5B Prince Arthur Road

Hampstead, London, NW3 6AX

SUSTAINABILITY AND ENERGY STATEMENT | MAY 2020

On behalf of Mr and Mrs Palsson

i | Table of Contents

Section 1

Executive Summary.

1 | Executive Summary

1.1 Iceni Projects Ltd was commissioned by Mr and Mrs Palsson to produce a Sustainability and Energy Statement for the proposed redevelopment of 5B Prince Arthur Road, Hampstead, London, NW3 6AX.

1.2 This application proposes the demolition of the existing property, and the construction of a new three storey plus basement family home, designed to be both contemporary and fit for the future.

1.3 Sustainability is a core consideration of this application, and has been considered from the outset. Resource and water efficiency have been maximised, whilst the production of waste and pollution is to be minimised, thus ensuring the impact of the proposals on its immediate surroundings and the environment as a whole is minimised.

1.4 Consideration has been given to the London Borough of Camden's Local Plan in the formulation of this strategy, aiming to minimise the environmental impact of the proposed development, and to ensure it is constructed to rigorous sustainability standards.

1.5 The proposed strategy has been based around the objectives of the Local Plan Policy CC1 (Climate change mitigation). In summary, based on this strategy, the proposed development:

- will provide a new family home to replace the existing dwelling on-site;
- will give consideration to the lifecycle environmental performance of the new dwelling when selecting materials to reduce embodied carbon;
- will minimise internal water consumption to 105 litres per person per day;
- will retain the existing copper beech tree, and provide new planting to maintain and enhance the biodiversity of the site;
- will manage surface water runoff through the incorporation of soft landscaping;
- will minimise energy demand through the specification of low u-values, low air permeability and low thermal bridging to reduce heat loss; and
- will utilise a highly efficient air source heat pump system to eliminate the need for on-site fossil fuel combustion to provide space and water heating, mechanical ventilation with heat recovery, and a degree of comfort cooling.

1.6 By designing to rigorous energy standards, and omitting the use of fossil fuels for space and water heating through the employment of an air source heat pump system, the application will respond directly to the Climate Emergency declared by the Council in April 2019. These measures combine to provide a carbon dioxide emissions saving of 27.9%, compared to the Part L:2013 baseline, meeting and exceeding the requirements of the London Borough of Camden's policies to achieve a 19% reduction through on-site means alone.

1.7 Overall, the proposals constitute sustainable development in accordance with national, regional and local policy requirements, and will provide a new dwelling seeking to promote these principles in operation.

Section 2

Introduction.

2 | Introduction

2.1 Iceni Projects have been appointed by Mr and Mrs Palsson to prepare a Sustainability and Energy Statement for the proposals to redevelop 5B Prince Arthur Road, Hampstead, London, NW3 6AX.

2.2 This document details the sustainable design and construction methods adopted by the proposals and gives an overview of the design proposals that will ensure the development operates in a sustainable manner over the lifespan of the proposed dwelling. The Sustainability and Energy Statement report headlines will provide a framework for the project team to operate consistently within the sustainability guidelines set out by the London Borough of Camden.

2.3 The site is currently occupied by an infill development building on the former western portion of the garden of 5 Prince Arthur Road, within the Fitzjohns and Frognal ward of the London Borough of Camden. The site currently comprises a large detached house of two storeys with a three storey bay to the east.

2.4 The site is bounded by Prince Arthur Road to the north west. Large residential dwellings surround the site to the north east, south east and south west. The proposed development site falls within both the Fitzjohns Netherhall Conservation Area and the Hampstead Neighbourhood Plan Area. A mix of Queen Anne, Domestic Revival, Gothic and Neo-Georgian architectural styles characterise the Fitzjohn's sub-area of the Conservation Area, however the site itself is not identified as being a property of particular interest.

2.5 This Statement has been produced to demonstrate how the proposals will meet the sustainability-related requirements of the London Borough of Camden, to provide a new dwelling that is fit for the future.

