

Sustainability & Energy Statement

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21st April 2023



Table of Contents

Executive Summary	3
1.0 Introduction	4
2.0 Planning policies	5
3.0 Assessment methodology	12
4.0 Proposal	12
5.0 Energy Efficiency	13
5.1 Demand Reduction (Be Lean)	13
• Passive design measures	
• Active design measures	
5.2 Establishing Energy Demand and Carbon Dioxide Emissions (Be Lean)	16
• SAP calculations	
5.3 Low-Carbon and Renewable Technologies (Be Clean and Be Green)	17
5.4 Establishing Energy Demand and Carbon Dioxide Emissions (Be Green – ASHP)	20
• SAP calculations	
5.5 Summary of Calculations and Proposals for Low-carbon and Renewable Technologies	21
6.0 Climate Change Adaption and Water Resources	22
• Sustainable drainage systems (SuDs)	
• Water efficiency measures	
7.0 Materials and Waste	24
 Appendix 1: TER & DER Worksheets for the house for the Be Lean scenario	
Appendix 2: DER Worksheets for the house for the Be Green scenario	
Appendix 3: Roof Plan showing Approximate Location of Photovoltaic Panels	

Executive Summary

This Sustainability and Energy Statement has been prepared in support of a planning application for the construction of a single-storey 2-bedroom dwelling to the rear of 41 Langdon Park Road with access off Wembury Road.

The Statement sets out the commitments of the applicant to the site and the targets that will be applied to the development.

The methodology used has been based upon the 'Energy Assessment Guidance' published by the Mayor of London in June 2022 and uses the carbon factors for gas and electricity proposed for SAP 10.2.

In order to demonstrate the energy efficiency of the house a set of SAP calculations have been prepared for the 'Be Lean' scenario based on the notional systems specification set out in the Part L 2021 baseline. This includes the installation of a gas boiler, WWHRs and a photovoltaic array which is based on an output in kWp of 40% of the ground-floor area/ 6.5. This is not the proposed strategy but purely demonstrates the reduction from the 'Be Lean' condition.

The TER & DER Worksheets for the Be Lean scenario are attached as Appendix 1.

The fabric standards of the house will exceed the requirements of the Building Regulations.

It is proposed to install an air source heat pump into the house to provide space heating and hot water. In addition, the plans for the building demonstrate a total of seven photovoltaic panels could be installed without detrimentally impacting on the aesthetics of the development (the output of the panels are assumed to be 400W).

A further SAP calculation has been prepared based on the proposed specification and the DER Worksheets for the Be Green scenario are attached as Appendix 2.

The completed GLA Carbon Emissions Reporting Spreadsheet accompanies the planning application but the reductions in emissions can be summarised as follows:

	Total Emissions	% Reduction
	kg CO ₂ per year	
Be Lean		
Baseline (Building Regulations TER) – based on gas	853	
Be Lean - after energy efficiency (DER) – based on gas	728	14.65%
Be Green (ASHP & Photovoltaic Panels)		
DER Emissions	-14	101.64%

There are no residual emissions from the house and therefore no carbon offset payment is applicable.

1.0 Introduction

This report has been commissioned by Mr George Georgiou and provides a Sustainability and Energy Statement in support of a planning application for the construction of a single-storey, 2-bedroom dwelling to the rear of 41 Langdon Park Road with access off Wembury Road.

The report describes the methodology used in assessing the development and the initiatives proposed.

The house has been designed and will be constructed to reduce energy demand and carbon dioxide emissions.

The objective is to reduce the energy demand to an economic minimum by making investments in the parts of the building that has the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric.

Once a cost-effective structure has been designed, low-carbon and renewable technologies have been considered to provide heat and/or electricity.

The following hierarchy has been followed:

- Lean reduce demand and consumption
- Clean increase energy efficiency
- Green provide low carbon renewable energy sources

The report has been prepared by Ivan Ball of Bluesky Unlimited who are sustainability consultants.

2.0 Planning Policy Context

National Policy

The UK Government published its sustainable development strategy in 1999 entitled “A better quality of life: A strategy for sustainable development in the UK”. This sets out four main objectives for sustainable development in the UK:

- Social progress that recognises the needs of everyone.
- Effective protection of the environment.
- Prudent use of natural resources.
- Maintenance of high stable levels of economic growth and employment.

Sustainable Communities: Building for the Future, known colloquially as the Communities Plan was published in 2003. The Plan sets out a long-term programme of action for delivering sustainable communities in both urban and rural areas. It aims to tackle housing supply issues in parts of the country, low demand in other parts and the quality of our public spaces. The Communities Plan describes sustainable communities as: Active, inclusive and safe, well run, environmentally sensitive, well designed and built, well connected, thriving, well served and fair for everyone.

The most relevant national planning policy guidance on sustainability is set out in:

- National Planning Policy Framework - 2021

Paragraph 152 states;

“The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.”

Regional and Local Policies

The Development Plan comprises the London Plan (2021) and the London Borough of Haringey Local Plan: Strategic Policies 2013 (with alterations 2017), the Development Management DPD (adopted July 2017) and the Sustainable Design and Construction SPD (adopted March 2013).

The policies have been edited for relevance to this application and reference to major development has been removed for clarity.

London Plan, published March 2021 – the following policies are relevant to the application:

Policy SI 1 Improving air quality

- A *Development Plans, through relevant strategic, site-specific and area-based policies, should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.*
- B *To tackle poor air quality, protect health and meet legal obligations the following criteria should be addressed:*
- 1) *Development proposals should not:*
 - a) *lead to further deterioration of existing poor air quality*
 - b) *create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits*
 - c) *create unacceptable risk of high levels of exposure to poor air quality.*
 - 2) *In order to meet the requirements in Part 1, as a minimum:*
 - a) *development proposals must be at least Air Quality Neutral*
 - b) *development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures*
 - c) *major development proposals must be submitted with an Air Quality Assessment. Air quality assessments should show how the development will meet the requirements of B1*
 - d) *development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people should demonstrate that design measures have been used to minimise exposure.*
- C *Masterplans and development briefs for large-scale development proposals subject to an Environmental Impact Assessment should consider how local air quality can be improved across the area of the proposal as part of an air quality positive approach. To achieve this a statement should be submitted demonstrating:*
- 1) *how proposals have considered ways to maximise benefits to local air quality, and*
 - 2) *what measures or design features will be put in place to reduce exposure to pollution, and how they will achieve this.*

- D In order to reduce the impact on air quality during the construction and demolition phase development proposals must demonstrate how they plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.*
- E Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development.*

Policy SI 2 Minimising greenhouse gas emissions

- A Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:
 - 1) be lean: use less energy and manage demand during operation*
 - 2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly*
 - 3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site*
 - 4) be seen: monitor, verify and report on energy performance.**
- B Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.*
- C A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:
 - 1) through a cash in lieu contribution to the borough's carbon offset fund, or*
 - 2) off-site provided that an alternative proposal is identified and delivery is certain.**
- D Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.*
- E Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.*

Policy SI 4 Managing heat risk

- A Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.*

Policy SI 5 Water infrastructure

- A** *In order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.*
- B** *Development Plans should promote improvements to water supply infrastructure to contribute to security of supply. This should be done in a timely, efficient and sustainable manner taking energy consumption into account.*
- C** *Development proposals should:*
- 1) through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)*
 - 2) achieve at least the BREEAM excellent standard for the 'Wat 01' water category or equivalent (commercial development)*
 - 3) incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.*
- D** *In terms of water quality, Development Plans should:*
- 1) promote the protection and improvement of the water environment in line with the Thames River Basin Management Plan, and should take account of Catchment Plans*
 - 2) support wastewater treatment infrastructure investment to accommodate London's growth and climate change impacts. Such infrastructure should be constructed in a timely and sustainable manner taking account of new, smart technologies, intensification opportunities on existing sites, and energy implications. Boroughs should work with Thames Water in relation to local wastewater infrastructure requirements.*
- E** *Development proposals should:*
- 1) seek to improve the water environment and ensure that adequate wastewater infrastructure capacity is provided*
 - 2) take action to minimise the potential for misconnections between foul and surface water networks. F Development Plans and proposals for strategically or locally defined growth locations with particular flood risk constraints or where there is insufficient water infrastructure capacity should be informed by Integrated Water Management Strategies at an early stage.*

London Borough of Haringey

Haringey Local Plan Strategic Policies 2013-2026, adopted in March 2013. The following policies have been edited for clarity.

SP4: Working Towards a Low Carbon Haringey

Over the life time of the Local Plan, reducing energy use in buildings and working towards a low carbon borough will be one of the key challenges facing Haringey. The Council will promote the measures outlined below to reduce carbon emissions from new and existing buildings.

1. *In line with London Plan policy, the Council will promote and require all new developments to take measures to reduce energy use and carbon emissions during design, construction and occupation, by incorporating the following measures:*
 - a. *From 2011 onwards, all new residential development will achieve a minimum 25% in emissions in total (regulated) CO₂ emissions in line with Code for Sustainable Homes Level 4* energy standards, and should aim to achieve Level 6*. All new residential development shall be zero carbon from 2016 onwards.*
2. *The Council will promote low- and zero-carbon energy generation through the following measures:*
 - a. *Requiring all developments to assess, identify and implement, where viable, site-wide and area-wide decentralised energy facilities including the potential to link into a wider network;*
 - d. *All new developments are required, where viable, to achieve a reduction in predicted carbon dioxide emissions of 20% from on-site renewable energy regeneration, which can include connections to local sources of decentralised renewable energy.*

SP5: Water Management and Flooding

The Council will require all development in Haringey to be water efficient during construction and operation and to reduce all forms of flood risk. All development shall:

Improve the water environment, water quality and drainage systems;

- *Minimise water use and illustrate how development would contribute to general and flash flooding;*
- *Take account of flood risk vulnerability classification as set out in paragraph 100 of the NPPF and will apply the NPPF Sequential Test and Exception Test;*
- *Implement measures to prevent (or mitigate as last resort) local surface water and downstream flooding;*
- *Implement Sustainable Drainage Systems from strategic to individual site level to improve water attenuation, quality and amenity;*

SP6: Waste and Recycling

The Council supports the objectives of sustainable waste management set out by the Government in PPS10 Planning for Sustainable Waste Management and the Mayor's London Plan. To achieve these, the Council shall:

- *Maximise self-sufficiency in waste management capacity;*
- *Seek to minimise waste creation, increase recycling rates in relation to commercial, industrial and municipal waste in order to achieve the Mayor's recycling targets;*

- *Address waste as a resource and look to disposal as the last option, in line with the Mayor's waste hierarchy;*
- *Require integrated, well-designed recycling facilities to be incorporated into all new developments;*
- *Monitor changes in the stock of waste management facilities, waste arisings, and the amount of waste recycled, recovered and going for disposal;*

Haringey will require Site Waste Management Plans for all major applications to identify volume and types of demolition and construction waste and to demonstrate how waste will be minimised and managed during construction and occupation.

