JS LEWIS LTD

Energy and Sustainability Strategy

Land at Foots Farm, Thorpe Road, Clacton on Sea

Revision A

Benferri Developments Ltd

February 2024

Applicants:	Benferri Developments Ltd
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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:
  - 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:
  - 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;
  - 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:
  - 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
CHP	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:

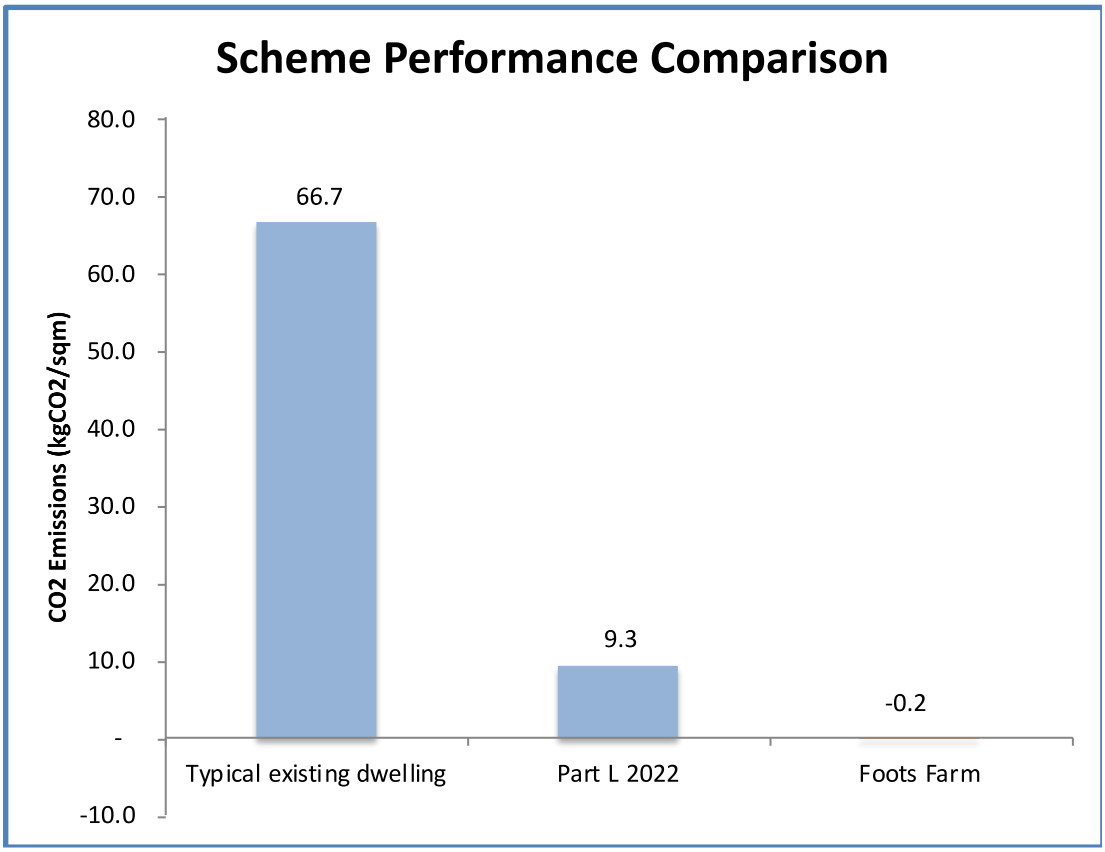

Figure 2 - Comparative Performance

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, CO_2, 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 anti-social 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 life-style 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;
    - Avoiding fossil fuel.
- Lifestyle Emissions
    - Facilitation of sustainable travel choices;
    - 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:

1. 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;
  - 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;
  - 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 zero-carbon 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.

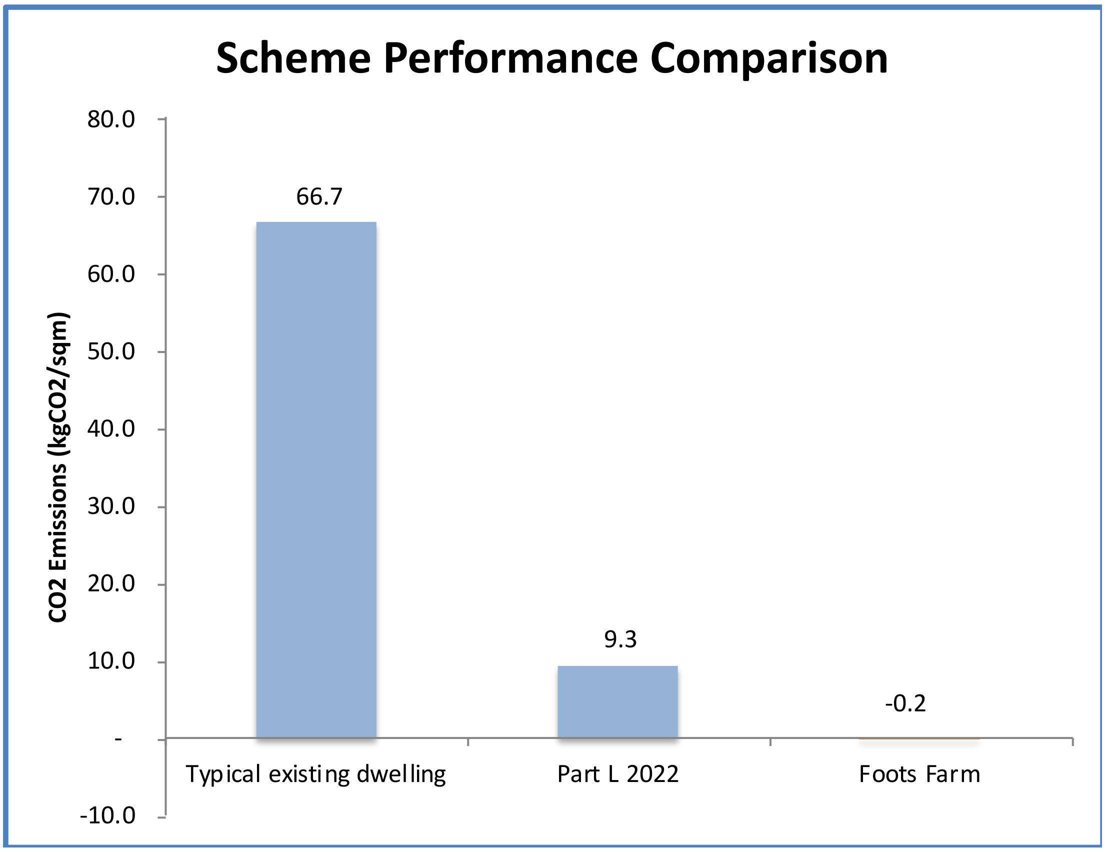

Figure 4 - Comparative Performance

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:
    - 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;
    - 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:
    - 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.

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

Full SAP Calculation Printout

elmhurst energy

Property Reference	Type A - Semi	Issued on Date	19/01/2024
Assessment Reference	Type A	Prop Type Ref	Type A - Semi
Property	Type A - Semi, 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	TFEE	41.68
Compliance Check	See BREL	% DFEE < TFEE			7.68
% DPER < TPER	66.69	DPER	18.48	TPER	55.49

Assessor Details	Mr. Jonathan Lewis	Assessor ID	AZ32-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	67.8000 (1b)	x	2.5000 (2b)	=	169.5000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 67.8000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	169.5000	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)
Effective ac	0.5132	0.5127	0.5122	0.5098	0.5094	0.5073	0.5073	0.5070	0.5081	0.5094	0.5103	0.5112	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.20)			10.1000	1.1450	11.5649			(27)
Solid Door			2.1000	1.2000	2.5200			(26)
Heatloss Floor 1			67.8000	0.1300	8.8140			(28a)
External Wall 1	69.0000	12.2000	56.8000	0.1700	9.6560			(29a)
External Roof 1	67.8000		67.8000	0.1200	8.1360			(30)
Total net area of external elements Aum(A, m2)			204.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.6909			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	8.0000	0.0280	0.2240
E3 Sill	8.0000	0.0390	0.3120
E4 Jamb	24.0000	0.0100	0.2400
E5 Ground floor (normal)	23.3000	0.0500	1.1650
E10 Eaves (insulation at ceiling level)	27.3000	0.0780	2.1294
E16 Corner (normal)	12.5000	0.0430	0.5375
E17 Corner (inverted - internal area greater than external area)	5.0000	0.0000	0.0000
E18 Party wall between dwellings	5.0000	0.0340	0.1700

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.7779 (36)

Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 45.4688 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.7066	28.6779	28.6498	28.5176	28.4929	28.3778	28.3778	28.3565	28.4221	28.4929	28.5429	28.5952	(38)
Heat transfer coeff	74.1754	74.1467	74.1185	73.9864	73.9617	73.8466	73.8466	73.8253	73.8909	73.9617	74.0117	74.0640	(39)
Average = Sum(39)m / 12 =												73.9863	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0940	1.0936	1.0932	1.0912	1.0909	1.0892	1.0892	1.0889	1.0898	1.0909	1.0916	1.0924	(40)
HLP (average)												1.0912	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.1916 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	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 for baths	70.2756	69.2319	67.7621	65.0522	63.0231	60.7730	59.5577	61.0171	62.6062	65.0138	67.7796	70.0380	(42b)
Hot water usage for other uses	37.0737	35.7255	34.3774	33.0293	31.6811	30.3330	30.3330	31.6811	33.0293	34.3774	35.7255	37.0737	(42c)
Average daily hot water use (litres/day)												98.8599	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	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)
Energy conte	170.0150	149.4580	156.9847	134.2687	127.4901	112.0255	108.7150	114.7798	117.9281	134.8730	147.4620	167.7110	(45)
Energy content (annual)										Total = Sum(45)m =		1641.7108	
Distribution loss (46)m = 0.15 x (45)m	25.5022	22.4187	23.5477	20.1403	19.1235	16.8038	16.3073	17.2170	17.6892	20.2309	22.1193	25.1566	(46)

Water storage loss:
Store volume 170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6000 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.2480 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	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 contains dedicated solar 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	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	263.5606	233.9508	250.5303	224.7967	221.0357	171.9775	170.6654	176.7302	177.8801	228.4186	237.9900	261.2566	(62)
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)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	263.5606	233.9508	250.5303	224.7967	221.0357	171.9775	170.6654	176.7302	177.8801	228.4186	237.9900	261.2566	(64)

Total per year (kWh/year) = Sum(64)m = 2618.7924 (64)
12Total per year (kWh/year) 2619 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	131.3665	117.2890	127.0339	117.0667	117.2269	85.2101	85.7081	87.7246	87.1727	119.6817	121.4535	130.6004	(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)m	109.5776	109.5776	109.5776	109.5776	109.5776	109.5776	109.5776	109.5776	109.5776	109.5776	109.5776	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	105.9973	102.5781	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	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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
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	(71)
Water heating gains (Table 5)	176.5678	174.5372	170.7445	162.5927	157.5631	118.3473	115.1990	117.9094	121.0732	160.8626	168.6854	175.5382	(72)
Total internal gains	527.1281	538.0815	518.2747	502.8476	480.8989	432.4144	417.3705	418.0874	429.6940	476.7586	501.5006	517.6220	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.3000	10.6334	0.6300	0.7000	0.7700	4.2246	(74)
East	5.9000	19.6403	0.6300	0.7000	0.7700	35.4137	(76)
West	2.9000	19.6403	0.6300	0.7000	0.7700	17.4067	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	57.0450	111.4014	183.8852	270.2134	333.8352	343.1305	326.0891	278.1591	214.4050	132.2177	71.0725	46.9588	(83)
Total gains	584.1731	649.4828	702.1598	773.0611	814.7341	775.5449	743.4596	696.2465	644.0990	608.9763	572.5731	564.5808	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	25.3903	25.4001	25.4097	25.4551	25.4636	25.5033	25.5033	25.5107	25.4880	25.4636	25.4464	25.4285	
alpha	2.6927	2.6933	2.6940	2.6970	2.6976	2.7002	2.7002	2.7007	2.6992	2.6976	2.6964	2.6952	
util living area	0.9255	0.9011	0.8610	0.7806	0.6653	0.5350	0.4094	0.4491	0.6399	0.8082	0.8968	0.9314	(86)
Living	20.1235	20.1921	20.2983	20.4353	20.5474	20.6153	20.6439	20.6391	20.5845	20.4467	20.2638	20.1078	
Non living	18.9479	19.0337	19.1658	19.3335	19.4638	19.5381	19.5640	19.5608	19.5086	19.3513	19.1266	18.9296	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.5516	20.1921	20.2983	20.4353	20.5474	20.6153	20.6439	20.6391	20.5845	20.4467	20.2638	20.2326	(87)
Th 2	20.0057	20.0061	20.0064	20.0080	20.0083	20.0097	20.0097	20.0099	20.0091	20.0083	20.0077	20.0071	(88)
util rest of house	0.9157	0.8883	0.8427	0.7514	0.6205	0.4695	0.3264	0.3646	0.5776	0.7762	0.8814	0.9222	(89)
MIT 2	19.5840	19.0337	19.1658	19.3335	19.4638	19.5381	19.5640	19.5608	19.5086	19.3513	19.1266	19.1237	(90)
Living area fraction									fLA = Living area / (4) =			0.4867	(91)
MIT	20.0549	19.5976	19.7170	19.8698	19.9912	20.0624	20.0896	20.0856	20.0323	19.8845	19.6801	19.6635	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.0549	19.5976	19.7170	19.8698	19.9912	20.0624	20.0896	20.0856	20.0323	19.8845	19.6801	19.6635	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9162	0.8824	0.8368	0.7470	0.6197	0.4732	0.3334	0.3714	0.5792	0.7717	0.8756	0.9187	(94)
Useful gains	535.2314	573.0850	587.5840	577.4830	504.8526	367.0103	247.8674	258.5687	373.0692	469.9733	501.3387	518.6749	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1168.6292	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	471.2480	347.2155	291.6790	168.5733	80.6348	0.0000	0.0000	0.0000	0.0000	161.2405	309.4079	466.1981	(98a)
Space heating requirement - total per year (kWh/year)												2296.1970	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	471.2480	347.2155	291.6790	168.5733	80.6348	0.0000	0.0000	0.0000	0.0000	161.2405	309.4079	466.1981	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2296.1970	
Space heating per m2										(98c) / (4) =		33.8672	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 265.2639 (206)
Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	471.2480	347.2155	291.6790	168.5733	80.6348	0.0000	0.0000	0.0000	0.0000	161.2405	309.4079	466.1981	(98)
Space heating efficiency (main heating system 1)	265.2639	265.2639	265.2639	265.2639	265.2639	0.0000	0.0000	0.0000	0.0000	265.2639	265.2639	265.2639	(210)
Space heating fuel (main heating system)	177.6525	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 efficiency (main heating system 2)	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 fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	263.5606	233.9508	250.5303	224.7967	221.0357	171.9775	170.6654	176.7302	177.8801	228.4186	237.9900	261.2566	(64)
Efficiency of water heater												163.6200	(216)
(217)m	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)
Fuel for water heating, kWh/month	161.0809	142.9842	153.1172	137.3895	135.0909	105.1079	104.3060	108.0126	108.7154	139.6031	145.4529	159.6728	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
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	20.2631	16.2558	14.6365	10.7234	8.2830	6.7673	7.5561	9.8217	12.7574	16.7383	18.9059	20.8263	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-59.7449	-86.5651	-126.9438	-140.6700	-146.8376	-125.3553	-123.7346	-118.2364	-105.9644	-96.7424	-65.6930	-51.1871	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-28.4180	-64.5728	-139.3980	-226.4152	-313.3699	-329.3283	-324.0380	-268.9186	-190.4779	-99.0663	-39.7151	-22.0046	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year
Space heating fuel - main system 1 865.6273 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 163.6200
Water heating fuel used 1600.5332 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
Total electricity for the above, kWh/year 0.0000 (231)
Electricity for lighting (calculated in Appendix L) 163.5347 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -3293.3975 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)

Appendix Q - special features			
Energy saved or generated			-0.0000 (236)
Energy used			0.0000 (237)
Total delivered energy for all uses			-663.7023 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	865.6273	0.1552	134.3508 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1600.5332	0.1416	226.5669 (264)
Space and water heating			360.9177 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	163.5347	0.1443	23.6031 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1247.6747	0.1354	-168.8770
PV Unit electricity exported	-2045.7228	0.1235	-252.6999
Total			-421.5769 (269)
Total CO2, kg/year			-37.0561 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-0.5500 (273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	865.6273	1.5746	1363.0093 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1600.5332	1.5235	2438.3752 (278)
Space and water heating			3801.3846 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	163.5347	1.5338	250.8350 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1247.6747	1.5003	-1871.8977
PV Unit electricity exported	-2045.7228	0.4533	-927.3104
Total			-2799.2081 (283)
Total Primary energy kWh/year			1253.0115 (286)
Dwelling Primary energy Rate (DPER)			18.4800 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)
Ground floor		67.8000 (1b)	x	2.5000 (2b)	=	169.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	67.8000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	169.5000 (5)