2.6 The report is structured to meet these guidelines as follows:

- Section 3 summaries the proposals;
- Section 4 discusses the planning context and policies which are relevant to sustainability;
- Section 5 discusses the development response to the policy drivers for sustainability;
- Section 6 discusses the development response to the policy drivers for energy; and
- Section 7 summarises the development's design response.

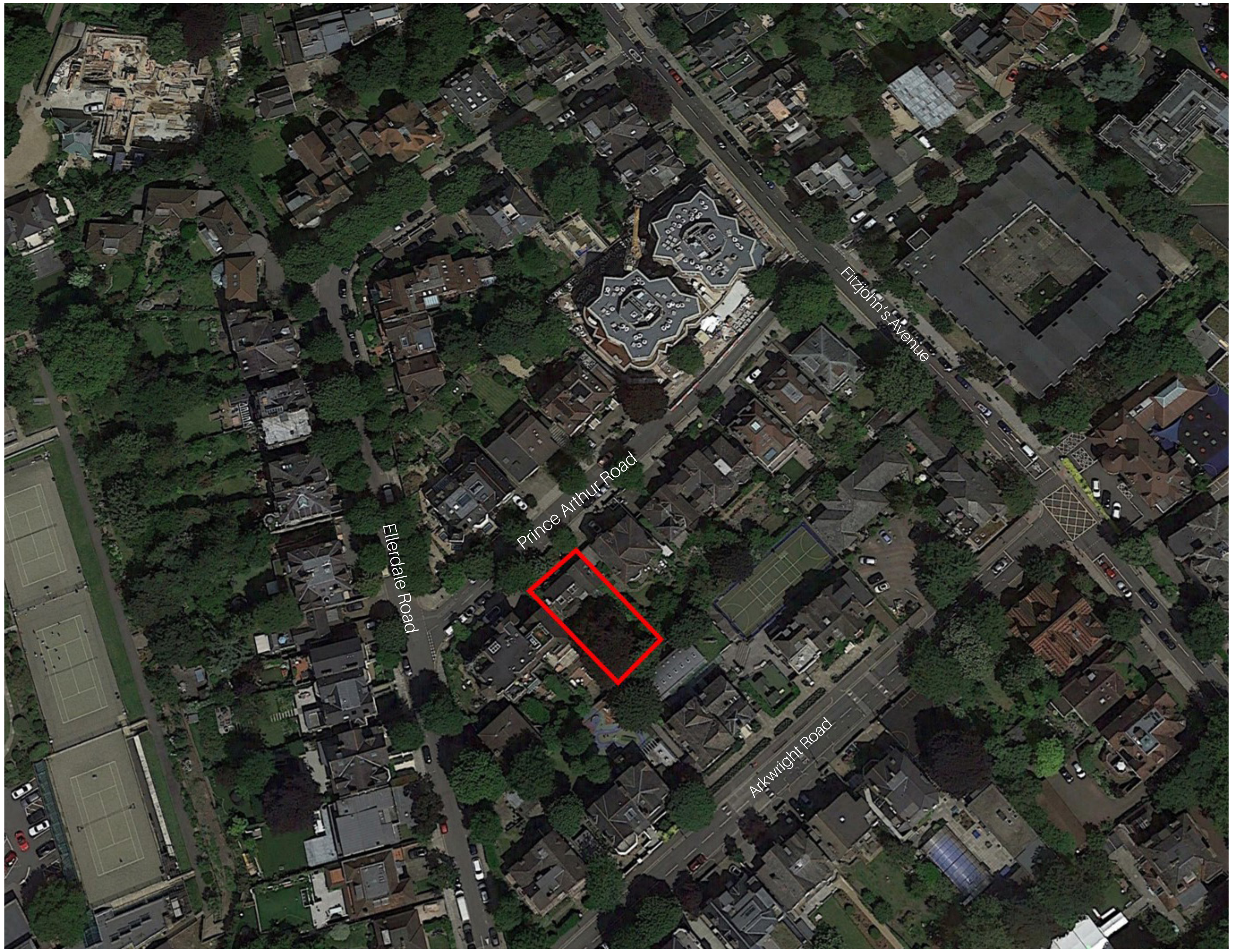


Figure 1.1 Aerial view of the site, marked in red

Section 3

The Proposal.

