0.0000	0.0000	0.0000	0.0000	82.6177	159.6901	240.1004	(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	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												
Efficiency of	278.0331	246.6734	263.8936	236.2263	231.8883	181.5137	179.9198	186.5009	187.9188	239.8996	250.5427	275.5330 163.6200	
(217)m Fuel for wate	163.6200	163.6200	163.6200	163.6200	163.6200	163.6200	163.6200	163.6200	163.6200	163.6200	163.6200	163.6200	(217)
Space cooling			161.2845	144.3749	141.7237	110.9361	109.9620	113.9842	114.8507	146.6200	153.1247	168.3981	(219)
(221)m Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting Electricity g						7.3529	8.2099	10.6715	13.8613	18.1867	20.5419	22.6284	
(233a)m Electricity g	enerated by	wind turbi	nes (Append		ive quanti	ty)					-73.3721		
(234a)m Electricity g								0.0000	0.0000	0.0000	0.0000		(234a)
(235a)m Electricity u									0.0000	0.0000	0.0000		(235a)
(235c)m Electricity g							0.0000	0.0000	0.0000	0.0000	0.0000		(235c)
(233b)m Electricity g	enerated by	wind turbi	nes (Append		ive quanti	ty)					-42.5768	-23.4157	
(234b)m Electricity g							0.0000 city) 0.0000	0.0000	0.0000	0.0000	0.0000		(234b)
(235b)m Electricity u (235d)m	0.0000 sed or net e 0.0000	0.0000 electricity 0.0000	0.0000 generated 0.0000		0.0000 (Appendix 0.0000			eneration)	0.0000	0.0000	0.0000		(235b) (235d)
Annual totals Space heating	kWh/year		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1170.5437	
Space heating Space heating Space heating	fuel - mair	n system 2										0.0000	(213)
Efficiency of Water heating	water heate											163.6200 1685.9450	
Space cooling												0.0000	
Electricity for Total electricity			h/vear									0.0000	(231)
Electricity f				ix L)								177.6856	
Energy saving PV generation		technologi	es (Appendi	ces M ,N and	l Q)							-3622.7372	(233)
Wind generation Hydro-electri	on	n (Appendix	N)									0.0000	
	_	-											

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Electricity gene			ppendix N)									0.0000	(235)	
Appendix Q - spe Energy saved or Energy used		ures										-0.0000		
Total delivered	energy fo	r all uses										-588.5629		
12a. Carbon diox	xide emiss	ions - Indi	vidual heati	ing systems	including	micro-CHP								
								Energy kWh/year		n factor CO2/kWh		Emissions kg CO2/year		
Space heating - Total CO2 associ			systems					1170.5437		0.1553		181.7922	(261)	
Water heating (of Space and water	other fuel							1685.9450		0.1416		238.6564 420.4486	(264)	
Pumps, fans and Energy for light	electric :	keep-hot						0.0000 177.6856		0.0000		0.0000 25.6455	(267)	
Energy saving/	generation	technologi	es											
PV Unit electric PV Unit electric								-1390.7503 -2231.9869		0.1354 0.1233		-188.3349 -275.2496		
Total CO2, kg/ye												-463.5845 -17.4903	(272)	
EPC Dwelling Car	rbon Dioxi	de Emission	Rate (DER)									-0.2100	(273)	
13a. Primary end	ergy - Ind	ividual hea	ting systems	including	micro-CHP									
									Primary energ			mary energy kWh/year		
Space heating - Total CO2 associ			systems					1170.5437		1.5750		1843.5526 0.0000	(473)	
Water heating (o Space and water	heating							1685.9450		1.5235		2568.4921 4412.0447	(279)	
Pumps, fans and Energy for light		keep-hot						0.0000 177.6856		0.0000 1.5338		0.0000 272.5402		
Energy saving/o								-1390.7503		1.5006		-2086.9039		
PV Unit electric								-2231.9869		0.4525		-1010.0344 -3096.9384		
Total Primary er Dwelling Primary												1587.6465 19.3600	(286)	
-	. 3.													
SAP 10 WORKSHEET	T FOR New 1	Build (As D												
CALCULATION OF														
1. Overall dwell														
								Area (m2)		y height (m)		Volume (m3)		
Ground floor Total floor area		a) + (1b) + (1c)+(1d)+(1e).	(1n)		82.0000			(1b) x	2.5000		205.0000	(4)	(3b)
Dwelling volume								(3	3a)+(3b)+(3c)+	(3d) + (3e))(3n) =	205.0000	(5)	
2. Ventilation	 rate													
											r	m3 per hour		
Number of open											0 * 80 = 0 * 20 =	0.0000		
Number of open in Number of chimne Number of flues	eys / flue:			ire							0 * 10 = 0 * 20 =	0.0000 0.0000 0.0000	(6c)	
Number of flues Number of blocke	attached	to other he									0 * 35 = 0 * 20 =	0.0000	(6e)	
Number of interr	mittent ex										3 * 10 = 0 * 10 =	0.0000	(7a)	
Number of passiv		res									0 * 40 =	0.0000		
Infiltration due	e to chimn	eys, flues	and fans =	= (6a)+(6h)	+ (6c) + (6d)	+(6e)+(6f)+(6q)+(7a)+(7	7b)+(7c) =		30.000	Air change 0 / (5) =	es per hour 0.1463		
Pressure test Pressure Test Me				, (55)	. , (/		3. (-7 - ()	/				Yes Blower Door		
Measured/design Infiltration rat	AP50											5.0000 0.3963	(17)	
Number of sides	sheltered											2	(19)	
Shelter factor Infiltration rat	te adjuste	d to includ	e shelter fa	actor					(20) = 1 - (21		x (19)] = x (20) =	0.8500 0.3369		
Wind annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov 4 5000	Dec	(22)	
Wind speed Wind factor Adj infilt rate	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		4.7000 1.1750		
Effective ac	0.4295	0.4211 0.5887	0.4127 0.5852	0.3706 0.5687	0.3622 0.5656	0.3200 0.5512	0.3200 0.5512	0.3116 0.5486		0.3622				
ac	0.0525		0.0002	0.0007	0.0000	J.JJ12	0.0012	0.0400	0.0007	0.5050	0.3710	0.5705	(20)	

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3. Heat losses and heat l												
Element TER Opaque door TER Opening Type (Uw = 1.			Gross m2	Openings m2	Ne 2	tArea m2 .1000	U-value W/m2K 1.0000 1.1450	A x W 2.10 18.32	/K 00	K-value kJ/m2K	A x K kJ/K	
Heatloss Floor 1 External Wall 1 External Roof 1 Total net area of externa Fabric heat loss, W/K = S	al elements		96.5000 82.0000	18.1000	78 82	.0000 .4000 .0000 .5000 (26)(0.1300 0.1800 0.1100 30) + (32)	10.66 14.11 9.02 = 54.21	20 00			(28a) (29a) (30) (31) (33)
Thermal mass parameter (1	TMP = Cm /	TFA) in kJ/	m2K								100.0000	(35)