Development Management DPD, adopted July 2017

Policy DM21: Sustainable Design, Layout and Construction

- A All new development, including building and landscape works, will be expected to consider and implement sustainable design, layout and construction techniques. Proposals should:*
- a Apply the energy hierarchy to minimise energy use in order to meet, and if possible exceed, minimum carbon dioxide reduction requirements;*
 - b Apply the cooling hierarchy to reduce the potential for overheating and limit reliance on mechanical air conditioning systems;*
 - c Maximise opportunities to enhance biodiversity on-site, including through appropriate landscaping, Sustainable Drainage Systems, living roofs and green walls*
 - d Wherever possible, use building materials with high environmental performance ratings; and*
 - e Seek opportunities for locally sourced labour.*
- B The Council will support appropriate measures to sustainably retrofit existing homes and non-residential buildings.*
- C Proposals that fail to demonstrate adequate consideration for sustainable design, layout and construction techniques will be resisted.*
- D Consideration will be given to the use of carbon offset payments, to be secured by planning obligations, where it can be demonstrated that proposals are unable to meet carbon dioxide emission reduction targets on-site.*

Policy DM22: Decentralised Energy

- A Subject to other policy requirements, proposals that contribute to the provision and use of Decentralised Energy network infrastructure will be supported.*
- Communal energy systems*
- B All development that incorporates site-wide communal energy systems should examine opportunities for extending such systems, irrespective of whether it is connected to a DE network.*

- C All development that incorporates site-wide communal energy systems should optimise opportunities for extending such systems beyond the site boundary to supply energy to neighbouring existing and planned future developments.*

Policy DM29: On-Site Management of Waste Water and Water Supply

- D All proposals for new residential development should be designed to meet the London Plan target for mains water consumption.*

- * The Code for Sustainable Homes has been revoked by the Government.

3.0 Assessment Methodology

The methodology used has followed that set out in the Energy Assessment Guidance published by the GLA in June 2022.

SAP calculations have been preparing using Part L 2021 to 'test' the Be Lean emissions. This uses the specification for building systems set out in the notional dwelling specification for new dwellings (Table 1.1). This includes the use of a gas boiler with an efficiency of 89.5%, a WWHR system and a photovoltaic array with an output (kW) of 40% of the ground floor area of the house/ 6.5.

Further SAP calculations have been prepared for the Be Green scenario, which uses the fabric specification established at the Be Lean stage but uses the actual building systems proposed.

Emission Factors

The CO₂ emission factors, where applicable, used throughout this report have been taken from SAP 10.2 as required by the GLA Energy Assessment Guidance.

	kg CO ₂ /kWh
Mains gas	0.210
Grid supplied and displaced electricity	0.136

4.0 Proposal

The proposal is for the construction of a single-storey 2-bedroom detached house to the rear of 41 Langdon Park Road.

The accommodation schedule in detail is;

Unit Type	Number	Area
		m ²
2-Bedroom, Single-storey detached house	1	70.0
Total	1	70.0

5.0 Energy Efficiency

5.1 Demand Reduction (Be Lean)

Design

The energy performance of a building is affected by its design, construction and use and whilst occupant behaviour is beyond the remit of this statement, better design and construction methods can significantly reduce the life cycle emissions of a building and assist the occupant to reduce consumption.

Sustainable design is not just about incorporating renewable technologies; buildings should be designed at the outset to provide suitable environmental conditions for the occupants whilst also consuming as little energy as practical.

Passive Design Measures

The passive design measures proposed include;

Passive Solar Gain

Passive measures include allowing for natural ventilation and exposed thermal mass coupled with high levels of insulation, air tightness and the control of solar gain.

The position of the building within the site is in context with surrounding development and the shape of the site. The house benefits from orientations towards the northwest and northeast into the rear courtyard garden. The house also benefits from a number of rooflights.

Natural Daylighting

The orientation and the size of the windows have been optimised to maximise the amount of natural daylight and therefore reduce the demand for artificial lighting.

Efficient Building Fabric

Building Envelope

U-values of the building envelope must meet Building Regulations Part L standards and further improvements to U-values will reduce the house's heating requirements.

The floor will be insulated with 200mm 'Kingspan' PIR insulation or similar.

The external walls will be built in traditional cavity wall construction with an overall width of 350mm. This will be comprised of 100mm facing brick, 150mm fully-filled cavity and 100mm medium density block internally.

The flat roof will be insulated with 200mm PIR insulation.

Windows are proposed as double glazed with Low 'e' soft coat and argon filled.

It is proposed to set maximum limits for the elemental U-values as follows:

Element	Part L Limiting U-values	Proposed U-values	Proposed Improvement
	W/m ² K	W/m ² K	
Ground Floor	0.18	0.11	39%
External Walls	0.26	0.15	42%
Flat Roof	0.16	0.10	38%
Windows	1.60	1.20	25%
Entrance Door	1.60	1.00	38%
'g' Value for Glazing	0.63		

Air Leakage

Large amounts of heat are lost in winter through air leakage from a building (also referred to as infiltration or air permeability) often through poor sealing of joints and openings in the building

The Building Regulations set a minimum standard for air permeability of 8 m³ of air per hour per m² of envelope area, at 50Pa. It is proposed to achieve a 50% improvement over Building Regulations and the house will target a permeability of 4.0 m³/hr/m².

Thermal Bridging

The significance of Thermal Bridging, as a potentially major source of fabric heat losses, is increasingly understood. Improving the U-values for the main building fabric without accurately addressing the Thermal Bridging is no longer an option and will not achieve the fabric energy efficiency and energy and CO₂ reduction targets set out in this strategy.

The building will use the thermal details formulated by the Concrete Block Association, which will enable the building to achieve the higher energy efficiency requirements of the Building Regulations.

The bridging losses have been based upon the following values;

Reference	Location	PSI Value
		W/mK
E2	Other Lintels (including other steel lintels)	0.058
E3	Sill	0.036
E4	Jamb	0.023
E5	Ground Floor (Normal)	0.064
E14	Flat Roof	0.032
E16	Corner (normal)	0.038
E17	Corner (inverted)	-0.061

Ventilation

As a result of increasing thermal efficiency and air tightness, Building Regulations Approved Document F was also revised in 2021 to address the possibility of overheating and poor air quality. The ventilation to the En-Suites and Bathrooms will be comprised of continuous extract ventilation as per System 3 criteria. This reduces the number of external penetrations required to the building envelope.

Active Design Measures will include;

Efficient Lighting and Controls

Throughout the scheme natural lighting will be optimised.

Part L of the Building Regulations requires all light fitting to have lamps with a minimum luminous efficacy of 75 light source lumens per circuit-watt.

Space Heating and Hot Water

The baseline SAP modelling has been based upon the use of a combination boiler installed to the house (as required by the GLA Guidance in order to test the efficiency of the building structure) but the proposed specification is based on the installation of a Vaillant aroTHERM air source heat pump provide space heating and hot water.

5.2 Establishing Energy Demand and Carbon Dioxide Emissions (Be Lean)

The GLA Energy Assessment Guidance requires the energy efficiency of a building (Be Lean) to be tested using the building systems set out in Table 1.1 of Part L 2021.

SAP calculations have been prepared for the house based on the fabric specification set out above but using the notional systems. These are not the proposed final option but are used to test the 'Be Lean' reductions only.

The TER & DER Worksheets for the 'Be Lean' scenario are attached as Appendix 1 but the emissions from the house can be summarised as follows;

2-Bedroom, Single-storey-detached house – 70.0 m ²	Energy Demand TER	Energy Demand DER
	kg CO ₂ /yr	kg CO ₂ /yr
Space heating	886.37	815.72
Water heating	416.30	375.88
Electricity for pumps, fans & keep-hot	10.20	4.08
Electricity for lighting	22.83	15.03
Energy saving/ generation technologies	-482.61	-482.36
Total	853.08	728.36

Summary

The TER emissions for the house are calculated as **853 kg CO₂ per year** with DER emissions of **728 kg CO₂ per year**.

The reduction in emissions is therefore **125 kg CO₂ per year**, which equates to a reduction of **14.65%** for the 'Be Lean' case.

The energy efficiency measures incorporated into the house therefore meet the requirements of the Guidance for the Be Lean stage.

5.3 Low-Carbon and Renewable Technologies (Be Clean and Be Green)

The carbon dioxide emissions established above have been used to test the viability of various renewable and low carbon technologies as follows.

The Government's Renewable Obligation defines renewable energy in the UK. The identified technologies are;

- Small hydro-electric
- Landfill and sewage gas
- Onshore and offshore wind
- Biomass
- Tidal and wave power
- Geothermal power
- Solar

The use of landfill or sewage gas, offshore wind or any form of hydroelectric power is not suitable for the site due to its location. The remaining technologies are considered below;

Wind

Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall-mounted units for individual dwellings.

The Government wind speed database predicts local wind speeds at Langdon Park Road to be 5.0 m/s at 10m above ground level and 5.8 m/s at 25m above ground level. This is below the level generally required for commercial investment in large wind turbines. In addition the land take, potential for noise and signal interference make a large wind turbine unsuitable for this development.

Roof mounted turbines could be used at the development to generate small but valuable amounts of renewable electricity but the small output and contribution to total emissions means any investment would be small and purely tokenism. In addition the use of wind turbines will have a detrimental aesthetic impact on the appearance of the development.

Combined Heat and Power and Community Heating

Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for use in buildings. The plant is essentially a small-scale electrical power station. The production and transportation of electricity via the National Grid is very inefficient with over 65% of the energy produced at the power station being lost to the atmosphere and through transportation.

CHP units are generally gas fuelled and generate electricity with heat being a by-product. The heat is usually used to meet the hot water load, which is fairly consistent throughout the year.

Historically CO₂ savings have been achieved because gas has been used to generate electricity and gas has had a lower emissions factor than electricity. However, with the de-carbonisation of the electricity grid the benefit of CHP is negated and consequently the use of a CHP would increase emissions rather than reduce them.

CHP is not proposed.

Ground Source Heat Pumps

Sub soil temperatures are reasonably constant and predictable in the UK, providing a store of the sun's energy throughout the year. Below London the groundwater in the lower London aquifer is at a fairly constant temperature of 12° C. Ground source heat pumps (GSHP) extract this low-grade heat and convert it to usable heat for space heating.

