Haven Road, Exeter

Energy and Sustainability Statement

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Contents

1.0 Executive Summary

This report considers the energy and sustainability measures to be incorporated within the proposed development on Haven Road, Exeter. This document reviews the requirements at both national and local level, as set out in the National Planning Policy Framework, Exeter City Council Core Strategy (Adopted February 2012) and Exeter City Council Local Plan Review (1995 – 2011) (Saved Policies).

The recommended sustainability features for the development, resulting from a Part L compliant model, will allow for a 22.39% carbon reduction from a base Part L 2013 compliance build. The sustainability features will allow for a 122.07 tonnes reduction in annual CO_2 emissions. This complies with the carbon reduction target set out by Exeter Council. The proposed energy strategy is compliant with the local policy requirements as use of 56.58 kWp PV has been proposed for the development to achieve the overall carbon reduction. The energy and carbon savings are to be achieved through passive design, energy efficient measures incorporating design features such as energy efficient lighting, submetering of relevant areas, upgrading of 'U' values and occupancy sensing in relative areas, as well as the incorporation of Air Source Heat Pump to supply hot water to the residential units.

To reduce the energy demand of the development as well as help to conserve water resources within the local area, it is anticipated that the fit out works will provide for sanitary fittings which will be water efficient through measures such as dual flush toilets and low flow taps.

The development is located in Exeter, and the site is in close proximity to the A377 Road. The development is located within walking distance from the nearest bus stop. The proposed development is near the national cycle network. It can also be noted that some leisure as well as a number of primary amenities including food outlets are available nearby.

Incorporating sustainability measures allows the development to be deemed sustainable in conjunction with local and national policies.

2.0 Introduction

This report has been prepared by Cudd Bentley Consulting Ltd, to investigate the issues of energy and sustainability surrounding the Haven Road development in Exeter. This development located on Haven Road is a mixed use Residential and Commercial Development as shown in Figure 2.1.

Figure 2.1 Site Location Plan

Government policies now require significant energy reductions from proposed buildings. Building a Greener Future sets a planned trajectory outlined via Part L 2013 of the Building Regulations. These commitments have been the key focus point in addressing policies and strategies to reduce energy use and carbon emissions through energy efficiency and low or zero carbon technologies (LZC).

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

3.0 Drivers of Sustainability

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

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

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

<u>Kyoto Protocol</u>

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

<u>Cancun Agreements</u>

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

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

<u>COP21: Paris Global Climate Agreement</u>

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

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

BRE's COP21 Climate Pledge (December 2015)

"We commit to continue to drive best practice and carbon reduction, as we have through the use of BREEAM for the past 25 years. By reaching over 9,000 BREEAM rated buildings we predict emissions savings will be in excess of 900,000 tonnes of CO_2, compared to regulatory minimum performance requirements, by 2020. Saving not only carbon, but bringing wider benefits to both the owner and occupiers."

4.0 National Policy

National Planning Policy

An effective planning system is required to contribute to achieving sustainable development. The ***National Planning Policy Framework*** (NPPF), 2021, outlines what the government deems as sustainable development in England.

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

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

The above objectives can be described as an energy trilemma, this is demonstrated in Figure 4.1 below. Each dimension is dependent on each other and sustainable development proposals should adhere to each role. This energy statement shall ensure the proposed Development is one that contributes economically, socially and environmentally in accordance with the NPPF, 2021.

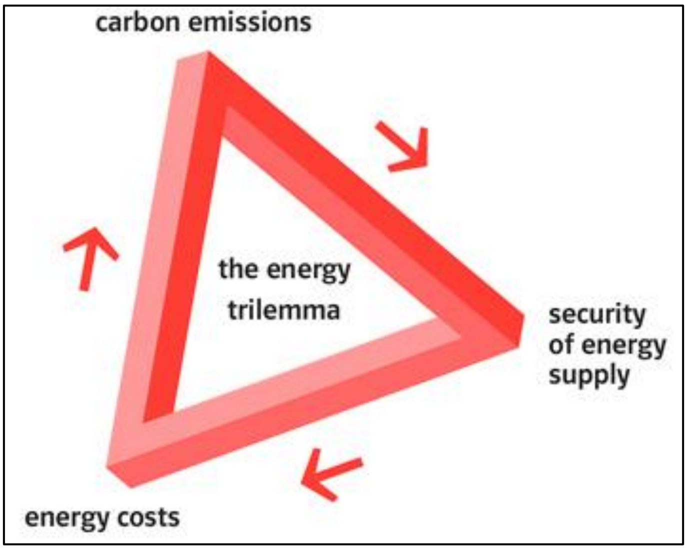


Figure 4.1 The Energy Trilemma

Guidance has been followed from the (NPPF), 2021, to provide an energy strategy which reduces energy use and carbon emissions, in line with best practice. This will provide a balanced scheme which focuses on optimal use of non-renewable resources (energy efficiency measures) whilst providing a renewable energy strategy best suited to the sites and their building uses. Below are some key extracts relevant to the development from Chapter fourteen 'Meeting the Challenge of Climate Change, Flooding & Coastal Change':

Paragraph 20

Strategic policies should set out an overall strategy for the pattern, scale and design quality of places, and make sufficient provision for:

- infrastructure for transport, telecommunications, security, waste management, water supply, wastewater, flood risk and coastal change management, and the provision of minerals and energy (including heat);

Paragraph 154

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

Paragraph 155

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.

<u>Paragraph 151</u>

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

a. provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

b. consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

c. identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for locating potential heat customers and suppliers.

<u>Paragraph 156</u>

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

<u>Paragraph 157</u>

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.

<u>Paragraph 158</u>

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

a. not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and

b. approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

Paragraph 185

Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life65;
b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and
c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

5.0 Local Policy

This section aims to highlight guidance available and the minimum requirements at local level from Exeter City Council Core Strategy (Adopted February 2012) and Exeter City Council Local Plan Review (1995 – 2011) (Saved Policies), which states the Council's vision, spatial strategy and policies for the future development of the area.

<u>Exeter City Council Core Strategy (Adopted February 2012)</u>

<u>Policy CP1</u>

Over the plan period 2006-2026 provision is made within the city, for:

- around 60 hectares of employment land
- at least 12,000 dwellings
- up to 40,000 sq metres net retail floorspace.

The spatial strategy identifies the opportunities for Exeter to grow within its environmental limits. Development will be guided to the most sustainable locations, recognising the contribution to be made to growth by the existing urban area, particularly the City Centre, and ensuring that the necessary infrastructure, including low and zero carbon energy, transport and green infrastructure, is in place to allow for sustainable urban extensions to the east and south west of the city.

Proposals are based on:

i. around 4,900 dwellings and 20 hectares of employment land that are completed or have planning permission.
vi. bringing forward development in the rest of the city to accommodate around 1,800 dwellings.

<u>Policy CP2</u>

The development of around 40 hectares of employment land and associated infrastructure (in addition to around 20 hectares comprising completions and permissions at 1 April 2010) is proposed, as follows:

- up to 30,000 square metres of office floorspace on about 1.5 hectares, as part of mixed development in the City Centre;
- around 5.5 hectares in the Pinhoe area;
- about 21 hectares to the east of the outer bypass: comprising 5 hectares on the fringes of Exeter Business Park in the Hill Barton area, and 16 hectares south of the A379 in the Newcourt area; and
- about 15 hectares to the south west of the city, in the Matford area (subject to an acceptable flood risk assessment, ecological survey and habitat regulations assessment).

The release of employment allocations for other uses will only be acceptable where it can be demonstrated that development for an alternative use represents an opportunity that would create significant economic benefits for the city and the Travel to Work Area.

<u>Policy CP3</u>

The development of at least 12,000 dwellings is proposed as follows:

Completions 2006-2010	2,687

Planning Permissions	2,224
Permissions subject to S106 agreement	26
Identified sites within the urban area	977
Regeneration Areas	1,048
Newcourt	2,300
Monkerton/Hill Barton	2,500
Alphington	500
Total	12,262

Policy CP4

Residential development should achieve the highest appropriate density compatible with the protection of heritage assets, local amenities, the character and quality of the local environment and the safety and convenience of the local and trunk road network.

Policy CP5

The supply of housing should meet the needs of all members of the community such that:

- all major developments (10 or more dwellings) should include a mix of housing informed by context, local housing need and the most up to date Housing Market Assessment;
- specialist housing, such as wheelchair accessible housing, sheltered housing, residential care homes, 'extra care' housing and continuing care retirement communities should be provided as part of mixed communities, where possible, in accessible locations close to facilities;
- all housing developments should be designed to meet Lifetime Homes Standards where feasible and practical; and
- purpose built student accommodation should be provided to meet the housing need.

Policy CP9

Comprehensive strategic transport measures to accommodate the additional development proposed for the city and adjoining areas shall include:

- a step change in the quality, capacity and environmental performance of public transport, especially between the City Centre and proposed developments adjoining the city to the east in East Devon and to the south west in Teignbridge;
- additional Park and Ride sites around the city including Ide interchange;
- improvements to the strategic road infrastructure including key junctions on the M5, outer bypass and the Alphington Road corridor;
- new rail halts at Hill Barton and Newcourt on the Exeter to Exmouth line and at Matford on the Exeter to Plymouth line;
- demand management measures; and
- improvements to facilities for pedestrians and cyclists.

The contributions necessary to ensure the delivery of transport infrastructure will be secured through the application of Policy CP18.

Policy CP11

Development should be located and designed so as to minimise and if necessary, mitigate against environmental impacts. Within the Air Quality Management Area shown on the following map, measures to reduce pollution and meet air quality objectives, that are proposed by the Local Transport Plan and the Air Quality Action Plan, will be brought forward.

Policy CP12

The spatial strategy reflects the precautionary approach to flooding and flood risk. Site allocations will be determined by applying a risk-based search sequence, utilising the sequential test and, where appropriate, the exception test, in accordance with national policy guidance. The Exeter Strategic Flood Risk Assessment will be used to ensure that development avoids areas of higher risk. All development proposals must mitigate against flood risk utilising SUDS where feasible and practical.

Policy CP13

Decentralised Energy Networks will be developed and brought forward. New development (either new build or conversion) with a floorspace of at least 1,000 square metres, or comprising ten or more dwellings, will be required to connect to any existing, or proposed, Decentralised Energy Network in the locality to bring forward low and zero carbon energy supply and distribution. Otherwise, it will be necessary to demonstrate that it would not be viable or feasible to do so. Where this is the case, alternative solutions that would result in the same or better carbon reduction must be explored and implemented, unless it can be demonstrated that they would not be viable or feasible.

Policy CP14

New development (either new build or conversion) with a floorspace of at least 1,000 sq. metres, or comprising ten or more dwellings, will be required to use decentralised and renewable or low carbon energy sources, to cut predicted CO2 emissions by the equivalent of at least 10% over and above those required to meet the building regulations current at the time of building regulations approval, unless it can be demonstrated that it would not be viable or feasible to do so.

Policy CP15

Proposals for development are expected to demonstrate how sustainable design and construction methods will be incorporated. All development must be resilient to climate change (particularly summer overheating) and optimise energy and water efficiency through appropriate design, insulation, layout, orientation, landscaping and materials, and by using technologies that reduce carbon emissions.

Residential development will be required to achieve the above (Para 10.29) Code for Sustainable Homes Level (overall performance across the code categories and complying with minimum standards).

All non-domestic development will be required to achieve BREEAM 'Very Good' standards increasing to 'Excellent' standards from 2013. Non-domestic buildings are expected to be zero carbon from 2019.

Policy CP16

The strategic green infrastructure (GI) network is shown on the key diagram. The Exeter GI network has been identified to protect and enhance current environmental assets and local identity and to provide a framework for sustainable new development.

Opportunities to provide green corridors, open space and allotments, to enhance cycling and walking opportunities, to link existing habitats, to incorporate environmental assets and to integrate biodiversity, proposed by the Exeter Green Infrastructure Strategy, will be secured through partnership working, direct implementation and the application of Policy CP18 (see Section 11).

Policy CP17

All proposals for development will exhibit a high standard of sustainable design that is resilient to climate change and complements or enhances Exeter's character, local identity and cultural diversity.

Development in the City Centre and Grecian Regeneration Area will:

- enhance the city's unique historic townscape quality;
- protect the integrity of the city wall and contribute positively to the historic character of the Central and Southernhay and Friars Conservation Areas;
- create places that encourage social interaction, utilising public art as an intrinsic component of a high quality public realm;
- enhance and expand the city's retail function to improve Exeter's draw as a regional shopping centre;
- include residential development in a mix of uses that encourage vitality and establish a safe and secure environment;
- create a City Centre that is vital and viable and presents a positive experience to the visitor;
- enhance the biodiversity of the City Centre and improve the links to the green infrastructure network;
- contribute to the establishment of a decentralised energy network.

Policy CP18

New development must be supported by appropriate infrastructure provided in a timely manner. The City Council will continue to work in partnership with infrastructure providers and other delivery agencies to keep an up to date infrastructure delivery plan that will enable proposals, in accordance with the spatial strategy, to be brought forward.

Developer contributions will be sought to ensure that the necessary physical, social, economic and green infrastructure is in place to deliver development. Contributions will be used to mitigate the adverse impacts of development (including any cumulative impact). Where appropriate, contributions will be used to facilitate the infrastructure needed to support sustainable development.

Exeter City Council Local Plan Review 1995 – 2011 (Saved Policies)

Policy AP1

Development should be designed and located to raise the quality of the urban and natural environment and reduce the need for car travel. Proposals should be located where safe and convenient access by public transport, walking and cycling is available or can be provided.

Policy H1

Proposals for housing development will be assessed against the following search sequence:

i. Previously-developed land, conversions and infill within the urban areas;
ii. Previously-developed land on the urban fringe within public transport corridors;
iii. Greenfield land through sustainable urban extensions within public transport corridors.

Policy H2

Priority will be given to meeting housing needs on previously-developed land by applying the search sequence set out in policy h1 and by permitting residential development at the highest density that can be achieved without detriment to local amenity, the character and quality of the local environment and the safety of local roads, whilst having regard to the need to provide a variety of housing provision which is accessible to a range of employment, shopping, education, health and social care, leisure and community facilities. Developers should consider:

a) The provision of semi-detached and terraced housing and flats;
b) The development of infill and corner sites;
c) Development in the city centre and in areas which are well served by public transport;
d) Development of sites in the core area of the city centre without provision for motor vehicle parking but with secure cycle parking facilities, car parking provision for disabled people and space for deliveries;
e) The conversion of buildings to flats or bedsits;
f) The conversion to residential use of buildings, which are vacant, under-used or in poor condition, including historic buildings, offices and vacant floorspace above offices and shops;
g) The development of new office buildings which are designed to enable subsequent conversion to residential use;
h) The provision of residential accommodation in upper floors of retail and office schemes.

Policy S5

Proposals for food and drink (class A3), including hot food takeaways, will be permitted, subject to policy s3 within:

a) The city centre, district centres and local centres;
b) Other commercial areas with active street frontage uses;
c) Areas of cultural or leisure use, public amenities and tourist attractions;
d) Purpose built cultural, leisure, retail or mixed use developments,

Provided that:

i. The proposal will not harm the amenities of nearby residents by virtue of noise, smell, litter or late night activity;
ii. In high street, cathedral yard, cathedral close, gandy street, castle street and west street, change of use to food and drink (class A3) will only be permitted subject to a condition preventing use as a hot food takeaway;
iii. The proposal will not create or increase the potential for public disorder and crime or reduce the perceived attractiveness of the centre;
iv. a financial contribution will be sought through a planning obligation to measures which would improve community safety, where this would enable the development to be permitted.