List of Thermal Bridges K1 Element E2 Other lintels E3 Sill E4 Jamb E5 Ground floor E10 Eaves (insula E16 Corner (norm E17 Corner (inven E18 Party wall be Thermal bridges (Sum (L x	(normal) ation at ce al) rted - inte	eiling level ernal area ga lings) reater than		cea)		12 12 29 34 34 12 2	ength .0000 .0000 .0000 .0000 .0000 .5000 .5000	Psi-value 0.0500 0.0500 0.0500 0.1600 0.0600 0.0900 -0.0900 0.0600	Tot 0.60 0.60 1.45 5.44 2.04 1.12 -0.22 0.00	00 00 00 00 00 50 50 50 00	(36)
Point Thermal bridges Total fabric heat loss								(33) + (36)	(36a) = + (36a) =	0.0000 65.2426	(37)
Ventilation heat loss cal	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m 40.0657 Heat transfer coeff	39.8234 105.0660	39.5859 104.8285	38.4702 103.7128	38.2614 103.5040	37.2897 102.5323	37.2897 102.5323	37.1097 102.3523	37.6640 102.9066	38.2614 103.5040	38.6837 103.9263	39.1252 104.3678	
Average = Sum(39)m / 12 =	=										103.7118	(,
HLP 1.2842 HLP (average)	Feb 1.2813	Mar 1.2784	Apr 1.2648	May 1.2622	Jun 1.2504	Jul 1.2504	Aug 1.2482	Sep 1.2550	Oct 1.2622	Nov 1.2674	Dec 1.2728 1.2648	
Days in mont 31	28	31	30	31	30	31	31	30	31	30	31	
4. Water heating energy	requirement	s (kWh/year)									
Assumed occupancy Hot water usage for mixer											2.4997	
0.0000 Hot water usage for baths 76.2578	0.0000 5 75.1253	0.0000 73.5304	0.0000 70.5898	0.0000 68.3879	0.0000	0.0000 64.6275	0.0000	0.0000 67.9356	0.0000 70.5481	0.0000 73.5493	0.0000 76.0000	
Hot water usage for other		37.3038	35.8409	34.3780	32.9151	32.9151	34.3780	35.8409	37.3038	38.7667	40.2296	
Average daily hot water u											107.2753	(43)
Jan Daily hot water use 116.4874	Feb	Mar 110.8342	Apr 106.4307	May 102.7659	Jun 98.8615	Jul 97.5426	Aug 100.5892	Sep 103.7765	Oct 107.8519	Nov 112.3160	Dec 116.2296	(44)
Energy conte 184.4875 Energy content (annual)	162.1806	170.3480	145.6983	138.3427	121.5617	117.9694	124.5505	127.9668	146.3540	160.0147 Sum(45)m =	181.9874	
Distribution loss (46)m 27.6731 Water storage loss:	= 0.15 x (24.3271		21.8547	20.7514	18.2343	17.6954	18.6826	19.1950	21.9531	24.0022	27.2981	(46)
Store volume a) If manufacturer decla Temperature factor from Enter (49) or (54) in (55) Total storage loss	n Table 2b	factor is kn	own (kWh/d	ay):							170.0000 1.5003 0.5400 0.8102	(48) (49)
25.1153 If cylinder contains dedi	22.6848 icated sola	25.1153 ar storage	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
25.1153 Primary loss 23.2624	22.6848 21.0112 0.0000	25.1153 23.2624 0.0000	24.3051 22.5120 0.0000	23.2624	24.3051 22.5120 0.0000	25.1153 23.2624 0.0000	25.1153 23.2624 0.0000	24.3051 22.5120 0.0000	25.1153 23.2624 0.0000	22.5120	25.1153 23.2624 0.0000	(59)
232.8652 WWHRS 0.0000	205.8766	218.7257	192.5154 0.0000	186.7204 0.0000	0.0000	0.0000	0.0000	174.7839 0.0000	194.7317 0.0000	0.0000	230.3651 0.0000	
PV diverter -0.0000 Solar input 0.0000 FGHRS 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000		0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	0.0000	-0.0000 0.0000 0.0000	0.0000	-0.0000 0.0000 0.0000	(63c)
Output from w/h				186.7204			172.9282	174.7839	194.7317		230.3651	(64)
12Total per year (kWh/yea Electric shower(s)		0.0000	0.0000	0.0000	0.0000	0.0000				0.0000	2351	(64)
0.0000 Heat gains from water hea	0.0000 ating, kWh/			0.0000 al Energy us	0.0000 sed by inst						0.0000	
100.0443	88.8818	95.3429	85.8984	84.7011	77.8730	77.9270	80.1152	80.0027	87.3649	90.6586	99.2130	(65)
5. Internal gains (see Ta												
Jan (66)m 124.9857	Feb 124.9857	124.9857		May 124.9857	124.9857		Aug 124.9857	Sep 124.9857	Oct 124.9857	Nov 124.9857	Dec 124.9857	(66)
Lighting gains (calculate 113.8740	ed in Appen 126.0748	ndix L, equa 113.8740	tion L9 or 117.6698	L9a), also s 113.8740	see Table 5 117.6698	113.8740		117.6698	113.8740	117.6698	113.8740	
Appliances gains (calculated 223.5697 Cooking gains (calculated 220.5697 Cooking gains	225.8896	220.0434	207.5975	191.8868	177.1210	167.2565	164.9365	170.7828	183.2286	198.9393	213.7052	(68)
35.4986 Pumps, fans 3.0000	35.4986 3.0000	35.4986 3.0000	35.4986	35.4986 3.0000	35.4986	35.4986 0.0000	35.4986 0.0000	35.4986 0.0000		35.4986 3.0000	35.4986 3.0000	
Losses e.g. evaporation -99.9886	(negative v -99.9886	values) (Tab	le 5)	-99.9886			-99.9886		-99.9886	-99.9886	-99.9886	
Water heating gains (Tabl 134.4681 Total internal gains		128.1490	119.3033	113.8456	108.1569	104.7406	107.6817	111.1148	117.4259	125.9147	133.3508	(72)
	547.7248	525.5622	508.0664	483.1021	463.4434	446.3668	446.9880	460.0631	478.0243	506.0196	524.4257	(73)

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6. Solar gains													
[Jan]			A	rea m2	Solar flux Table 6a W/m2	Speci or	g fic data Table 6b	Specific or Tab	FF data le 6c	Acce fact Table	or	Gains W	
North East South West			2.9 3.6 0.7 8.8	000 000 000 000	10.6334 19.6403 46.7521 19.6403		0.6300 0.6300 0.6300 0.6300	0 0 0	.7000 .7000 .7000 .7000	0.77 0.77 0.77 0.77	00 00	9.4241 21.6084 10.0016 52.8204	(76) (78)
Solar gains Total gains	93.8545 629.2620		291.2487 816.8108		519.3694 1002.4715		506.9743 953.3411	433.7324 880.7204	337.4655 797.5286	211.8709 689.8952	116.2851 622.3047	77.7054 602.1310	
7. Mean inter	nal temperat	ture (heati	ng season)										
Temperature du Utilisation fa	uring heatir	ng periods	in the livi	ng area fro	m Table 9,							21.0000	(85)
tau alpha	Jan 21.6296 2.4420	Feb 21.6795 2.4453	Mar 21.7286 2.4486	Apr 21.9624 2.4642	May 22.0067 2.4671	Jun 22.2152 2.4810	Jul 22.2152 2.4810	Aug 22.2543 2.4836	Sep 22.1344 2.4756	Oct 22.0067 2.4671	Nov 21.9172 2.4611	Dec 21.8245 2.4550	
util living a	rea 0.9462	0.9234	0.8854	0.8083	0.6970	0.5544	0.4312	0.4754	0.6698	0.8476	0.9243	0.9512	(86)
MIT Th 2	18.2358 19.8532	18.5747 19.8555	19.1029 19.8578	19.7974 19.8685	20.3684 19.8705	20.7509 19.8799	20.9036 19.8799	20.8746 19.8816	20.5781 19.8763	19.8230 19.8705	18.9224 19.8665	18.1837 19.8622	
util rest of b	0.9381 16.6590	0.9121 17.0853	0.8681 17.7461	0.7787 18.6012	0.6489 19.2711	0.4812 19.6894	0.3351 19.8279	0.3780 19.8093	0.6021 19.5245	0.8173 18.6550	0.9111 17.5368	0.9438 16.5983	
Living area f: MIT Temperature ad	raction 17.2551	17.6484	18.2590	19.0534	19.6859	20.0907	20.2346	20.2121		Living are		0.3780 17.1977 0.0000	(91)