GSHP operates on a similar principle to refrigerators, transferring heat from a cool place to a warmer place. They operate most efficiently when providing space heating at a low temperature, typically via under floor heating or with low temperature radiators.

There is insufficient external area to install a shallow, horizontal collection system and in order to use a ground source heat pump the collection system would need to include a number of boreholes.

This would be cost prohibitive and therefore the installation of ground source heat pumps is not proposed.

Solar

(i) Solar Water Heating

Solar hot water panels use the sun's energy to directly heat water circulating through panels or pipes. The technology is simple and easily understood by purchasers.

Solar hot water heating panels are based generally around two types, which are available being 'flat plate collectors' and 'evacuated tubes'. Flat plate collectors can achieve an output of up to 1,124 kWh/annum (Schuco) and evacuated tubes can achieve outputs up to 1,365 kWh/annum (Riomay).

Panels are traditionally roof mounted and for highest efficiencies should be mounted plus or minus 30 degrees of due south. Evacuated tubes can be laid horizontally on flat roofs but flat plate collectors are recommended for installation at an incline of 30 degrees

The total hot water demand for the house is 1,790 kWh per year (based on the gas system) and assuming panels would reduce demand by 50% the reduction in CO₂ emissions would be 188 kg CO₂ per year.

When combined with the energy efficiency measures incorporated into the scheme this equates to a total reduction of 36.69%.

Solar hot water panels could be used to reduce emissions but the reductions are not significant.

Solar hot water heating panels are not proposed.

(ii) Photovoltaics

Photovoltaic panels (PV) provide clean silent electricity. They generate electricity during most daylight conditions although they are most efficient when exposed to direct sunlight or are orientated to face plus or minus 30 degrees of due south.

PV panels can be integrated into many different aspects of a development including roofs, walls, shading devices or architectural panels. The panels typically have an electrical warranty of 20-25 years and an expected system lifespan of 25-40 years.

The Roof Plan attached as Appendix 3 demonstrate a total of seven panels could be installed and assuming the installation of 400W panels the total reduction in emissions from the array would be **314 kg CO₂ per year**.

Air Source Heat Pumps (ASHP)

Air sourced heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps; however, the initial heat energy is extracted from the external air rather than the ground.

The installation of an ASHP is feasible and the analysis set out in 5.4 below considers the use of a Vaillant aroTHERM air source heat pump.

The outdoor unit could be located adjacent the cycle store.

5.4 Establishing Energy Demand and Carbon Dioxide Emissions (Be Green – ASHP)

SAP calculations have been prepared for the house based on the fabric specification set out above but with the actual systems proposed for installation. These include an air source heat pump and photovoltaic panels.

The DER Worksheets for the 'Be Green' scenario are attached as Appendix 2 but the emissions from the house can be summarised as follows;

2-Bedroom, Single-storey detached house – 70.0 m ²	Energy Demand DER
	kg CO ₂ /yr
Space heating	167.35
Water heating	116.72
Electricity for pumps, fans & keep-hot	0.00
Electricity for lighting	15.03
Energy saving/ generation technologies	-313.53
Total	-14.43

Summary

The DER emissions for the house based on the Be Green scenario are calculated as **-14 kg CO₂ per year** (i.e, zero carbon, the house generates more energy than it requires for regulated demand).

The reduction in emissions is therefore **867 kg CO₂ per year**, which equates to a reduction of **101.64%** for the 'Be Green' case.

5.5 Summary of Calculations and Proposals for Low-carbon and Renewable Technologies

Be Lean

SAP calculations have been prepared using Part L 2021 of the Building Regulations.

Based on the Be Lean scenario the total CO₂ emissions are calculated as **853 kg CO₂ per year** (TER) and **728 kg CO₂ per year** (DER).

This equates to a reduction of **125 kg CO₂ per year** or **14.65%** of the total TER emissions and is therefore compliant with the GLA energy guidance. The TER & DER Worksheets for the house for the Be Lean scenario are attached as Appendix 1.

Be Green - ASHP

A further set of calculations has been prepared for the proposed energy strategy.

These propose the installation of an air source heat pump into the house as well as seven x 400W photovoltaic panels installed on the flat roof element of the roof. The panels are placed away from the Wembury Road elevation in order to reduce their visibility.

Based on the Be Green scenario the total DER CO₂ emissions are calculated as **-14 kg CO₂ per year** (i.e., zero carbon, the house generates more energy than it requires for regulated demand).

This equates to a reduction of **867 kg CO₂ per year** or **101.64%** of the total TER emissions.

The DER Worksheets for the house for the Be Green scenario are attached as Appendix 2.

Summary

The GLA Carbon Emissions Reporting Spreadsheet has been completed and (separately) accompanies this Statement

The total reduction in emissions from energy efficiency, low-carbon and renewable technologies are calculated as; 867 kg CO₂ per year, which equates to a reduction of 101.64% (% of TER).

There are no residual emissions and therefore no carbon offset payment is applicable.

6.0 Climate change adaption and Water resources

Sustainable Drainage Systems (SUDS)

The site lies within Flood Zone 1 and is classified as being of low risk.

Surface Water Management

Consideration has been given to the use of grey water recycling. However, customer's resistance to the appearance of the recycled water and the cost of the systems does not currently make them a viable option. They have therefore not been included in the proposals.

Water efficiency measures

In excess of 20% of the UK's water is used domestically with over 50% of this used for flushing WCs and washing (source: Environment Agency). The majority of this comes from drinking quality standard or potable water.

The water efficiency measures included will ensure that the water use target of 110 litres per person per day is achieved.

Water efficient devices will be fully evaluated, and installed, wherever possible. The specification of such devices will be considered at detailed design stage and each will be subject to an evaluation based on technical performance, cost and market appeal, together with compliance with the water use regulations.

The following devices will be incorporated within the house:

- water efficient taps
- water efficient toilets
- low output showers
- flow restrictors to manage water pressures to achieve optimum levels and
- water meters

Water consumption calculations have been carried out using the Water Efficiency Calculator provided by the BRE. Although not perfect this calculator gives a good indication of the probable water use in a dwelling, although this is largely dependent on the way on which occupants use their homes.

Below is a typical specification, which would achieve the 110 Litres per person per day target (including five litres per person per day allowance for external water use).

Schedule of Appliance Water Consumption		
Appliance	Flow rate or capacity	Total Litres
WC	6/3 litres dual flush	17.64
Basin	2.0 litres/min.	4.74
Shower	9.0 litres/min	39.33
Bath	175 litres	19.25
Sink	5.0 litres/min	12.56
Washing Machine	6.75 litres/kg	14.18
Dishwasher	1.25 litres/places	4.50
		112.20
	Normalisation Factor	0.91
Total Internal Water Consumption		102.10
External Water Use		5.00
Total Water Consumption		107.10

7.0 Materials and Waste

The BRE Green Guide to Specification is a simple guide for design professionals. The guide provides environmental impact, cost and replacement interval information for a wide range of commonly used building specifications over a notional 60-year building life. The construction specification will prioritise materials within ratings A+, A or B.

Preference will be given to the use of local materials & suppliers where viable to reduce the transport distances and to support the local economy. A full evaluation of these suppliers will be undertaken at the next stage of design.

In addition, timber would be sourced, where practical, certified by PEFC or an equivalent approved certification body and all site timber used within the construction process would be recycled.

All insulation materials to will have a zero ozone depleting potential

Construction waste

Targets will be set to promote resource efficiency in accordance with guidance from WRAP, Envirowise, BRE and DEFRA.

The overarching principle of waste management is that waste should be treated or disposed of within the region where it is produced.

Construction operations generate waste materials as a result of general handling losses and surpluses. These wastes can be reduced through appropriate selection of the construction method, good site management practices and spotting opportunities to avoid creating unnecessary waste.

The Construction Strategy will explore these issues, some of which are set out below:

- Proper handling and storage of all materials to avoid damage.
- Efficient purchasing arrangements to minimise over ordering.
- Segregation of construction waste to maximise potential for reuse/recycling.
- Suppliers who collect and reuse/recycle packaging materials.

Appendix 1 – TER & DER Worksheets for the house for the Be Lean scenario

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 10 Beta

Software Version:

Version: 1.0.0.37

Property Address: Langdon Park 2BH 70

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	70 (1a)	2.5 (2a)	175 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	175 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
-chimneys/flues attached to closed fire	0	0	0	0	0 (6c)
-flues attached to solid fuel boiler	0	0	0	0	0 (6d)
-flues attached to other heater	0	0	0	0	0 (6e)
Number of blocked chimneys				0	0 (6f)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.11 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)		
Number of storeys in the dwelling (ns)		0 (9)
Additional infiltration	[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0 (11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35		
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0 (12)
If no draught lobby, enter 0.05, else enter 0		0 (13)
Percentage of windows and doors draught stripped		0 (14)
Window infiltration	0.25 - [0.2 x (14) + 100] =	0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5 (17)
If based on air permeability value, then (18) = [(17) + 20] + (8), otherwise (18) = (16)		0.36 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used		
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31 (21)

TER WorkSheet: New dwelling design stage

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.39	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36
--	------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² × 0.5]

(24d)m=	0.58	0.57	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
---------	------	------	------	------	------	------	------	------	------	------	------	------

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.58	0.57	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
--------	------	------	------	------	------	------	------	------	------	------	------	------

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.36	x 1	= 2.36		(26)
Windows Type 1			7.43	x1/[1/(1.2)+ 0.04]	= 8.51		(27)
Windows Type 2			2.7	x1/[1/(1.2)+ 0.04]	= 3.09		(27)
Windows Type 3			4.05	x1/[1/(1.2)+ 0.04]	= 4.64		(27)
Floor			70	x 0.13	= 9.099999		(28)
Walls	98.97	16.54	82.43	x 0.18	= 14.84		(29)
Roof	70	0	70	x 0.11	= 7.45		(30)
Total area of elements, m²			238.97				(31)
Party wall			69.72	x 0	= 0		(32)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 49.99 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 23376.06 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

TER WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

13.52 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

(33) + (36) =

63.51 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

(38)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
33.38	33.2	33.03	32.22	32.07	31.37	31.37	31.24	31.64	32.07	32.38	32.7

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=

96.88	96.71	96.54	95.73	95.58	94.88	94.88	94.75	95.15	95.58	95.89	96.2
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Average = Sum(39)_{1...12} / 12 =

95.73 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m + (4)

(40)m=

1.38	1.38	1.38	1.37	1.37	1.36	1.36	1.35	1.36	1.37	1.37	1.37
------	------	------	------	------	------	------	------	------	------	------	------