2. Ventilation rate

		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	2 * 10 =	20.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1180 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3680 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3128 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3988	0.3910	0.3832	0.3441	0.3363	0.2972	0.2972	0.2893	0.3128	0.3363	0.3519	0.3675	(22b)
Effective ac	0.5795	0.5764	0.5734	0.5592	0.5565	0.5442	0.5442	0.5419	0.5489	0.5565	0.5619	0.5675	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.20)			10.1000	1.1450	11.5649			(27)
Heatloss Floor 1			67.8000	0.1300	8.8140			(28a)
External Wall 1	69.0000	12.2000	56.8000	0.1800	10.2240			(29a)
External Roof 1	67.8000		67.8000	0.1100	7.4580			(30)
Total net area of external elements Aum(A, m2)			204.6000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.1609			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	8.0000	0.0500	0.4000
E3 Sill	8.0000	0.0500	0.4000
E4 Jamb	24.0000	0.0500	1.2000
E5 Ground floor (normal)	23.3000	0.1600	3.7280
E10 Eaves (insulation at ceiling level)	27.3000	0.0600	1.6380
E16 Corner (normal)	12.5000	0.0900	1.1250
E17 Corner (inverted – internal area greater than external area)	5.0000	-0.0900	-0.4500
E18 Party wall between dwellings	5.0000	0.0600	0.3000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.3410 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 48.5019 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	32.4158	32.2431	32.0738	31.2785	31.1297	30.4371	30.4371	30.3088	30.7039	31.1297	31.4307	31.7454	(38)
Heat transfer coeff	80.9177	80.7449	80.5756	79.7804	79.6316	78.9390	78.9390	78.8107	79.2057	79.6316	79.9326	80.2473	(39)
Average = Sum(39)m / 12 =												79.7797	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1935	1.1909	1.1884	1.1767	1.1745	1.1643	1.1643	1.1624	1.1682	1.1745	1.1789	1.1836	(40)
HLP (average)												1.1767	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.1916 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	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 for baths	70.2756	69.2319	67.7621	65.0522	63.0231	60.7730	59.5577	61.0171	62.6062	65.0138	67.7796	70.0380	(42b)
Hot water usage for other uses	37.0737	35.7255	34.3774	33.0293	31.6811	30.3330	30.3330	31.6811	33.0293	34.3774	35.7255	37.0737	(42c)

Average daily hot water use (litres/day) 98.8599 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	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)
Energy conte	170.0150	149.4580	156.9847	134.2687	127.4901	112.0255	108.7150	114.7798	117.9281	134.8730	147.4620	167.7110	(45)
Energy content (annual)										Total = Sum(45)m =		1641.7108	
Distribution loss (46)m = 0.15 x (45)m	25.5022	22.4187	23.5477	20.1403	19.1235	16.8038	16.3073	17.2170	17.6892	20.2309	22.1193	25.1566	(46)

Water storage loss:
Store volume 170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.5003 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.8102 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
If cylinder contains dedicated solar storage	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(57)
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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
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)
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)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output 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)

Total per year (kWh/year) = Sum(64)m = 2211.3193 (64)
12Total per year (kWh/year) 2211 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	95.2321	84.6516	90.8996	82.0980	81.0926	74.7022	74.8499	76.8665	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)m	109.5776	109.5776	109.5776	109.5776	109.5776	109.5776	109.5776	109.5776	109.5776	109.5776	109.5776	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	105.9973	102.5781	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	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	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
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	(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	481.5604	492.5138	472.7070	457.2800	435.3313	417.8201	402.7762	403.4931	415.0997	431.1909	455.9330	472.0544	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.3000	10.6334	0.6300	0.7000	0.7700	4.2246	(74)
East	5.9000	19.6403	0.6300	0.7000	0.7700	35.4137	(76)
West	2.9000	19.6403	0.6300	0.7000	0.7700	17.4067	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	57.0450	111.4014	183.8852	270.2134	333.8352	343.1305	326.0891	278.1591	214.4050	132.2177	71.0725	46.9588	(83)
Total gains	538.6055	603.9152	656.5922	727.4934	769.1665	760.9506	728.8653	681.6522	629.5047	563.4086	527.0054	519.0132	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	23.2747	23.3245	23.3735	23.6065	23.6506	23.8581	23.8581	23.8969	23.7777	23.6506	23.5615	23.4691	
alpha	2.5516	2.5550	2.5582	2.5738	2.5767	2.5905	2.5905	2.5931	2.5852	2.5767	2.5708	2.5646	
util living area	0.9402	0.9192	0.8849	0.8130	0.7066	0.5637	0.4372	0.4778	0.6684	0.8416	0.9169	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	(87)
Th 2	19.9252	19.9273	19.9293	19.9387	19.9404	19.9487	19.9487	19.9502	19.9455	19.9404	19.9369	19.9332	(88)
util rest of house	0.9316	0.9078	0.8682	0.7850	0.6611	0.4938	0.3455	0.3854	0.6038	0.8117	0.9033	0.9371	(89)
MIT 2	17.0258	17.3961	17.9791	18.7549	19.3753	19.7702	19.9007	19.8845	19.6275	18.8442	17.8352	16.9720	(90)

Living area fraction fLA = Living area / (4) = 0.4867 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	17.7416	18.0750	18.6009	19.3053	19.8800	20.2576	20.3940	20.3738	20.1126	19.3796	18.4656	17.6914	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	17.7416	18.0750	18.6009	19.3053	19.8800	20.2576	20.3940	20.3738	20.1126	19.3796	18.4656	17.6914	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9085	0.8826	0.8427	0.7659	0.6583	0.5154	0.3857	0.4242	0.6149	0.7931	0.8792	0.9148	(94)
Useful gains	489.2971	532.9863	553.3209	557.1865	506.3493	392.1841	281.1225	289.1810	387.0845	446.8116	463.3223	474.7965	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	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)
Space heating kWh	445.1842	356.7173	313.7592	196.5267	107.9102	0.0000	0.0000	0.0000	0.0000	187.7262	320.5152	452.2414	(98a)

Space heating requirement - total per year (kWh/year) 2380.5804

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)

Solar heating contribution - total per year (kWh/year) 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating kWh	445.1842	356.7173	313.7592	196.5267	107.9102	0.0000	0.0000	0.0000	0.0000	187.7262	320.5152	452.2414	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 2380.5804

Space heating per m2 (98c) / (4) = 35.1118 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	445.1842	356.7173	313.7592	196.5267	107.9102	0.0000	0.0000	0.0000	0.0000	187.7262	320.5152	452.2414	(98)
Space heating efficiency (main heating system 1)	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 fuel (main heating system)	482.3231	386.4760	339.9341	212.9217	116.9124	0.0000	0.0000	0.0000	0.0000	203.3870	347.2538	489.9690	(211)
Space heating efficiency (main heating system 2)	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 fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	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)

Efficiency of water heater 79.8000 (216)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(217)m	85.6219	85.4161	85.0073	84.2437	82.9988	79.8000	79.8000	79.8000	79.8000	84.1140	85.1747	85.6758	(217)
Fuel for water heating, kWh/month	255.0665	226.1331	241.5821	214.9548	211.8920	199.0509	196.8580	204.4581	206.4477	217.8600	228.0948	252.2167	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	21.3137	17.0986	15.3954	11.2794	8.7125	7.1182	7.9478	10.3309	13.4188	17.6062	19.8862	21.9061	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-52.9027	-69.7903	-93.9662	-98.7932	-101.1507	-92.6137	-91.4955	-88.9346	-83.7428	-76.4341	-56.4469	-46.3270	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-46.3699	-95.0346	-184.4471	-270.8544	-352.3869	-351.9734	-347.7731	-296.9682	-221.1257	-133.6562	-61.1425	-36.8555	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year		
Space heating fuel - main system 1	2579.1770	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	2654.6147	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	172.0137	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3351.1849	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	2140.6206	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2579.1770	0.2100	541.6272	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2654.6147	0.2100	557.4691	(264)
Space and water heating			1099.0963	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	172.0137	0.1443	24.8269	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-952.5976	0.1360	-129.5625	
PV Unit electricity exported	-2398.5873	0.1266	-303.6063	
Total			-433.1687	(269)
Total CO2, kg/year			702.6837	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.3600	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2579.1770	1.1300	2914.4701	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2654.6147	1.1300	2999.7146	(278)
Space and water heating			5914.1846	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	172.0137	1.5338	263.8404	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-952.5976	1.5027	-1431.5121	
PV Unit electricity exported	-2398.5873	0.4647	-1114.5169	
Total			-2546.0290	(283)
Total Primary energy kWh/year			3762.0968	(286)
Target Primary Energy Rate (TPER)			55.4900	(287)

Full SAP Calculation Printout

elmhurst energy

Property Reference	Type B	Issued on Date	19/01/2024
Assessment Reference	Type B	Prop Type Ref	Type A - Semi
Property	Type A - Semi, A, Clacton, -		

SAP Rating	94 A	DER	-0.21	TER	9.96
Environmental	100 A	% DER < TER			102.11
CO_2 Emissions (t/year)	-0.1	DFEE	41.60	TFEE	45.06
Compliance Check	See BREL	% DFEE < TFEE			7.68
% DPER < TPER	63.80	DPER	19.36	TPER	53.48

Assessor Details	Mr. Jonathan Lewis	Assessor ID	AZ32-0001
Client			

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SAP 10 WORKSHEET FOR New Build (As Designed)   (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE
----------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------


----------------------------------------------------------------------------------------------------
1. Overall dwelling characteristics
----------------------------------------------------------------------------------------------------
                                                                           Area         Storey height              Volume
                                                                           (m2)              (m)                    (m3)
Ground floor                                                            82.0000 (1b)    x      2.5000 (2b)    =     205.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)             82.0000                                          (4)
Dwelling volume                                                           (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     205.0000 (5)


----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                                                                         m3 per hour