adjusted MIT		17.6484	18.2590	19.0534	19.6859	20.0907	20.2346	20.2121	19.9228	19.0966	18.0606	17.1977	(93)
8. Space heat:	ing require	 nent											
Utilisation Useful gains		Feb 0.8830 642.5402	Mar 0.8375 684.1109	Apr 0.7539 701.4802	May 0.6403 641.8342	Jun 0.4958 494.1702	Jul 0.3668 349.7144	Aug 0.4083 359.6105	Sep 0.6052 482.6316	0.7919 546.3131	Nov 0.8831 549.5677	Dec 0.9194 553.6054	(95)
Ext temp. Heat loss rate		4.9000	6.5000 1232.6818	8.9000 1053.0365	11.7000 826.5738	14.6000 562.9708	16.6000 372.6626	16.4000 390.1729	14.1000 599.2028	10.6000	7.1000 1139.0952	4.2000	
Space heating Space heating	kWh 587.8260	468.3042	408.1367	253.1205	137.4463	0.0000	0.0000	0.0000	0.0000	247.8391	424.4598	597.3806 3124.5131	
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 Space heating	kWh 587.8260	468.3042	408.1367	253.1205		0.0000	0.0000	0.0000	0.0000	247.8391	424.4598	0.0000 597.3806	(98c)
Space heating Space heating		t after sol	ar contribu.	tion - tota	l per year	(kWh/year)				(98c) / (4) =	3124.5131 38.1038	(99)
9a. Energy red													
Fraction of sp Fraction of sp Efficiency of Efficiency of Efficiency of	pace heat fi main space main space	rom main sy heating sy heating sy	ystem(s) ystem 1 (in ystem 2 (in	%) %)	m (Table 11)						0.0000 1.0000 92.3000 0.0000 0.0000	(202) (206) (207)
_	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating Space heating	587.8260	468.3042	408.1367		137.4463	0.0000	0.0000	0.0000	0.0000	247.8391	424.4598	597.3806	(98)
Space heating	92.3000 fuel (main	92.3000 heating sy	92.3000 /stem)	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	
Space heating	efficiency	(main heat		2)	148.9126	0.0000	0.0000	0.0000	0.0000	268.5147	459.8697	647.2163	
Space heating	0.0000 fuel (main 0.0000	0.0000 heating sy 0.0000		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	
Water heating Water heating	requirement	=											
Efficiency of	232.8652 water heate	205.8766 er	218.7257	192.5154	186.7204	168.3788	166.3471	172.9282	174.7839	194.7317	206.8318	230.3651 79.8000	(216)
(217)m Fuel for water	86.0464 r heating, }	85.8435 «Wh/month	85.4378 256.0057	84.6745 227.3594	83.3832 223.9304	79.8000	79.8000 208.4550	79.8000	79.8000 219.0274	84.6017 230.1747	85.6357 241.5253	86.0976 267.5628	
Space cooling (221)m			0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Pumps and Fa Lighting	7.3041 23.6608	6.5973 18.9816	7.3041 17.0908	7.0685 12.5214	7.3041 9.6719	7.0685 7.9020	7.3041 8.8230	7.3041 11.4685	7.0685 14.8965	7.3041 19.5450	7.0685 22.0760	7.3041 24.3184	(231)
Electricity ge (233a)m Electricity ge	-62.8836	-82.4495	-110.3341	-115.2512	-117.3676		-105.8152	-103.1055	-97.5761	-89.8059	-66.8683	-55.1235	(233a)
(234a)m Electricity ge	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 us	0.0000 sed or net e	0.0000 electricity	0.0000 generated	0.0000 by micro-CH	0.0000 P (Appendix	0.0000 N) (negati	0.0000 ve if net g		0.0000	0.0000	0.0000	0.0000	
(235c)m Electricity ge	0.0000 enerated by	0.0000 PVs (Apper	0.0000 ndix M) (neg	0.0000 ative quant	0.0000 ity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
(233b)m Electricity ge (234b)m	enerated by 0.0000	wind turbi	0.0000	ix M) (nega 0.0000	tive quanti 0.0000	ty) 0.0000	0.0000	0.0000	0.0000	0.0000	-75.3489 0.0000	-45.4806 0.0000	(233b) (234b)
Electricity ge	enerated by	nyaro-elec	uric genera	cors (Appen	uix M) (neg	acive quant	тсЛ)						

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(235b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000				
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative			0.0000 0.0000	
(235d)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Annual totals kWh/year Space heating fuel - main system 1	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000 3385.1713	
Space heating fuel - main system 2 Space heating fuel - secondary			0.0000	(213)
Efficiency of water heater Water heating fuel used			79.8000 2812.1989	
Space cooling fuel			0.0000	
Electricity for pumps and fans: Total electricity for the above, kWh/year			86.0000	(231)
Electricity for lighting (calculated in Appendix L)			190.9560	
Energy saving/generation technologies (Appendices M ,N and Q) PV generation			-4053.0554	(233)
Wind generation Hydro-electric generation (Appendix N)			0.0000	
Electricity generated - Micro CHP (Appendix N) Appendix Q - special features			0.0000	
Energy saved or generated Energy used			-0.0000 0.0000	
Total delivered energy for all uses			2421.2708	
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP				
	Energy	Emission factor	Emissions	
Space heating - main system 1	kWh/year 3385.1713	kg CO2/kWh	kg CO2/year 710.8860	(261)
Total CO2 associated with community systems Water heating (other fuel)	2812.1989	0.2100	0.0000 590.5618	
Space and water heating Pumps, fans and electric keep-hot	86.0000	0.1387	1301.4478 11.9293	
Energy for lighting	190.9560		27.5609	
Energy saving/generation technologies PV Unit electricity used in dwelling	-1113.7663	0.1362	-151.6522	
PV Unit electricity exported	-2939.2891			
	2303.2031	0.1266	-372.2071	
Total Total CO2, kg/year	2303.2031	0.1266	-523.8593 817.0786	(269) (272)
	2333,12032	0.1266	-523.8593	(269) (272)
Total CO2, kg/year		0.1266	-523.8593 817.0786	(269) (272)
Total CO2, kg/year EPC Target Carbon Dioxide Emission Rate (TER)		0.1266	-523.8593 817.0786	(269) (272)
Total CO2, kg/year EPC Target Carbon Dioxide Emission Rate (TER) 13a. Primary energy - Individual heating systems including micro-CHP	Energy	Primary energy factor	-523.8593 817.0786 9.9600 Primary energy	(269) (272) (273)
Total CO2, kg/year EPC Target Carbon Dioxide Emission Rate (TER) 13a. Primary energy - Individual heating systems including micro-CHP Space heating - main system 1	Energy	Primary energy factor kg CO2/kWh	-523.8593 817.0786 9.9600 Primary energy kWh/year 3825.2436	(269) (272) (273)
Total CO2, kg/year EPC Target Carbon Dioxide Emission Rate (TER) 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 kWh/year	Primary energy factor kg CO2/kWh 1.1300	-523.8593 817.0786 9.9600 Primary energy kWh/year 3825.2436 0.0000 3177.7848	(269) (272) (273) (273)