3 | The Proposal

3.1 The proposed development comprises the demolition of the existing dwelling on the site, and the erection of a replacement family home. It is intended that the new dwelling will:

1. better utilise space and light than the existing dwelling;
2. provide a strong connection between the indoors and outdoors;
3. promote lateral, rather than cellular, living;
4. benefit from improved sustainability and environmental credentials when compared with the existing dwelling;
5. maintain and showcase the copper beech tree that gives the plot its distinctiveness; and
6. positively contribute to the Hampstead street scene and conservation area, with architectural inspiration to be drawn from the character of the surrounding area.

3.2 The proposed front and rear elevations and the illustrative floor plans are displayed to the right. The proposed site layout is provided in Appendix A1.

Figure 3.1 Proposed front elevations

Figure 3.2 Proposed rear elevations

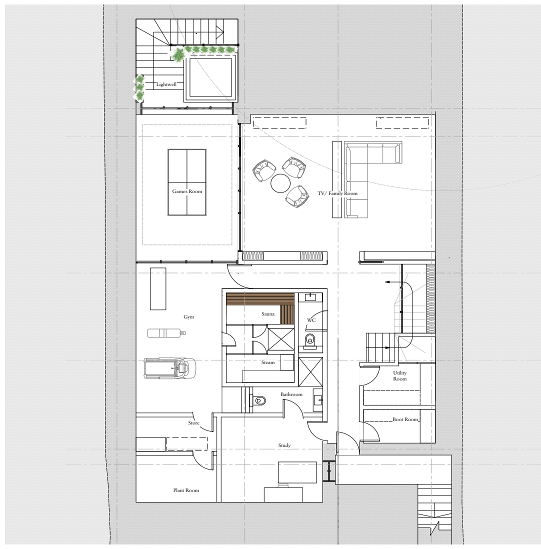


Figure 3.3 Proposed basement

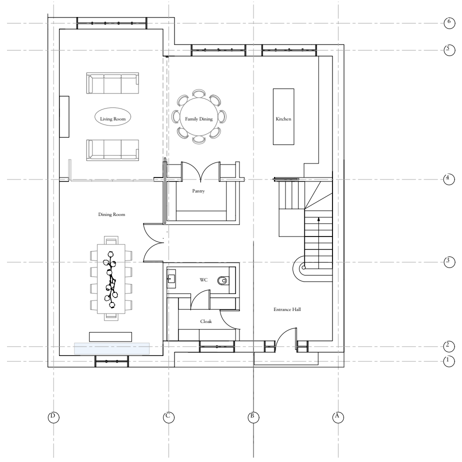


Figure 3.4 Proposed ground floor

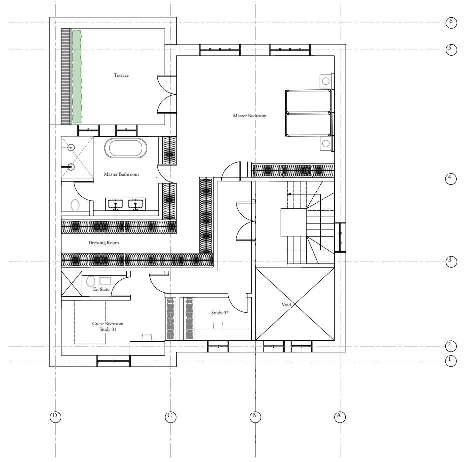


Figure 3.5 Proposed first floor

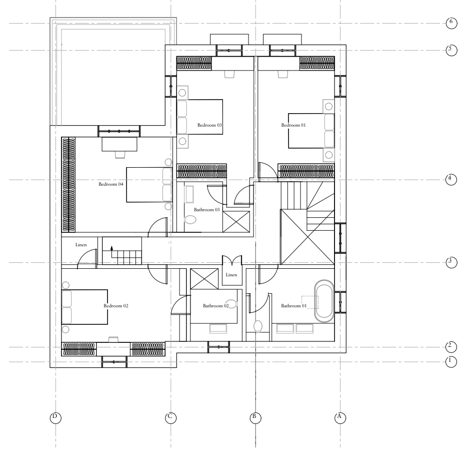


Figure 3.6 Proposed second floor

Section 4

Planning and Regulatory Context.

4 | Planning and Regulatory Context