Number of open chimneys                                                                          0 * 80 =      0.0000 (6a)
Number of open flues                                                                             0 * 20 =      0.0000 (6b)
Number of chimneys / flues attached to closed fire                                               0 * 10 =      0.0000 (6c)
Number of flues attached to solid fuel boiler                                                    0 * 20 =      0.0000 (6d)
Number of flues attached to other heater                                                         0 * 35 =      0.0000 (6e)
Number of blocked chimneys                                                                       0 * 20 =      0.0000 (6f)
Number of intermittent extract fans                                                              0 * 10 =      0.0000 (7a)
Number of passive vents                                                                          0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                     0 * 40 =      0.0000 (7c)

                                                                                                   Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =      0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                    Yes
Pressure Test Method                                                                                     Blower Door
Measured/design AP50                                                                                          3.0000 (17)
Infiltration rate                                                                                             0.1500 (18)
Number of sides sheltered                                                                                          2 (19)

Shelter factor                                                          (20) = 1  -  [0.075 x (19)]  =      0.8500 (20)
Infiltration rate adjusted to include shelter factor                           (21) = (18) x (20)    =      0.1275 (21)

              Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Wind speed    5.1000    5.0000    4.9000    4.4000    4.3000    3.8000    3.8000    3.7000    4.0000    4.3000    4.5000    4.7000 (22)
Wind factor   1.2750    1.2500    1.2250    1.1000    1.0750    0.9500    0.9500    0.9250    1.0000    1.0750    1.1250    1.1750 (22a)
Adj infilt rate
              0.1626    0.1594    0.1562    0.1403    0.1371    0.1211    0.1211    0.1179    0.1275    0.1371    0.1434    0.1498 (22b)
Effective ac  0.5132    0.5127    0.5122    0.5098    0.5094    0.5073    0.5073    0.5070    0.5081    0.5094    0.5103    0.5112 (25)