Total CO2, kg/year EPC Target Carbon Dioxide Emission Rate (TER) 13a. Primary energy - Individual heating systems including micro-CHP Space heating - main system 1 Total CO2 associated with community systems	Energy kWh/year 3385.1713	Primary energy factor kg CO2/kWh 1.1300	-523.8593 817.0786 9.9600 Primary energy kWh/year 3825.2436 0.0000	(269) (272) (273) (273) (275) (473) (278) (279)
Total CO2, kg/year EPC Target Carbon Dioxide Emission Rate (TER) 13a. Primary energy - Individual heating systems including micro-CHP Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Space and water heating	Energy kWh/year 3385.1713 2812.1989	Primary energy factor kg CO2/kWh 1.1300 1.1300	-523.8593 817.0786 9.9600 Primary energy kWh/year 3825.2436 0.0000 3177.7848 7003.0284	(269) (272) (273) (273) (275) (473) (278) (279) (281)
Total CO2, kg/year EPC Target Carbon Dioxide Emission Rate (TER) 13a. Primary energy - Individual heating systems including micro-CHP Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Space and water heating Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies	Energy kWh/year 3385.1713 2812.1989 86.0000 190.9560	Primary energy factor kg CO2/kWh 1.1300 1.1300 1.5128 1.5338	-523.8593 817.0786 9.9600 Primary energy kWh/year 3825.2436 0.0000 3177.7848 7003.0284 130.1008 292.8947	(275) (473) (278) (278) (278) (278) (278) (281) (282)
Total CO2, kg/year EPC Target Carbon Dioxide Emission Rate (TER)	Energy kWh/year 3385.1713 2812.1989 86.0000	Primary energy factor kg CO2/kWh 1.1300 1.1300 1.5128 1.5338	-523.8593 817.0786 9.9600 Primary energy kWh/year 3825.2436 0.0000 3177.7848 7003.0284 130.1008 292.8947 -1674.3424 -1366.3512	(269) (272) (273) (273) (275) (473) (278) (279) (281) (282)
Total CO2, kg/year EPC Target Carbon Dioxide Emission Rate (TER) 13a. Primary energy - Individual heating systems including micro-CHP Space heating - main system 1 Total CO2 associated with community systems Water heating (other fuel) Space and water heating Pumps, fans and electric keep-hot Energy for lighting Energy saving/generation technologies EV Unit electricity used in dwelling	Energy kWh/year 3385.1713 2812.1989 86.0000 190.9560	Primary energy factor kg CO2/kWh 1.1300 1.1300 1.5128 1.5338	-523.8593 817.0786 9.9600 Primary energy kWh/year 3825.2436 0.0000 3177.7848 7003.0284 130.1008 292.8947	(269) (272) (273) (273) (273) (473) (279) (281) (282)

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Property Reference Assessment Refe			pe C					Prop Type Ref		Issued on D		19/01/2024	
Property		Тур	pe A - Semi, A,	Clacton, -									
SAP Rating					94 A		DER	-0.09)	TER		8.21	
Environmental					100 A		% DER < TER					101.10	
CO ₂ Emissions (t/					-0.12		DFEE	41.2	1	TFE	E	44.32	
Compliance Chec	k				See BREL		% DFEE < TFE					7.00	
% DPER < TPER					60.07		DPER	17.8	2	TPE	R	44.63	
Assessor Details		Mr. Jona	than Lewis							Ass	essor ID	AZ32-000)1
SAP 10 WORKSHEET						2022)							
1. Overall dwell	Ling charac												
Ground floor Total floor area Dwelling volume)+(1d)+(1e)	(1n)	11	0.5000			Store (1b) x a) + (3b) + (3c)		(2b) =		(1b) - (3b (4)
2. Ventilation													
Number of open of Number of open in Number of chimme Number of flues Number of flues Number of blocke Number of intern Number of passif Number of fluele	flues eys / flues attached attached ed chimneys mittent ex ye vents	to solid fur to other he s tract fans	el boiler	ire							0 * 80 = 0 * 20 = 0 * 10 = 0 * 35 = 0 * 20 = 0 * 10 = 0 * 10 = 0 * 10 = 0 * 10 = 0 * 40 = 0 * 40 = 0 * 40 = 0 * 10 = 0 * 40 = 0 * 10 = 0 * 40 = 0 * 10 = 0 * 40 = 0 * 10 = 0 * 40 = 0 * 10 = 0 * 40 = 0 * 10 = 0 *	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	(6b) (6c) (6d) (6e) (6f) (7a) (7b)
Infiltration due	to chimn	evs. flues	and fans	= (6a)+(6h)	ı + (6c) + (6d) + (6e)+(6f)+	(6a) + (7a) + (°	7h)+(7c) =		0 0000	Air change		
Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides	ethod AP50		and Tanb	(00) (00)	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	00,1 (01,11,	(09) (14)	, . (,		0.000		Yes lower Door 3.0000 0.1500	(17)
Shelter factor Infiltration rat	ie adjuste	d to includ	e shelter f	actor					(20) = 1 - (2)		x (19)] = x (20) =	0.8500 0.1275	
Wind speed Wind factor	Jan 5.1000		Mar 4.9000	Apr 4.4000 1.1000	May 4.3000 1.0750	Jun 3.8000 0.9500		Aug 3.7000	Sep 4.0000 1.0000	Oct 4.3000 1.0750		Dec 4.7000	
Adj infilt rate Effective ac	1.2750 0.1626 0.5132	1.2500 0.1594 0.5127	1.2250 0.1562 0.5122	0.1403 0.5098	0.1371 0.5094	0.1211 0.5073	0.9500 0.1211 0.5073		0.1275 0.5081	0.1371 0.5094	0.1434	1.1750 0.1498 0.5112	(22b)
3. Heat losses a	and heat le	oss paramet	er										
Element Windows (Uw = 1.	20)			Gross m2	Openings m2		:Area m2 .3000	U-value W/m2K 1.1450	A x t W/I 27.824	K	K-value kJ/m2K	A x K kJ/K	
Solid Door Heatloss Floor I External Wall 1 External Roof 1 Total net area of Fabric heat loss	L of externa	l elements . um (A x U)	1	15.0000	26.4000	2. 110. 88. 110.	.1000 .0000 .6000 .0000	1.2000 0.1300 0.1700 0.1200	2.5200 14.3000 15.0620)))			(27) (26) (28a) (29a) (30) (31) (33)
E3 Sill E4 Jamb E5 Grour E10 Eave E16 Corr E17 Corr	Bridges ent r lintels and floor (nes (insulaner (normaner (inver-	(including one of the control of the	other steel ling level) nal area gr ings	lintels)	external are	a)		15. 15. 28. 46. 46. 15.		si-value 0.0280 0.0390 0.0100 0.0500 0.0780 0.0430 0.0000 0.0340	Tot. 0.42 0.58 0.28 2.30 3.58 0.64 0.00	00 50 00 00 80 50	

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21.0000 (85)

Point Thermal	bridges										(36a) =	0.0000	
otal fabric h									,	(33) + (36)		80.7244	
entilation he	at loss cal Jan 46.7858	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
38)m eat transfer	coeff	46.7390 127.4635	46.6932 127.4176	46.4778 127.2023	46.4375 127.1620	46.2500 126.9744	46.2500 126.9744	46.2153 126.9397	46.3222 127.0467	46.4375 127.1620	46.5191 127.2435	46.6043 127.3287	
verage = Sum(39)m / 12 =	=					_					127.2021	