Average = Sum(40)_{1...12} / 12 =

1.37 (40)

Number of days in month (Table 1a)

(41)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

2.25 (42)

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=

0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81
------	------	------	------	------	------	-----	------	------	------	------	------

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=

39.61	38.17	36.73	35.29	33.85	32.41	32.41	33.85	35.29	36.73	38.17	39.61
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Annual average hot water usage in litres per day Vd,average (from Appendix J)

108.73

(43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=

40.39	38.94	37.5	36.03	34.58	33.12	33.11	34.56	36.01	37.47	38.95	40.42
-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Total = Sum(44)_{1...12} =

441.1 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=

170.76	152.31	160.35	140.52	136.98	119.66	110.34	123.85	122.99	141.98	156.25	169.61
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(45)_{1...12} =

1705.62 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=

25.61	22.85	24.05	21.08	20.55	17.95	16.55	18.58	18.45	21.3	23.44	25.44
-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

TER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)																					
b) If manufacturer's declared cylinder loss factor is not known:																								
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)																					
If Heat network see section 4.3																								
Volume factor from Table 2a		0	(52)																					
Temperature factor from Table 2b		0	(53)																					
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)																					
Enter (50) or (54) in (55)		0	(55)																					
Water storage loss calculated for each month (56)m = (55) x (41)m																								
(56)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>											0	0	0	0	0	0	0	0	0	0	0	0	(56)
0	0	0	0	0	0	0	0	0	0	0	0													
If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) - Vs] ÷ (47), else (57)m = (56)m																								
where Vs is Vvw from Appendix G3 or (H12) from Appendix H (as applicable)																								
(57)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>											0	0	0	0	0	0	0	0	0	0	0	0	(57)
0	0	0	0	0	0	0	0	0	0	0	0													
Primary circuit loss (annual) from Table 3	0											(58)												
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m																								
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)																								
(59)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>											0	0	0	0	0	0	0	0	0	0	0	0	(59)
0	0	0	0	0	0	0	0	0	0	0	0													
Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m																								
(61)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>20.58</td><td>17.93</td><td>19.11</td><td>17.77</td><td>17.62</td><td>16.33</td><td>16.88</td><td>17.61</td><td>17.76</td><td>19.1</td><td>19.21</td><td>20.6</td> </tr> </table>											20.58	17.93	19.11	17.77	17.62	16.33	16.88	17.61	17.76	19.1	19.21	20.6	(61)
20.58	17.93	19.11	17.77	17.62	16.33	16.88	17.61	17.76	19.1	19.21	20.6													
Total heat required for water heating calculated for each month (62)m = 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m																								
(62)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>191.34</td><td>170.24</td><td>179.46</td><td>158.29</td><td>154.6</td><td>136</td><td>127.21</td><td>141.47</td><td>140.75</td><td>161.08</td><td>175.46</td><td>190.21</td> </tr> </table>											191.34	170.24	179.46	158.29	154.6	136	127.21	141.47	140.75	161.08	175.46	190.21	(62)
191.34	170.24	179.46	158.29	154.6	136	127.21	141.47	140.75	161.08	175.46	190.21													
WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating)																								
(63a)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>-26.17</td><td>-23.02</td><td>-23.5</td><td>-19.35</td><td>-17.97</td><td>-14.83</td><td>-12.56</td><td>-15.21</td><td>-15.64</td><td>-19.33</td><td>-22.38</td><td>-25.29</td> </tr> </table>											-26.17	-23.02	-23.5	-19.35	-17.97	-14.83	-12.56	-15.21	-15.64	-19.33	-22.38	-25.29	(63a)
-26.17	-23.02	-23.5	-19.35	-17.97	-14.83	-12.56	-15.21	-15.64	-19.33	-22.38	-25.29													
PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)																								
(63b)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table>																							(63b)
FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)																								
(63c)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>											0	0	0	0	0	0	0	0	0	0	0	0	(63c)
0	0	0	0	0	0	0	0	0	0	0	0													
Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)																								
(63b)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>											0	0	0	0	0	0	0	0	0	0	0	0	(63b)
0	0	0	0	0	0	0	0	0	0	0	0													
Output from water heater																								
(64)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>165.17</td><td>147.21</td><td>155.96</td><td>138.94</td><td>136.63</td><td>121.17</td><td>114.65</td><td>126.26</td><td>125.11</td><td>141.75</td><td>153.08</td><td>164.92</td> </tr> </table>											165.17	147.21	155.96	138.94	136.63	121.17	114.65	126.26	125.11	141.75	153.08	164.92	
165.17	147.21	155.96	138.94	136.63	121.17	114.65	126.26	125.11	141.75	153.08	164.92													
											Output from water heater (annual) _{1...12}	1690.85	(64)											
if (64)m < 0 then set to 0																								
Energy	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>											0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0													
Heat gains from water heating, kWh/month 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]																								
(65)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>61.92</td><td>55.12</td><td>58.09</td><td>51.17</td><td>49.95</td><td>43.87</td><td>40.91</td><td>45.58</td><td>45.33</td><td>51.98</td><td>56.76</td><td>61.55</td> </tr> </table>											61.92	55.12	58.09	51.17	49.95	43.87	40.91	45.58	45.33	51.98	56.76	61.55	(65)
61.92	55.12	58.09	51.17	49.95	43.87	40.91	45.58	45.33	51.98	56.76	61.55													
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from Heat network																								

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

Metabolic gains (Table 5), Watts												
(66)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31
(66)												
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
(67)m=	9.5	8.44	6.86	5.2	3.88	3.28	3.54	4.61	6.18	7.85	9.16	9.77
(67)												

TER WorkSheet: New dwelling design stage

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

197.3	199.34	194.19	183.2	169.34	156.31	147.6	145.55	150.71	161.7	175.56	188.59
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 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

83.23	82.03	78.08	71.06	67.14	60.93	54.98	61.27	62.96	69.87	78.83	82.72
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

349.72	349.51	338.83	319.16	300.05	280.21	265.82	271.12	279.55	299.11	323.24	340.77
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	7.43	x	11.28	x	0.63	x	0.7	=	25.62	(75)
Northeast 0.9x	0.77	x	7.43	x	22.97	x	0.63	x	0.7	=	52.15	(75)
Northeast 0.9x	0.77	x	7.43	x	41.38	x	0.63	x	0.7	=	93.96	(75)
Northeast 0.9x	0.77	x	7.43	x	67.96	x	0.63	x	0.7	=	154.31	(75)
Northeast 0.9x	0.77	x	7.43	x	91.35	x	0.63	x	0.7	=	207.42	(75)
Northeast 0.9x	0.77	x	7.43	x	97.38	x	0.63	x	0.7	=	221.13	(75)
Northeast 0.9x	0.77	x	7.43	x	91.1	x	0.63	x	0.7	=	206.86	(75)
Northeast 0.9x	0.77	x	7.43	x	72.63	x	0.63	x	0.7	=	164.91	(75)
Northeast 0.9x	0.77	x	7.43	x	50.42	x	0.63	x	0.7	=	114.49	(75)
Northeast 0.9x	0.77	x	7.43	x	28.07	x	0.63	x	0.7	=	63.73	(75)
Northeast 0.9x	0.77	x	7.43	x	14.2	x	0.63	x	0.7	=	32.24	(75)
Northeast 0.9x	0.77	x	7.43	x	9.21	x	0.63	x	0.7	=	20.92	(75)
Northwest 0.9x	0.77	x	2.7	x	11.28	x	0.63	x	0.7	=	9.31	(81)
Northwest 0.9x	0.77	x	4.05	x	11.28	x	0.63	x	0.7	=	13.97	(81)
Northwest 0.9x	0.77	x	2.7	x	22.97	x	0.63	x	0.7	=	18.95	(81)
Northwest 0.9x	0.77	x	4.05	x	22.97	x	0.63	x	0.7	=	28.43	(81)
Northwest 0.9x	0.77	x	2.7	x	41.38	x	0.63	x	0.7	=	34.14	(81)
Northwest 0.9x	0.77	x	4.05	x	41.38	x	0.63	x	0.7	=	51.22	(81)
Northwest 0.9x	0.77	x	2.7	x	67.96	x	0.63	x	0.7	=	56.07	(81)
Northwest 0.9x	0.77	x	4.05	x	67.96	x	0.63	x	0.7	=	84.11	(81)
Northwest 0.9x	0.77	x	2.7	x	91.35	x	0.63	x	0.7	=	75.37	(81)
Northwest 0.9x	0.77	x	4.05	x	91.35	x	0.63	x	0.7	=	113.06	(81)
Northwest 0.9x	0.77	x	2.7	x	97.38	x	0.63	x	0.7	=	80.36	(81)
Northwest 0.9x	0.77	x	4.05	x	97.38	x	0.63	x	0.7	=	120.54	(81)

TER WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	2.7	x	91.1	x	0.63	x	0.7	=	75.17	(81)
Northwest 0.9x	0.77	x	4.05	x	91.1	x	0.63	x	0.7	=	112.76	(81)
Northwest 0.9x	0.77	x	2.7	x	72.63	x	0.63	x	0.7	=	59.93	(81)
Northwest 0.9x	0.77	x	4.05	x	72.63	x	0.63	x	0.7	=	89.89	(81)
Northwest 0.9x	0.77	x	2.7	x	50.42	x	0.63	x	0.7	=	41.6	(81)
Northwest 0.9x	0.77	x	4.05	x	50.42	x	0.63	x	0.7	=	62.41	(81)
Northwest 0.9x	0.77	x	2.7	x	28.07	x	0.63	x	0.7	=	23.16	(81)
Northwest 0.9x	0.77	x	4.05	x	28.07	x	0.63	x	0.7	=	34.74	(81)
Northwest 0.9x	0.77	x	2.7	x	14.2	x	0.63	x	0.7	=	11.71	(81)
Northwest 0.9x	0.77	x	4.05	x	14.2	x	0.63	x	0.7	=	17.57	(81)
Northwest 0.9x	0.77	x	2.7	x	9.21	x	0.63	x	0.7	=	7.6	(81)
Northwest 0.9x	0.77	x	4.05	x	9.21	x	0.63	x	0.7	=	11.4	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	48.9	99.53	179.32	294.49	395.86	422.02	394.8	314.74	218.5	121.63	61.52	39.93	(83)
--------	------	-------	--------	--------	--------	--------	-------	--------	-------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	398.62	449.04	518.14	613.65	695.91	702.24	660.61	585.86	498.06	420.74	384.77	380.71	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.75	0.6	0.68	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.21	19.37	19.7	20.17	20.61	20.88	20.97	20.94	20.7	20.15	19.6	19.18	(87)
--------	-------	-------	------	-------	-------	-------	-------	-------	------	-------	------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.78	19.78	19.79	19.79	19.8	19.8	19.8	19.79	19.79	19.79	19.78	(88)
--------	-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.85	0.65	0.45	0.53	0.85	0.98	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.7	17.91	18.33	18.93	19.45	19.73	19.79	19.78	19.57	18.91	18.21	17.67	(90)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.39 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.28	18.47	18.86	19.41	19.9	20.17	20.24	20.23	20	19.39	18.75	18.25	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	----	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.28	18.47	18.86	19.41	19.9	20.17	20.24	20.23	20	19.39	18.75	18.25	(93)
--------	-------	-------	-------	-------	------	-------	-------	-------	----	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.95	0.86	0.69	0.51	0.59	0.86	0.98	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	397.23	446.25	510.31	584.19	598.08	481.29	335.89	344.8	428.58	410.39	382.39	379.63	(95)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