Policy T1

Development should facilitate the most sustainable and environmentally acceptable modes of transport, having regard to the following hierarchy:

1. Pedestrians
2. People with mobility problems
3. Cyclists
4. Public transport users
5. Servicing traffic
6. Taxi users
7. Coach borne visitors
8. Powered two wheelers
9. Car borne shoppers
10. Car borne commercial/ business users
11. Car borne visitors
12. Car borne commuters.

Policy T2

In accordance with the accessibility criteria set out in schedule 1: residential development should be located within walking distance of a food shop and a primary school and should be accessible by bus or rail to employment, convenience and comparison shopping, secondary and tertiary education, primary and secondary health care, social care and other essential facilities.

Non-residential development should be accessible within walking distance and/or by bus or rail to a majority of its potential users.

Policy T3

Development should be laid out and linked to existing or proposed developments and facilities in ways that will maximise the use of sustainable modes of transport. Proposals should ensure that:

a) All existing and proposed walking and cycle routes are safeguarded or that alternative reasonably convenient routes are provided;
b) Suitable cycle parking provision is provided in accordance with the standards set out in schedule 2;
c) Where more than 20 people are employed facilities for showering and changing are provided;
d) Full account is taken of the needs of bus operation through and alongside new development by the provision of lay-bys, roads and other associated facilities;
e) Where appropriate, pedestrian and cycling links are provided to existing or proposed rail stations;
f) The particular needs of people with disabilities are taken into account.

Policy LS1

Development which would harm the landscape setting of the city will not be permitted. Proposals should maintain local distinctiveness and character and:

a) Be reasonably necessary for the purposes of agriculture, forestry, the rural economy, outdoor recreation or the provision of infrastructure; or

b) Be concerned with change of use, conversion or extension of existing buildings:

Any built development associated with outdoor recreation must be essential to the viability of the proposal unless the recreational activity provides sufficient benefit to outweigh any harm to the character and amenity of the area.

Policy EN1

Development that may be liable to cause pollution, including proposals which allow the use, movement or storage of hazardous substances, will only be permitted if:

a) The health, safety and amenity of users of the site or surrounding land are not put at risk; and
b) The quality and enjoyment of the environment would not be damaged or put at risk. Development on or in the vicinity of the site that may be liable to cause pollution will only be permitted if there is no unacceptable risk to the health and safety of its users.

Policy EN5

Noise-generating development will not be permitted if it would be liable to increase adversely the noise experienced by the users of existing or proposed noise- sensitive development nearby.

Noise-sensitive development will not be permitted if its users would be affected by noise from existing or proposed noise-generating uses unless adequate mitigation works can be implemented to achieve an acceptable environment.

Policy DG1

Development Should:

a) Be compatible with the urban structure of the city, connecting effectively with existing routes and spaces and putting people before traffic;
b) Ensure that the pattern of street blocks, plots and their buildings (the grain of development) promotes the urban character of Exeter;
c) Fully integrate landscape design into the proposal and ensure that schemes are integrated into the existing landscape of the city including its three- dimensional shape, natural features and ecology;
d) Be at a density which promotes Exeter s urban character and which supports urban services;
e) Contribute to the provision of a compatible mix of uses which work together to create vital and viable places;
f) Be of a height which is appropriate to the surrounding townscape and ensure that the height of constituent part of buildings relate well to adjoining buildings, spaces and to human scale;
g) Ensure that the volume and shape (the massing) of structures relates well to the character and appearance of the adjoining buildings and the surrounding townscape;
h) Ensure that all designs promote local distinctiveness and contribute positively to the visual richness and amenity of the townscape;
i) Use materials which relate well to the palette of materials in the locality and which reinforce local distinctiveness.

Policy DG4

Residential development should:

a) Be at the maximum feasible density taking into account site constraints and impact on the local area;
b) Ensure a quality of amenity which allows residents to feel at ease within their homes and gardens;
c) Ensure that the boundaries of private rear gardens facing public places are designed to make a positive contribution to the townscape;
d) Where front gardens are included provide enclosure to create defensible space.

Policy DG6

In providing for vehicle circulation and car parking in new residential development the design of the scheme should:

a) Ensure that parking provision is arranged so that urban form may be created without vehicles dominating the street scene;
b) Provide permeable highway systems linked to adjoining roads;
c) Ensure that the means of calming traffic do not detract from the character of the townscape;
d) Provide safe and secure parking that is subject to clear surveillance by local residents.

6.0 Energy Usage and Carbon Emissions

Government policies require significant energy reductions from buildings. Building a Greener Future sets a planned trajectory (delivered via Part L of the building regulations 2013) with an aspiration for all non-domestic new buildings to be zero carbon by 2020. The Climate Change Act (Nov 2008) sets the UK targets of; CO_2 reduction of 26% by 2020 and CO_2 reduction of 80% by 2050.

6.1 Policy Review

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

National Planning Policy Framework (2021)

Section 14 – Meeting the Challenge of Climate Change, Flooding and Coastal Change

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

a. provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

b. consider identifying suitable areas for renewable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

c. identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for collocating potential heat customers and suppliers.

Exeter City Council Core Strategy (Adopted February 2012)

Core Policy 13:

Decentralised Energy Networks will be developed and brought forward. New development (either new build or conversion) with a floorspace of at least 1,000 square metres, or comprising ten or more dwellings, will be required to connect to any existing, or proposed, Decentralised Energy Network in the locality to bring forward low and zero carbon energy supply and distribution. Otherwise, it will be necessary to demonstrate that it would not be viable or feasible to do so. Where this is the case, alternative solutions that would result in the same or better carbon reduction must be explored and implemented, unless it can be demonstrated that they would not be viable or feasible.

Core Policy 14:

New development (either new build or conversion) with a floorspace of at least 1,000 sq. metres, or comprising ten or more dwellings, will be required to use decentralised and renewable or low carbon energy sources, to cut predicted CO2 emissions by the equivalent of at least 10% over and above those required to meet the building regulations current at the time of building regulations approval, unless it can be demonstrated that it would not be viable or feasible to do so.

6.2 Development Sustainability Features

The total baseline energy and carbon emissions for the development (built to Part L 2013), taking into account regulated energy demands are:

- *233,439.61 kWh/annum*
- *545.30 Tonnes CO_2/annum*

The primary energy demands of the development will be:

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

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

- *177,234 kWh/annum*
- *455 Tonnes CO_2/annum*

<u>Be Lean</u>

To provide energy and carbon saving further to a base Part L (2013) build; targeting compliance with local and national policies, the following passive design and energy efficiency measures are recommended.

The following 'U' values shall be incorporated within the residential development, in accordance with Part L1A (2013):

- External Walls (including any walls separating unconditioned and conditioned spaces)
  - $U = 0.16$ W/m².K;
- Exposed Floors (including any floors separating unconditioned and conditioned spaces)
  - $U = 0.11$ W/m².K;
- Exposed Roofs - $U = 0.11$ W/m².K;
- Glazing - $U = 1.2$ W/m².K;
- Air Permeability - 3 $m^3/hr/m^2$@ 50 Pa.

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

- The provision of energy efficient lighting (PIR controls and occupancy sensing in relevant areas);
- The provision of zonal thermal and lighting controls;
- The provision of variable speed pumps and fans;

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

Be Clean

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

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

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

Table 6.1 CHP Analysis

Be Green

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

Renewable Technology Feasibility Assessment		Viable?
Bio Fuel Boilers 	Bio-fuel boilers are specifically designed to burn solid biomass or liquid bio-fuel in order to heat water, or raise steam. This can then be used for space heating or Domestic Hot Water (DHW) supply. Bio-fuel boilers could potentially provide the annual space heating and DHW demand for the Units, however they are not recommended for this development for the following reasons:- 1. Biomass boilers generate increased Oxides of Nitrogen (NOx) and particulates (PM10) which would affect air quality. 2. The storage requirements for the biofuel would require a large plant space, with an auxiliary storage facility to allow for a two week period where delivery of fuel might not be available.	No

<table>
<tr><th colspan="2">Renewable Technology Feasibility Assessment</th><th>Viable?</th></tr>
<tr><td colspan="2"><u>Land Use</u>
Large volumes of storage is required for fuel at ground level or basement level with sufficient vehicular access for fuel delivered.
<u>Noise</u>
Noise levels are generated by the operation of the bio-fuel boiler and associated deliveries of the bio-fuel. The plant room enclosure will have to be attenuated to acceptable levels imposed by planning and Acoustician recommendations.</td><td></td></tr>
<tr><td>Wind Turbines
</td><td>Wind turbines convert the kinetic energy in the wind into mechanical energy which is then converted into electricity. Wind turbines can provide electrical power either directly to a load or via a battery system. The use of wind turbines is not recommended for this development for the following reasons:-
1. Wind turbines, of a size necessary to make a contribution to the Units' renewable energy requirements are considered inappropriate on spatial, planning, aesthetic and noise grounds. Noise pollution from commercial wind turbines can be quiet significant within a few hundred metres.
2. The site is not ideal; an ideal site is a hill with a flat, clear exposure. It should be free from strong turbulence and obstructions like large trees, houses or other buildings.
3. The financial viability of a small scale installation on the site would be compromised by the operational efficiency of the units (circa 30%).
4. Wind turbines, can cause electrical interference within a 2km radius.
5. Finally, the main disadvantage is down to the winds unreliability factor. The wind strength is often too low in many areas, where this site is located the wind speed is 4.1 m/s at 10m, as can be seen in the wind map presented in Appendix C, in order for the wind turbines to be feasible, wind speeds of greater than 5.5m/s are required.
6. Due to the wind speed not being adequate Wind Turbines have not been proposed.</td><td>No</td></tr>
<tr><td colspan="2"><u>Land Use</u>
There would be an adverse visual impact on the site which will be dependent on the height at which the wind turbines are located.
<u>Noise</u>
Noise levels are generated by the rotating blades; these noise levels will vary dependent on wind velocity and will need to be in acceptable levels imposed by planning and Acoustician recommendations.</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">Renewable Technology Feasibility Assessment</th><th>Viable?</th></tr>
<tr><td>Ground Source Heat Pumps
</td><td>Space cooling and heating can be provided by circulating water cooled or heated directly by the ground or via subterranean water. Ground water cooling and heating through the use of aquifers makes use of the relatively stable ground/ water temperature which is available at a temperature range of 10 – 14°C. The use of Ground Source Heat Pumps is not recommended for this development for the following reasons:-
1. Cost of boreholes may be prohibitive (subject to site geological conditions).
2. Favourable ground conditions may not exist.
3. Problems can arise with boreholes silting up (open-loop).
4. Changes in local ground conditions could affect water quality and the amount that can be extracted (open-loop).
GSHP have not been implemented for this development at this point because an EA assessment must be undertaken as well as a hydrogeological survey to determine the number of boreholes required.</td><td rowspan="2">No</td></tr>
<tr><td colspan="2"><u>Land Use</u>
This installation would require Environmental Agency approval. Ground and Hydrology analysis would be required to investigate if favourable conditions exist.
<u>Noise</u>
There are no noise issues generated by this technology.</td></tr>
<tr><td>Solar Water Heating
</td><td>Solar Water Heating systems use radiant energy from the sun to heat water. Systems comprise of a roof mounted heat collector piped to a coil located within a hot water storage cylinder. The use of Solar Panels are not recommended for this development.</td><td rowspan="2">No</td></tr>
<tr><td colspan="2"><u>Noise</u>
Noise levels are generated by pumps at roof level, these are insignificant so should pose no issues.</td></tr>
<tr><td>Air Source Heat Pumps
</td><td>An Air Source Heat Pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside. It can extract heat from the air even when the outside temperature is as low as minus 15°C and typically draws approximately a quarter to a third of the electricity of a standard resistance heater for the same amount of heating, reducing utility bills. This typical efficiency compares to 70-95% for a fossil-fuel powered boiler.</td><td>Yes</td></tr>
</table>

Renewable Technology Feasibility Assessment		Viable?
	Air Source Heat Pumps (ASHP) are proposed to supply hot water to the development.	
<u>Land Use</u> Air Source Heat Pumps can be installed on ground mounted, roof mounted or wall mounted frames. When installing Air Source Heat Pumps there are various factors to consider; Heat Pumps should be positioned to provide shelter from high winds which can reduce efficiency by causing defrost problems. <u>Noise</u> Noise levels are generated by fans, and compressors causing vibrations. The noise levels are dependent on manufacturer and vary accordingly, these will need to be in acceptable levels imposed by planning and Acousticians recommendations.		
Photovoltaics 	Photovoltaic (PV) modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases silicon. They have the following advantages for use on this development; 1. Photovoltaic panels can be situated at roof level, east facing, to provide a source of renewable energy. 2. Panels can be grid connected to sell surplus electricity produced. 3. Low maintenance issues. 4. Visual use of renewable energy can be seen by general public. A total of 56.58 kWp PV has been proposed for the development.	Yes
<u>Land Use</u> There are no land issues or adverse visual impacts as the photovoltaic panels are roof mounted. <u>Noise</u> There are no noise issues generated by this technology.		

<u>Table 6.2 Renewable Technology Feasibility Assessment</u>

6.3 Summary

By applying the above passive design measures and renewable energy technologies the savings generated are displayed in Table 6.3, and Figures 6.1 – 6.2. The full calculations can be seen in Appendix D.

	Carbon Dioxide Emissions (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	545.30	455
After Energy Efficient and Passive Measures	453.13	It is anticipated that a circa 3% saving can be achieved through the use of energy efficient fittings, for example A or A+ appliances. This would reduce the unregulated carbon emissions to: 441.35
After ASHP	423.23	
Total Cumulative Saving	**122.07 (22.39%)**	**13.65 (3%)**