LP LP (average)	Jan 1.1539	Feb 1.1535	Mar 1.1531	Apr 1.1512	May 1.1508	Jun 1.1491	Jul 1.1491	Aug 1.1488	Sep 1.1497	0ct 1.1508	Nov 1.1515	Dec 1.1523 1.1511	
ays in mont	31	28	31	30	31	30	31	31	30	31	30	31	
. Water heati		requirement	s (kWh/year)								2.8178	(42)
ot water usag		showers 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
ot water usag	82.4325	81.2083	79.4843	76.3056	73.9254	71.2861	69.8605	71.5725	73.4364	76.2605	79.5047	82.1538	(42b
ot water usag verage daily	43.4870	41.9057	40.3243	38.7430	37.1616	35.5803	35.5803	37.1616	38.7430	40.3243	41.9057	43.4870 115.9616	
verage daily	Jan	Feb	/day) Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(43)
aily hot wate	125.9195	123.1139	119.8086	115.0486	111.0870	106.8664	105.4408	108.7341	112.1794	116.5849	121.4104	125.6409	
nergy conte nergy content	(annual)	175.3126	184.1414	157.4957	149.5445	131.4047	127.5216	134.6355	138.3284	158.2046 Total = S	172.9713 um(45)m =	196.7232 1925.7093	
istribution l	29.9139	26.2969	27.6212	23.6244	22.4317	19.7107	19.1282	20.1953	20.7493	23.7307	25.9457	29.5085	(46)
tore volume) If manufac	turer decla		actor is kn	own (kWh/c	lay):							170.0000 1.6000	
Temperature Inter (49) or	(54) in (55											0.7800 1.2480	
otal storage f cylinder co	38.6880	34.9440	38.6880	37.4400	38.6880	37.4400	38.6880	38.6880	37.4400	38.6880	37.4400	38.6880	(56)
rimary loss	38.6880 54.8576	34.9440 49.5488	38.6880 54.8576	37.4400 53.0880	38.6880 54.8576	37.4400 22.5120	38.6880 23.2624	38.6880 23.2624	37.4400 22.5120	38.6880 54.8576	37.4400 53.0880	38.6880 54.8576	
ombi loss otal heat req	0.0000 uired for v		0.0000 ng calculat			0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
WHRS	0.0000	259.8054	0.0000	248.0237	0.0000	191.3567	189.4720	196.5859	198.2804	251.7502 0.0000	263.4993	290.2688	(63a
V diverter olar input GHRS	-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	(63c
utput from w/	h	259.8054	277.6870	248.0237	243.0901	191.3567			198.2804		263.4993	290.2688	
.2Total per ye	ar (kWh/yea									Nh/year) = S		2902.7909	
lectric showe	0.0000	0.0000	0.0000	0.0000	0.0000 al Energy u	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
leat gains fro			month 136.0635		124.5600	91.6537	91.9612	94.3266	93.9558	127.4395	129.9354	140.2469	
. Internal ga Metabolic gain													
(66) m	Jan 140.8897	Feb 140.8897	140.8897	140.8897	May 140.8897			Aug 140.8897	Sep 140.8897	Oct 140.8897	Nov 140.8897	Dec 140.8897	(66)
ighting gains	137.3793	152.0985	137.3793	141.9586	137.3793	141.9586	137.3793	137.3793	141.9586	137.3793	141.9586	137.3793	(67)
ppliances gai cooking gains	272.2724	275.0978	267.9780	252.8209	233.6878	215.7053	203.6919	200.8666	207.9863	223.1435	242.2766	260.2591	(68)
umps, fans	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890			37.0890 0.0000		37.0890 0.0000	
osses e.g. ev	aporation	(negative v	alues) (Tab	le 5)	-112.7118								
	189.7118		182.8810	173.3191	167.4194	127.2968	123.6038	126.7831	130.4942	171.2896	180.4658	188.5040	(72)
otal internal		679.7931	653.5052	633.3655	603.7533	550.2276	529.9419	530.2959	545.7060	597.0793	629.9679	651.4092	(73)
5. Solar gains													
Jan]					Solar flux Table 6a W/m2				FF	Acce	ss	Gains W	
North Nast			11.9 2.1	000	10.6334 19.6403		0.6300 0.6300	0	0.7000 0.7000	0.77 0.77	00	38.6715 12.6049	(76)
South West 			5.0 5.3	000 000 	10.6334 19.6403 46.7521 19.6403		0.6300 0.6300		0.7000 0.7000	0.77 0.77	00	71.4402 31.8123	
		277 7022	417 7120	578.8530	703.0195	721.6339	685 8952	589 8653	473.0999	317.2698	187.7702	130.4959	(83)

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Temperature during heating periods in the living area from Table 9, Th1 (C) Utilisation factor for gains for living area, nil,m (see Table 9a)



tau alpha util living ar	Jan 24.0721 2.6048 ea 0.9472	Feb 24.0810 2.6054 0.9218	Mar 24.0896 2.6060	Apr 24.1304 2.6087 0.8027	May 24.1381 2.6092 0.6860	Jun 24.1737 2.6116	Jul 24.1737 2.6116	Aug 24.1803 2.6120	Sep 24.1600 2.6107	Oct 24.1381 2.6092 0.8399	Nov 24.1226 2.6082 0.9234	Dec 24.1065 2.6071 0.9527	(86)
Living Non living 24 / 16 24 / 9	20.0239 18.7795 0 3	20.1087 18.8860 0	20.2316 19.0396 0	20.3870 19.2306 0	20.5161 19.3815 0	20.5960 19.4689 0	20.6289 19.4989 0	20.6225 19.4946 0	20.5573 19.4319 0	20.3923 19.2421 0	20.1806 18.9798 0	20.0051 18.7570 0	
16 / 9 MIT Th 2 util rest of h	28 20.5007 19.9570	0 20.1087 19.9574	0 20.2316 19.9577	0 20.3870 19.9593	0 20.5161 19.9596	0 20.5960 19.9609	0 20.6289 19.9609	0 20.6225 19.9612	0 20.5573 19.9604	0 20.3923 19.9596	0 20.1806 19.9590	10 20.1443 19.9584	
MIT 2 Living area fr	0.9396 19.4876	0.9109 18.8860	0.8651 19.0396	0.7743 19.2306	0.6402 19.3815	0.4809 19.4689	0.3359 19.4989	0.3802 19.4946	0.6028 19.4319 fLA =	0.8102 19.2421 Living are	0.9107 18.9798 a / (4) =	0.9459 18.9735 0.1810	(90)
MIT Temperature ad adjusted MIT	19.6709	19.1073 19.1073	19.2553 19.2553	19.4399 19.4399	19.5869 19.5869	19.6729 19.6729	19.7034 19.7034	19.6987 19.6987	19.6356 19.6356	19.4503 19.4503	19.1971 19.1971	19.1854 0.0000 19.1854	(92)
8. Space heati													
Utilisation Useful gains Ext temp. Heat loss rate	Jan 0.9373 767.8082 4.3000	Feb 0.9004 862.2091 4.9000	Mar 0.8521 912.7461 6.5000	Apr 0.7582 919.1558 8.9000	May 0.6221 812.8982 11.7000	Jun 0.4602 585.3001 14.6000	Jul 0.3123 379.7644 16.6000	Aug 0.3554 398.0848 16.4000	Sep 0.5802 591.0813 14.1000	Oct 0.7932 725.2528 10.6000	Nov 0.8997 735.7342 7.1000	Dec 0.9399 734.9360 4.2000	(95)
	1959.9525 kWh		1625.2548	1340.6976	1002.9112	644.1261	394.0542	418.7403	703.2753		1539.2765	1908.0711	,
Space heating Solar heating		_	530.1065 er year (kW	303.5101 h/year)	141.3697	0.0000	0.0000	0.0000	0.0000	297.7216	578.5505	872.8125 4248.5578	
Solar heating Space heating		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 Space heating	886.9553 requirement			303.5101 tion - tota	141.3697 l per year	0.0000 (kWh/year)	0.0000	0.0000	0.0000	297.7216 (98c	578.5505) / (4) =	872.8125 4248.5578 38.4485	
9a. Energy req												0.000	(001)