TER WorkSheet: New dwelling design stage

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, $L_m, W = [(39)m \times ((93)m - (96)m)]$

(97)m=	1354.55	1312.49	1192.79	1005.91	783.74	528.88	345.61	362.74	561.78	839.76	1116.9	1351.97	(97)
--------	---------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(97a)m=	712.24	582.11	507.77	303.63	138.13	0	0	0	0	319.45	528.85	723.43	
Total per year (kWh/year) = Sum(97a) _{1...5,9...12} =												3815.62	(97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(97b)
Total per year (kWh/year) = Sum(97b) _{1...5,9...12} =												0	(97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	712.24	582.11	507.77	303.63	138.13	0	0	0	0	319.45	528.85	723.43	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												3815.62	(98)

Space heating requirement in kWh/m²/year

54.51	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

90.4	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

712.24	582.11	507.77	303.63	138.13	0	0	0	0	319.45	528.85	723.43
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

787.88	643.93	561.69	335.88	152.8	0	0	0	0	353.38	585.01	800.25
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1...5,10...12} =$$

4220.81	(211)
---------	-------

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1...5,10...12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

165.17	147.21	155.96	138.94	136.63	121.17	114.65	126.26	125.11	141.75	153.08	164.92
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3	(216)
------	-------

(217)m=	88.31	88.16	87.8	86.97	85.08	80.3	80.3	80.3	80.3	87.04	87.92	88.34	(217)
---------	-------	-------	------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, kWh/month

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	187.04	166.98	177.62	159.77	160.59	150.89	142.78	157.24	155.8	162.86	174.12	186.69
---------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

$$\text{Total} = \text{Sum}(219a)_{1...12} =$$

1982.38	(219)
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Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

4220.81

TER WorkSheet: New dwelling design stage

Water heating fuel used		1982.38	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		167.84	(232)
Electricity generated by PVs		-3548.64	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.21	=	886.37 (261)
Space heating (secondary)	(215) x	0.136	=	0 (263)
Water heating	(219) x	0.21	=	416.3 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1302.67 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	10.2 (267)
Electricity for lighting	(232) x	0.136	=	22.83 (268)
Energy saving/generation technologies Item 1		0.136	=	-482.61 (269)
Total CO2, kg/year	sum of (265)...(271) =			853.08 (272)
TER =				12.19 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 10 Beta

Software Version:

Version: 1.0.0.37

Property Address: Langdon Park 2BH 70

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	70 (1a) x	2.5 (2a) =	175 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	175 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 x 40 =	0 (6a)
Number of open flues	0	0	0	0 x 20 =	0 (6b)
-chimneys/flues attached to closed fire	0	0	0	0 x 10 =	0 (6c)
-flues attached to solid fuel boiler	0	0	0	0 x 20 =	0 (6d)
-flues attached to other heater	0	0	0	0 x 35 =	0 (6e)
Number of blocked chimneys				0 x 20 =	0 (6f)
Number of intermittent fans				1 x 10 =	10 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues, fans, PSVs, etc. [(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.06 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)	
Number of storeys in the dwelling (ns)	0 (9)
Additional infiltration [(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0 (11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35	
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0 (12)
If no draught lobby, enter 0.05, else enter 0	0 (13)
Percentage of windows and doors draught stripped	0 (14)
Window infiltration 0.25 - [0.2 x (14) + 100] =	0 (15)
Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4 (17)
If based on air permeability value, then (18) = [(17) + 20]÷(8), otherwise (18) = (16)	0.26 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used	
Number of sides sheltered	2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor (21) = (18) x (20) =	0.22 (21)

DER WorkSheet: New dwelling design stage

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.28	0.27	0.27	0.24	0.23	0.21	0.21	0.2	0.22	0.23	0.25	0.26
--	------	------	------	------	------	------	------	-----	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53
---------	------	------	------	------	------	------	------	------	------	------	------	------

(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53
--------	------	------	------	------	------	------	------	------	------	------	------	------

(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.36	x 1	= 2.36		(26)
Windows Type 1			7.43	x1/[1/(1.2)+ 0.04]	= 8.51		(27)
Windows Type 2			2.7	x1/[1/(1.2)+ 0.04]	= 3.09		(27)
Windows Type 3			4.05	x1/[1/(1.2)+ 0.04]	= 4.64		(27)
Floor			70	x 0.11	= 7.7		(28)
Walls	98.97	16.54	82.43	x 0.15	= 12.37		(29)
Roof	70	0	70	x 0.1	= 7		(30)
Total area of elements, m²			238.97				(31)
Party wall			69.72	x 0	= 0		(32)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 45.66 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 23376.06 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

DER WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

13.9 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

(33) + (36) =

59.56 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

(38)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31.12	31.03	30.95	30.54	30.47	30.12	30.12	30.06	30.25	30.47	30.62	30.78

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=

90.68	90.59	90.5	90.1	90.03	89.68	89.68	89.61	89.81	90.03	90.18	90.34
-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------

Average = Sum(39)_{1...12} / 12 =

90.1 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m + (4)

(40)m=

1.3	1.29	1.29	1.29	1.29	1.28	1.28	1.28	1.28	1.29	1.29	1.29
-----	------	------	------	------	------	------	------	------	------	------	------

Average = Sum(40)_{1...12} / 12 =

1.29 (40)

Number of days in month (Table 1a)

(41)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.25

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=

0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81
------	------	------	------	------	------	-----	------	------	------	------	------

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=

39.61	38.17	36.73	35.29	33.85	32.41	32.41	33.85	35.29	36.73	38.17	39.61
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Annual average hot water usage in litres per day Vd,average (from Appendix J)

108.73

(43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=

40.39	38.94	37.5	36.03	34.58	33.12	33.11	34.56	36.01	37.47	38.95	40.42
-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Total = Sum(44)_{1...12} =

441.1 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=

170.76	152.31	160.35	140.52	136.98	119.66	110.34	123.85	122.99	141.98	156.25	169.61
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(45)_{1...12} =

1705.62 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=

25.61	22.85	24.05	21.08	20.55	17.95	16.55	18.58	18.45	21.3	23.44	25.44
-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)																					
b) If manufacturer's declared cylinder loss factor is not known:																								
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)																					
If Heat network see section 4.3																								
Volume factor from Table 2a		0	(52)																					
Temperature factor from Table 2b		0	(53)																					
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)																					
Enter (50) or (54) in (55)		0	(55)																					
Water storage loss calculated for each month (56)m = (55) x (41)m																								
(56)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>											0	0	0	0	0	0	0	0	0	0	0	0	(56)
0	0	0	0	0	0	0	0	0	0	0	0													
If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) - Vs] ÷ (47), else (57)m = (56)m																								
where Vs is Vvw from Appendix G3 or (H12) from Appendix H (as applicable)																								
(57)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>											0	0	0	0	0	0	0	0	0	0	0	0	(57)
0	0	0	0	0	0	0	0	0	0	0	0													
Primary circuit loss (annual) from Table 3		0											(58)											
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m																								
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)																								
(59)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>											0	0	0	0	0	0	0	0	0	0	0	0	(59)
0	0	0	0	0	0	0	0	0	0	0	0													
Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m																								
(61)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>20.58</td><td>17.93</td><td>19.11</td><td>17.77</td><td>17.62</td><td>16.33</td><td>16.88</td><td>17.61</td><td>17.76</td><td>19.1</td><td>19.21</td><td>20.6</td> </tr> </table>											20.58	17.93	19.11	17.77	17.62	16.33	16.88	17.61	17.76	19.1	19.21	20.6	(61)
20.58	17.93	19.11	17.77	17.62	16.33	16.88	17.61	17.76	19.1	19.21	20.6													
Total heat required for water heating calculated for each month (62)m = 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m																								
(62)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>191.34</td><td>170.24</td><td>179.46</td><td>158.29</td><td>154.6</td><td>136</td><td>127.21</td><td>141.47</td><td>140.75</td><td>161.08</td><td>175.46</td><td>190.21</td> </tr> </table>											191.34	170.24	179.46	158.29	154.6	136	127.21	141.47	140.75	161.08	175.46	190.21	(62)
191.34	170.24	179.46	158.29	154.6	136	127.21	141.47	140.75	161.08	175.46	190.21													
WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating)																								
(63a)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>-44.48</td><td>-39.13</td><td>-39.94</td><td>-32.88</td><td>-30.55</td><td>-25.21</td><td>-21.35</td><td>-25.84</td><td>-26.59</td><td>-32.85</td><td>-38.04</td><td>-42.99</td> </tr> </table>											-44.48	-39.13	-39.94	-32.88	-30.55	-25.21	-21.35	-25.84	-26.59	-32.85	-38.04	-42.99	(63a)
-44.48	-39.13	-39.94	-32.88	-30.55	-25.21	-21.35	-25.84	-26.59	-32.85	-38.04	-42.99													
PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)																								
(63b)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table>																							(63b)
FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)																								
(63c)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>											0	0	0	0	0	0	0	0	0	0	0	0	(63c)
0	0	0	0	0	0	0	0	0	0	0	0													
Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)																								
(63b)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>											0	0	0	0	0	0	0	0	0	0	0	0	(63b)
0	0	0	0	0	0	0	0	0	0	0	0													
Output from water heater																								
(64)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>146.86</td><td>131.1</td><td>139.52</td><td>125.41</td><td>124.05</td><td>110.79</td><td>105.86</td><td>115.62</td><td>114.16</td><td>128.22</td><td>137.42</td><td>147.23</td> </tr> </table>											146.86	131.1	139.52	125.41	124.05	110.79	105.86	115.62	114.16	128.22	137.42	147.23	
146.86	131.1	139.52	125.41	124.05	110.79	105.86	115.62	114.16	128.22	137.42	147.23													
	Output from water heater (annual) _{1...12}											1526.26	(64)											
if (64)m < 0 then set to 0																								
Energy	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>											0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0													
Heat gains from water heating, kWh/month 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]																								
(65)m=	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>61.92</td><td>55.12</td><td>58.09</td><td>51.17</td><td>49.95</td><td>43.87</td><td>40.91</td><td>45.58</td><td>45.33</td><td>51.98</td><td>56.76</td><td>61.55</td> </tr> </table>											61.92	55.12	58.09	51.17	49.95	43.87	40.91	45.58	45.33	51.98	56.76	61.55	(65)
61.92	55.12	58.09	51.17	49.95	43.87	40.91	45.58	45.33	51.98	56.76	61.55													
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from Heat network																								