----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                      Gross       Openings      NetArea     U-value        A x U      K-value        A x K
                                                m2             m2           m2       W/m2K          W/K        kJ/m2K         kJ/K
Windows (Uw = 1.20)                                                    16.0000      1.1450      18.3206                            (27)
Solid Door                                                              2.1000      1.2000       2.5200                            (26)
Heatloss Floor 1                                                       82.0000      0.1300      10.6600                            (28a)
External Wall 1                            96.5000        18.1000      78.4000      0.1700      13.3280                            (29a)
External Roof 1                            82.0000                     82.0000      0.1200       9.8400                            (30)
Total net area of external elements Aum(A, m2)                        260.5000                                                    (31)
Fabric heat loss, W/K = Sum (A x U)                            (26)...(30) + (32) =   54.6686                                    (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                 100.0000 (35)
List of Thermal Bridges
        K1 Element                                                         Length      Psi-value        Total
        E2 Other lintels (including other steel lintels)                  12.0000         0.0280       0.3360
        E3 Sill                                                            12.0000         0.0390       0.4680
        E4 Jamb                                                            29.0000         0.0100       0.2900
        E5 Ground floor (normal)                                           34.0000         0.0500       1.7000
        E10 Eaves (insulation at ceiling level)                            34.0000         0.0780       2.6520
        E16 Corner (normal)                                                12.5000         0.0430       0.5375
        E17 Corner (inverted - internal area greater than external area)    2.5000         0.0000       0.0000
        E18 Party wall between dwellings                                    0.0000         0.0340       0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                          5.9835 (36)
```

Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	60.6521 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	34.7189	34.6842	34.6501	34.4903	34.4604	34.3213	34.3213	34.2955	34.3749	34.4604	34.5209	34.5842	(38)
Heat transfer coeff													
	95.3710	95.3363	95.3023	95.1425	95.1126	94.9734	94.9734	94.9476	95.0270	95.1126	95.1730	95.2363	(39)
Average = Sum(39)m / 12 =												95.1423	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1631	1.1626	1.1622	1.1603	1.1599	1.1582	1.1582	1.1579	1.1589	1.1599	1.1606	1.1614	(40)
HLP (average)												1.1603	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.4997	(42)
Hot water usage for mixer showers													
	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 for baths													
	76.2578	75.1253	73.5304	70.5898	68.3879	65.9463	64.6275	66.2112	67.9356	70.5481	73.5493	76.0000	(42b)
Hot water usage for other uses													
	40.2296	38.7667	37.3038	35.8409	34.3780	32.9151	32.9151	34.3780	35.8409	37.3038	38.7667	40.2296	(42c)
Average daily hot water use (litres/day)												107.2753	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	116.4874	113.8919	110.8342	106.4307	102.7659	98.8615	97.5426	100.5892	103.7765	107.8519	112.3160	116.2296	(44)
Energy conte	184.4875	162.1806	170.3480	145.6983	138.3427	121.5617	117.9694	124.5505	127.9668	146.3540	160.0147	181.9874	(45)
Energy content (annual)										Total = Sum(45)m =		1781.4615	
Distribution loss (46)m = 0.15 x (45)m													
	27.6731	24.3271	25.5522	21.8547	20.7514	18.2343	17.6954	18.6826	19.1950	21.9531	24.0022	27.2981	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.2480	(55)
Total storage loss													
	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 contains dedicated solar 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	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	278.0331	246.6734	263.8936	236.2263	231.8883	181.5137	179.9198	186.5009	187.9188	239.8996	250.5427	275.5330	(62)
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)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	278.0331	246.6734	263.8936	236.2263	231.8883	181.5137	179.9198	186.5009	187.9188	239.8996	250.5427	275.5330	(64)
								Total per year (kWh/year) = Sum(64)m =				2758.5431	(64)
12Total per year (kWh/year)												2759	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
					Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							0.0000	(64a)
Heat gains from water heating, kWh/month													
	136.1786	121.5193	131.4772	120.8671	120.8354	88.3809	88.7851	90.9734	90.5106	123.4992	125.6273	135.3473	(65)

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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	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	113.8740	126.0748	113.8740	117.6698	113.8740	117.6698	113.8740	113.8740	117.6698	113.8740	117.6698	113.8740	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	223.5697	225.8896	220.0434	207.5975	191.8868	177.1210	167.2565	164.9365	170.7828	183.2286	198.9393	213.7052	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	(71)
Water heating gains (Table 5)													
	183.0357	180.8323	176.7167	167.8709	162.4132	122.7512	119.3349	122.2760	125.7091	165.9935	174.4823	181.9184	(72)
Total internal gains													
	580.9751	593.2924	571.1298	553.6340	528.6698	478.0377	460.9611	461.5823	474.6574	523.5919	551.5872	569.9933	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.9000	10.6334	0.6300	0.7000	0.7700	9.4241	(74)
East	3.6000	19.6403	0.6300	0.7000	0.7700	21.6084	(76)
South	0.7000	46.7521	0.6300	0.7000	0.7700	10.0016	(78)
West	8.8000	19.6403	0.6300	0.7000	0.7700	52.8204	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	93.8545	179.9886	291.2487	422.4440	519.3694	533.2627	506.9743	433.7324	337.4655	211.8709	116.2851	77.7054	(83)
Total gains	674.8297	773.2810	862.3785	976.0780	1048.0392	1011.3005	967.9354	895.3147	812.1229	735.4628	667.8724	647.6987	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	23.8833	23.8920	23.9006	23.9407	23.9482	23.9833	23.9833	23.9898	23.9698	23.9482	23.9330	23.9171	
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 area	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	20.0505	20.1306	20.2520	20.4039	20.5259	20.5991	20.6293	20.6236	20.5630	20.4066	20.2025	20.0327	
Non living	18.8060	18.9062	19.0572	19.2428	19.3841	19.4635	19.4906	19.4869	19.4295	19.2513	18.9999	18.7848	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.5143	20.1306	20.2520	20.4039	20.5259	20.5991	20.6293	20.6236	20.5630	20.4066	20.2025	20.1680	(87)
Th 2	19.9497	19.9500	19.9503	19.9519	19.9522	19.9536	19.9536	19.9538	19.9530	19.9522	19.9516	19.9510	(88)
util rest of house	0.9257	0.8959	0.8458	0.7482	0.6116	0.4571	0.3165	0.3577	0.5763	0.7866	0.8935	0.9324	(89)
MIT 2	19.4937	18.9062	19.0572	19.2428	19.3841	19.4635	19.4906	19.4869	19.4295	19.2513	18.9999	18.9950	(90)
Living area fraction										fLA = Living area / (4) =		0.3780	(91)
MIT	19.8795	19.3691	19.5089	19.6818	19.8157	19.8928	19.9211	19.9166	19.8580	19.6881	19.4545	19.4384	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8795	19.3691	19.5089	19.6818	19.8157	19.8928	19.9211	19.9166	19.8580	19.6881	19.4545	19.4384	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9250	0.8880	0.8370	0.7396	0.6050	0.4528	0.3137	0.3544	0.5699	0.7775	0.8855	0.9278	(94)
Useful gains	624.2510	686.6895	721.8392	721.9132	634.1021	457.9659	303.6717	317.2961	462.8009	571.7865	591.4024	600.9033	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1485.8371	1379.4304	1239.7781	1025.8033	771.9096	502.6742	315.4156	333.8967	547.1655	864.3877	1175.8177	1451.2498	(97)
Space heating kWh	641.0200	465.5219	385.3466	218.8009	102.5287	0.0000	0.0000	0.0000	0.0000	217.6954	420.7790	632.6578	(98a)
Space heating requirement - total per year (kWh/year)												3084.3503	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	641.0200	465.5219	385.3466	218.8009	102.5287	0.0000	0.0000	0.0000	0.0000	217.6954	420.7790	632.6578	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3084.3503	
Space heating per m2											(98c) / (4) =	37.6140	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	263.4972	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	641.0200	465.5219	385.3466	218.8009	102.5287	0.0000	0.0000	0.0000	0.0000	217.6954	420.7790	632.6578	(98)
Space heating efficiency (main heating system 1)	263.4972	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 fuel (main heating system)	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 efficiency (main heating system 2)	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 fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	278.0331	246.6734	263.8936	236.2263	231.8883	181.5137	179.9198	186.5009	187.9188	239.8996	250.5427	275.5330	(64)
Efficiency of water heater												163.6200	(216)
(217)m	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)
Fuel for water heating, kWh/month	169.9261	150.7599	161.2845	144.3749	141.7237	110.9361	109.9620	113.9842	114.8507	146.6200	153.1247	168.3981	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
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	22.0165	17.6624	15.9031	11.6513	8.9998	7.3529	8.2099	10.6715	13.8613	18.1867	20.5419	22.6284	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-66.7331	-96.9960	-142.4453	-157.5618	-163.6093	-139.2192	-137.3247	-131.0632	-117.3509	-107.9796	-73.3721	-57.0951	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-30.2461	-69.2557	-150.5308	-246.2319	-342.6189	-360.9328	-355.2251	-294.8073	-208.7357	-107.4100	-42.5768	-23.4157	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	1170.5437	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	163.6200	
Water heating fuel used	1685.9450	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	177.6856	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3622.7372	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)

Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	-588.5629	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1170.5437	0.1553	181.7922	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1685.9450	0.1416	238.6564	(264)
Space and water heating			420.4486	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	177.6856	0.1443	25.6455	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1390.7503	0.1354	-188.3349	
PV Unit electricity exported	-2231.9869	0.1233	-275.2496	
Total			-463.5845	(269)
Total CO2, kg/year			-17.4903	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-0.2100	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1170.5437	1.5750	1843.5526	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1685.9450	1.5235	2568.4921	(278)
Space and water heating			4412.0447	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	177.6856	1.5338	272.5402	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1390.7503	1.5006	-2086.9039	
PV Unit electricity exported	-2231.9869	0.4525	-1010.0344	
Total			-3096.9384	(283)
Total Primary energy kWh/year			1587.6465	(286)
Dwelling Primary energy Rate (DPER)			19.3600	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	82.0000 (1b)	x	2.5000 (2b)	=	205.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 82.0000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	205.0000	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1463	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3963	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3369	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4295	0.4211	0.4127	0.3706	0.3622	0.3200	0.3200	0.3116	0.3369	0.3622	0.3790	0.3958	(22b)
Effective ac	0.5923	0.5887	0.5852	0.5687	0.5656	0.5512	0.5512	0.5486	0.5567	0.5656	0.5718	0.5783	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.20)			16.0000	1.1450	18.3206			(27)
Heatloss Floor 1			82.0000	0.1300	10.6600			(28a)
External Wall 1	96.5000	18.1000	78.4000	0.1800	14.1120			(29a)
External Roof 1	82.0000		82.0000	0.1100	9.0200			(30)
Total net area of external elements Aum(A, m2)			260.5000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		54.2126			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	12.0000	0.0500	0.6000
E3 Sill	12.0000	0.0500	0.6000
E4 Jamb	29.0000	0.0500	1.4500
E5 Ground floor (normal)	34.0000	0.1600	5.4400
E10 Eaves (insulation at ceiling level)	34.0000	0.0600	2.0400
E16 Corner (normal)	12.5000	0.0900	1.1250
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	0.0000	0.0600	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.0300 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 65.2426 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.0657	39.8234	39.5859	38.4702	38.2614	37.2897	37.2897	37.1097	37.6640	38.2614	38.6837	39.1252	(38)
Heat transfer coeff	105.3083	105.0660	104.8285	103.7128	103.5040	102.5323	102.5323	102.3523	102.9066	103.5040	103.9263	104.3678	(39)
Average = Sum(39)m / 12 =												103.7118	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2842	1.2813	1.2784	1.2648	1.2622	1.2504	1.2504	1.2482	1.2550	1.2622	1.2674	1.2728	(40)
HLP (average)												1.2648	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4997 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	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 for baths	76.2578	75.1253	73.5304	70.5898	68.3879	65.9463	64.6275	66.2112	67.9356	70.5481	73.5493	76.0000	(42b)
Hot water usage for other uses	40.2296	38.7667	37.3038	35.8409	34.3780	32.9151	32.9151	34.3780	35.8409	37.3038	38.7667	40.2296	(42c)
Average daily hot water use (litres/day)												107.2753	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	116.4874	113.8919	110.8342	106.4307	102.7659	98.8615	97.5426	100.5892	103.7765	107.8519	112.3160	116.2296	(44)
Energy conte	184.4875	162.1806	170.3480	145.6983	138.3427	121.5617	117.9694	124.5505	127.9668	146.3540	160.0147	181.9874	(45)
Energy content (annual)										Total = Sum(45)m =		1781.4615	
Distribution loss (46)m = 0.15 x (45)m	27.6731	24.3271	25.5522	21.8547	20.7514	18.2343	17.6954	18.6826	19.1950	21.9531	24.0022	27.2981	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5003	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8102	(55)
Total storage loss	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
If cylinder contains dedicated solar storage	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(57)
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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	232.8652	205.8766	218.7257	192.5154	186.7204	168.3788	166.3471	172.9282	174.7839	194.7317	206.8318	230.3651	(62)
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)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	232.8652	205.8766	218.7257	192.5154	186.7204	168.3788	166.3471	172.9282	174.7839	194.7317	206.8318	230.3651	(64)
								Total per year (kWh/year) = Sum(64)m =				2351.0700	(64)
12Total per year (kWh/year)												2351	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
					Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							0.0000	(64a)
Heat gains from water heating, kWh/month	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 Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	113.8740	126.0748	113.8740	117.6698	113.8740	117.6698	113.8740	113.8740	117.6698	113.8740	117.6698	113.8740	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.5697	225.8896	220.0434	207.5975	191.8868	177.1210	167.2565	164.9365	170.7828	183.2286	198.9393	213.7052	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	(71)
Water heating gains (Table 5)	134.4681	132.2646	128.1490	119.3033	113.8456	108.1569	104.7406	107.6817	111.1148	117.4259	125.9147	133.3508	(72)
Total internal gains	535.4075	547.7248	525.5622	508.0664	483.1021	463.4434	446.3668	446.9880	460.0631	478.0243	506.0196	524.4257	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.9000	10.6334	0.6300	0.7000	0.7700	9.4241	(74)
East	3.6000	19.6403	0.6300	0.7000	0.7700	21.6084	(76)
South	0.7000	46.7521	0.6300	0.7000	0.7700	10.0016	(78)
West	8.8000	19.6403	0.6300	0.7000	0.7700	52.8204	(80)

Solar gains	93.8545	179.9886	291.2487	422.4440	519.3694	533.2627	506.9743	433.7324	337.4655	211.8709	116.2851	77.7054	(83)
Total gains	629.2620	727.7133	816.8108	930.5104	1002.4715	996.7062	953.3411	880.7204	797.5286	689.8952	622.3047	602.1310	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.6296	21.6795	21.7286	21.9624	22.0067	22.2152	22.2152	22.2543	22.1344	22.0067	21.9172	21.8245	
alpha	2.4420	2.4453	2.4486	2.4642	2.4671	2.4810	2.4810	2.4836	2.4756	2.4671	2.4611	2.4550	
util living area	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	18.2358	18.5747	19.1029	19.7974	20.3684	20.7509	20.9036	20.8746	20.5781	19.8230	18.9224	18.1837	(87)
Th 2	19.8532	19.8555	19.8578	19.8685	19.8705	19.8799	19.8799	19.8816	19.8763	19.8705	19.8665	19.8622	(88)
util rest of house	0.9381	0.9121	0.8681	0.7787	0.6489	0.4812	0.3351	0.3780	0.6021	0.8173	0.9111	0.9438	(89)
MIT 2	16.6590	17.0853	17.7461	18.6012	19.2711	19.6894	19.8279	19.8093	19.5245	18.6550	17.5368	16.5983	(90)
Living area fraction									fLA = Living area / (4) =			0.3780	(91)
MIT	17.2551	17.6484	18.2590	19.0534	19.6859	20.0907	20.2346	20.2121	19.9228	19.0966	18.0606	17.1977	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.2551	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 heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9125	0.8830	0.8375	0.7539	0.6403	0.4958	0.3668	0.4083	0.6052	0.7919	0.8831	0.9194	(94)
Useful gains	574.1907	642.5402	684.1109	701.4802	641.8342	494.1702	349.7144	359.6105	482.6316	546.3131	549.5677	553.6054	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1364.2794	1339.4213	1232.6818	1053.0365	826.5738	562.9708	372.6626	390.1729	599.2028	879.4301	1139.0952	1356.5364	(97)
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	(98a)
Space heating requirement - total per year (kWh/year)												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 contribution - total per year (kWh/year)												0.0000	
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	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3124.5131	
Space heating per m2											(98c) / (4) =	38.1038	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 92.3000 (206)
Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	587.8260	468.3042	408.1367	253.1205	137.4463	0.0000	0.0000	0.0000	0.0000	247.8391	424.4598	597.3806	(98)
Space heating efficiency (main heating system 1)	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 fuel (main heating system)	636.8645	507.3718	442.1850	274.2367	148.9126	0.0000	0.0000	0.0000	0.0000	268.5147	459.8697	647.2163	(211)
Space heating efficiency (main heating system 2)	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 fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	232.8652	205.8766	218.7257	192.5154	186.7204	168.3788	166.3471	172.9282	174.7839	194.7317	206.8318	230.3651	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.0464	85.8435	85.4378	84.6745	83.3832	79.8000	79.8000	79.8000	79.8000	84.6017	85.6357	86.0976	(217)
Fuel for water heating, kWh/month	270.6274	239.8278	256.0057	227.3594	223.9304	211.0010	208.4550	216.7020	219.0274	230.1747	241.5253	267.5628	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	23.6608	18.9816	17.0908	12.5214	9.6719	7.9020	8.8230	11.4685	14.8965	19.5450	22.0760	24.3184	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-62.8836	-82.4495	-110.3341	-115.2512	-117.3676	-107.1857	-105.8152	-103.1055	-97.5761	-89.8059	-66.8683	-55.1235	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-57.1806	-116.8962	-226.3899	-331.8152	-431.1586	-430.5155	-425.4537	-363.6205	-271.1438	-164.2855	-75.3489	-45.4806	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1	3385.1713	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	2812.1989	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	190.9560	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4053.0554	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	2421.2708	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3385.1713	0.2100	710.8860	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2812.1989	0.2100	590.5618	(264)
Space and water heating			1301.4478	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	190.9560	0.1443	27.5609	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1113.7663	0.1362	-151.6522	
PV Unit electricity exported	-2939.2891	0.1266	-372.2071	
Total			-523.8593	(269)
Total CO2, kg/year			817.0786	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.9600	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3385.1713	1.1300	3825.2436	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2812.1989	1.1300	3177.7848	(278)
Space and water heating			7003.0284	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	190.9560	1.5338	292.8947	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1113.7663	1.5033	-1674.3424	
PV Unit electricity exported	-2939.2891	0.4649	-1366.3512	
Total			-3040.6937	(283)
Total Primary energy kWh/year			4385.3302	(286)
Target Primary Energy Rate (TPER)			53.4800	(287)

Full SAP Calculation Printout

elmhurst energy

Property Reference	Type C	Issued on Date	19/01/2024
Assessment Reference	Type C	Prop Type Ref	Type A - Semi
Property	Type 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/year)	-0.12	DFEE	41.21	TFEE	44.32
Compliance Check	See BREL	% DFEE < TFEE			7.00
% DPER < TPER	60.07	DPER	17.82	TPER	44.63

Assessor Details	Mr. Jonathan Lewis	Assessor ID	AZ32-0001
Client			

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SAP 10 WORKSHEET FOR New Build (As Designed)   (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE
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-----------------------------------------------------------------------------------------------------
1. Overall dwelling characteristics
-----------------------------------------------------------------------------------------------------
                                                                                                       Area          Storey height              Volume
                                                                                                      (m2)                (m)                   (m3)
Ground floor                                                                                      110.5000 (1b)     x      2.5000 (2b)    =     276.2500 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              110.5000                                                                   (4)
Dwelling volume                                                                                           (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     276.2500 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                                                                                                                           m3 per hour

Number of open chimneys                                                                                                       0 * 80 =       0.0000 (6a)
Number of open flues                                                                                                          0 * 20 =       0.0000 (6b)
Number of chimneys / flues attached to closed fire                                                                            0 * 10 =       0.0000 (6c)
Number of flues attached to solid fuel boiler                                                                                 0 * 20 =       0.0000 (6d)
Number of flues attached to other heater                                                                                      0 * 35 =       0.0000 (6e)
Number of blocked chimneys                                                                                                    0 * 20 =       0.0000 (6f)
Number of intermittent extract fans                                                                                           0 * 10 =       0.0000 (7a)
Number of passive vents                                                                                                       0 * 10 =       0.0000 (7b)
Number of flueless gas fires                                                                                                  0 * 40 =       0.0000 (7c)

                                                                                                                              Air changes per hour
Infiltration due to chimneys, flues and fans    = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =          0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                                                  Yes
Pressure Test Method                                                                                                                   Blower Door
Measured/design AP50                                                                                                                       3.0000 (17)
Infiltration rate                                                                                                                          0.1500 (18)
Number of sides sheltered                                                                                                                       2 (19)

Shelter factor                                                                                      (20) = 1  -  [0.075 x (19)]  =       0.8500 (20)
Infiltration rate adjusted to include shelter factor                                                          (21) = (18) x (20)   =       0.1275 (21)


                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed       5.1000     5.0000     4.9000     4.4000     4.3000     3.8000     3.8000     3.7000     4.0000     4.3000     4.5000     4.7000 (22)
Wind factor      1.2750     1.2500     1.2250     1.1000     1.0750     0.9500     0.9500     0.9250     1.0000     1.0750     1.1250     1.1750 (22a)
Adj infilt rate
                 0.1626     0.1594     0.1562     0.1403     0.1371     0.1211     0.1211     0.1179     0.1275     0.1371     0.1434     0.1498 (22b)
Effective ac     0.5132     0.5127     0.5122     0.5098     0.5094     0.5073     0.5073     0.5070     0.5081     0.5094     0.5103     0.5112 (25)


-----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------------
Element                                            Gross        Openings         NetArea        U-value          A x U        K-value           A x K
                                                      m2              m2              m2          W/m2K            W/K          kJ/m2K           kJ/K
Windows (Uw = 1.20)                                                              24.3000         1.1450        27.8244                                  (27)
Solid Door                                                                        2.1000         1.2000         2.5200                                  (26)
Heatloss Floor 1                                                                110.0000         0.1300        14.3000                                  (28a)
External Wall 1                                 115.0000         26.4000         88.6000         0.1700        15.0620                                  (29a)
External Roof 1                                 110.0000                        110.0000         0.1200        13.2000                                  (30)
Total net area of external elements Aum(A, m2)                                  335.0000                                                                (31)
Fabric heat loss, W/K = Sum (A x U)                                       (26)...(30) + (32) =     72.9064                                              (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                       100.0000 (35)
List of Thermal Bridges
        K1 Element                                                                               Length       Psi-value         Total
        E2 Other lintels (including other steel lintels)                                        15.0000          0.0280        0.4200
        E3 Sill                                                                                 15.0000          0.0390        0.5850
        E4 Jamb                                                                                 28.0000          0.0100        0.2800
        E5 Ground floor (normal)                                                                46.0000          0.0500        2.3000
        E10 Eaves (insulation at ceiling level)                                                 46.0000          0.0780        3.5880
        E16 Corner (normal)                                                                     15.0000          0.0430        0.6450
        E17 Corner (inverted - internal area greater than external area)                         2.5000          0.0000        0.0000
        E18 Party wall between dwellings                                                         0.0000          0.0340        0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                                7.8180 (36)
```

Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	80.7244	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	46.7858	46.7390	46.6932	46.4778	46.4375	46.2500	46.2500	46.2153	46.3222	46.4375	46.5191	46.6043	(38)
Heat transfer coeff	127.5102	127.4635	127.4176	127.2023	127.1620	126.9744	126.9744	126.9397	127.0467	127.1620	127.2435	127.3287	(39)
Average = Sum(39)m / 12 =												127.2021	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1539	1.1535	1.1531	1.1512	1.1508	1.1491	1.1491	1.1488	1.1497	1.1508	1.1515	1.1523	(40)
HLP (average)												1.1511	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.8178	(42)
Hot water usage for mixer showers	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 for baths	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)
Hot water usage for other uses	43.4870	41.9057	40.3243	38.7430	37.1616	35.5803	35.5803	37.1616	38.7430	40.3243	41.9057	43.4870	(42c)
Average daily hot water use (litres/day)												115.9616	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	125.9195	123.1139	119.8086	115.0486	111.0870	106.8664	105.4408	108.7341	112.1794	116.5849	121.4104	125.6409	(44)
Energy conte	199.4258	175.3126	184.1414	157.4957	149.5445	131.4047	127.5216	134.6355	138.3284	158.2046	172.9713	196.7232	(45)
Energy content (annual)											Total = Sum(45)m =	1925.7093	
Distribution loss (46)m = 0.15 x (45)m	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)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.2480	(55)
Total storage loss	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 contains dedicated solar 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	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	292.9714	259.8054	277.6870	248.0237	243.0901	191.3567	189.4720	196.5859	198.2804	251.7502	263.4993	290.2688	(62)
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)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	292.9714	259.8054	277.6870	248.0237	243.0901	191.3567	189.4720	196.5859	198.2804	251.7502	263.4993	290.2688	(64)
								Total per year (kWh/year) = Sum(64)m =				2902.7909	(64)
12Total per year (kWh/year)												2903	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
					Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							0.0000	(64a)
Heat gains from water heating, kWh/month	141.1455	125.8857	136.0635	124.7897	124.5600	91.6537	91.9612	94.3266	93.9558	127.4395	129.9354	140.2469	(65)