Fraction of sp Fraction of sp Efficiency of Efficiency of Efficiency of	ace heat fi main space main space	rom main sy heating sy heating sy	stem(s) stem 1 (in stem 2 (in	%) %)	m (Table II)						0.0000 1.0000 257.9568 0.0000 0.0000	(202) (206) (207)
Space heating	Jan requirement	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating	886.9553 efficiency 257.9568	637.5316 (main heat 257.9568	530.1065 ing system 257.9568	303.5101 1) 257.9568	141.3697 257.9568	0.0000	0.0000	0.0000	0.0000	297.7216 257.9568	578.5505 257.9568	872.8125 257.9568	
Space heating				117.6593	54.8036	0.0000	0.0000	0.0000	0.0000	115.4153	224.2819	338.3561	
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 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)
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	(215)
Water heating	292.9714	259.8054	277.6870	248.0237	243.0901	191.3567	189.4720	196.5859	198.2804	251.7502	263.4993	290.2688	
Efficiency of (217)m Fuel for water	163.7728	163.7728	163.7728	163.7728	163.7728	163.7728	163.7728	163.7728	163.7728	163.7728	163.7728	163.7728 163.7728	
Space cooling	178.8889	158.6377	169.5563	151.4438	148.4313	116.8428	115.6920	120.0358	121.0705	153.7192	160.8933	177.2387	(219)
(221)m Pumps and Fa Lighting	0.0000 0.0000 26.5610	0.0000 0.0000 21.3082	0.0000 0.0000 19.1857	0.0000 0.0000 14.0563	0.0000 0.0000 10.8575	0.0000 0.0000 8.8706	0.0000 0.0000 9.9045	0.0000 0.0000 12.8743	0.0000 0.0000 16.7224	0.0000 0.0000 21.9407	0.0000 0.0000 24.7820	0.0000 0.0000 27.2992	(231)
Electricity ge (233a)m	nerated by -79.5957	PVs (Appen -115.7519	dix M) (neg -169.9656	ative quant -187.1982	ity) -192.2733	-161.8207					-87.3477	-68.0348	
Electricity ge (234a)m Electricity ge	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 us	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 ge	0.0000 nerated by	0.0000 PVs (Appen	0.0000 dix M) (neg	0.0000 ative quant	0.0000 ity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
(233b) m Electricity ge (234b) m			-176.2788 nes (Append 0.0000				0.0000	0.0000	0.0000	0.0000	-49.6828 0.0000	-27.1144	(233b) (234b)
Electricity ge (235b)m	nerated by 0.0000	hydro-elec 0.0000	tric genera 0.0000	tors (Appen 0.0000	dix M) (neg 0.0000	ative quant 0.0000	ity) 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Electricity us (235d)m	0.0000	electricity 0.0000	generated 0.0000		P (Appendix 0.0000		ve if net g 0.0000	eneration) 0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals Space heating Space heating	fuel - mair fuel - mair	n system 2										1647.0036 0.0000	(213)
Space heating Efficiency of Water heating Space cooling	water heate fuel used											0.0000 163.7728 1772.4502 0.0000	(219)
Electricity fo Total electric Electricity fo	ity for the	e above, kW		ix L)								0.0000 214.3625	
Energy saving/ PV generation Wind generatio Hydro-electric	n			ces M ,N an	d Q)							-4281.4167 0.0000 0.0000	(234)

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Electricity gene Appendix Q - spe Energy saved or Energy used Total delivered	ecial featu generated	res	opendix N)									0.0000 -0.0000 0.0000 -647.6004	(236) (237)
12a. Carbon diox	xide emissi	ons - Indiv	vidual heati	ng systems	including								
								Energy kWh/year	Emission			Emissions	
Space heating - Total CO2 associ			systems					1647.0036		0.1553		255.8054 0.0000	(261)
Water heating (o Space and water	other fuel) heating							1772.4502		0.1416		250.9006 506.7060	(265)
Pumps, fans and Energy for light		eep-hot						0.0000 214.3625		0.0000 0.1443		0.0000 30.9391	
Energy saving/o PV Unit electric PV Unit electric Total	city used i	n dwelling	es					1638.5686 2642.8482		0.1356 0.1231		-222.2012 -325.3726 -547.5738	(269)
Total CO2, kg/ye EPC Dwelling Car		e Emission	Rate (DER)									-9.9287 -0.0900	
13a. Primary ene	ergy - Indi	vidual heat	ting systems	including	micro-CHP								
One and he is the		1							Primary energy	CO2/kWh		wary energy kWh/year	
Space heating - Total CO2 associ Water heating (c	iated with	m I community s	systems					1772.4502		1.5750 1.5235		2594.0120 0.0000 2700.2746	(473)
Space and water Pumps, fans and	heating	eep-hot						0.0000				5294.2867	(279)
Energy for light								214.3625		0.0000 1.5338		328.7964	(282)
Energy saving/o PV Unit electric PV Unit electric Total Total Primary er	city used i city export	n dwelling ed	es					1638.5686 2642.8482		1.5013 0.4518		-2459.9270 -1193.9277 -3653.8547 1969.2284	
Dwelling Primary												17.8200	
	I FOR New B	uild (As De	esigned) (Version 10	.2, Februar	y 2022) 							
1. Overall dwell	ling charac	teristics							Chamara	hoi wh+		Wolumo	
Ground floor Total floor area Dwelling volume	a TFA = (1a)+(1b)+(1c))+(1d)+(1e).	(1n)	1	10.5000					(2b) =		(1b) - (3b) (4) (5)
2. Ventilation													
											r	n3 per hour	
Number of open of Number of open in Number of chimme Number of flues Number of flues Number of blocke Number of intern Number of passiv Number of fluele	flues eys / flues attached t attached t ed chimneys mittent ext ve vents	o solid fue o other hea ract fans	el boiler	re							0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 = 0 * 20 = 4 * 10 = 0 * 10 = 0 * 40 =	0.0000 0.0000 0.0000 0.0000 0.0000 40.0000 0.0000 0.0000	(6b) (6c) (6d) (6e) (6f) (7a) (7b)
Infiltration due	e to chimne	ys, flues a	and fans =	= (6a)+(6b)-	+(6c)+(6d)+	(6e)+(6f)+(6	6g)+(7a)+(7	b)+(7c) =		40.0000	Air change	es per hour 0.1448	(8)
Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides	ethod AP50 te	2.,										Yes Blower Door 5.0000 0.3948	(17) (18)
Shelter factor Infiltration rat		to include	e shelter fa	ıctor					(20) = 1 - (21)		x (19)] = x (20) =	0.8500 0.3356	
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		
Adj infilt rate		0.4195 0.5880	0.4111	0.3691	0.3607 0.5651	0.3188 0.5508	0.3188 0.5508	0.3104 0.5482	0.3356	0.3607 0.5651	0.3775	0.3943	(22b)

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3. Heat losses and heat l												
Element			Gross m2	Opening:	s Ne	tArea m2	U-value W/m2K	A >	K U F	K-value kJ/m2K	A x K kJ/K	