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=	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
(67)m=	6.26	5.56	4.52	3.42	2.56	2.16	2.33	3.03	4.07	5.17	6.03	6.43

DER WorkSheet: New dwelling design stage

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

197.3	199.34	194.19	183.2	169.34	156.31	147.6	145.55	150.71	161.7	175.56	188.59
-------	--------	--------	-------	--------	--------	-------	--------	--------	-------	--------	--------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

83.23	82.03	78.08	71.06	67.14	60.93	54.98	61.27	62.96	69.87	78.83	82.72
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

346.48	346.63	336.48	317.38	298.73	279.09	264.61	269.55	277.44	296.43	320.11	337.44
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	7.43	x	11.28	x	0.63	x	0.7	=	25.62	(75)
Northeast 0.9x	0.77	x	7.43	x	22.97	x	0.63	x	0.7	=	52.15	(75)
Northeast 0.9x	0.77	x	7.43	x	41.38	x	0.63	x	0.7	=	93.96	(75)
Northeast 0.9x	0.77	x	7.43	x	67.96	x	0.63	x	0.7	=	154.31	(75)
Northeast 0.9x	0.77	x	7.43	x	91.35	x	0.63	x	0.7	=	207.42	(75)
Northeast 0.9x	0.77	x	7.43	x	97.38	x	0.63	x	0.7	=	221.13	(75)
Northeast 0.9x	0.77	x	7.43	x	91.1	x	0.63	x	0.7	=	206.86	(75)
Northeast 0.9x	0.77	x	7.43	x	72.63	x	0.63	x	0.7	=	164.91	(75)
Northeast 0.9x	0.77	x	7.43	x	50.42	x	0.63	x	0.7	=	114.49	(75)
Northeast 0.9x	0.77	x	7.43	x	28.07	x	0.63	x	0.7	=	63.73	(75)
Northeast 0.9x	0.77	x	7.43	x	14.2	x	0.63	x	0.7	=	32.24	(75)
Northeast 0.9x	0.77	x	7.43	x	9.21	x	0.63	x	0.7	=	20.92	(75)
Northwest 0.9x	0.77	x	2.7	x	11.28	x	0.63	x	0.7	=	9.31	(81)
Northwest 0.9x	0.77	x	4.05	x	11.28	x	0.63	x	0.7	=	13.97	(81)
Northwest 0.9x	0.77	x	2.7	x	22.97	x	0.63	x	0.7	=	18.95	(81)
Northwest 0.9x	0.77	x	4.05	x	22.97	x	0.63	x	0.7	=	28.43	(81)
Northwest 0.9x	0.77	x	2.7	x	41.38	x	0.63	x	0.7	=	34.14	(81)
Northwest 0.9x	0.77	x	4.05	x	41.38	x	0.63	x	0.7	=	51.22	(81)
Northwest 0.9x	0.77	x	2.7	x	67.96	x	0.63	x	0.7	=	56.07	(81)
Northwest 0.9x	0.77	x	4.05	x	67.96	x	0.63	x	0.7	=	84.11	(81)
Northwest 0.9x	0.77	x	2.7	x	91.35	x	0.63	x	0.7	=	75.37	(81)
Northwest 0.9x	0.77	x	4.05	x	91.35	x	0.63	x	0.7	=	113.06	(81)
Northwest 0.9x	0.77	x	2.7	x	97.38	x	0.63	x	0.7	=	80.36	(81)
Northwest 0.9x	0.77	x	4.05	x	97.38	x	0.63	x	0.7	=	120.54	(81)

DER WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	2.7	x	91.1	x	0.63	x	0.7	=	75.17	(81)
Northwest 0.9x	0.77	x	4.05	x	91.1	x	0.63	x	0.7	=	112.76	(81)
Northwest 0.9x	0.77	x	2.7	x	72.63	x	0.63	x	0.7	=	59.93	(81)
Northwest 0.9x	0.77	x	4.05	x	72.63	x	0.63	x	0.7	=	89.89	(81)
Northwest 0.9x	0.77	x	2.7	x	50.42	x	0.63	x	0.7	=	41.6	(81)
Northwest 0.9x	0.77	x	4.05	x	50.42	x	0.63	x	0.7	=	62.41	(81)
Northwest 0.9x	0.77	x	2.7	x	28.07	x	0.63	x	0.7	=	23.16	(81)
Northwest 0.9x	0.77	x	4.05	x	28.07	x	0.63	x	0.7	=	34.74	(81)
Northwest 0.9x	0.77	x	2.7	x	14.2	x	0.63	x	0.7	=	11.71	(81)
Northwest 0.9x	0.77	x	4.05	x	14.2	x	0.63	x	0.7	=	17.57	(81)
Northwest 0.9x	0.77	x	2.7	x	9.21	x	0.63	x	0.7	=	7.6	(81)
Northwest 0.9x	0.77	x	4.05	x	9.21	x	0.63	x	0.7	=	11.4	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	48.9	99.53	179.32	294.49	395.86	422.02	394.8	314.74	218.5	121.63	61.52	39.93	(83)
--------	------	-------	--------	--------	--------	--------	-------	--------	-------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	395.37	446.15	515.8	611.87	694.58	701.12	659.4	584.28	495.94	418.06	381.64	377.37	(84)
--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.89	0.73	0.57	0.66	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.33	19.49	19.8	20.26	20.67	20.91	20.98	20.96	20.74	20.22	19.7	19.3	(87)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.85	19.85	19.85	19.85	19.86	19.86	19.86	19.85	19.85	19.85	19.85	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.95	0.84	0.63	0.44	0.52	0.84	0.98	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.9	18.1	18.51	19.08	19.57	19.8	19.85	19.84	19.66	19.04	18.37	17.86	(90)
--------	------	------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.39 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.45	18.64	19.01	19.53	19.99	20.23	20.28	20.27	20.08	19.49	18.88	18.42	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.45	18.64	19.01	19.53	19.99	20.23	20.28	20.27	20.08	19.49	18.88	18.42	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.95	0.85	0.67	0.49	0.57	0.85	0.98	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	394.12	443.53	508.04	581.23	590.23	467.92	323.39	333.54	422.84	407.73	379.41	376.4	(95)
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DER WorkSheet: New dwelling design stage

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	1283.29	1244.47	1132.11	958.07	746.64	504.81	330.33	346.97	536.81	800.66	1062.71	1284.17	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(97a)m=	661.54	538.23	464.31	271.32	116.37	0	0	0	0	292.34	491.97	675.38	
Total per year (kWh/year) = Sum(97a) _{1...5,9...12} =												3511.47	(97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(97b)
Total per year (kWh/year) = Sum(97b) _{1...5,9...12} =												0	(97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	661.54	538.23	464.31	271.32	116.37	0	0	0	0	292.34	491.97	675.38	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												3511.47	(98)

Space heating requirement in kWh/m²/year

50.16	(99)
-------	------

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

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

90.4	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

661.54	538.23	464.31	271.32	116.37	0	0	0	0	292.34	491.97	675.38
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

731.8	595.39	513.62	300.13	128.73	0	0	0	0	323.39	544.21	747.1
-------	--------	--------	--------	--------	---	---	---	---	--------	--------	-------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1...5,10...12} =$$

3884.37	(211)
---------	-------

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1...5,10...12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

146.86	131.1	139.52	125.41	124.05	110.79	105.86	115.62	114.16	128.22	137.42	147.23
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3	(216)
------	-------

(217)m=	88.38	88.23	87.85	86.94	84.89	80.3	80.3	80.3	80.3	87.06	87.98	88.41	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, kWh/month

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	166.17	148.6	158.82	144.24	146.13	137.97	131.84	143.99	142.17	147.28	156.19	166.53
---------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

$$\text{Total} = \text{Sum}(219a)_{1...12} =$$

1789.93	(219)
---------	-------

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

3884.37

DER WorkSheet: New dwelling design stage

Water heating fuel used		1789.93	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	30	(231)
Electricity for lighting		110.53	(232)
Electricity generated by PVs		-3546.74	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.21	= 815.72 (261)
Space heating (secondary)	(215) x	0.136	= 0 (263)
Water heating	(219) x	0.21	= 375.88 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1191.6 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	= 4.08 (267)
Electricity for lighting	(232) x	0.136	= 15.03 (268)
Energy saving/generation technologies Item 1		0.136	= -482.36 (269)
Total CO2, kg/year		sum of (265)...(271) =	728.36 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	10.41 (273)
El rating (section 14)			92 (274)

Appendix 2 – DER Worksheets for the house for the Be Green scenario

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 10

Software Version:

Version: 1.0.0.37

Property Address: Langdon Park 2BH 70 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	70 (1a) x	2.5 (2a) =	175 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	175 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0 +	0 +	0 =	0 x 40 =	0 (6a)
Number of open flues	0 +	0 +	0 =	0 x 20 =	0 (6b)
-chimneys/flues attached to closed fire	0 +	0 +	0 =	0 x 10 =	0 (6c)
-flues attached to solid fuel boiler	0 +	0 +	0 =	0 x 20 =	0 (6d)
-flues attached to other heater	0 +	0 +	0 =	0 x 35 =	0 (6e)
Number of blocked chimneys				0 x 20 =	0 (6f)
Number of intermittent fans				1 x 10 =	10 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.06 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>		
Number of storeys in the dwelling (ns)		0 (9)
Additional infiltration	[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>		
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0 (12)
If no draught lobby, enter 0.05, else enter 0		0 (13)
Percentage of windows and doors draught stripped		0 (14)
Window infiltration	0.25 - [0.2 x (14) + 100] =	0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4 (17)
If based on air permeability value, then (18) = [(17) + 20]÷(8), otherwise (18) = (16)		0.26 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>		
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.22 (21)