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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	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	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)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	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)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	(71)
Water heating gains (Table 5)	189.7118	187.3299	182.8810	173.3191	167.4194	127.2968	123.6038	126.7831	130.4942	171.2896	180.4658	188.5040	(72)
Total internal gains	664.6304	679.7931	653.5052	633.3655	603.7533	550.2276	529.9419	530.2959	545.7060	597.0793	629.9679	651.4092	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.9000	10.6334	0.6300	0.7000	0.7700	38.6715	(74)
East	2.1000	19.6403	0.6300	0.7000	0.7700	12.6049	(76)
South	5.0000	46.7521	0.6300	0.7000	0.7700	71.4402	(78)
West	5.3000	19.6403	0.6300	0.7000	0.7700	31.8123	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	154.5288	277.7932	417.7120	578.8530	703.0195	721.6339	685.8952	589.8653	473.0999	317.2698	187.7702	130.4959	(83)
Total gains	819.1592	957.5862	1071.2173	1212.2185	1306.7728	1271.8614	1215.8371	1120.1612	1018.8059	914.3491	817.7381	781.9051	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)		

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           24.0721    24.0810    24.0896    24.1304    24.1381    24.1737    24.1737    24.1803    24.1600    24.1381    24.1226    24.1065
alpha          2.6048     2.6054     2.6060     2.6087     2.6092     2.6116     2.6116     2.6120     2.6107     2.6092     2.6082     2.6071
util living area
               0.9472     0.9218     0.8819     0.8027     0.6860     0.5496     0.4248     0.4710     0.6668     0.8399     0.9234     0.9527 (86)

Living        20.0239    20.1087    20.2316    20.3870    20.5161    20.5960    20.6289    20.6225    20.5573    20.3923    20.1806    20.0051
Non living    18.7795    18.8860    19.0396    19.2306    19.3815    19.4689    19.4989    19.4946    19.4319    19.2421    18.9798    18.7570
24 / 16             0          0          0          0          0          0          0          0          0          0          0          0
24 / 9              3          0          0          0          0          0          0          0          0          0          0          0
16 / 9             28          0          0          0          0          0          0          0          0          0          0         10
MIT           20.5007    20.1087    20.2316    20.3870    20.5161    20.5960    20.6289    20.6225    20.5573    20.3923    20.1806    20.1443 (87)
Th 2          19.9570    19.9574    19.9577    19.9593    19.9596    19.9609    19.9609    19.9612    19.9604    19.9596    19.9590    19.9584 (88)
util rest of house
               0.9396     0.9109     0.8651     0.7743     0.6402     0.4809     0.3359     0.3802     0.6028     0.8102     0.9107     0.9459 (89)
MIT 2         19.4876    18.8860    19.0396    19.2306    19.3815    19.4689    19.4989    19.4946    19.4319    19.2421    18.9798    18.9735 (90)
Living area fraction                                                                               fLA = Living area / (4) =          0.1810 (91)
MIT           19.6709    19.1073    19.2553    19.4399    19.5869    19.6729    19.7034    19.6987    19.6356    19.4503    19.1971    19.1854 (92)
Temperature adjustment                                                                                                                0.0000
adjusted MIT  19.6709    19.1073    19.2553    19.4399    19.5869    19.6729    19.7034    19.6987    19.6356    19.4503    19.1971    19.1854 (93)
```

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-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9373     0.9004     0.8521     0.7582     0.6221     0.4602     0.3123     0.3554     0.5802     0.7932     0.8997     0.9399 (94)
Useful gains  767.8082   862.2091   912.7461   919.1558   812.8982   585.3001   379.7644   398.0848   591.0813   725.2528   735.7342   734.9360 (95)
Ext temp.      4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
            1959.9525  1810.9168  1625.2548  1340.6976  1002.9112   644.1261   394.0542   418.7403   703.2753  1125.4162  1539.2765  1908.0711 (97)
Space heating kWh
             886.9553   637.5316   530.1065   303.5101   141.3697     0.0000     0.0000     0.0000     0.0000   297.7216   578.5505   872.8125 (98a)
Space heating requirement - total per year (kWh/year)                                                                             4248.5578
Solar heating kWh
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (98b)
Solar heating contribution - total per year (kWh/year)                                                                               0.0000
Space heating kWh
             886.9553   637.5316   530.1065   303.5101   141.3697     0.0000     0.0000     0.0000     0.0000   297.7216   578.5505   872.8125 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)                                                    4248.5578
Space heating per m2                                                                                      (98c) / (4) =      38.4485 (99)
```

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9a. Energy requirements - Individual heating systems, including micro-CHP
-----------------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                                0.0000 (201)
Fraction of space heat from main system(s)                                                                                           1.0000 (202)
Efficiency of main space heating system 1 (in %)                                                                                   257.9568 (206)
Efficiency of main space heating system 2 (in %)                                                                                     0.0000 (207)
Efficiency of secondary/supplementary heating system, %                                                                              0.0000 (208)

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
             886.9553   637.5316   530.1065   303.5101   141.3697     0.0000     0.0000     0.0000     0.0000   297.7216   578.5505   872.8125 (98)
Space heating efficiency (main heating system 1)
             257.9568   257.9568   257.9568   257.9568   257.9568     0.0000     0.0000     0.0000     0.0000   257.9568   257.9568   257.9568 (210)
Space heating fuel (main heating system)
             343.8387   247.1467   205.5020   117.6593    54.8036     0.0000     0.0000     0.0000     0.0000   115.4153   224.2819   338.3561 (211)
Space heating efficiency (main heating system 2)
               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 fuel (main heating system 2)
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (213)
Space heating fuel (secondary)
               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
             292.9714   259.8054   277.6870   248.0237   243.0901   191.3567   189.4720   196.5859   198.2804   251.7502   263.4993   290.2688 (64)
Efficiency of water heater                                                                                                         163.7728 (216)
(217)m       163.7728   163.7728   163.7728   163.7728   163.7728   163.7728   163.7728   163.7728   163.7728   163.7728   163.7728   163.7728 (217)
Fuel for water heating, kWh/month
             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)
Space cooling fuel requirement
(221)m         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (221)
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      26.5610    21.3082    19.1857    14.0563    10.8575     8.8706     9.9045    12.8743    16.7224    21.9407    24.7820    27.2992 (232)
Electricity generated by PVs (Appendix M) (negative quantity)
(233a)m      -79.5957  -115.7519  -169.9656  -187.1982  -192.2733  -161.8207  -159.5233  -152.3723  -136.7861  -127.8990   -87.3477   -68.0348 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234a)m        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235a)m        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235c)m        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)
(233b)m      -35.0162   -80.7274  -176.2788  -290.0125  -405.9965  -429.2681  -422.5810  -350.9292  -248.5890  -126.6524   -49.6828   -27.1144 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234b)m        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235b)m        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235d)m        0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (235d)
Annual totals kWh/year
Space heating fuel - main system 1                                                                                                1647.0036 (211)
Space heating fuel - main system 2                                                                                                   0.0000 (213)
Space heating fuel - secondary                                                                                                       0.0000 (215)
Efficiency of water heater                                                                                                         163.7728
Water heating fuel used                                                                                                           1772.4502 (219)
Space cooling fuel                                                                                                                   0.0000 (221)