Table 6.3 Carbon Dioxide Emissions

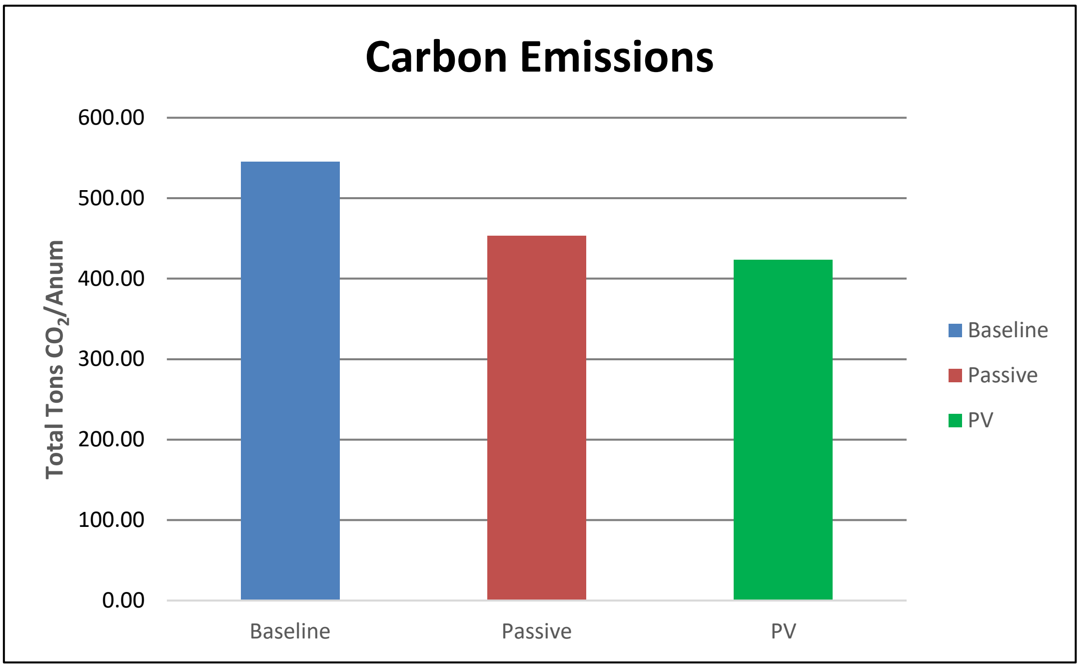


Figure 6.1 Site Carbon Emissions

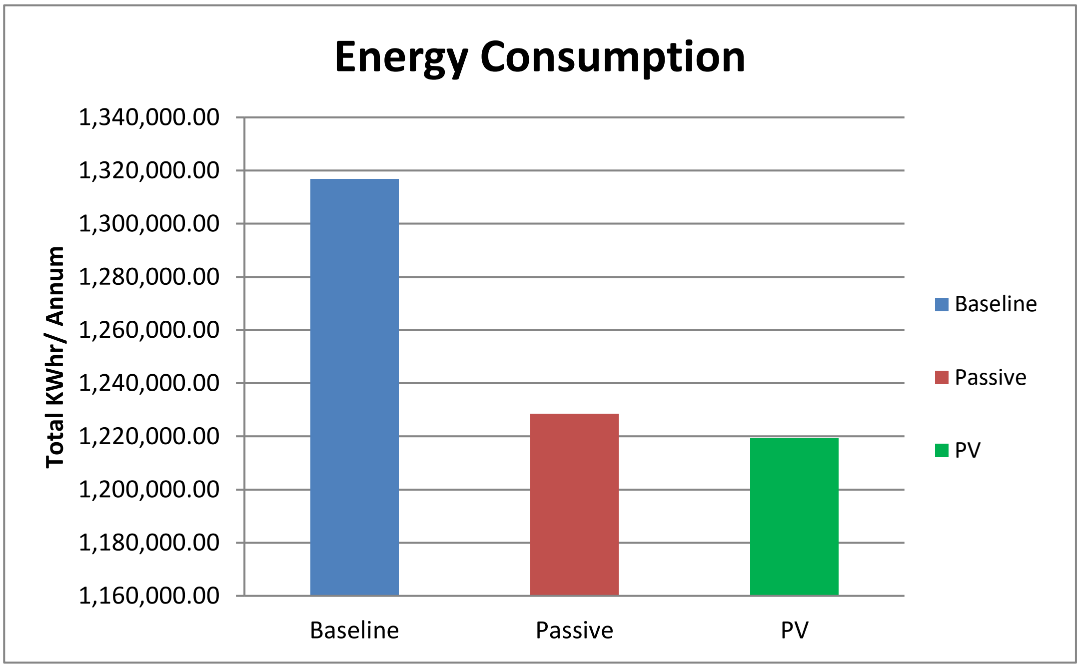


Figure 6.2 Site Energy Consumption

The strategy for the residential elements of the development is shown in table 6.4 below.

Residential Element Energy Strategy	
Heating	Heating is provided through Electric Panel Heaters
Cooling	Cooling not proposed within the residential development
How Water (DHW)	Low Temperature On-Site Communal Heating Network via ASHP
Ventilation	Natural Ventilation via openable windows, and MVHR in accordance with Approved Document F
Lighting	Energy efficient LED lighting where applicable

Table 6.4 Proposed Energy Strategy for the residential elements of the development

The above review has resulted in the formulation of an Energy Strategy that may be adopted for the development involving the use of passive design and energy efficiency measures aimed at achieving the targets and recommendations set out by Exeter Council.

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

7.0 Water Consumption

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

7.1 Policy Review

National Planning Policy Framework (2021)

Section 15- Conserving and Enhancing the Natural Environment

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

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

Exeter City Council Core Strategy (Adopted February 2012)

Policy CP15

Proposals for development are expected to demonstrate how sustainable design and construction methods will be incorporated. All development must be resilient to climate change (particularly summer overheating) and optimise energy and water efficiency through appropriate design, insulation, layout, orientation, landscaping and materials, and by using technologies that reduce carbon emissions.

7.2 Development Sustainability Features

In order to ensure the reduction and management of water consumption within the proposed residential units, it is anticipated that various measures shall be undertaken, and specific features installed during the fit out works to minimise the building's potable water consumption. This will be done through a water consumption calculator tool to manage the final water consumption of the development.

Table 2.1 Maximum fittings consumption	
Water fitting	**Maximum consumption**
WC	6/4 litres dual flush or 4.5 litres single flush
Shower	10 l/min
Bath	185 litres
Basin taps	6 l/min
Sink taps	8 l/min
Dishwasher	1.25 l/place setting
Washing machine	8.17 l/kilogram

Figure 7.1 – Maximum fitting consumption from document G of building regulation

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

7.3 Summary

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

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

8.0 Transport

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

8.1 Policy Preview

<u>National Planning Policy Framework (2021)</u>

<u>Section 9 – Promoting Sustainable Transport</u>

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

a. the potential impacts of development on transport networks can be addressed;
b. opportunities from existing or proposed transport infrastructure, and changing transport technology and usage, are realised – for example in relation to the scale, location or density of development that can be accommodated;
c. opportunities to promote walking, cycling and public transport use are identified and pursued;
d. the environmental impacts of traffic and transport infrastructure can be identified, assessed and taken into account – including appropriate opportunities for avoiding and mitigating any adverse effects, and for net environmental gains.

<u>Exeter City Council Local Plan Review 1995 – 2011 (Saved Policies)</u>

<u>Policy T2</u>

In accordance with the accessibility criteria set out in schedule 1: residential development should be located within walking distance of a food shop and a primary school and should be accessible by bus or rail to employment, convenience and comparison shopping, secondary and tertiary education, primary and secondary health care, social care and other essential facilities.

Non-residential development should be accessible within walking distance and/or by bus or rail to a majority of its potential users.

8.2 Development Sustainability Features

The proposed development is located in Exeter, and the site is in close proximity to the A377 Road. The development is located within 0.1 miles from the nearest bus stop.

The proposed development is in close proximity to the national cycle network as shown in Figure 8.1 below as well as the availability of cycle storage.

A Transport Assessment has been carried out by RGP which demonstrates that the proposed development meets the requirements set out within National and Local Government policies.

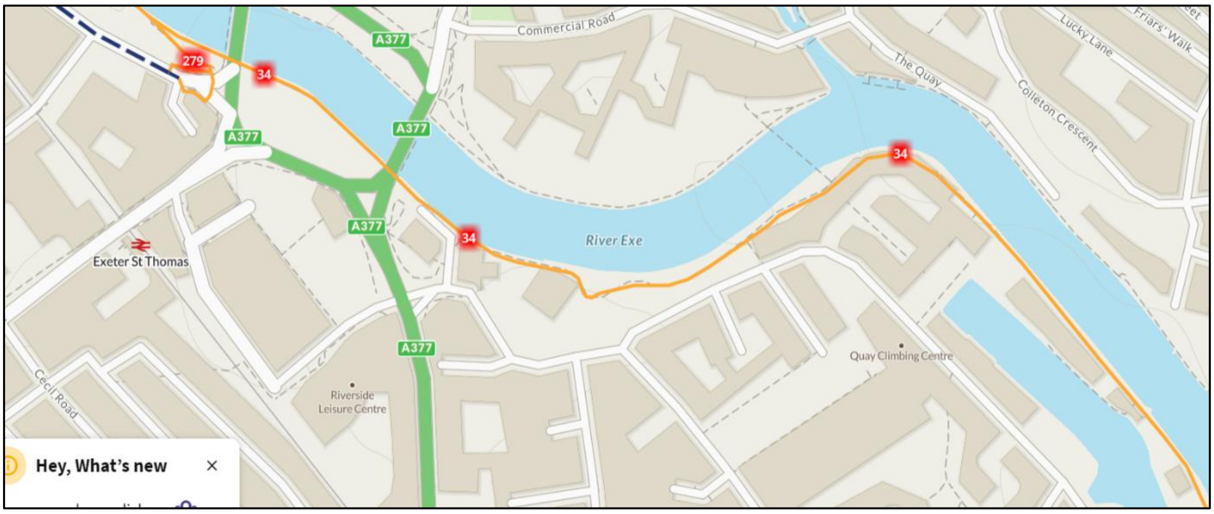


Figure 8.1. National Cycle Network

8.3 Summary

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

The proposed development is located in Exeter, and the site is in close proximity to the A377 Road. The development is located within walking distance from the nearest bus stop.

It can also be noted that some leisure as well as a number of primary amenities including food outlets are available nearby for example Co-op and Malthouse Exeter.

The proposed development is in close proximity to the national cycle network as shown in Figure 8.1 below. It can also be noted that some leisure as well as a number of food outlets are available nearby.

9.0 Sustainable Design

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

9.1 Policy Review

National Planning Policy Framework (2021)

Section 12- Achieving Well-Designed Places

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

Exeter City Council Core Strategy (Adopted February 2012)

Core Policy 15:

Proposals for development are expected to demonstrate how sustainable design and construction methods will be incorporated. All development must be resilient to climate change (particularly summer overheating) and optimise energy and water efficiency through appropriate design, insulation, layout, orientation, landscaping and materials, and by using technologies that reduce carbon emissions.

Residential development will be required to achieve the above (Para 10.29) Code for Sustainable Homes Level (overall performance across the code categories and complying with minimum standards).

Exeter City Council Local Plan Review 1995 – 2011 (Saved Policies)

Policy DG1

Development Should:

a) Be compatible with the urban structure of the city, connecting effectively with existing routes and spaces and putting people before traffic;
b) Ensure that the pattern of street blocks, plots and their buildings (the grain of development) promotes the urban character of Exeter;
c) Fully integrate landscape design into the proposal and ensure that schemes are integrated into the existing landscape of the city including its three- dimensional shape, natural features and ecology;

9.2 Development Sustainability Features

The proposed development shall include a variety of features which are regarded as having a good sustainable design.

To ensure the risk of potential overheating is minimised, building modelling of each typical residential unit has confirmed that no occupied space is at risk from excessive solar gains; this being achieved through using glazing with a low shading coefficient. Additionally, to ensure that overheating will not occur during summer months and the building is suitably insulated as well as allowing for adaptation due to the effects of climate change, it is anticipated that the development will use building fabrics with enhanced 'U' values which go beyond the minimum requirements of Part L1A (2013) and Part L2A (2013), this is displayed within Table 9.1 and 9.2. Further to this the energy efficiency measures discussed within Section 6.0 will be incorporated into the design of the development. It is anticipated that such measures will lower the building's energy requirements making its operation feasible and practical for years to come.

Element	Part L1A Requirement	U Value Specified	% Improvement
Wall	0.30	0.16	46.6%
Roof	0.20	0.11	45%
Floor	0.25	0.11	56%
Glazing (Windows/Doors and Rooflights combined)	2	1.2	40%

Table 9.1 U Value for the Residential Element

Element	Part L2A Requirement	U Value Specified	% Improvement
Wall	0.35	0.16	54.3%
Roof	0.25	n/a	n/a
Floor	0.25	0.15	40%
Glazing	2.2	1.2	45.5%

Table 9.1 U Value for the Commercial Element

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

- *External walls;*
- *Internal Partitions*
- *Ground floor;*
- *Internal floors;*
- *Roof;*

- *Internal Ceilings*
- *Windows.*

9.3 Summary

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

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

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

10.0 Construction Site Management

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

10.1 Policy Review

National Planning Policy Framework (2021)

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

Exeter City Council Core Strategy (Adopted February 2012)

Policy CP18

New development must be supported by appropriate infrastructure provided in a timely manner. The City Council will continue to work in partnership with infrastructure providers and other delivery agencies to keep an up to date infrastructure delivery plan that will enable proposals, in accordance with the spatial strategy, to be brought forward.

Developer contributions will be sought to ensure that the necessary physical, social, economic and green infrastructure is in place to deliver development. Contributions will be used to mitigate the adverse impacts of development (including any cumulative impact). Where appropriate, contributions will be used to facilitate the infrastructure needed to support sustainable development.

10.2 Development Sustainability Features

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

It is expected that the main contractor will also set targets and monitor site consumption data for water consumption, energy consumption as well as fuel from deliveries and collection of waste and materials to and from site. Monitoring of such actions can encourage contractors to become more resource efficient to meet given targets.

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

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

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

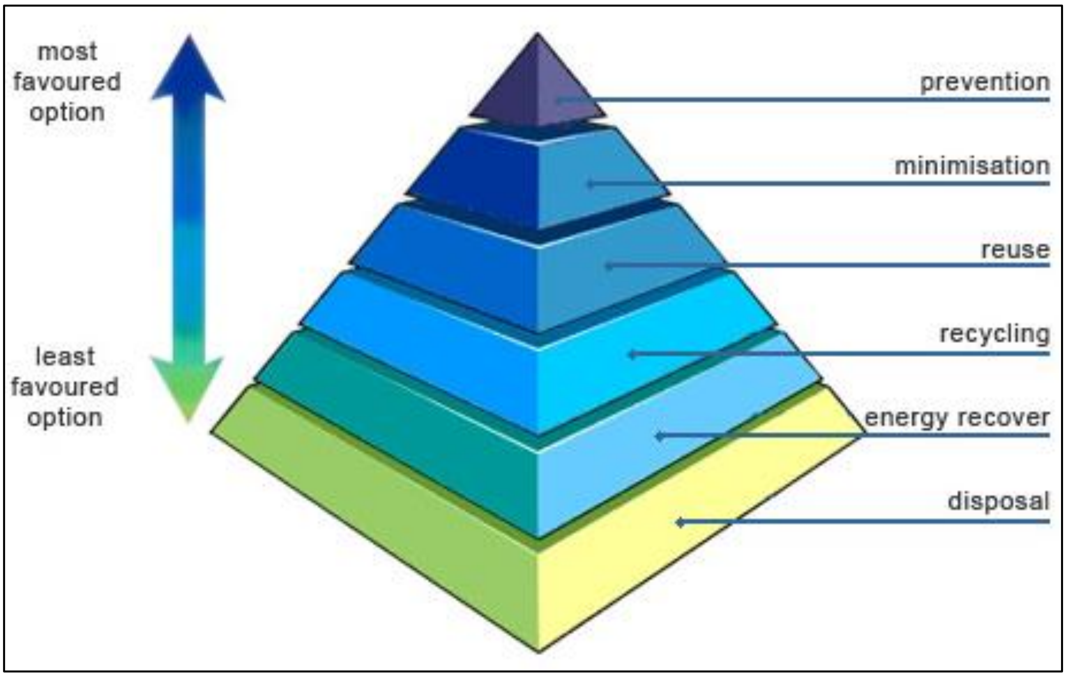


Figure 9.1 Waste Hierarchy Diagram

10.3 Summary

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

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

11.0 Flood Risk

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

11.1 Policy Review

National Planning Policy Framework (2021)

Section 14- Meeting the Challenge of Climate Change, Flooding and Coastal Change

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

Exeter City Council Core Strategy (Adopted February 2012)

Policy CP12

The spatial strategy reflects the precautionary approach to flooding and flood risk. Site allocations will be determined by applying a risk-based search sequence, utilising the sequential test and, where appropriate, the exception test, in accordance with national policy guidance. The Exeter Strategic Flood Risk Assessment will be used to ensure that development avoids areas of higher risk. All development proposals must mitigate against flood risk utilising SUDS where feasible and practical.

11.2 Development Sustainability Features

The flood map sourced from The Government Flood Warning Information Service seen below in Figure 11.1, demonstrates that the proposed site is not at risk of flooding from fluvial sources.

A Flood Risk Assessment has been undertaken by Richard Jackson Ltd, which also confirms that the site did not flood in any of the historic floods from 1950 to 1993.

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

Figure 11.2: Reservoir Flooding (Sourced from Flood Warning Information Service)

11.3 Summary

The above maps confirm that the site is at moderate risk of flooding from reservoirs, however not at risk of flooding from fluvial sources. For further details on flooding please refer to the Flood Risk Assessment submitted as part of planning.

12.0 Noise

Noise is a subjective concept that can affect people differently, however there are set standards as to acceptable levels of noise, for different areas and times of day. In this instance, the proposed development would not be subject to potential noise pollution from either road or rail sources.