DER WorkSheet: New dwelling design stage

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.28	0.27	0.27	0.24	0.23	0.21	0.21	0.2	0.22	0.23	0.25	0.26
--	------	------	------	------	------	------	------	-----	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24d)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53
---------	------	------	------	------	------	------	------	------	------	------	------	------

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53
--------	------	------	------	------	------	------	------	------	------	------	------	------

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.36	x 1	= 2.36		(26)
Windows Type 1			7.43	x1/[1/(1.2)+ 0.04]	= 8.51		(27)
Windows Type 2			2.7	x1/[1/(1.2)+ 0.04]	= 3.09		(27)
Windows Type 3			4.05	x1/[1/(1.2)+ 0.04]	= 4.64		(27)
Floor			70	x 0.11	= 7.7		(28)
Walls	98.97	16.54	82.43	x 0.15	= 12.37		(29)
Roof	70	0	70	x 0.1	= 7		(30)
Total area of elements, m²			238.97				(31)
Party wall			69.72	x 0	= 0		(32)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 45.66 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 23376.06 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

DER WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

13.9 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

(33) + (36) =

59.56 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

(38)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31.12	31.03	30.95	30.54	30.47	30.12	30.12	30.06	30.25	30.47	30.62	30.78

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=

90.68	90.59	90.5	90.1	90.03	89.68	89.68	89.61	89.81	90.03	90.18	90.34
-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------

Average = Sum(39)_{1...12} /12=

90.1 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m + (4)

(40)m=

1.3	1.29	1.29	1.29	1.29	1.28	1.28	1.28	1.28	1.29	1.29	1.29
-----	------	------	------	------	------	------	------	------	------	------	------

Average = Sum(40)_{1...12} /12=

1.29 (40)

Number of days in month (Table 1a)

(41)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.25

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=

0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81
------	------	------	------	------	------	-----	------	------	------	------	------

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=

39.61	38.17	36.73	35.29	33.85	32.41	32.41	33.85	35.29	36.73	38.17	39.61
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Annual average hot water usage in litres per day Vd,average (from Appendix J)

108.73

(43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=

40.39	38.94	37.5	36.03	34.58	33.12	33.11	34.56	36.01	37.47	38.95	40.42
-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Total = Sum(44)_{1...12} =

441.1 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=

170.76	152.31	160.35	140.52	136.98	119.66	110.34	123.85	122.99	141.98	156.25	169.61
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(45)_{1...12} =

1705.62 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=

25.61	22.85	24.05	21.08	20.55	17.95	16.55	18.58	18.45	21.3	23.44	25.44
-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

180

(47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.2

(48)

Temperature factor from Table 2b

0.54

(49)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year (48) x (49) =

0.65

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If Heat network see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) =

0

(54)

Enter (50) or (54) in (55)

0.65

(55)

Water storage loss calculated for each month (56)m = (55) x (41)m (56)

(56)m=

20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) - Vs] ÷ (47), else (57)m = (56)m

where Vs is Vvw from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=

20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m

(61)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(61)

Total heat required for water heating calculated for each month (62)m = 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

214.11	191.47	203.7	182.48	180.33	161.62	153.69	167.2	164.94	185.33	198.2	212.96
--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	-------	--------

(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating)

(63a)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=

--	--	--	--	--	--	--	--	--	--	--	--

(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(63c)

Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)

(63b)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(63b)

Output from water heater

(64)m=

214.11	191.47	203.7	182.48	180.33	161.62	153.69	167.2	164.94	185.33	198.2	212.96
--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	-------	--------

Output from water heater (annual)_{1...12}

2216.03

 (64)

if (64)m < 0 then set to 0

Energy

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(64a)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

0

(64a)

(65)m=

91.46	81.97	88	80.29	80.23	73.35	71.37	75.86	74.46	81.89	85.51	91.08
-------	-------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------

(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from Heat network

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

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31	112.31

(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=

6.26	5.56	4.52	3.42	2.56	2.16	2.33	3.03	4.07	5.17	6.03	6.43
------	------	------	------	------	------	------	------	------	------	------	------

(67)

DER WorkSheet: New dwelling design stage

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

197.3	199.34	194.19	183.2	169.34	156.31	147.6	145.55	150.71	161.7	175.56	188.59
-------	--------	--------	-------	--------	--------	-------	--------	--------	-------	--------	--------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23	34.23
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84	-89.84
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

122.93	121.98	118.28	111.51	107.83	101.87	95.92	101.96	103.41	110.07	118.77	122.41
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

383.17	383.57	373.67	354.82	336.42	317.03	302.55	307.24	314.89	333.63	357.06	374.13
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)								
Northeast	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.43</td></tr></table>	7.43	x	<table><tr><td>11.28</td></tr></table>	11.28	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>25.62</td></tr></table>	25.62	(75)
0.77																			
7.43																			
11.28																			
0.63																			
0.7																			
25.62																			
Northeast	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.43</td></tr></table>	7.43	x	<table><tr><td>22.97</td></tr></table>	22.97	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>52.15</td></tr></table>	52.15	(75)
0.77																			
7.43																			
22.97																			
0.63																			
0.7																			
52.15																			
Northeast	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.43</td></tr></table>	7.43	x	<table><tr><td>41.38</td></tr></table>	41.38	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>93.96</td></tr></table>	93.96	(75)
0.77																			
7.43																			
41.38																			
0.63																			
0.7																			
93.96																			
Northeast	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.43</td></tr></table>	7.43	x	<table><tr><td>67.96</td></tr></table>	67.96	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>154.31</td></tr></table>	154.31	(75)
0.77																			
7.43																			
67.96																			
0.63																			
0.7																			
154.31																			
Northeast	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.43</td></tr></table>	7.43	x	<table><tr><td>91.35</td></tr></table>	91.35	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>207.42</td></tr></table>	207.42	(75)
0.77																			
7.43																			
91.35																			
0.63																			
0.7																			
207.42																			
Northeast	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.43</td></tr></table>	7.43	x	<table><tr><td>97.38</td></tr></table>	97.38	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>221.13</td></tr></table>	221.13	(75)
0.77																			
7.43																			
97.38																			
0.63																			
0.7																			
221.13																			
Northeast	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.43</td></tr></table>	7.43	x	<table><tr><td>91.1</td></tr></table>	91.1	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>206.86</td></tr></table>	206.86	(75)
0.77																			
7.43																			
91.1																			
0.63																			
0.7																			
206.86																			
Northeast	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.43</td></tr></table>	7.43	x	<table><tr><td>72.63</td></tr></table>	72.63	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>164.91</td></tr></table>	164.91	(75)
0.77																			
7.43																			
72.63																			
0.63																			
0.7																			
164.91																			
Northeast	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.43</td></tr></table>	7.43	x	<table><tr><td>50.42</td></tr></table>	50.42	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>114.49</td></tr></table>	114.49	(75)
0.77																			
7.43																			
50.42																			
0.63																			
0.7																			
114.49																			
Northeast	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.43</td></tr></table>	7.43	x	<table><tr><td>28.07</td></tr></table>	28.07	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>63.73</td></tr></table>	63.73	(75)
0.77																			
7.43																			
28.07																			
0.63																			
0.7																			
63.73																			
Northeast	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.43</td></tr></table>	7.43	x	<table><tr><td>14.2</td></tr></table>	14.2	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>32.24</td></tr></table>	32.24	(75)
0.77																			
7.43																			
14.2																			
0.63																			
0.7																			
32.24																			
Northeast	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.43</td></tr></table>	7.43	x	<table><tr><td>9.21</td></tr></table>	9.21	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>20.92</td></tr></table>	20.92	(75)
0.77																			
7.43																			
9.21																			
0.63																			
0.7																			
20.92																			
Northwest	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.7</td></tr></table>	2.7	x	<table><tr><td>11.28</td></tr></table>	11.28	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>9.31</td></tr></table>	9.31	(81)
0.77																			
2.7																			
11.28																			
0.63																			
0.7																			
9.31																			
Northwest	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>4.05</td></tr></table>	4.05	x	<table><tr><td>11.28</td></tr></table>	11.28	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>13.97</td></tr></table>	13.97	(81)
0.77																			
4.05																			
11.28																			
0.63																			
0.7																			
13.97																			
Northwest	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.7</td></tr></table>	2.7	x	<table><tr><td>22.97</td></tr></table>	22.97	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>18.95</td></tr></table>	18.95	(81)
0.77																			
2.7																			
22.97																			
0.63																			
0.7																			
18.95																			
Northwest	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>4.05</td></tr></table>	4.05	x	<table><tr><td>22.97</td></tr></table>	22.97	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>28.43</td></tr></table>	28.43	(81)
0.77																			
4.05																			
22.97																			
0.63																			
0.7																			
28.43																			
Northwest	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.7</td></tr></table>	2.7	x	<table><tr><td>41.38</td></tr></table>	41.38	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>34.14</td></tr></table>	34.14	(81)
0.77																			
2.7																			
41.38																			
0.63																			
0.7																			
34.14																			
Northwest	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>4.05</td></tr></table>	4.05	x	<table><tr><td>41.38</td></tr></table>	41.38	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>51.22</td></tr></table>	51.22	(81)
0.77																			
4.05																			
41.38																			
0.63																			
0.7																			
51.22																			
Northwest	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.7</td></tr></table>	2.7	x	<table><tr><td>67.96</td></tr></table>	67.96	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>56.07</td></tr></table>	56.07	(81)
0.77																			
2.7																			
67.96																			
0.63																			
0.7																			
56.07																			
Northwest	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>4.05</td></tr></table>	4.05	x	<table><tr><td>67.96</td></tr></table>	67.96	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>84.11</td></tr></table>	84.11	(81)
0.77																			
4.05																			
67.96																			
0.63																			
0.7																			
84.11																			
Northwest	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.7</td></tr></table>	2.7	x	<table><tr><td>91.35</td></tr></table>	91.35	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>75.37</td></tr></table>	75.37	(81)
0.77																			
2.7																			
91.35																			
0.63																			
0.7																			
75.37																			
Northwest	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>4.05</td></tr></table>	4.05	x	<table><tr><td>91.35</td></tr></table>	91.35	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>113.06</td></tr></table>	113.06	(81)
0.77																			
4.05																			
91.35																			
0.63																			
0.7																			
113.06																			
Northwest	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>2.7</td></tr></table>	2.7	x	<table><tr><td>97.38</td></tr></table>	97.38	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>80.36</td></tr></table>	80.36	(81)
0.77																			
2.7																			
97.38																			
0.63																			
0.7																			
80.36																			
Northwest	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>4.05</td></tr></table>	4.05	x	<table><tr><td>97.38</td></tr></table>	97.38	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>120.54</td></tr></table>	120.54	(81)
0.77																			
4.05																			
97.38																			
0.63																			
0.7																			
120.54																			