TER Opaque door TER Opening Type (Uw = 1.	.20)				24	.1000 .3000	1.0000 1.1450	2.10 27.82	244			(26) (27)
Heatloss Floor 1 External Wall 1			115.0000	26.400	88	.0000	0.1300	14.30 15.94	180			(28a) (29a)
External Roof 1 Total net area of externa		s Aum(A, m2)	110.0000			.0000	0.1100	12.10 = 72.27				(30) (31) (33)
Fabric heat loss, W/K = S Thermal mass parameter (T			m2K			(20)(30) + (32)	- /2.2	24		100.0000	
List of Thermal Bridges K1 Element		,					L	ength	Psi-value	Tot		, ,
E2 Other lintels E3 Sill	(including	g other stee	l lintels)				15	.0000	0.0500 0.0500	0.75	00	
E4 Jamb E5 Ground floor							46	.0000	0.0500 0.1600	1.40	000	
E10 Eaves (insula E16 Corner (norma E17 Corner (inver	al)	-		outomnal a	ma n)		15	.0000 .0000 .5000	0.0600 0.0900 -0.0900	2.76 1.35 -0.22	00	
E18 Party wall be Thermal bridges (Sum(L x	etween dwel	llings			Lea)			.0000	0.0600	0.00		(36)
Point Thermal bridges Total fabric heat loss			11.						(33) + (36)	(36a) = + (36a) =	0.0000 86.4174	
Ventilation heat loss cal					-	- 1			0.1			
Jan (38)m 53.9256 Heat transfer coeff	Feb 53.6015	Mar 53.2839	Apr 51.7922	May 51.5131	Jun 50.2138	Jul 50.2138	Aug 49.9732	Sep 50.7142	Oct 51.5131	Nov 52.0777	Dec 52.6680	(38)
		139.7014	138.2096	137.9305	136.6312	136.6312	136.3906	137.1317	137.9305	138.4951	139.0854 138.2083	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP 1.2701 HLP (average) Days in mont 31	1.2671	1.2643	1.2508	1.2482	1.2365	1.2365	1.2343	1.2410	1.2482	1.2533	1.2587 1.2508 31	
Days in mont 31	28	31	30	31	30	31	31	30	31	30	31	
4. Water heating energy r	requirement	s (kWh/year)									
Assumed occupancy Hot water usage for mixer	r showers										2.8178	(42)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
82.4325 Hot water usage for other		79.4843	76.3056	73.9254	71.2861	69.8605	71.5725	73.4364	76.2605	79.5047	82.1538	
Average daily hot water to	41.9057 use (litres	40.3243 s/day)	38.7430	37.1616	35.5803	35.5803	37.1616	38.7430	40.3243	41.9057	43.4870 115.9616	
Jan Daily hot water use	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content (annual)	175.3126		115.0486 157.4957	111.0870 149.5445	106.8664 131.4047	105.4408 127.5216	108.7341 134.6355	112.1794 138.3284	116.5849 158.2046 Total = 8	121.4104 172.9713 Sum(45)m =	125.6409 196.7232 1925.7093	
Distribution loss (46)m 29.9139 Water storage loss:	26.2969		23.6244	22.4317	19.7107	19.1282	20.1953	20.7493	23.7307	25.9457	29.5085	(46)
Store volume a) If manufacturer decla	ared loss f	factor is kn	own (kWh/c	day):							170.0000 1.5003	(48)
Temperature factor from Enter (49) or (54) in (55											0.5400 0.8102	
Total storage loss 25.1153 If cylinder contains dedi	22.6848		24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
	22.6848	25.1153	24.3051 22.5120		24.3051 22.5120	25.1153 23.2624	25.1153 23.2624	24.3051 22.5120	25.1153 23.2624		25.1153 23.2624	
Combi loss 0.0000 Total heat required for w	0.0000 water heati	0.0000 ing calculat	0.0000 ed for each	0.0000 n month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
WWHRS 0.0000	0.0000	0.0000	0.0000	197.9222	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	(63a)
	-0.0000 0.0000 0.0000	0.0000	-0.0000 0.0000 0.0000	0.0000	-0.0000 0.0000 0.0000	-0.0000 0.0000 0.0000	0.0000	0.0000	-0.0000 0.0000 0.0000	0.0000		(63c)
Output from w/h				197.9222								
12Total per year (kWh/yea	ar)						Total p	er year (kV	Wh/year) = S	3um(64)m =		(64) (64)
Electric shower(s) 0.0000	0.0000	0.0000	0.0000 Tot	0.0000 al Energy u	0.0000 sed by inst					0.0000 um(64a)m =	0.0000	
Heat gains from water heat 105.0112	ating, kWh/ 93.2482	month 99.9292		88.4257	-				-			
5. Internal gains (see Ta	able 5 and	5a)										
Metabolic gains (Table 5)	, Watts							_			_	
		140.8897		May 140.8897			Aug 140.8897	Sep 140.8897	Oct 140.8897	Nov 140.8897	Dec 140.8897	(66)
	152.0985	137.3793	141.9586	137.3793	141.9586	137.3793	137.3793	141.9586	137.3793	141.9586	137.3793	(67)
272.2724 Cooking gains (calculated	275.0978 d in Append	267.9780 dix L, equat	252.8209 ion L15 or	233.6878 L15a), also	215.7053 see Table	203.6919		207.9863	223.1435	242.2766	260.2591	(68)
37.0890 Pumps, fans 3.0000	37.0890 3.0000	37.0890 3.0000	37.0890 3.0000	37.0890 3.0000	37.0890 0.0000	37.0890 0.0000	37.0890 0.0000	37.0890 0.0000	37.0890 3.0000		37.0890 3.0000	
	-112.7118			-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	(71)
Water heating gains (Tabl 141.1441 Total internal gains		134.3134	124.7514	118.8517	112.7025	109.0095	112.1888	115.8999	122.7220	131.8982	139.9363	(72)
	634.2254	607.9376	587.7978	558.1857	535.6333	515.3476	515.7016	531.1117	551.5117	584.4003	605.8416	(73)

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[Jan]			A	rea	Solar flux		g		FF	Acce	ss	Gains	
		m2		Table 6a W/m2	Specific data or Table 6b		Specific data or Table 6c		factor Table 6d		W		
North East South West		11.9 2.5 5.0						0.7000 0.7000 0.7000 0.7000		0.7700 0.7700 0.7700 0.7700		38.6715 12.6049 71.4402 31.8123	(76) (78)
Solar gains Total gains	154.5288 773.5916	277.7932 912.0186	417.7120 1025.6496	578.8530 1166.6508	703.0195 1261.2052		685.8952 1201.2428	589.8653 1105.5669	473.0999 1004.2116	317.2698 868.7815	187.7702 772.1705	130.4959 736.3374	,
7. Mean inter	nal temperat	ure (heati	ing season)										
Temperature d Utilisation f	uring heatir	ng periods	in the livi	ng area fro	m Table 9,							21.0000	(85)
tau	Jan 21.8710	Feb 21.9216	Mar 21.9715	Apr 22.2086	May 22.2536	Jun 22.4652	Jul 22.4652	Aug 22.5048	Sep 22.3832	Oct 22.2536	Nov 22.1628	Dec 22.0688	
alpha util living a		2.4614	2.4648	2.4806	2.4836	2.4977	2.4977	2.5003	2.4922	2.4836	2.4775	2.4713	
	0.9551	0.9329	0.8981	0.8268	0.7190	0.5766	0.4518	0.4985	0.6921	0.8625	0.9350	0.9598	
MIT Th 2 util rest of 1	18.1566 19.8644	18.5109 19.8667	19.0393 19.8689	19.7378 19.8796	20.3289 19.8816	20.7322 19.8909	20.8952 19.8909	20.8631 19.8927	20.5506 19.8873	19.7773 19.8816	18.8565 19.8776	18.1013 19.8733	