Electricity for pumps and fans:
Total electricity for the above, kWh/year                                                                                            0.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                                214.3625 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation                                                                                                                    -4281.4167 (233)
Wind generation                                                                                                                      0.0000 (234)
Hydro-electric generation (Appendix N)                                                                                               0.0000 (235a)
```

Electricity generated - Micro CHP (Appendix N)			0.0000 (235)
Appendix Q - special features			
Energy saved or generated			-0.0000 (236)
Energy used			0.0000 (237)
Total delivered energy for all uses			-647.6004 (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1647.0036	0.1553	255.8054 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1772.4502	0.1416	250.9006 (264)
Space and water heating			506.7060 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	214.3625	0.1443	30.9391 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1638.5686	0.1356	-222.2012
PV Unit electricity exported	-2642.8482	0.1231	-325.3726
Total			-547.5738 (269)
Total CO2, kg/year			-9.9287 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-0.0900 (273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1647.0036	1.5750	2594.0120 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1772.4502	1.5235	2700.2746 (278)
Space and water heating			5294.2867 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	214.3625	1.5338	328.7964 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1638.5686	1.5013	-2459.9270
PV Unit electricity exported	-2642.8482	0.4518	-1193.9277
Total			-3653.8547 (283)
Total Primary energy kWh/year			1969.2284 (286)
Dwelling Primary energy Rate (DPER)			17.8200 (287)

SAP 10 WORKSHEET FOR New Build (As Designed)   (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)
Ground floor	110.5000 (1b)	x	2.5000 (2b)	=	276.2500 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 110.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	276.2500 (5)

2. Ventilation rate

		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1448 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3948 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3356 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4279	0.4195	0.4111	0.3691	0.3607	0.3188	0.3188	0.3104	0.3356	0.3607	0.3775	0.3943	(22b)
Effective ac	0.5915	0.5880	0.5845	0.5681	0.5651	0.5508	0.5508	0.5482	0.5563	0.5651	0.5713	0.5777	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.20)			24.3000	1.1450	27.8244			(27)
Heatloss Floor 1			110.0000	0.1300	14.3000			(28a)
External Wall 1	115.0000	26.4000	88.6000	0.1800	15.9480			(29a)
External Roof 1	110.0000		110.0000	0.1100	12.1000			(30)
Total net area of external elements Aum(A, m2)			335.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.2724			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	15.0000	0.0500	0.7500
E3 Sill	15.0000	0.0500	0.7500
E4 Jamb	28.0000	0.0500	1.4000
E5 Ground floor (normal)	46.0000	0.1600	7.3600
E10 Eaves (insulation at ceiling level)	46.0000	0.0600	2.7600
E16 Corner (normal)	15.0000	0.0900	1.3500
E17 Corner (inverted – internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	0.0000	0.0600	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.1450 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 86.4174 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.9256	53.6015	53.2839	51.7922	51.5131	50.2138	50.2138	49.9732	50.7142	51.5131	52.0777	52.6680	(38)
Heat transfer coeff	140.3430	140.0190	139.7014	138.2096	137.9305	136.6312	136.6312	136.3906	137.1317	137.9305	138.4951	139.0854	(39)
Average = Sum(39)m / 12 =												138.2083	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2701	1.2671	1.2643	1.2508	1.2482	1.2365	1.2365	1.2343	1.2410	1.2482	1.2533	1.2587	(40)
HLP (average)												1.2508	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8178 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	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 for baths	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)
Hot water usage for other uses	43.4870	41.9057	40.3243	38.7430	37.1616	35.5803	35.5803	37.1616	38.7430	40.3243	41.9057	43.4870	(42c)
Average daily hot water use (litres/day)												115.9616	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	125.9195	123.1139	119.8086	115.0486	111.0870	106.8664	105.4408	108.7341	112.1794	116.5849	121.4104	125.6409	(44)
Energy conte	199.4258	175.3126	184.1414	157.4957	149.5445	131.4047	127.5216	134.6355	138.3284	158.2046	172.9713	196.7232	(45)
Energy content (annual)										Total = Sum(45)m =		1925.7093	
Distribution loss (46)m = 0.15 x (45)m	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)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5003	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8102	(55)
Total storage loss	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
If cylinder contains dedicated solar storage	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(57)
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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	247.8035	219.0086	232.5191	204.3128	197.9222	178.2219	175.8993	183.0132	185.1456	206.5823	219.7885	245.1009	(62)
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)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	247.8035	219.0086	232.5191	204.3128	197.9222	178.2219	175.8993	183.0132	185.1456	206.5823	219.7885	245.1009	(64)
								Total per year (kWh/year) = Sum(64)m =				2495.3177	(64)
12Total per year (kWh/year)												2495	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
					Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							0.0000	(64a)
Heat gains from water heating, kWh/month	105.0112	93.2482	99.9292	89.8210	88.4257	81.1458	81.1031	83.4685	83.4479	91.3052	94.9667	104.1126	(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)m	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	140.8897	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	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)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	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)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	37.0890	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	-112.7118	(71)
Water heating gains (Table 5)	141.1441	138.7623	134.3134	124.7514	118.8517	112.7025	109.0095	112.1888	115.8999	122.7220	131.8982	139.9363	(72)
Total internal gains	619.0627	634.2254	607.9376	587.7978	558.1857	535.6333	515.3476	515.7016	531.1117	551.5117	584.4003	605.8416	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.9000	10.6334	0.6300	0.7000	0.7700	38.6715	(74)
East	2.1000	19.6403	0.6300	0.7000	0.7700	12.6049	(76)
South	5.0000	46.7521	0.6300	0.7000	0.7700	71.4402	(78)
West	5.3000	19.6403	0.6300	0.7000	0.7700	31.8123	(80)

Solar gains	154.5288	277.7932	417.7120	578.8530	703.0195	721.6339	685.8952	589.8653	473.0999	317.2698	187.7702	130.4959	(83)
Total gains	773.5916	912.0186	1025.6496	1166.6508	1261.2052	1257.2671	1201.2428	1105.5669	1004.2116	868.7815	772.1705	736.3374	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.8710	21.9216	21.9715	22.2086	22.2536	22.4652	22.4652	22.5048	22.3832	22.2536	22.1628	22.0688	
alpha	2.4581	2.4614	2.4648	2.4806	2.4836	2.4977	2.4977	2.5003	2.4922	2.4836	2.4775	2.4713	
util living area	0.9551	0.9329	0.8981	0.8268	0.7190	0.5766	0.4518	0.4985	0.6921	0.8625	0.9350	0.9598	(86)
MIT	18.1566	18.5109	19.0393	19.7378	20.3289	20.7322	20.8952	20.8631	20.5506	19.7773	18.8565	18.1013	(87)
Th 2	19.8644	19.8667	19.8689	19.8796	19.8816	19.8909	19.8909	19.8927	19.8873	19.8816	19.8776	19.8733	(88)
util rest of house	0.9482	0.9228	0.8823	0.7991	0.6723	0.5033	0.3535	0.3993	0.6258	0.8344	0.9235	0.9536	(89)
MIT 2	16.5660	17.0129	17.6761	18.5406	19.2391	19.6837	19.8335	19.8124	19.5081	18.6099	17.4621	16.5010	(90)
Living area fraction									fLA = Living area / (4) =			0.1810	(91)
MIT	16.8539	17.2841	17.9228	18.7573	19.4364	19.8735	20.0257	20.0026	19.6968	18.8212	17.7145	16.7906	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.8539	17.2841	17.9228	18.7573	19.4364	19.8735	20.0257	20.0026	19.6968	18.8212	17.7145	16.7906	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9213	0.8907	0.8467	0.7656	0.6513	0.5020	0.3662	0.4099	0.6129	0.8004	0.8922	0.9283	(94)
Useful gains	712.6747	812.3225	868.3878	893.1709	821.3706	631.2006	439.8776	453.1910	615.4534	695.3832	688.9302	683.5727	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1761.8474	1734.0031	1595.7820	1362.3724	1067.0786	720.5202	468.0529	491.3631	767.4977	1133.9496	1470.0568	1751.1707	(97)
Space heating kWh	780.5845	619.3694	541.1813	337.8251	182.8068	0.0000	0.0000	0.0000	0.0000	326.2934	562.4111	794.2929	(98a)
Space heating requirement - total per year (kWh/year)												4144.7644	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	780.5845	619.3694	541.1813	337.8251	182.8068	0.0000	0.0000	0.0000	0.0000	326.2934	562.4111	794.2929	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4144.7644	
Space heating per m2										(98c) / (4) =		37.5092	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	780.5845	619.3694	541.1813	337.8251	182.8068	0.0000	0.0000	0.0000	0.0000	326.2934	562.4111	794.2929	(98)
Space heating efficiency (main heating system 1)	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 fuel (main heating system)	845.7037	671.0394	586.3286	366.0077	198.0572	0.0000	0.0000	0.0000	0.0000	353.5140	609.3295	860.5557	(211)
Space heating efficiency (main heating system 2)	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 fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	247.8035	219.0086	232.5191	204.3128	197.9222	178.2219	175.8993	183.0132	185.1456	206.5823	219.7885	245.1009	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.4506	86.2587	85.8889	85.1796	83.8820	79.8000	79.8000	79.8000	79.8000	85.0801	86.0723	86.4995	(217)
Fuel for water heating, kWh/month	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)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	28.5447	22.8996	20.6186	15.1060	11.6683	9.5331	10.6443	13.8358	17.9713	23.5794	26.6328	29.3380	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-81.4861	-105.3281	-138.9474	-142.9580	-143.7987	-130.6142	-128.8421	-126.3513	-120.9996	-113.4695	-86.0354	-71.6137	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-80.3076	-163.3024	-314.8087	-459.4913	-595.3739	-593.9710	-587.0751	-502.5905	-375.8730	-228.9343	-105.6110	-63.9566	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1	4490.5356	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	2973.7049	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	230.3721	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-5461.7394	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	2318.8732	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4490.5356	0.2100	943.0125	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2973.7049	0.2100	624.4780	(264)
Space and water heating			1567.4905	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	230.3721	0.1443	33.2498	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1390.4441	0.1365	-189.8028	
PV Unit electricity exported	-4071.2953	0.1268	-516.0641	
Total			-705.8669	(269)
Total CO2, kg/year			906.8027	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.2100	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4490.5356	1.1300	5074.3053	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2973.7049	1.1300	3360.2865	(278)
Space and water heating			8434.5917	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	230.3721	1.5338	353.3524	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1390.4441	1.5046	-2092.0672	
PV Unit electricity exported	-4071.2953	0.4653	-1894.4618	
Total			-3986.5290	(283)
Total Primary energy kWh/year			4931.5160	(286)
Target Primary Energy Rate (TPER)			44.6300	(287)

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