12.1 Policy Review

National Planning Policy Framework (2021)

Paragraph 185

> Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:
>
> a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;
> b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and
> c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

12.2 Development Sustainability Features

The proposed development will not be subject to noise pollution from road or rail sources as seen in Figure 12.1

It should be noted that the noise levels are 'A' weighted and as such only demonstrate sounds on a frequency that would affect human populations, it does not consider noise on frequencies that may affect any local habitats.

12.2 Summary

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

Auricl acoustic consulting was commissioned to produce the Noise Assessment Report, which should be read in conjunction with this report as it covers Noise Assessment in more detail.

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

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

13.0 Ecology

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

13.1 Policy Review

National Planning Policy Framework (2021)

Section 15- Conserving and Enhancing the Natural Environment

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

Figure 13.1 Ecological Sensitivity (Sourced from MAGIC)

13.2 Summary

An Ecology conservation map (sourced from MAGIC) has shown there are no Sites of Special Scientific Interest (SSSI) in the vicinity of the site development.

Appendix A - Flood Risk Map

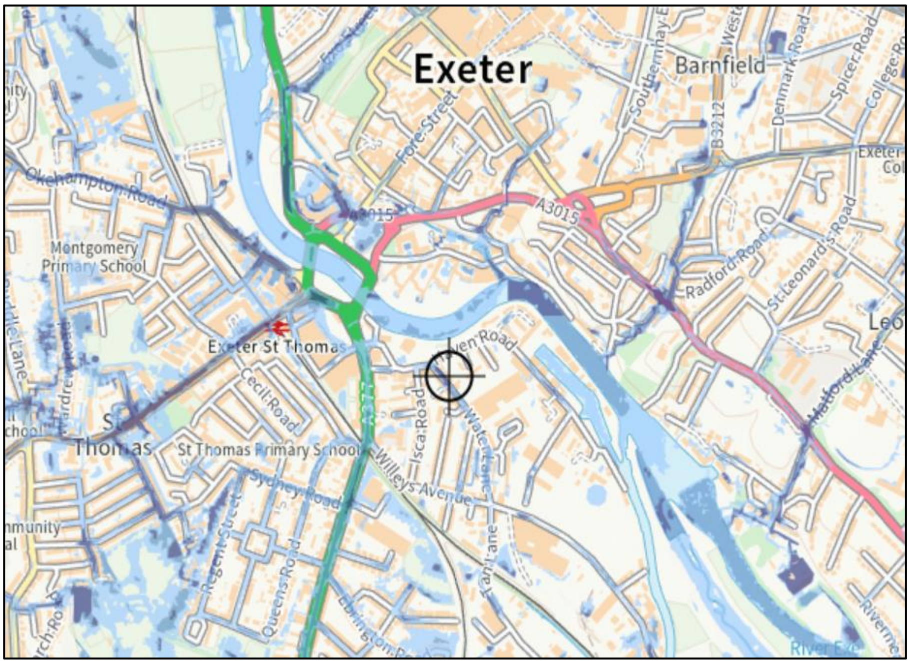
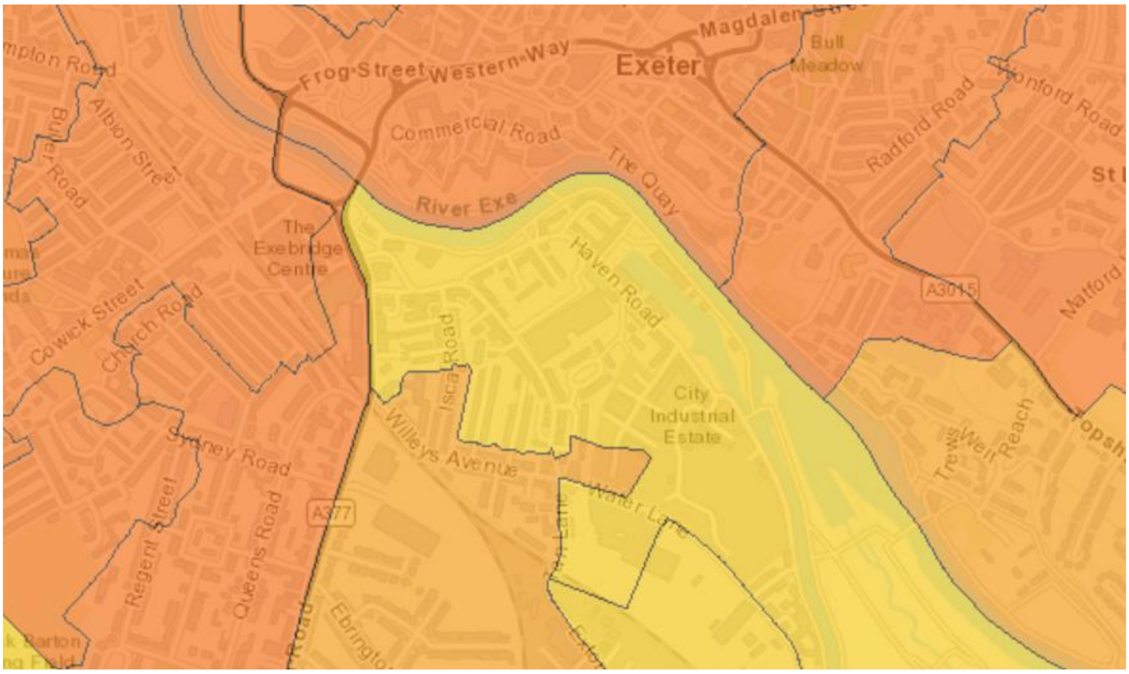


Figure 11.1: Fluvial Flooding (Sourced from Flood Warning Information Service)

Appendix B – CHP Search



CHP availability Search Area

Sector Name	Share	Total MWh
Communications and Transport	0.07%	4 MWh
Commercial Offices	0.84%	45 MWh
Domestic	90.57%	4,880 MWh
Education	0%	0 MWh
Government Buildings	0%	0 MWh
Hotels	1.49%	80 MWh
Large Industrial	0%	0 MWh
Health	0%	0 MWh
Other	0%	0 MWh
Small Industrial	0.82%	44 MWh
Prisons	0%	0 MWh
Retail	2.32%	125 MWh
Sport and Leisure	3.71%	200 MWh
Warehouses	0.17%	9 MWh
District Heating	0%	0 MWh
Total heat load in Area		**5,388 MWh**

Total Heat Load Distribution

Appendix C – Wind Map

Chart C.1 Wind Velocity Chart for the Development Site

Appendix D – Energy Calculations

	resi and non resi carbon calcs		
	Total Baseline	Total Passive	Total PV
Block A	42.83417	36.33431	33.83431
Block B	38.02382	32.04523	30.34523
Block C	294.79676	231.95188	206.2519
Block D	169.64688	152.79764	152.7976
Total	545.30163	453.12906	423.2291
		16.90304318	22.38625

	Total Energy Calcs		
	Baseline	Passive	PV
Block A	103083.069	93220.987	89558.99
Block B	91745.191	83588.508	80230.51
Block C	703468.452	649222.404	646991.4
Block D	418595.5	402499.742	402499.7
Total	**1316892.212**	**1228531.641**	**1219281**

Appendix E – Sample SAP Report

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Block D TF Studio 20.1m2	Issued on Date	29/06/2022
Assessment Reference	Passive+PV	Prop Type Ref	
Property			

SAP Rating	87 B	DER	25.36	TER	44.56
Environmental	92 A	% DER<TER	43.09		
CO_2 Emissions (t/year)	0.38	DFEE	46.42	TFEE	46.76
General Requirements Compliance	Fail	% DFEE<TFEE	0.72		

Assessor Details	Mr. Sushil Pathak, Cudd Bentley Consulting Ltd, Tel: 01344 628 821, sushil.pathak@cuddbentley.co.uk	Assessor ID	Z621-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Top-floor flat, total floor area 20 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
----------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 44.56 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 25.36 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)46.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.4 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.16 (max. 0.30)        0.16 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            0.11 (max. 0.20)        0.11 (max. 0.35)          OK
Openings        1.20 (max. 2.00)        1.20 (max. 3.30)          OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         3.00 (design value)
Maximum                                 10.0                                            OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Room heaters - Electric
Panel, convector or radiant heaters



Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Measured cylinder loss: 0.06 kWh/day
Permitted by DBSCG 0.29                           OK
Primary pipework insulated:             No primary pipework
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 No thermostatic control of room temperature       Fail


Hot water controls:                     No cylinderstat


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                             OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     0.63
Maximum                                 1.5                                             OK
MVHR efficiency:                        90%
Minimum:                                70%                                             OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Slight                                          OK
Based on:
Overshading:                            Average
Windows facing South:                   3.60 m², No overhang
Air change rate:                        4.00 ach
Blinds/curtains:                        None
----------------------------------------------------------------------------------------------------
10 Key features
Party wall U-value                      0.00 W/m²K
Roof U-value                            0.11 W/m²K
Air permeability                        3.0 m³/m²h
Photovoltaic array                      0.25 kW



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		20.1000 (1b)	x	2.7000 (2b)	=	54.2700	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	20.1000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	54.2700	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test			Yes	
Measured/design AP50			3.0000	
Infiltration rate			0.1500	(18)
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.1163	(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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2657	0.2628	0.2599	0.2454	0.2425	0.2279	0.2279	0.2250	0.2338	0.2425	0.2483	0.2541	(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	
Opening Type 1 (Uw = 1.20)			3.6000	1.1450	4.1221			(27)
External Wall 1	10.8800	3.6000	7.2800	0.1600	1.1648	190.0000	1383.2000	(29a)
External Roof 1	8.5000		8.5000	0.1100	0.9350	9.0000	76.5000	(30)
Total net area of external elements Aum(A, m2)			19.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		6.2219			(33)
Party Wall 1			48.6400	0.0000	0.0000	140.0000	6809.6000	(32)
Party Floor 1			20.1000			40.0000	804.0000	(32d)
Internal Wall 1			21.6000			9.0000	194.4000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	9267.7000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		461.0796	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.8280	(36)
Total fabric heat loss	(33) + (36) =	15.0499	(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	4.7588	4.7067	4.6547	4.3944	4.3424	4.0822	4.0822	4.0301	4.1863	4.3424	4.4465	4.5506	(38)
Heat transfer coeff	19.8087	19.7567	19.7046	19.4444	19.3923	19.1321	19.1321	19.0800	19.2362	19.3923	19.4964	19.6005	(39)
Average = Sum(39)m / 12 =												19.4314	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9855	0.9829	0.9803	0.9674	0.9648	0.9518	0.9518	0.9493	0.9570	0.9648	0.9700	0.9752	(40)
HLP (average)												0.9667	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.0315 (42)
Average daily hot water use (litres/day) 58.6985 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	64.5683	62.2204	59.8724	57.5245	55.1765	52.8286	52.8286	55.1765	57.5245	59.8724	62.2204	64.5683	(44)
Energy conte	95.7529	83.7461	86.4185	75.3417	72.2922	62.3827	57.8067	66.3340	67.1263	78.2292	85.3933	92.7316	(45)
Energy content (annual)										Total = Sum(45)m =		923.5552	(45)

Distribution loss (46)m = 0.15 x (45)m

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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               14.3629    12.5619    12.9628    11.3013    10.8438     9.3574     8.6710     9.9501    10.0689    11.7344    12.8090    13.9097 (46)
Water storage loss:
Store volume                                                                                                                            1.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                           0.0600 (48)
  Temperature factor from Table 2b                                                                                                      1.0000 (49)
Enter (49) or (54) in (55)                                                                                                              0.0600 (55)
Total storage loss
                1.8600     1.6800     1.8600     1.8000     1.8600     1.8000     1.8600     1.8600     1.8000     1.8600     1.8000     1.8600 (56)
If cylinder contains dedicated solar storage
                1.8600     1.6800     1.8600     1.8000     1.8600     1.8000     1.8600     1.8600     1.8000     1.8600     1.8000     1.8600 (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)
Total heat required for water heating calculated for each month
              120.8753   106.4373   111.5409    99.6537    97.4146    86.6947    82.9291    91.4564    91.4383   103.3516   109.7053   117.8540 (62)
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 (63)
                                                                                          Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              120.8753   106.4373   111.5409    99.6537    97.4146    86.6947    82.9291    91.4564    91.4383   103.3516   109.7053   117.8540 (64)
                                                                                            Total per year (kWh/year) = Sum(64)m =   1219.3512 (64)
Heat gains from water heating, kWh/month
               51.9358    45.9985    48.8321    44.5007    44.1351    40.1918    39.3186    42.1540    41.7691    46.1091    47.8429    50.9312 (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          51.5757    51.5757    51.5757    51.5757    51.5757    51.5757    51.5757    51.5757    51.5757    51.5757    51.5757    51.5757 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                6.9184     6.1448     4.9973     3.7833     2.8281     2.3876     2.5798     3.3534     4.5009     5.7149     6.6702     7.1107 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               75.9197    76.7075    74.7222    70.4958    65.1608    60.1466    56.7969    56.0091    57.9943    62.2207    67.5557    72.5699 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               28.1576    28.1576    28.1576    28.1576    28.1576    28.1576    28.1576    28.1576    28.1576    28.1576    28.1576    28.1576 (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)
              -41.2605   -41.2605   -41.2605   -41.2605   -41.2605   -41.2605   -41.2605   -41.2605   -41.2605   -41.2605   -41.2605   -41.2605 (71)
Water heating gains (Table 5)
               69.8061    68.4502    65.6345    61.8066    59.3213    55.8220    52.8476    56.6586    58.0126    61.9746    66.4484    68.4559 (72)
Total internal gains
              191.1169   189.7752   183.8267   174.5584   165.7829   156.8289   150.6971   154.4937   158.9805   168.3829   179.1470   186.6091 (73)


----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------
[Jan]                                        Area          Solar flux                 g                   FF             Access              Gains
                                               m2            Table 6a      Specific data       Specific data             factor                  W
                                                                 W/m2        or Table 6b         or Table 6c           Table 6d
----------------------------------------------------------------------------------------------------
South                                      3.6000             46.7521              0.3600              0.7000             0.7700            29.3925 (78)
----------------------------------------------------------------------------------------------------

Solar gains    29.3925    48.1374    61.3185    69.3032    72.2183    69.5002    67.9060    65.9461    64.0544    51.9207    34.8402    25.3979 (83)
Total gains   220.5094   237.9126   245.1452   243.8616   238.0012   226.3291   218.6030   220.4398   223.0350   220.3037   213.9872   212.0070 (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           129.9610   130.3034   130.6476   132.3961   132.7515   134.5572   134.5572   134.9243   133.8291   132.7515   132.0427   131.3414
alpha           9.6641     9.6869     9.7098     9.8264     9.8501     9.9705     9.9705     9.9950     9.9219     9.8501     9.8028     9.7561
util living area
                0.9933     0.9842     0.9602     0.8905     0.7452     0.5405     0.3851     0.3981     0.5937     0.8629     0.9775     0.9951 (86)

MIT            20.6811    20.7604    20.8563    20.9482    20.9914    20.9996    21.0000    21.0000    20.9991    20.9669    20.8233    20.6620 (87)
Th 2           20.0954    20.0976    20.0998    20.1106    20.1128    20.1237    20.1237    20.1258    20.1193    20.1128    20.1084    20.1041 (88)
util rest of house
                0.9897     0.9762     0.9416     0.8491     0.6802     0.4668     0.3084     0.3225     0.5188     0.8096     0.9648     0.9924 (89)
MIT 2          19.8254    19.9035    19.9937    20.0794    20.1092    20.1236    20.1237    20.1258    20.1191    20.0953    19.9737    19.8146 (90)
Living area fraction                                                                                    fLA = Living area / (4) =       0.8458 (91)
MIT            20.5491    20.6283    20.7233    20.8142    20.8554    20.8645    20.8648    20.8652    20.8634    20.8324    20.6922    20.5313 (92)
Temperature adjustment                                                                                                                  0.3000
adjusted MIT   20.8491    20.9283    21.0233    21.1142    21.1554    21.1645    21.1648    21.1652    21.1634    21.1324    20.9922    20.8313 (93)