DER WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	2.7	x	91.1	x	0.63	x	0.7	=	75.17	(81)
Northwest 0.9x	0.77	x	4.05	x	91.1	x	0.63	x	0.7	=	112.76	(81)
Northwest 0.9x	0.77	x	2.7	x	72.63	x	0.63	x	0.7	=	59.93	(81)
Northwest 0.9x	0.77	x	4.05	x	72.63	x	0.63	x	0.7	=	89.89	(81)
Northwest 0.9x	0.77	x	2.7	x	50.42	x	0.63	x	0.7	=	41.6	(81)
Northwest 0.9x	0.77	x	4.05	x	50.42	x	0.63	x	0.7	=	62.41	(81)
Northwest 0.9x	0.77	x	2.7	x	28.07	x	0.63	x	0.7	=	23.16	(81)
Northwest 0.9x	0.77	x	4.05	x	28.07	x	0.63	x	0.7	=	34.74	(81)
Northwest 0.9x	0.77	x	2.7	x	14.2	x	0.63	x	0.7	=	11.71	(81)
Northwest 0.9x	0.77	x	4.05	x	14.2	x	0.63	x	0.7	=	17.57	(81)
Northwest 0.9x	0.77	x	2.7	x	9.21	x	0.63	x	0.7	=	7.6	(81)
Northwest 0.9x	0.77	x	4.05	x	9.21	x	0.63	x	0.7	=	11.4	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	48.9	99.53	179.32	294.49	395.86	422.02	394.8	314.74	218.5	121.63	61.52	39.93	(83)
--------	------	-------	--------	--------	--------	--------	-------	--------	-------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	432.07	483.1	552.99	649.32	732.27	739.06	697.35	621.98	533.39	455.26	418.58	414.06	(84)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21

(85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	1	1	0.99	0.96	0.87	0.71	0.55	0.63	0.88	0.98	1	1	

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.72	19.84	20.08	20.41	20.71	20.87	20.92	20.91	20.76	20.38	20	19.7	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.85	19.85	19.85	19.85	19.86	19.86	19.86	19.85	19.85	19.85	19.85	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.82	0.61	0.41	0.49	0.81	0.97	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.35	18.5	18.81	19.23	19.58	19.74	19.77	19.76	19.64	19.2	18.71	18.32	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.39

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.88	19.02	19.3	19.68	20.01	20.17	20.21	20.2	20.08	19.66	19.2	18.85	(92)
--------	-------	-------	------	-------	-------	-------	-------	------	-------	-------	------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.88	19.02	19.3	19.68	20.01	20.17	20.21	20.2	20.08	19.66	19.2	18.85	(93)
--------	-------	-------	------	-------	-------	-------	-------	------	-------	-------	------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.94	0.83	0.64	0.46	0.53	0.82	0.97	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	430.32	479.6	543.05	611.59	607.98	469.96	318.64	330.9	439.65	440.94	415.41	412.68	(95)
--------	--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

DER WorkSheet: New dwelling design stage

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]$

(97)m=	1322.07	1279.02	1158.11	971.65	748.43	499.96	323.74	340.82	536.73	815.53	1091.63	1323.73	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(97a)m=	663.46	537.21	457.6	259.25	104.5	0	0	0	0	278.7	486.88	677.82	
Total per year (kWh/year) = Sum(97a) _{1...5,9...12} =												3465.42	(97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(97b)
Total per year (kWh/year) = Sum(97b) _{1...5,9...12} =												0	(97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	663.46	537.21	457.6	259.25	104.5	0	0	0	0	278.7	486.88	677.82	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												3465.42	(98)

Space heating requirement in kWh/m²/year

49.51	(99)
-------	------

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

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s) (202) = $1 - (201) =$

1	(202)
---	-------

Fraction of total heating from main system 1 (204) = $(202) \times [1 - (203)] =$

1	(204)
---	-------

Efficiency of main space heating system 1

281.62	(206)
--------	-------

Efficiency of secondary/supplementary heating system, %

	(208)
--	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

663.46	537.21	457.6	259.25	104.5	0	0	0	0	278.7	486.88	677.82
--------	--------	-------	--------	-------	---	---	---	---	-------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

235.59	190.76	162.49	92.05	37.11	0	0	0	0	98.96	172.88	240.69		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												1230.53	(211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	(215)
Total (kWh/year) = Sum(215) _{1...5,10...12} =												0	(215)

Water heating

Output from water heater (calculated above)

214.11	191.47	203.7	182.48	180.33	161.62	153.69	167.2	164.94	185.33	198.2	212.96
--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	-------	--------

Efficiency of water heater

258.21	(216)
--------	-------

(217)m=

258.21	258.21	258.21	258.21	258.21	258.21	258.21	258.21	258.21	258.21	258.21	258.21	258.21	(217)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Fuel for water heating, kWh/month

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	82.92	74.15	78.89	70.67	69.84	62.59	59.52	64.76	63.88	71.78	76.76	82.48	
Total = Sum(219a) _{1...12} =												858.23	(219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1230.53

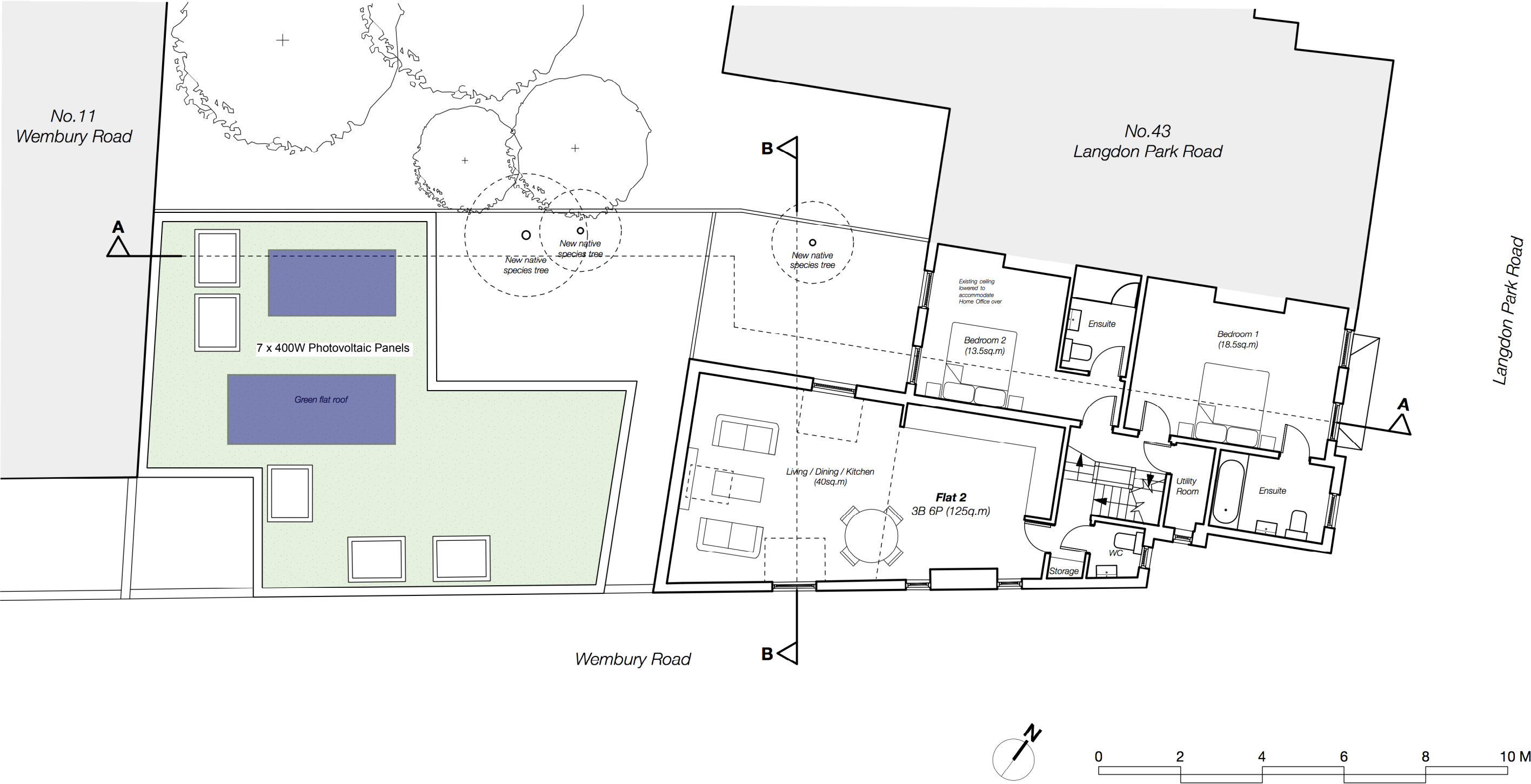
DER WorkSheet: New dwelling design stage

Water heating fuel used		858.23	
Electricity for pumps, fans and electric keep-hot			
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	0	(231)
Electricity for lighting		110.53	(232)
Electricity generated by PVs		-2305.38	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.136	=	167.35	(261)
Space heating (secondary)	(215) x	0.136	=	0	(263)
Water heating	(219) x	0.136	=	116.72	(264)
Space and water heating	(261) + (262) + (263) + (264) =			284.07	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	0	(267)
Electricity for lighting	(232) x	0.136	=	15.03	(268)
Energy saving/generation technologies Item 1		0.136	=	-313.53	(269)
Total CO2, kg/year		sum of (265)...(271) =		-14.43	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		-0.21	(273)
El rating (section 14)				100	(274)

Appendix 3 – Roof Plan showing Approximate Location of Photovoltaic Panels



- GENERAL NOTES
- This drawing is the copyright of Haines Phillips Architects.
 - Do not scale from this drawing. Use figured dimensions only.
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DRAWING ISSUE STATUS		
ISSUE	STATUS	COMMENT
P	PRELIMINARY	For comment and review
PL	PLANNING	Planning/Listed Building Application
BR	BUILDING REGS	Building Regs Application
T	TENDER	For pricing purposes only
C	CONSTRUCTION	For procurement & construction
FC	FINAL CONSTRUCTION	Record drawings on completion
L	LEGAL	Conveyancing or other legal purposes

REVISIONS		
REV	DATE	NOTES

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DRAWING TITLE
First Floor Plan
As Proposed

DRAWN	DATE	SCALE
PL	Jan 2023	1:100@A3
JOB NR	DRAWING NO.	ISSUE REVISION
4182	GA 332	PL