4.1 Built environment sustainability is incorporated within policy and regulation at a national, regional and local level, as set out below.

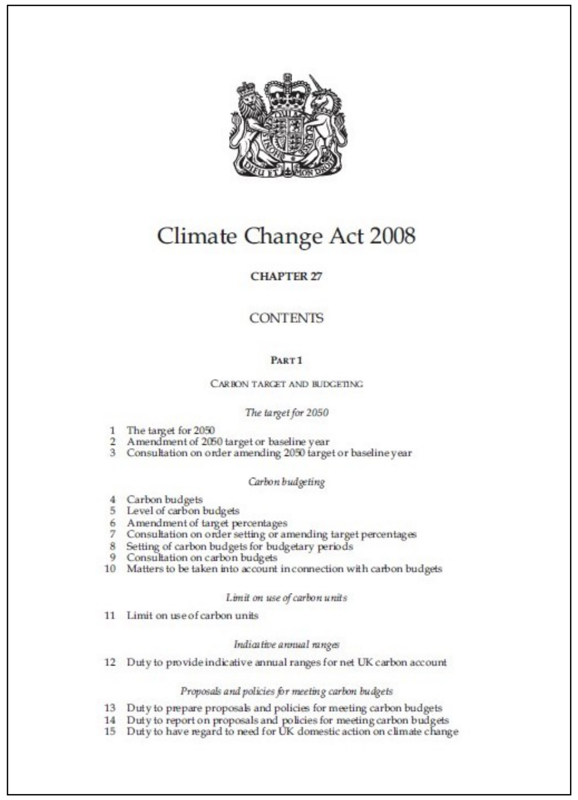
NATIONAL

Climate Change Act 2008

4.2 On 26th November 2008, the UK Government published the Climate Change Act 2008; the world's first long-term legally binding framework to mitigate against climate change. Within this framework, the Act sets legally binding targets to increase greenhouse gas emission reductions through action in the UK and abroad from the 60% target set out in the Energy White Paper, to 80% by 2050.

4.3 As required under Section 34 of the Climate Change Act, the Fifth Annual Carbon Budget was accepted by the Government in June 2016. This sets out a budget for UK emissions for the period 2028-2032.

4.4 Following a commitment in June 2019, the Climate Change Act has been amended to target net zero emissions by 2050.



Climate Change Act 2008

CHAPTER 27

CONTENTS

PART 1

CARBON TARGET AND BUDGETING

The target for 2050

1 The target for 2050
2 Amendment of 2050 target or baseline year
3 Consultation on order amending 2050 target or baseline year

Carbon budgeting

4 Carbon budgets
5 Level of carbon budgets
6 Amendment of target percentages
7 Consultation on order setting or amending target percentages
8 Setting of carbon budgets for budgetary periods
9 Consultation on carbon budgets
10 Matters to be taken into account in connection with carbon budgets