----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9928     0.9836     0.9606     0.8952     0.7560     0.5542     0.3995     0.4124     0.6074     0.8699     0.9774     0.9947 (94)
Useful gains  218.9223   234.0214   235.4811   218.2987   179.9346   125.4355    87.3292    90.9119   135.4821   191.6347   209.1484   210.8814 (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
              327.8163   316.6652   286.1754   237.4979   183.3618   125.5932    87.3348    90.9196   135.8724   204.2486   270.8488   325.9825 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               81.0172    55.5366    37.7166    13.8235     2.5498     0.0000     0.0000     0.0000     0.0000     9.3847    44.4243    85.6352 (98)
Space heating                                                                                                                         330.0878 (98)
Space heating per m2                                                                                              (98) / (4) =         16.4223 (99)


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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8c. Space cooling requirement
----------------------------------------------------------------------------------------------------
Not applicable


----------------------------------------------------------------------------------------------------
9b. Energy requirements
----------------------------------------------------------------------------------------------------
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 %)                                                                          100.0000 (206)
Efficiency of secondary/supplementary heating system, %                                                                     0.0000 (208)
Space heating requirement                                                                                                 330.0878 (211)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
               81.0172    55.5366    37.7166    13.8235     2.5498     0.0000     0.0000     0.0000     0.0000     9.3847    44.4243    85.6352 (98)
Space heating efficiency (main heating system 1)
              100.0000   100.0000   100.0000   100.0000   100.0000     0.0000     0.0000     0.0000     0.0000   100.0000   100.0000   100.0000 (210)
Space heating fuel (main heating system)
               81.0172    55.5366    37.7166    13.8235     2.5498     0.0000     0.0000     0.0000     0.0000     9.3847    44.4243    85.6352 (211)
Water heating requirement
                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
Annual water heating requirement                                                                                         1219.3512 (64)
Fraction of heat from community Heat pump                                                                                   1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for community water heating                                            1.0500 (305a)
Distribution loss factor (Table 12c) for community heating system                                                           1.2000 (306)
Water heat from Heat pump = (64) x 1.00 x 1.05 x 1.20                                                                    1536.3825 (310a)
Electricity used for heat distribution                                                                                     15.3638 (313)
Annual totals kWh/year
Space heating fuel - main system                                                                                          330.0878 (211)
Space heating fuel - secondary                                                                                              0.0000 (215)

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7875)
   mechanical ventilation fans (SFP =       0.7875)                                                                        52.1399 (230a)
Total electricity for the above, kWh/year                                                                                  52.1399 (231)
Electricity for lighting (calculated in Appendix L)                                                                       122.1807 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 0.25 * 951 * 0.80) =                                                         -152.0986                 -152.0986 (233)
Total delivered energy for all uses                                                                                      1888.6924 (238)


----------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions
----------------------------------------------------------------------------------------------------
                                                                               Energy       Emission factor             Emissions
                                                                             kWh/year           kg CO2/kWh            kg CO2/year
Space heating - main system 1                                                330.0878               0.5190               171.3156 (261)
Efficiency of heat source Heat pump                                                                                      250.0000 (367a)
Space heating from Heat pump                                                 614.5530               0.5190               318.9530 (367)
Electrical energy for heat distribution                                       15.3638               0.5190                 7.9738 (372)
Total CO2 associated with community systems                                                                              326.9268 (373)
 (negative value allowed since DFEE <= TFEE)
Space heating - secondary                                                      0.0000               0.0000                 0.0000 (263)
Space and water heating                                                                                                  498.2424 (265)
Pumps and fans                                                                52.1399               0.5190                27.0606 (267)
Energy for lighting                                                          122.1807               0.5190                63.4118 (268)

 Energy saving/generation technologies
PV Unit                                                                     -152.0986               0.5190               -78.9392 (269)
Total CO2, kg/year                                                                                                       509.7756 (272)
Dwelling Carbon Dioxide Emission Rate (DER)                                                                               25.3600 (273)


16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER                                                                                                                       25.3600 ZC1
Total Floor Area                                                                                                   TFA    20.1000
Assumed number of occupants                                                                                          N     1.0315
CO2 emission factor in Table 12 for electricity displaced from grid                                                 EF     0.5190
CO2 emissions from appliances, equation (L14)                                                                             22.3823 ZC2
CO2 emissions from cooking, equation (L16)                                                                                 7.1521 ZC3
Total CO2 emissions                                                                                                       54.8943 ZC4
Residual CO2 emissions offset from biofuel CHP                                                                             0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year                                                                   0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation                                            0.0000 ZC7
Net CO2 emissions                                                                                                         54.8943 ZC8


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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS      09 Jan 2014
-----------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------



-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                                                        Area           Storey height                  Volume
                                                                                                        (m2)                (m)                        (m3)
Ground floor                                                                                         20.1000 (1b)     x       2.7000 (2b)     =       54.2700 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)                  20.1000                                                                         (4)
Dwelling volume                                                                                            (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =       54.2700 (5)



-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                                                     main           secondary             other              total        m3 per hour
                                                                  heating             heating
Number of chimneys                                                       0       +          0       +          0      =          0 * 40 =       0.0000 (6a)
Number of open flues                                                     0       +          0       +          0      =          0 * 20 =       0.0000 (6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =                                          20.0000 / (5) =       0.3685 (8)
Pressure test                                                                                                                                     Yes
Measured/design AP50                                                                                                                           5.0000
Infiltration rate                                                                                                                              0.6185 (18)
Number of sides sheltered                                                                                                                           3 (19)

Shelter factor                                                                                        (20) =  1  -  [0.075 x (19)]  =       0.7750 (20)
Infiltration rate adjusted to include shelter factor                                                            (21) = (18) x (20)  =       0.4794 (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
                 0.6112      0.5992      0.5872      0.5273      0.5153      0.4554      0.4554      0.4434      0.4794      0.5153      0.5393      0.5632 (22b)
Effective ac     0.6868      0.6795      0.6724      0.6390      0.6328      0.6037      0.6037      0.5983      0.6149      0.6328      0.6454      0.6586 (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
TER Opening Type (Uw = 1.40)                                                    3.6000         1.3258          4.7727                                     (27)
External Wall 1                               10.8800          3.6000           7.2800         0.1800          1.3104                                     (29a)
External Roof 1                                8.5000                           8.5000         0.1300          1.1050                                     (30)
Total net area of external elements Aum(A, m2)                                 19.3800                                                                    (31)
Fabric heat loss, W/K = Sum (A x U)                                                (26)...(30) + (32) =      7.1881                                     (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                             250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                                       6.9580 (36)
Total fabric heat loss                                                                                                      (33) + (36) =      14.1461 (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           12.2995     12.1696     12.0423     11.4443     11.3324     10.8116     10.8116     10.7151     11.0122     11.3324     11.5587     11.7954 (38)
Heat transfer coeff
                26.4456     26.3157     26.1884     25.5904     25.4785     24.9577     24.9577     24.8612     25.1583     25.4785     25.7049     25.9415 (39)
Average = Sum(39)m / 12 =                                                                                                                      25.5899 (39)

                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
HLP              1.3157      1.3092      1.3029      1.2732      1.2676      1.2417      1.2417      1.2369      1.2517      1.2676      1.2788      1.2906 (40)
HLP (average)                                                                                                                                  1.2731 (40)
Days in month
                     31          28          31          30          31          30          31          31          30          31          30          31 (41)



-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                               1.0315 (42)
Average daily hot water use (litres/day)                                                                                                       58.6985 (43)

                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Daily hot water use
                64.5683     62.2204     59.8724     57.5245     55.1765     52.8286     52.8286     55.1765     57.5245     59.8724     62.2204     64.5683 (44)
Energy conte    95.7529     83.7461     86.4185     75.3417     72.2922     62.3827     57.8067     66.3340     67.1263     78.2292     85.3933     92.7316 (45)
Energy content (annual)                                                                                                 Total = Sum(45)m =    923.5552 (45)
Distribution loss  (46)m = 0.15 x (45)m
                14.3629     12.5619     12.9628     11.3013     10.8438      9.3574      8.6710      9.9501     10.0689     11.7344     12.8090     13.9097 (46)
Water storage loss:
Store volume                                                                                                                                    1.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                   0.2134 (48)
  Temperature factor from Table 2b                                                                                                              0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                      0.1152 (55)
Total storage loss
                 3.5715      3.2259      3.5715      3.4563      3.5715      3.4563      3.5715      3.5715      3.4563      3.5715      3.4563      3.5715 (56)
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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage	3.5715	3.2259	3.5715	3.4563	3.5715	3.4563	3.5715	3.5715	3.4563	3.5715	3.4563	3.5715	(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)
Total heat required for water heating calculated for each month	122.5868	107.9832	113.2524	101.3100	99.1261	88.3509	84.6406	93.1679	93.0945	105.0631	111.3616	119.5655	(62)
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	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	122.5868	107.9832	113.2524	101.3100	99.1261	88.3509	84.6406	93.1679	93.0945	105.0631	111.3616	119.5655	(64)
Total per year (kWh/year) = Sum(64)m =												1239.5025	(64)
Heat gains from water heating, kWh/month	53.3049	47.2352	50.2013	45.8257	45.5043	41.5169	40.6878	43.5232	43.0941	47.4783	49.1679	52.3004	(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	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	6.9184	6.1448	4.9973	3.7833	2.8281	2.3876	2.5798	3.3534	4.5009	5.7149	6.6702	7.1107	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	75.9197	76.7075	74.7222	70.4958	65.1608	60.1466	56.7969	56.0091	57.9943	62.2207	67.5557	72.5699	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	(71)
Water heating gains (Table 5)	71.6464	70.2905	67.4748	63.6469	61.1616	57.6623	54.6879	58.4989	59.8529	63.8149	68.2887	70.2962	(72)
Total internal gains	195.9572	194.6155	188.6670	179.3987	170.6232	161.6692	155.5374	159.3340	163.8208	173.2232	183.9873	191.4494	(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	
South	3.6000	46.7521	0.6300	0.7000	0.7700	51.4369	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	51.4369	84.2405	107.3074	121.2806	126.3819	121.6254	118.8354	115.4057	112.0952	90.8612	60.9703	44.4463	(83)
Total gains	247.3941	278.8560	295.9744	300.6794	297.0051	283.2946	274.3728	274.7397	275.9161	264.0845	244.9576	235.8957	(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	52.7813	53.0418	53.2997	54.5452	54.7847	55.9280	55.9280	56.1450	55.4820	54.7847	54.3023	53.8070	
alpha	4.5188	4.5361	4.5533	4.6363	4.6523	4.7285	4.7285	4.7430	4.6988	4.6523	4.6202	4.5871	
util living area	0.9666	0.9431	0.9054	0.8344	0.7196	0.5468	0.3971	0.4124	0.6007	0.8245	0.9376	0.9716	(86)
MIT	20.0815	20.2704	20.4919	20.7315	20.8937	20.9779	20.9960	20.9952	20.9640	20.7839	20.4173	20.0587	(87)
Th 2	20.3421	20.3454	20.3485	20.3634	20.3662	20.3792	20.3792	20.3816	20.3742	20.3662	20.3606	20.3547	(88)
util rest of house	0.9616	0.9351	0.8922	0.8123	0.6844	0.4986	0.3423	0.3585	0.5536	0.7977	0.9275	0.9674	(89)
MIT 2	19.4970	19.6838	19.9004	20.1390	20.2859	20.3655	20.3773	20.3793	20.3507	20.1917	19.8417	19.4851	(90)
Living area fraction									fLA = Living area / (4) =			0.8458	(91)
MIT	19.9913	20.1799	20.4007	20.6402	20.8000	20.8834	20.9006	20.9002	20.8694	20.6925	20.3285	19.9702	(92)
Temperature adjustment												0.6000	
adjusted MIT	20.5913	20.7799	21.0007	21.2402	21.4000	21.4834	21.5006	21.5002	21.4694	21.2925	20.9285	20.5702	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9636	0.9406	0.9054	0.8421	0.7402	0.5826	0.4403	0.4551	0.6340	0.8356	0.9365	0.9689	(94)
Useful gains	238.3838	262.2818	267.9676	253.2109	219.8326	165.0590	120.8066	125.0319	174.9223	220.6790	229.4059	228.5513	(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	430.8338	417.8910	379.7497	315.7894	247.1416	171.7940	122.3071	126.7965	185.4011	272.4298	355.4603	424.6683	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	143.1827	104.5694	83.1659	45.0565	20.3179	0.0000	0.0000	0.0000	0.0000	38.5026	90.7592	145.9110	(98)
Space heating												671.4652	(98)
Space heating per m2											(98) / (4) =	33.4062	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)	88.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	758.7178	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	143.1827	104.5694	83.1659	45.0565	20.3179	0.0000	0.0000	0.0000	0.0000	38.5026	90.7592	145.9110	(98)
Space heating efficiency (main heating system 1)	88.5000	88.5000	88.5000	88.5000	88.5000	0.0000	0.0000	0.0000	0.0000	88.5000	88.5000	88.5000	(210)
Space heating fuel (main heating system)	161.7884	118.1575	93.9728	50.9114	22.9581	0.0000	0.0000	0.0000	0.0000	43.5057	102.5527	164.8712	(211)
Water heating requirement	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	122.5868	107.9832	113.2524	101.3100	99.1261	88.3509	84.6406	93.1679	93.0945	105.0631	111.3616	119.5655	(64)
Efficiency of water heater												74.8000	(216)
(217)m	80.2078	79.7074	78.9853	77.7971	76.4270	74.8000	74.8000	74.8000	74.8000	77.3977	79.2537	80.3250	(217)
Fuel for water heating, kWh/month	152.8365	135.4744	143.3841	130.2234	129.7004	118.1162	113.1559	124.5560	124.4579	135.7445	140.5128	148.8522	(219)