MIT 2	0.9482 16.5660	0.9228 17.0129	0.8823 17.6761	0.7991 18.5406	0.6723 19.2391	0.5033 19.6837	0.3535 19.8335	0.3993 19.8124	0.6258 19.5081	0.8344 18.6099	0.9235 17.4621	0.9536 16.5010	
Living area f MIT	raction 16.8539	17.2841	17.9228	18.7573	19.4364	19.8735	20.0257	20.0026	fLA = 19.6968	Living are 18.8212	a / (4) = 17.7145	0.1810 16.7906	
Temperature a adjusted MIT	16.8539	17.2841	17.9228	18.7573	19.4364	19.8735	20.0257	20.0026	19.6968	18.8212	17.7145	0.0000 16.7906	(93)
8. Space heat		ment											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation Useful gains Ext temp.	0.9213	0.8907 812.3225 4.9000	0.8467 868.3878 6.5000	0.7656 893.1709 8.9000	0.6513 821.3706 11.7000	0.5020 631.2006 14.6000	0.3662 439.8776 16.6000	0.4099 453.1910 16.4000	0.6129 615.4534 14.1000	0.8004 695.3832 10.6000	0.8922 688.9302 7.1000	0.9283 683.5727 4.2000	(95)
Heat loss rat	e W		1595.7820			720.5202	468.0529	491.3631		1133.9496			
Space heating Space heating	780.5845		541.1813		182.8068	0.0000	0.0000	0.0000	0.0000	326.2934	562.4111	794.2929 4144.7644	(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 Space heating	kWh		541.1813		182.8068	0.0000	0.0000	0.0000	0.0000	326.2934	562.4111	0.0000 794.2929	(98c)
Space heating Space heating		after sol	lar contribu	tion - tota	l per year	(kWh/year)				(98c) / (4) =	4144.7644 37.5092	(99)
9a. Energy re	quirements -	 - Individua	al heating s	ystems, inc	luding micr								
Fraction of s												0.0000	(201)
Fraction of s Efficiency of Efficiency of Efficiency of	main space main space	heating sy	ystem 1 (in ystem 2 (in	%)								1.0000 92.3000 0.0000 0.0000	(206) (207)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(===,
Space heating	780.5845	619.3694	541.1813		182.8068	0.0000	0.0000	0.0000	0.0000	326.2934	562.4111	794.2929	(98)
Space heating Space heating	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating	845.7037	671.0394	586.3286	2)	198.0572	0.0000	0.0000	0.0000	0.0000	353.5140	609.3295	860.5557	(211)
Space heating	0.0000 fuel (main	0.0000 heating sy	0.0000 ystem 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Space heating	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	(210)
Water heating	247.8035	219.0086	232.5191	204.3128	197.9222	178.2219	175.8993	183.0132	185.1456	206.5823	219.7885	245.1009	
Efficiency of (217)m	86.4506	86.2587	85.8889	85.1796	83.8820	79.8000	79.8000	79.8000	79.8000	85.0801	86.0723	79.8000 86.4995	
Fuel for wate Space cooling	286.6417	253.8975	270.7209	239.8613	235.9531	223.3357	220.4251	229.3399	232.0120	242.8092	255.3532	283.3552	(219)
(221)m Pumps and Fa	0.0000 7.3041	0.0000 6.5973	7.3041	0.0000 7.0685	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	(231)
Lighting Electricity g		22.8996 PVs (Apper	20.6186 ndix M) (neg			9.5331	10.6443	13.8358	17.9713	23.5794	26.6328	29.3380	(232)
(233a)m Electricity g	enerated by	wind turbi	ines (Append	ix M) (nega		ty)	-128.8421	-126.3513		-113.4695 0.0000	-86.0354	-71.6137	
(234a)m Electricity g (235a)m	0.0000 enerated by 0.0000	0.0000 hydro-elec 0.0000		0.0000 tors (Appen 0.0000	0.0000 dix M) (negal 0.0000	0.0000 ative quant 0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	
Electricity u									0.0000	0.0000	0.0000	0.0000	
(235c)m													
(235c)m Electricity g (233b)m Electricity g	enerated by -80.3076	-163.3024	-314.8087	-459.4913	-595.3739		-587.0751	-502.5905	-375.8730	-228.9343	-105.6110	-63.9566	(233b

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(235b) m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative (235d)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 Annual totals kWh/year		.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Space heating fuel - main system 1						4490.5356	
Space heating fuel - main system 2 Space heating fuel - secondary						0.0000	
Efficiency of water heater Water heating fuel used						79.8000 2973.7049	(219)
Space cooling fuel						0.0000	
Electricity for pumps and fans:							
Total electricity for the above, kWh/year Electricity for lighting (calculated in Appendix L)						86.0000 230.3721	
Energy saving/generation technologies (Appendices M , N and Q)							
PV generation					-	5461.7394	
Wind generation Hydro-electric generation (Appendix N)						0.0000	
Electricity generated - Micro CHP (Appendix N) Appendix Q - special features						0.0000	(235)
Energy saved or generated						-0.0000	
Energy used Total delivered energy for all uses						0.0000 2318.8732	
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP							
		nergy	Emission			Emissions	
Space heating - main system 1		/year .5356	kg (0.2100		CO2/year 943.0125	
Total CO2 associated with community systems Water heating (other fuel)	2973	.7049		0.2100		0.0000 624.4780	
Space and water heating						1567.4905	(265)
Pumps, fans and electric keep-hot Energy for lighting		.0000 .3721		0.1387 0.1443		11.9293 33.2498	
Energy saving/generation technologies							
PV Unit electricity used in dwelling PV Unit electricity exported	-1390 -4071			0.1365 0.1268		-189.8028 -516.0641	
Total	4071	.2333		0.1200		-705.8669	
Total CO2, kg/year EPC Target Carbon Dioxide Emission Rate (TER)					906.8027 8.2100		
13a. Primary energy - Individual heating systems including micro-CHP							
			mary energy kg (ry energy kWh/year	
Space heating - main system 1		.5356		1.1300		5074.3053	(275)
Total CO2 associated with community systems Water heating (other fuel)	2973	.7049		1.1300		0.0000 3360.2865	
Space and water heating						8434.5917	(279)
Pumps fans and alastric koon-hot	0.0	0000		1 5120		130 1000	
Pumps, fans and electric keep-hot Energy for lighting		.0000 .3721		1.5128 1.5338		130.1008 353.3524	
Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling	-1390	.3721		1.5338	_	353.3524	
Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported Total	230	.3721		1.5338	- - -	353.3524 2092.0672 1894.4618 3986.5290	(282)
Energy for lighting Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported	-1390	.3721		1.5338	- - -	353.3524 2092.0672 1894.4618	(282) (283) (286)

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