Limit on use of carbon units

11 Limit on use of carbon units

Indicative annual ranges

12 Duty to provide indicative annual ranges for net UK carbon account

Proposals and policies for meeting carbon budgets

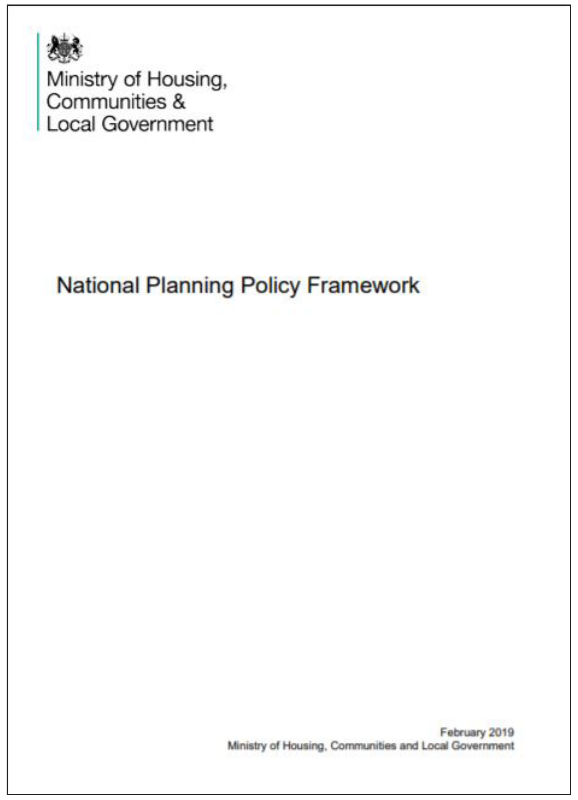
13 Duty to prepare proposals and policies for meeting carbon budgets
14 Duty to report on proposals and policies for meeting carbon budgets
15 Duty to have regard to need for UK domestic action on climate change

National Planning Policy Framework (February 2019)

4.5 The Department for Communities and Local Government determines national policies on different aspects of planing and the rules that govern the operation of the system. Accordingly, the National Planning Policy Framework (NPPF), which came into force in March 2012 and was updated in February 2019, aims to strengthen local decision making.

4.6 Paragraph 10 of the NPPF confirms that at the heart of this document is a *"presumption in favour of sustainable development"*, and that development proposals that accord with an up-to-date development plan should be approved without delay.

- Paragraph 7 states that the purpose of the planning system is to contribute to the achievement of sustainable development. At a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs.



Ministry of Housing, Communities & Local Government

National Planning Policy Framework

February 2019
Ministry of Housing, Communities and Local Government

- **An Economic Role** - ensuring the provision of land and infrastructure needed to help build a *strong, responsive and competitive economy.*
- **A Social Role** - supplying the required amount of housing while at the same time ensuring and building *strong, vibrant and healthy communities.* Ensuring the built environment is sited around accessible local services which help support a community's *health, social and cultural well-being.*
- **An Environmental Role** - ensuring development contributes to the protection and enhancement of the *natural, built and historic environment* through the improvement of biodiversity, minimising the use of natural resources and production of pollution/waste, and guaranteeing sufficient adaptation to climate change.