Water heating fuel used	1597.0144	(219)
Annual totals kWh/year		
Space heating fuel - main system	758.7178	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	39.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	84.0000	(231)
Electricity for lighting (calculated in Appendix L)	122.1807	(232)
Total delivered energy for all uses	2561.9128	(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	758.7178	0.2160	163.8830	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1597.0144	0.2160	344.9551	(264)
Space and water heating			508.8381	(265)
Pumps and fans	84.0000	0.5190	43.5960	(267)
Energy for lighting	122.1807	0.5190	63.4118	(268)
Total CO2, kg/m2/year			615.8459	(272)
Emissions per m2 for space and water heating			25.3153	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			3.1548	(272b)
Emissions per m2 for pumps and fans			2.1690	(272c)
Target Carbon Dioxide Emission Rate (TER) = (25.3153 * 1.55) + 3.1548 + 2.1690, rounded to 2 d.p.			44.5600	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)			Storey height (m)			Volume (m3)	
Ground floor		20.1000	(1b)	x	2.7000	(2b)	=	54.2700	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	20.1000								(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	54.2700	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.3685	(8)
Pressure test			Yes	
Measured/design AP50			3.0000	
Infiltration rate			0.5185	(18)
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.4019	(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	0.5124	0.5023	0.4923	0.4420	0.4320	0.3818	0.3818	0.3717	0.4019	0.4320	0.4521	0.4722	(22b)
Effective ac	0.6313	0.6262	0.6212	0.5977	0.5933	0.5729	0.5729	0.5691	0.5807	0.5933	0.6022	0.6115	(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	
Opening Type 1 (Uw = 1.20)			3.6000	1.1450	4.1221			(27)
External Wall 1	10.8800	3.6000	7.2800	0.1600	1.1648	190.0000	1383.2000	(29a)
External Roof 1	8.5000		8.5000	0.1100	0.9350	9.0000	76.5000	(30)
Total net area of external elements Aum(A, m2)			19.3800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	6.2219			(33)
Party Wall 1			48.6400	0.0000	0.0000	140.0000	6809.6000	(32)
Party Floor 1			20.1000			40.0000	804.0000	(32d)
Internal Wall 1			21.6000			9.0000	194.4000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	9267.7000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		461.0796	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.8280	(36)
Total fabric heat loss	(33) + (36) =	15.0499	(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	11.3053	11.2140	11.1246	10.7043	10.6257	10.2596	10.2596	10.1918	10.4006	10.6257	10.7847	10.9510	(38)
Heat transfer coeff	26.3553	26.2640	26.1745	25.7542	25.6756	25.3096	25.3096	25.2418	25.4506	25.6756	25.8347	26.0010	(39)
Average = Sum(39)m / 12 =												25.7539	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3112	1.3067	1.3022	1.2813	1.2774	1.2592	1.2592	1.2558	1.2662	1.2774	1.2853	1.2936	(40)
HLP (average)												1.2813	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.0315	(42)
Average daily hot water use (litres/day)	58.6985	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	64.5683	62.2204	59.8724	57.5245	55.1765	52.8286	52.8286	55.1765	57.5245	59.8724	62.2204	64.5683	(44)
Energy conte	95.7529	83.7461	86.4185	75.3417	72.2922	62.3827	57.8067	66.3340	67.1263	78.2292	85.3933	92.7316	(45)
Energy content (annual)										Total = Sum(45)m =		923.5552	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	20.3475	17.7960	18.3639	16.0101	15.3621	13.2563	12.2839	14.0960	14.2643	16.6237	18.1461	19.7055	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	6.9184	6.1448	4.9973	3.7833	2.8281	2.3876	2.5798	3.3534	4.5009	5.7149	6.6702	7.1107	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	75.9197	76.7075	74.7222	70.4958	65.1608	60.1466	56.7969	56.0091	57.9943	62.2207	67.5557	72.5699	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	(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)	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	(71)
Water heating gains (Table 5)	27.3488	26.4822	24.6827	22.2363	20.6480	18.4115	16.5107	18.9462	19.8116	22.3437	25.2029	26.4858	(72)
Total internal gains	148.6595	147.8072	142.8749	134.9881	127.1095	119.4185	114.3601	116.7814	120.7795	128.7520	137.9015	144.6391	(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	
South	3.6000	46.7521	0.3600	0.7000	0.7700	29.3925	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	29.3925	48.1374	61.3185	69.3032	72.2183	69.5002	67.9060	65.9461	64.0544	51.9207	34.8402	25.3979	(83)
Total gains	178.0521	195.9446	204.1934	204.2913	199.3278	188.9187	182.2660	182.7275	184.8339	180.6727	172.7416	170.0369	(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	97.6792	98.0187	98.3538	99.9587	100.2649	101.7149	101.7149	101.9881	101.1514	100.2649	99.6475	99.0102	
alpha	7.5119	7.5346	7.5569	7.6639	7.6843	7.7810	7.7810	7.7992	7.7434	7.6843	7.6432	7.6007	
util living area	0.9993	0.9984	0.9957	0.9861	0.9479	0.8076	0.6058	0.6286	0.8617	0.9834	0.9981	0.9995	(86)
MIT	20.2780	20.3740	20.5143	20.6956	20.8623	20.9739	20.9974	20.9965	20.9548	20.7530	20.4845	20.2638	(87)
Th 2	19.8321	19.8356	19.8391	19.8555	19.8586	19.8729	19.8729	19.8756	19.8674	19.8586	19.8524	19.8459	(88)
util rest of house	0.9989	0.9973	0.9927	0.9753	0.9056	0.6919	0.4539	0.4793	0.7625	0.9679	0.9966	0.9992	(89)
MIT 2	19.1946	19.2933	19.4355	19.6265	19.7785	19.8653	19.8727	19.8752	19.8512	19.6849	19.4180	19.1923	(90)
Living area fraction									fLA = Living area / (4) =			0.8458	(91)
MIT	20.1109	20.2073	20.3479	20.5307	20.6951	20.8029	20.8239	20.8236	20.7846	20.5883	20.3200	20.0985	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1109	20.2073	20.3479	20.5307	20.6951	20.8029	20.8239	20.8236	20.7846	20.5883	20.3200	20.0985	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9977	0.9942	0.9824	0.9388	0.7896	0.5827	0.6059	0.8457	0.9790	0.9973	0.9993	(94)
Useful gains	177.8803	195.4968	203.0184	200.7027	187.1302	149.1705	106.2030	110.7146	156.3123	176.8729	172.2741	169.9199	(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	416.7008	402.0313	362.4624	299.5410	230.9550	156.9939	106.9053	111.6591	170.1266	256.4558	341.5343	413.3771	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	177.6824	138.7912	118.6263	71.1635	32.6057	0.0000	0.0000	0.0000	0.0000	59.2097	121.8674	181.1321	(98)
Space heating												901.0783	(98)
Space heating per m2											(98) / (4) =	44.8298	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	237.9100	187.2908	191.8376	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9190	0.9712	0.9679	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	218.6289	181.8924	185.6855	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	258.2365	249.9532	250.8560	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	28.5175	50.6372	48.4869	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												127.6416	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Intermittency factor (Table 10b)
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                 0.0000     0.0000     0.0000     0.0000     0.0000     7.1294    12.6593    12.1217     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          31.9104 (107)
Space cooling per m2                                                                                                                    1.5876 (108)
Energy for space heating                                                                                                               44.8298 (99)
Energy for space cooling                                                                                                                1.5876 (108)
Total                                                                                                                                  46.4174 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                                                  46.4 (109)


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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)			Volume (m3)	
Ground floor		20.1000 (1b)	x	2.7000 (2b)		=	54.2700	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	20.1000							(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	54.2700	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.3685	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.6185	(18)
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.4794	(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	0.6112	0.5992	0.5872	0.5273	0.5153	0.4554	0.4554	0.4434	0.4794	0.5153	0.5393	0.5632	(22b)
Effective ac	0.6868	0.6795	0.6724	0.6390	0.6328	0.6037	0.6037	0.5983	0.6149	0.6328	0.6454	0.6586	(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 Opening Type (Uw = 1.40)			3.6000	1.3258	4.7727			(27)
External Wall 1	10.8800	3.6000	7.2800	0.1800	1.3104			(29a)
External Roof 1	8.5000		8.5000	0.1300	1.1050			(30)
Total net area of external elements Aum(A, m2)			19.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		7.1881			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.9580	(36)
Total fabric heat loss (33) + (36) =	14.1461	(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	12.2995	12.1696	12.0423	11.4443	11.3324	10.8116	10.8116	10.7151	11.0122	11.3324	11.5587	11.7954	(38)
Heat transfer coeff	26.4456	26.3157	26.1884	25.5904	25.4785	24.9577	24.9577	24.8612	25.1583	25.4785	25.7049	25.9415	(39)
Average = Sum(39)m / 12 =												25.5899	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3157	1.3092	1.3029	1.2732	1.2676	1.2417	1.2417	1.2369	1.2517	1.2676	1.2788	1.2906	(40)
HLP (average)												1.2731	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.0315	(42)
Average daily hot water use (litres/day)	58.6985	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	64.5683	62.2204	59.8724	57.5245	55.1765	52.8286	52.8286	55.1765	57.5245	59.8724	62.2204	64.5683	(44)
Energy conte	95.7529	83.7461	86.4185	75.3417	72.2922	62.3827	57.8067	66.3340	67.1263	78.2292	85.3933	92.7316	(45)
Energy content (annual)										Total = Sum(45)m =		923.5552	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss: Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	20.3475	17.7960	18.3639	16.0101	15.3621	13.2563	12.2839	14.0960	14.2643	16.6237	18.1461	19.7055	(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	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	51.5757	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	6.9184	6.1448	4.9973	3.7833	2.8281	2.3876	2.5798	3.3534	4.5009	5.7149	6.6702	7.1107	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	75.9197	76.7075	74.7222	70.4958	65.1608	60.1466	56.7969	56.0091	57.9943	62.2207	67.5557	72.5699	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	28.1576	(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)													
	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	(71)
Water heating gains (Table 5)													
	27.3488	26.4822	24.6827	22.2363	20.6480	18.4115	16.5107	18.9462	19.8116	22.3437	25.2029	26.4858	(72)
Total internal gains													
	148.6595	147.8072	142.8749	134.9881	127.1095	119.4185	114.3601	116.7814	120.7795	128.7520	137.9015	144.6391	(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	
South	3.6000	46.7521	0.6300	0.7000	0.7700	51.4369	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	51.4369	84.2405	107.3074	121.2806	126.3819	121.6254	118.8354	115.4057	112.0952	90.8612	60.9703	44.4463	(83)
Total gains	200.0965	232.0477	250.1823	256.2688	253.4915	241.0439	233.1955	232.1870	232.8747	219.6132	198.8718	189.0853	(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	52.7813	53.0418	53.2997	54.5452	54.7847	55.9280	55.9280	56.1450	55.4820	54.7847	54.3023	53.8070	
alpha	4.5188	4.5361	4.5533	4.6363	4.6523	4.7285	4.7285	4.7430	4.6988	4.6523	4.6202	4.5871	
util living area													
	0.9845	0.9694	0.9434	0.8907	0.7942	0.6274	0.4637	0.4837	0.6867	0.8907	0.9693	0.9876	(86)
MIT	19.8904	20.0976	20.3467	20.6280	20.8371	20.9609	20.9923	20.9906	20.9373	20.6827	20.2488	19.8653	(87)
Th 2	19.8286	19.8336	19.8386	19.8619	19.8663	19.8868	19.8868	19.8906	19.8789	19.8663	19.8574	19.8482	(88)
util rest of house													
	0.9797	0.9603	0.9264	0.8576	0.7335	0.5326	0.3501	0.3715	0.5968	0.8515	0.9585	0.9837	(89)
MIT 2	18.8551	19.0610	19.3042	19.5844	19.7651	19.8704	19.8851	19.8883	19.8495	19.6417	19.2305	18.8462	(90)
Living area fraction									fLA = Living area / (4) =			0.8458	(91)
MIT	19.7307	19.9378	20.1859	20.4671	20.6717	20.7927	20.8215	20.8205	20.7695	20.5222	20.0918	19.7081	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7307	19.9378	20.1859	20.4671	20.6717	20.7927	20.8215	20.8205	20.7695	20.5222	20.0918	19.7081	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9792	0.9613	0.9320	0.8763	0.7780	0.6107	0.4460	0.4660	0.6695	0.8757	0.9610	0.9831	(94)
Useful gains	195.9417	223.0561	233.1714	224.5683	197.2262	147.1983	103.9963	108.2107	155.9053	192.3096	191.1150	185.8992	(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													
	408.0751	395.7292	358.4125	296.0057	228.5863	154.5562	105.3598	109.9003	167.7932	252.8019	333.9520	402.3032	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	157.8273	116.0363	93.1793	51.4349	23.3319	0.0000	0.0000	0.0000	0.0000	45.0063	102.8427	161.0046	(98)
Space heating												750.6633	(98)
Space heating per m2										(98) / (4) =		37.3464	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	234.6022	184.6868	188.9453	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9254	0.9630	0.9598	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	217.1007	177.8471	181.3463	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	319.1620	309.4811	308.6659	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	73.4842	97.9357	94.7258	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												266.1457	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	18.3710	24.4839	23.6815	0.0000	0.0000	0.0000	0.0000	(107)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling	66.5364 (107)
Space cooling per m2	3.3103 (108)
Energy for space heating	37.3464 (99)
Energy for space cooling	3.3103 (108)
Total	40.6567 (109)
Target Fabric Energy Efficiency (TFEE)	46.8 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)			Volume (m3)	
Ground floor		20.1000	(1b)	x	2.7000	(2b) =	54.2700	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	20.1000							(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		54.2700	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1221	0.1163	0.1163	0.1075	0.1075	0.0959	0.0988	0.0930	0.0959	0.1017	0.1017	0.1104	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2396	0.2338	0.2338	0.2250	0.2250	0.2134	0.2163	0.2105	0.2134	0.2192	0.2192	0.2279	(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	
Opening Type 1 (Uw = 1.20)			3.6000	1.1450	4.1221			(27)
External Wall 1	10.8800	3.6000	7.2800	0.1600	1.1648	190.0000	1383.2000	(29a)
External Roof 1	8.5000		8.5000	0.1100	0.9350	9.0000	76.5000	(30)
Total net area of external elements Aum(A, m2)			19.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		6.2219			(33)
Party Wall 1			48.6400	0.0000	0.0000	140.0000	6809.6000	(32)
Party Floor 1			20.1000			40.0000	804.0000	(32d)
Internal Wall 1			21.6000			9.0000	194.4000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	9267.7000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		461.0796	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.8280	(36)
Total fabric heat loss	(33) + (36) =	15.0499	(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	4.2903	4.1863	4.1863	4.0301	4.0301	3.8219	3.8740	3.7699	3.8219	3.9260	3.9260	4.0822	(38)
Heat transfer coeff	19.3403	19.2362	19.2362	19.0800	19.0800	18.8719	18.9239	18.8198	18.8719	18.9759	18.9759	19.1321	(39)
Average = Sum(39)m / 12 =												19.0453	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9622	0.9570	0.9570	0.9493	0.9493	0.9389	0.9415	0.9363	0.9389	0.9441	0.9441	0.9518	(40)
HLP (average)												0.9475	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.0315 (42)
Average daily hot water use (litres/day) 58.6985 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	64.5683	62.2204	59.8724	57.5245	55.1765	52.8286	52.8286	55.1765	57.5245	59.8724	62.2204	64.5683	(44)
Energy conte	95.7529	83.7461	86.4185	75.3417	72.2922	62.3827	57.8067	66.3340	67.1263	78.2292	85.3933	92.7316	(45)
Energy content (annual)											Total = Sum(45)m =	923.5552	(45)

Distribution loss (46)m = 0.15 x (45)m

CALCULATION OF HEAT DEMAND 09 Jan 2014

	14.3629	12.5619	12.9628	11.3013	10.8438	9.3574	8.6710	9.9501	10.0689	11.7344	12.8090	13.9097	(46)
Water storage loss:													
Store volume												1.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												0.0600	(48)
Temperature factor from Table 2b												1.0000	(49)
Enter (49) or (54) in (55)												0.0600	(55)
Total storage loss	1.8600	1.6800	1.8600	1.8000	1.8600	1.8000	1.8600	1.8600	1.8000	1.8600	1.8000	1.8600	(56)
If cylinder contains dedicated solar storage	1.8600	1.6800	1.8600	1.8000	1.8600	1.8000	1.8600	1.8600	1.8000	1.8600	1.8000	1.8600	(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)
Total heat required for water heating calculated for each month	120.8753	106.4373	111.5409	99.6537	97.4146	86.6947	82.9291	91.4564	91.4383	103.3516	109.7053	117.8540	(62)
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	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	120.8753	106.4373	111.5409	99.6537	97.4146	86.6947	82.9291	91.4564	91.4383	103.3516	109.7053	117.8540	(64)
Total per year (kWh/year) = Sum(64)m =												1219.3512	(64)
RHI water heating demand												1219	(64)
Heat gains from water heating, kWh/month	51.9358	45.9985	48.8321	44.5007	44.1351	40.1918	39.3186	42.1540	41.7691	46.1091	47.8429	50.9312	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.2959	15.3621	12.4933	9.4582	7.0701	5.9689	6.4496	8.3835	11.2523	14.2873	16.6754	17.7767	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	113.3129	114.4887	111.5257	105.2177	97.2549	89.7711	84.7714	83.5956	86.5587	92.8667	100.8294	108.3132	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	(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)	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	(71)
Water heating gains (Table 5)	69.8061	68.4502	65.6345	61.8066	59.3213	55.8220	52.8476	56.6586	58.0126	61.9746	66.4484	68.4559	(72)
Total internal gains	263.2659	261.1519	252.5044	239.3333	226.4973	214.4129	206.9196	211.4885	218.6744	231.9795	246.8041	257.3966	(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	
South	3.6000	50.9848	0.3600	0.7000	0.7700	32.0536	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	32.0536	47.1116	59.1840	69.1730	70.7100	73.1233	70.5427	69.6000	67.0570	54.2001	38.8916	27.4538	(83)
Total gains	295.3195	308.2635	311.6884	308.5063	297.2072	287.5362	277.4623	281.0885	285.7315	286.1796	285.6958	284.8504	(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	133.1087	133.8291	133.8291	134.9243	134.9243	136.4127	136.0376	136.7900	136.4127	135.6644	135.6644	134.5572	
alpha	9.8739	9.9219	9.9219	9.9950	9.9950	10.0942	10.0692	10.1193	10.0942	10.0443	10.0443	9.9705	
util living area	0.9253	0.8893	0.8115	0.6814	0.5133	0.3282	0.2114	0.2143	0.3831	0.6212	0.8298	0.9357	(86)
MIT	20.9020	20.9368	20.9752	20.9955	20.9997	21.0000	21.0000	21.0000	21.0000	20.9983	20.9725	20.8921	(87)
Th 2	20.1149	20.1193	20.1193	20.1258	20.1258	20.1346	20.1324	20.1367	20.1346	20.1302	20.1302	20.1237	(88)
util rest of house	0.9002	0.8575	0.7685	0.6300	0.4574	0.2714	0.1523	0.1565	0.3259	0.5648	0.7860	0.9129	(89)
MIT 2	20.0447	20.0765	20.1046	20.1237	20.1257	20.1346	20.1324	20.1367	20.1346	20.1295	20.1141	20.0452	(90)
Living area fraction									fLA = Living area / (4) =			0.8458	(91)
MIT	20.7698	20.8041	20.8409	20.8610	20.8649	20.8665	20.8662	20.8669	20.8665	20.8643	20.8401	20.7615	(92)
Temperature adjustment												0.3000	
adjusted MIT	21.0698	21.1041	21.1409	21.1610	21.1649	21.1665	21.1662	21.1669	21.1665	21.1643	21.1401	21.0615	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9270	0.8927	0.8180	0.6907	0.5238	0.3391	0.2228	0.2254	0.3941	0.6318	0.8364	0.9371	(94)
Useful gains	273.7654	275.1878	254.9460	213.0734	155.6708	97.5007	61.8090	63.3637	112.5935	180.8029	238.9451	266.9306	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	308.8602	298.2396	264.3227	214.8612	155.7873	97.5018	61.8090	63.3637	112.5992	181.4922	249.3453	305.3769	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	(97a)
Space heating kWh	26.1105	15.4908	6.9762	1.2872	0.0867	0.0000	0.0000	0.0000	0.0000	0.5128	7.4881	28.6041	(98)
Space heating												86.5565	(98)
RHI space heating demand												87	(98)

CALCULATION OF HEAT DEMAND **09 Jan 2014**

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)    (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS      09 Jan 2014
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1. Overall dwelling dimensions
--------------------------------------------------------------------------------------------------
                                                                                        Area         Storey height              Volume
                                                                                        (m2)              (m)                     (m3)
Ground floor                                                                         20.1000 (1b)    x       2.7000 (2b)     =     54.2700 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              20.1000                                                            (4)
Dwelling volume                                                                            (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     54.2700 (5)



--------------------------------------------------------------------------------------------------
2. Ventilation rate
--------------------------------------------------------------------------------------------------
                                                            main            secondary              other              total        m3 per hour
                                                           heating            heating
Number of chimneys                                               0       +          0       +          0       =          0 * 40 =       0.0000 (6a)
Number of open flues                                             0       +          0       +          0       =          0 * 20 =       0.0000 (6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =                                    0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                                          Yes
Measured/design AP50                                                                                                                3.0000
Infiltration rate                                                                                                                   0.1500 (18)
Number of sides sheltered                                                                                                                3 (19)

Shelter factor                                                                                (20) = 1 - [0.075 x (19)] =           0.7750 (20)
Infiltration rate adjusted to include shelter factor                                                    (21) = (18) x (20) =        0.1163 (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
                 0.1482     0.1453     0.1424     0.1279     0.1250     0.1104     0.1104     0.1075     0.1163     0.1250     0.1308     0.1366 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                          0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                       76.5000 (23c)

Effective ac     0.2657     0.2628     0.2599     0.2454     0.2425     0.2279     0.2279     0.2250     0.2338     0.2425     0.2483     0.2541 (25)



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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
Opening Type 1 (Uw = 1.20)                                                      3.6000         1.1450         4.1221                               (27)
External Wall 1                                10.8800          3.6000          7.2800         0.1600         1.1648       190.0000      1383.2000 (29a)
External Roof 1                                 8.5000                          8.5000         0.1100         0.9350         9.0000        76.5000 (30)
Total net area of external elements Aum(A, m2)                                 19.3800                                                             (31)
Fabric heat loss, W/K = Sum (A x U)                                          (26)...(30) + (32) =           6.2219                                 (33)
Party Wall 1                                                                   48.6400         0.0000         0.0000       140.0000      6809.6000 (32)
Party Floor 1                                                                  20.1000                                      40.0000       804.0000 (32d)
Internal Wall 1                                                                21.6000                                       9.0000       194.4000 (32c)

Heat capacity Cm = Sum(A x k)                                                      (28)...(30) + (32) + (32a)...(32e) =       9267.7000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                           461.0796 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                    8.8280 (36)
Total fabric heat loss                                                                                       (33) + (36) =   15.0499 (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            4.7588     4.7067     4.6547     4.3944     4.3424     4.0822     4.0822     4.0301     4.1863     4.3424     4.4465     4.5506 (38)
Heat transfer coeff
                19.8087    19.7567    19.7046    19.4444    19.3923    19.1321    19.1321    19.0800    19.2362    19.3923    19.4964    19.6005 (39)
Average = Sum(39)m / 12 =                                                                                                          19.4314 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              0.9855     0.9829     0.9803     0.9674     0.9648     0.9518     0.9518     0.9493     0.9570     0.9648     0.9700     0.9752 (40)
HLP (average)                                                                                                                       0.9667 (40)
Days in month
                     31         28         31         30         31         30         31         31         30         31         30         31 (41)



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4. Water heating energy requirements (kWh/year)
--------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                   1.0315 (42)
Average daily hot water use (litres/day)                                                                                           58.6985 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                64.5683    62.2204    59.8724    57.5245    55.1765    52.8286    52.8286    55.1765    57.5245    59.8724    62.2204    64.5683 (44)
Energy conte    95.7529    83.7461    86.4185    75.3417    72.2922    62.3827    57.8067    66.3340    67.1263    78.2292    85.3933    92.7316 (45)
Energy content (annual)                                                                                 Total = Sum(45)m =      923.5552 (45)
Distribution loss  (46)m = 0.15 x (45)m
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	14.3629	12.5619	12.9628	11.3013	10.8438	9.3574	8.6710	9.9501	10.0689	11.7344	12.8090	13.9097	(46)
Water storage loss:													
Store volume												1.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												0.0600	(48)
Temperature factor from Table 2b												1.0000	(49)
Enter (49) or (54) in (55)												0.0600	(55)
Total storage loss	1.8600	1.6800	1.8600	1.8000	1.8600	1.8000	1.8600	1.8600	1.8000	1.8600	1.8000	1.8600	(56)
If cylinder contains dedicated solar storage	1.8600	1.6800	1.8600	1.8000	1.8600	1.8000	1.8600	1.8600	1.8000	1.8600	1.8000	1.8600	(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)
Total heat required for water heating calculated for each month	120.8753	106.4373	111.5409	99.6537	97.4146	86.6947	82.9291	91.4564	91.4383	103.3516	109.7053	117.8540	(62)
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	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	120.8753	106.4373	111.5409	99.6537	97.4146	86.6947	82.9291	91.4564	91.4383	103.3516	109.7053	117.8540	(64)
Total per year (kWh/year) = Sum(64)m =												1219.3512	(64)
Heat gains from water heating, kWh/month	51.9358	45.9985	48.8321	44.5007	44.1351	40.1918	39.3186	42.1540	41.7691	46.1091	47.8429	50.9312	(65)

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.2959	15.3621	12.4933	9.4582	7.0701	5.9689	6.4496	8.3835	11.2523	14.2873	16.6754	17.7767	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	113.3129	114.4887	111.5257	105.2177	97.2549	89.7711	84.7714	83.5956	86.5587	92.8667	100.8294	108.3132	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	(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)	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	(71)
Water heating gains (Table 5)	69.8061	68.4502	65.6345	61.8066	59.3213	55.8220	52.8476	56.6586	58.0126	61.9746	66.4484	68.4559	(72)
Total internal gains	263.2659	261.1519	252.5044	239.3333	226.4973	214.4129	206.9196	211.4885	218.6744	231.9795	246.8041	257.3966	(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	
South	3.6000	46.7521	0.3600	0.7000	0.7700	29.3925	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	29.3925	48.1374	61.3185	69.3032	72.2183	69.5002	67.9060	65.9461	64.0544	51.9207	34.8402	25.3979	(83)
Total gains	292.6584	309.2893	313.8229	308.6366	298.7155	283.9131	274.8255	277.4346	282.7288	283.9002	281.6443	282.7945	(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	129.9610	130.3034	130.6476	132.3961	132.7515	134.5572	134.5572	134.9243	133.8291	132.7515	132.0427	131.3414	
alpha	9.6641	9.6869	9.7098	9.8264	9.8501	9.9705	9.9705	9.9950	9.9219	9.8501	9.8028	9.7561	
util living area	0.9516	0.9186	0.8587	0.7490	0.6021	0.4312	0.3063	0.3164	0.4693	0.7031	0.8890	0.9603	(86)
MIT	20.8507	20.9031	20.9537	20.9883	20.9986	21.0000	21.0000	21.0000	20.9999	20.9941	20.9411	20.8351	(87)
Th 2	20.0954	20.0976	20.0998	20.1106	20.1128	20.1237	20.1237	20.1258	20.1193	20.1128	20.1084	20.1041	(88)
util rest of house	0.9335	0.8924	0.8209	0.6993	0.5455	0.3722	0.2453	0.2562	0.4095	0.6465	0.8532	0.9447	(89)
MIT 2	19.9822	20.0284	20.0702	20.1045	20.1122	20.1236	20.1237	20.1258	20.1193	20.1101	20.0703	19.9768	(90)
Living area fraction									fLA = Living area / (4) =			0.8458	(91)
MIT	20.7168	20.7682	20.8174	20.8520	20.8619	20.8648	20.8648	20.8652	20.8641	20.8578	20.8068	20.7027	(92)
Temperature adjustment												0.3000	
adjusted MIT	21.0168	21.0682	21.1174	21.1520	21.1619	21.1648	21.1648	21.1652	21.1641	21.1578	21.1068	21.0027	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9519	0.9204	0.8632	0.7572	0.6123	0.4423	0.3178	0.3277	0.4804	0.7129	0.8928	0.9603	(94)
Useful gains	278.5809	284.6556	270.8987	233.6887	182.9026	125.5778	87.3343	90.9189	135.8367	202.3906	251.4526	271.5780	(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	331.1381	319.4290	288.0304	238.2318	183.4878	125.5984	87.3350	90.9198	135.8858	204.7397	273.0820	329.3424	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	39.1025	23.3677	12.7460	3.2711	0.4354	0.0000	0.0000	0.0000	0.0000	1.7477	15.5731	42.9767	(98)
Space heating												139.2202	(98)
Space heating per m2											(98) / (4) =	6.9264	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

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 %)	100.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	139.2202	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	39.1025	23.3677	12.7460	3.2711	0.4354	0.0000	0.0000	0.0000	0.0000	1.7477	15.5731	42.9767	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	39.1025	23.3677	12.7460	3.2711	0.4354	0.0000	0.0000	0.0000	0.0000	1.7477	15.5731	42.9767	(211)
Water heating requirement	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			
Annual water heating requirement		1219.3512	(64)
Fraction of heat from community Heat pump		1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for community water heating		1.0500	(305a)
Distribution loss factor (Table 12c) for community heating system		1.2000	(306)
Water heat from Heat pump = (64) x 1.00 x 1.05 x 1.20		1536.3825	(310a)
Electricity used for heat distribution		15.3638	(313)
Annual totals kWh/year			
Space heating fuel - main system		139.2202	(211)
Space heating fuel - secondary		0.0000	(215)
Electricity for pumps and fans:			
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7875)			
mechanical ventilation fans (SFP = 0.7875)		52.1399	(230a)
Total electricity for the above, kWh/year		52.1399	(231)
Electricity for lighting (calculated in Appendix L)		122.1807	(232)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV Unit 0 (0.80 * 0.25 * 951 * 0.80) =	-152.0986	-152.0986	(233)
Total delivered energy for all uses		1697.8248	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	139.2202	13.1900	18.3631	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating from Heat pump	1536.3825	4.2400	65.1426	(342a)
Mechanical ventilation fans	52.1399	13.1900	6.8773	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	122.1807	13.1900	16.1156	(250)
Additional standing charges			60.0000	(251)
Energy saving/generation technologies				
PV Unit	-152.0986	13.1900	-20.0618	(252)
Total energy cost			146.4369	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.9448	(257)
SAP value		86.8207	
SAP rating (Section 12)		87	(258)
SAP band		B	

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	139.2202	0.5190	72.2553	(261)
Efficiency of heat source Heat pump			250.0000	(367a)
Space heating from Heat pump	614.5530	0.5190	318.9530	(367)
Electrical energy for heat distribution	15.3638	0.5190	7.9738	(372)
Total CO2 associated with community systems			326.9268	(373)
(negative value allowed since DFEE <= TFEE)				
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Space and water heating			399.1821	(265)
Pumps and fans	52.1399	0.5190	27.0606	(267)
Energy for lighting	122.1807	0.5190	63.4118	(268)
Energy saving/generation technologies				
PV Unit	-152.0986	0.5190	-78.9392	(269)
Total kg/year			410.7154	(272)
CO2 emissions per m2			20.4300	(273)
EI value			91.5460	
EI rating			92	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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----------------------------------------------------------------------------------------------------
Calculation of stars for heating and DHW
----------------------------------------------------------------------------------------------------
Main heating energy efficiency                                               13.19 × (1 + 0.29 × 0.00) / 1.0000 = 13.190, stars = 1
Main heating environmental impact                                            0.519 × (1 + 0.29 × 0.00) / 1.0000 = 0.5190, stars = 2
Water heating energy efficiency                                                             1.00 × 4.240 × 1.20
= 5.088, stars = 4
Water heating environmental impact                                                1.00 × 0.519 × 1.20 / 2.5000
= 0.2491, stars = 4


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CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY      09 Jan 2014
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-------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------------------
                                                                             Area         Storey height              Volume
                                                                             (m2)              (m)                    (m3)
Ground floor                                                              20.1000 (1b)    x       2.7000 (2b)    =     54.2700 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              20.1000                                                   (4)
Dwelling volume                                                                 (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     54.2700 (5)



-------------------------------------------------------------------------------------------------
2. Ventilation rate
-------------------------------------------------------------------------------------------------
                                                        main           secondary            other              total       m3 per hour
                                                     heating           heating
Number of chimneys                                         0       +         0       +          0       =         0 * 40 =      0.0000 (6a)
Number of open flues                                       0       +         0       +          0       =         0 * 20 =      0.0000 (6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =                              0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                                    Yes
Measured/design AP50                                                                                                          3.0000
Infiltration rate                                                                                                             0.1500 (18)
Number of sides sheltered                                                                                                          3 (19)

Shelter factor                                                                            (20) = 1  -  [0.075 x (19)]  =      0.7750 (20)
Infiltration rate adjusted to include shelter factor                                                (21) = (18) x (20)  =      0.1163 (21)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed      4.2000     4.0000     4.0000     3.7000     3.7000     3.3000     3.4000     3.2000     3.3000     3.5000     3.5000     3.8000 (22)
Wind factor     1.0500     1.0000     1.0000     0.9250     0.9250     0.8250     0.8500     0.8000     0.8250     0.8750     0.8750     0.9500 (22a)
Adj infilt rate
                0.1221     0.1163     0.1163     0.1075     0.1075     0.0959     0.0988     0.0930     0.0959     0.1017     0.1017     0.1104 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                    0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                 76.5000 (23c)

Effective ac    0.2396     0.2338     0.2338     0.2250     0.2250     0.2134     0.2163     0.2105     0.2134     0.2192     0.2192     0.2279 (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
Opening Type 1 (Uw = 1.20)                                                     3.6000         1.1450         4.1221                              (27)
External Wall 1                                10.8800         3.6000          7.2800         0.1600         1.1648       190.0000      1383.2000 (29a)
External Roof 1                                 8.5000                         8.5000         0.1100         0.9350         9.0000        76.5000 (30)
Total net area of external elements Aum(A, m2)                                19.3800                                                             (31)
Fabric heat loss, W/K = Sum (A x U)                                       (26)...(30) + (32) =        6.2219                                      (33)
Party Wall 1                                                                  48.6400         0.0000         0.0000       140.0000      6809.6000 (32)
Party Floor 1                                                                 20.1000                                    40.0000       804.0000 (32d)
Internal Wall 1                                                               21.6000                                     9.0000       194.4000 (32c)

Heat capacity Cm = Sum(A x k)                                                              (28)...(30) + (32) + (32a)...(32e) =    9267.7000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                               461.0796 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                        8.8280 (36)
Total fabric heat loss                                                                                         (33) + (36) =     15.0499 (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           4.2903     4.1863     4.1863     4.0301     4.0301     3.8219     3.8740     3.7699     3.8219     3.9260     3.9260     4.0822 (38)
Heat transfer coeff
               19.3403    19.2362    19.2362    19.0800    19.0800    18.8719    18.9239    18.8198    18.8719    18.9759    18.9759    19.1321 (39)
Average = Sum(39)m / 12 =                                                                                                                19.0453 (39)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP             0.9622     0.9570     0.9570     0.9493     0.9493     0.9389     0.9415     0.9363     0.9389     0.9441     0.9441     0.9518 (40)
HLP (average)                                                                                                                             0.9475 (40)
Days in month
                    31         28         31         30         31         30         31         31         30         31         30         31 (41)



-------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                         1.0315 (42)
Average daily hot water use (litres/day)                                                                                                 58.6985 (43)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
               64.5683    62.2204    59.8724    57.5245    55.1765    52.8286    52.8286    55.1765    57.5245    59.8724    62.2204    64.5683 (44)
Energy conte   95.7529    83.7461    86.4185    75.3417    72.2922    62.3827    57.8067    66.3340    67.1263    78.2292    85.3933    92.7316 (45)
Energy content (annual)                                                                                           Total = Sum(45)m =    923.5552 (45)
Distribution loss  (46)m = 0.15 x (45)m
```

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	14.3629	12.5619	12.9628	11.3013	10.8438	9.3574	8.6710	9.9501	10.0689	11.7344	12.8090	13.9097	(46)

Water storage loss:
Store volume 1.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 0.0600 (48)
Temperature factor from Table 2b 1.0000 (49)
Enter (49) or (54) in (55) 0.0600 (55)

Total storage loss	1.8600	1.6800	1.8600	1.8000	1.8600	1.8000	1.8600	1.8600	1.8000	1.8600	1.8000	1.8600	(56)
If cylinder contains dedicated solar storage	1.8600	1.6800	1.8600	1.8000	1.8600	1.8000	1.8600	1.8600	1.8000	1.8600	1.8000	1.8600	(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)
Total heat required for water heating calculated for each month	120.8753	106.4373	111.5409	99.6537	97.4146	86.6947	82.9291	91.4564	91.4383	103.3516	109.7053	117.8540	(62)
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	(63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h	120.8753	106.4373	111.5409	99.6537	97.4146	86.6947	82.9291	91.4564	91.4383	103.3516	109.7053	117.8540	(64)

Total per year (kWh/year) = Sum(64)m = 1219.3512 (64)

Heat gains from water heating, kWh/month	51.9358	45.9985	48.8321	44.5007	44.1351	40.1918	39.3186	42.1540	41.7691	46.1091	47.8429	50.9312	(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	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	61.8908	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.2959	15.3621	12.4933	9.4582	7.0701	5.9689	6.4496	8.3835	11.2523	14.2873	16.6754	17.7767	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	113.3129	114.4887	111.5257	105.2177	97.2549	89.7711	84.7714	83.5956	86.5587	92.8667	100.8294	108.3132	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	42.2206	(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)	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	-41.2605	(71)
Water heating gains (Table 5)	69.8061	68.4502	65.6345	61.8066	59.3213	55.8220	52.8476	56.6586	58.0126	61.9746	66.4484	68.4559	(72)
Total internal gains	263.2659	261.1519	252.5044	239.3333	226.4973	214.4129	206.9196	211.4885	218.6744	231.9795	246.8041	257.3966	(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	
South	3.6000	50.9848	0.3600	0.7000	0.7700	32.0536	(78)

Solar gains	32.0536	47.1116	59.1840	69.1730	70.7100	73.1233	70.5427	69.6000	67.0570	54.2001	38.8916	27.4538	(83)
Total gains	295.3195	308.2635	311.6884	308.5063	297.2072	287.5362	277.4623	281.0885	285.7315	286.1796	285.6958	284.8504	(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	133.1087	133.8291	133.8291	134.9243	134.9243	136.4127	136.0376	136.7900	136.4127	135.6644	135.6644	134.5572	
alpha	9.8739	9.9219	9.9219	9.9950	9.9950	10.0942	10.0692	10.1193	10.0942	10.0443	10.0443	9.9705	
util living area	0.9253	0.8893	0.8115	0.6814	0.5133	0.3282	0.2114	0.2143	0.3831	0.6212	0.8298	0.9357	(86)
MIT	20.9020	20.9368	20.9752	20.9955	20.9997	21.0000	21.0000	21.0000	21.0000	20.9983	20.9725	20.8921	(87)
Th 2	20.1149	20.1193	20.1193	20.1258	20.1258	20.1346	20.1324	20.1367	20.1346	20.1302	20.1302	20.1237	(88)
util rest of house	0.9002	0.8575	0.7685	0.6300	0.4574	0.2714	0.1523	0.1565	0.3259	0.5648	0.7860	0.9129	(89)
MIT 2	20.0447	20.0765	20.1046	20.1237	20.1257	20.1346	20.1324	20.1367	20.1346	20.1295	20.1141	20.0452	(90)

Living area fraction fLA = Living area / (4) = 0.8458 (91)

MIT	20.7698	20.8041	20.8409	20.8610	20.8649	20.8665	20.8662	20.8669	20.8665	20.8643	20.8401	20.7615	(92)

Temperature adjustment 0.3000

adjusted MIT	21.0698	21.1041	21.1409	21.1610	21.1649	21.1665	21.1662	21.1669	21.1665	21.1643	21.1401	21.0615	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9270	0.8927	0.8180	0.6907	0.5238	0.3391	0.2228	0.2254	0.3941	0.6318	0.8364	0.9371	(94)
Useful gains	273.7654	275.1878	254.9460	213.0734	155.6708	97.5007	61.8090	63.3637	112.5935	180.8029	238.9451	266.9306	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	308.8602	298.2396	264.3227	214.8612	155.7873	97.5018	61.8090	63.3637	112.5992	181.4922	249.3453	305.3769	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	(97a)
Space heating kWh	26.1105	15.4908	6.9762	1.2872	0.0867	0.0000	0.0000	0.0000	0.0000	0.5128	7.4881	28.6041	(98)

Space heating 86.5565 (98)
Space heating per m2 (98) / (4) = 4.3063 (99)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

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 %)	100.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	86.5565	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	26.1105	15.4908	6.9762	1.2872	0.0867	0.0000	0.0000	0.0000	0.0000	0.5128	7.4881	28.6041	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	26.1105	15.4908	6.9762	1.2872	0.0867	0.0000	0.0000	0.0000	0.0000	0.5128	7.4881	28.6041	(211)
Water heating requirement	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			
Annual water heating requirement		1219.3512	(64)
Fraction of heat from community Heat pump		1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for community water heating		1.0500	(305a)
Distribution loss factor (Table 12c) for community heating system		1.2000	(306)
Water heat from Heat pump = (64) x 1.00 x 1.05 x 1.20		1536.3825	(310a)
Electricity used for heat distribution		15.3638	(313)
Annual totals kWh/year			
Space heating fuel - main system		86.5565	(211)
Space heating fuel - secondary		0.0000	(215)
Electricity for pumps and fans:			
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7875)			
mechanical ventilation fans (SFP = 0.7875)		52.1399	(230a)
Total electricity for the above, kWh/year		52.1399	(231)
Electricity for lighting (calculated in Appendix L)		122.1807	(232)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV Unit 0 (0.80 * 0.25 * 1019 * 0.80) =	-162.9850	-162.9850	(233)
Total delivered energy for all uses		1634.2747	(238)

10a. Fuel costs - using BEDF prices (485)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	86.5565	19.1200	16.5496	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating from Heat pump	1536.3825	4.5600	70.0590	(342a)
Mechanical ventilation fans	52.1399	19.1200	9.9691	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	122.1807	19.1200	23.3610	(250)
Additional standing charges			47.0000	(251)
Energy saving/generation technologies				
PV Unit	-162.9850	19.1200	-31.1627	(252)
Total energy cost			135.7760	(255)

12a. Carbon dioxide emissions

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	86.5565	0.5190	44.9228	(261)
Efficiency of heat source Heat pump			250.0000	(367a)
Space heating from Heat pump	614.5530	0.5190	318.9530	(367)
Electrical energy for heat distribution	15.3638	0.5190	7.9738	(372)
Total CO2 associated with community systems			326.9268	(373)
(negative value allowed since DFEE <= TFEE)				
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Space and water heating			371.8497	(265)
Pumps and fans	52.1399	0.5190	27.0606	(267)
Energy for lighting	122.1807	0.5190	63.4118	(268)
Energy saving/generation technologies				
PV Unit	-162.9850	0.5190	-84.5892	(269)
Total kg/year			377.7329	(272)

13a. Primary energy

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	86.5565	3.0700	265.7285	(261)
Efficiency of heat source Heat pump			250.0000	(367a)
Space heating from Heat pump	614.5530	3.0700	1886.6777	(367)
Electrical energy for heat distribution	15.3638	3.0700	47.1669	(372)
Total CO2 associated with community systems			1933.8447	(373)
(negative value allowed since DFEE <= TFEE)				
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Space and water heating			2199.5732	(265)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Pumps and fans	52.1399	3.0700	160.0695 (267)
Energy for lighting	122.1807	3.0700	375.0948 (268)
Energy saving/generation technologies			
PV Unit	-162.9850	3.0700	-500.3638 (269)
Primary energy kWh/year			2234.3737 (272)
Primary energy kWh/m2/year			111.1629 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
Current environmental impact rating: A 92

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Not applicable
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Not applicable
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures: SAP change Cost change CO2 change
(none)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
(none)				
Total Savings	£0	0.00 kg/m²		

Potential energy efficiency rating: B 87
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 485 TEST (29 Oct 2021)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£50	£50	£0
Community scheme	£117	£117	£0
Space heating	£74	£74	£0
Water heating	£70	£70	£0
Lighting	£23	£23	£0
Generated (PV)	-£31	-£31	£0
Total cost of fuels	£136	£136	£0
Total cost of uses	£136	£136	£0
Delivered energy	81 kWh/m²	81 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.4 tonnes	0.0 tonnes
CO2 emissions per m²	19 kg/m²	19 kg/m²	0 kg/m²
Primary energy	111 kWh/m²	111 kWh/m²	0 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)    (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING      09 Jan 2014
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No improvements selected / applicable



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CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	MidTerrace Flat
Number of storeys	1
Cross ventilation possible	No
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	461.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	71.64	(P1)
Transmission heat loss coefficient	15.05	(37)
Summer heat loss coefficient	86.69	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
South	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
South	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South	3.6000	112.2060	0.3600	0.7000	0.9000	82.4526
total:						82.4526

	Jun	Jul	Aug	
Solar gains	85	82	81	(P3)
Internal gains	214	207	211	
Total summer gains	300	289	293	(P5)
Summer gain/loss ratio	3.46	3.34	3.38	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 461.1)	0.00	0.00	0.00	
Threshold temperature	19.46	21.24	21.18	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

Appendix F – DHN Correspondence

Hasnaat Mahmood

From:	Howard Smith <howard.smith@exeter.gov.uk>
Sent:	21 October 2021 09:17
To:	Alistair Morgan
Cc:	Emily Perryman; Roger Clotworthy
Subject:	RE: Possible Heating Network, New Development: Haven Road Exeter

Alistair,

There is no current heat network serving that area.

The City Council have undertaken feasibility work regarding heat networks including a network in that area.

We would welcome development proposals that would enable the future connection of heating systems to a low temperature hot water district heating network.

I would be happy to discuss the proposed development and your energy/carbon strategy.

Policies CP13, CP14, and C15 of the Exeter Core Strategy are relevant to this issue: adopted-core-strategy.pdf (exeter.gov.uk)

Regards

Howard

Howard Smith
Principal Project Manager (Development)

City Development | Exeter City Council
Phone: 01392 265272
Email: howard.smith@exeter.gov.uk
Website: www.exeter.gov.uk

From: Roger Clotworthy <roger.clotworthy@exeter.gov.uk>
Sent: 21 October 2021 08:17
To: Howard Smith <howard.smith@exeter.gov.uk>
Cc: Emily Perryman <Emily.Perryman@exeter.gov.uk>
Subject: Fwd: Possible Heating Network, New Development: Haven Road Exeter

Hi Howard,

Are you able to help with this?

Many thanks,

Roger

Roger Clotworthy
Assistant Service Lead (Planning)
City Development
Exeter City Council

01392 265285

Begin forwarded message:

From: Planning <Planning@exeter.gov.uk>
Date: 20 October 2021 at 10:22:54 BST
To: Roger Clotworthy <roger.clotworthy@exeter.gov.uk>
Subject: FW: Possible Heating Network, New Development: Haven Road Exeter

Hello Roger,

Who would be best to answer this enquiry?

Emily

Emily Perryman
Project Officer (Planning)

City Development
Exeter City Council
01392 265212

From: Alistair Morgan <alistair.morgan@cuddbentley.co.uk>
Sent: 20 October 2021 10:21
To: Planning <Planning@exeter.gov.uk>
Subject: Possible Heating Network, New Development: Haven Road Exeter

Hi there,
I am contacting on behalf of Cudd Bentley Consulting regarding a new Development and whether a connection to a current District Heating Network would be feasible, I couldn't find an email for the local council's energy officer, if this could be forwarded to the right person that would be very helpful.
The build location is, **UNIT 3-4 HAVENBANKS RETAIL PARK EXETER EX2** .

Kind regards,
Alistair Morgan
Graduate Sustainability Engineer

Cudd Bentley Consulting

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