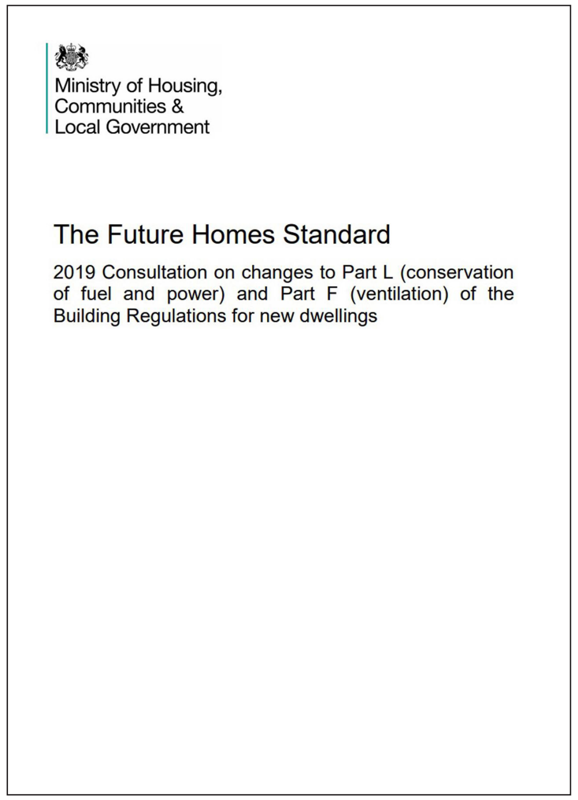
National Planning Practice Guidance

- **Climate Change** - advises how planning can identify suitable mitigation and adaptation measures in plan-making and the application process to address the potential for climate change.
- **Design** - design impacts on how people interact with places and can affect a range of economic, social and environmental objectives. The guidance states that planning policies and decisions should seek to ensure that the physical environment supports these objectives.
- **Natural Environment** - explains key issues in implementing policy to protect biodiversity, including local requirements.
- **Renewable and Low Carbon Energy** - the guidance is intended to assist local councils in developing policies for renewable energy in local plans, and identifies the planning considerations for a range of renewable sources.

Future Homes Standard 2025 (March 2019)

4.7 Within the Spring Statement 2019, The Chancellor announced the future introduction of the Future Homes Standard 2025. The Standard will mandate the end of fossil fuel heating systems in new homes from 2025 and target "world-leading levels of energy efficiency". In doing this, the Standard aims to utilise green technology to reduce environmental impacts, as well as reducing consumer energy bills.

4.8 This Standard is expected to build on the Prime Minister's Clean Growth Grand Challenge mission, which aims to at least halve the energy usage of new build properties by 2030. It also looks to halve the costs of renovating existing buildings to achieve a similar standard of energy efficiency as new buildings, whilst improving their quality and safety.



Ministry of Housing, Communities & Local Government

The Future Homes Standard

2019 Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings

4 | Planning and Regulatory Context

REGIONAL

4.9 Within Greater London, key sustainable development principles for economic, environmental and social improvement are set out below:

The London Plan (March 2016)

4.10 The London Plan is the overall strategic plan for London and includes policies for sustainable development and energy within Chapter 5 (London's response to climate change). Key policies of relevance to this scheme are as follows:

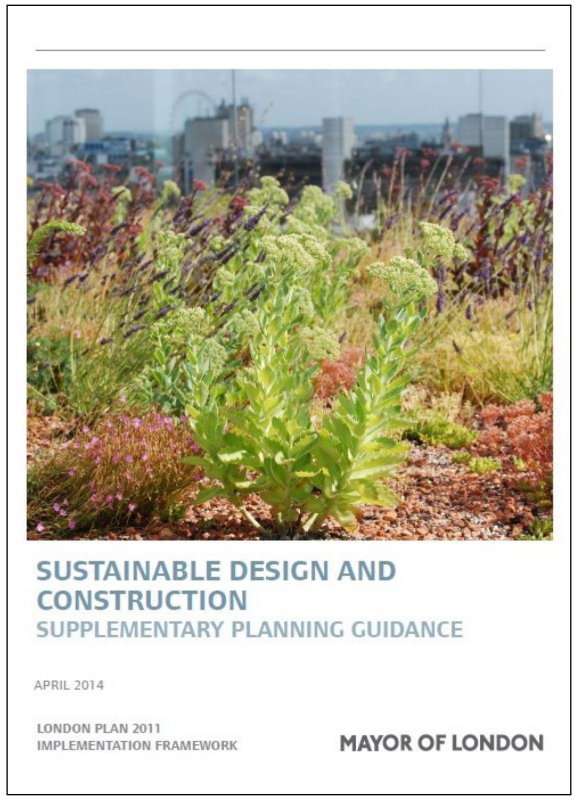
- **Policy 5.2 Minimising Carbon Dioxide Emissions.** This states that development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

  7. Be lean: use less energy
  8. Be clean: supply energy efficiently
  9. Be green: use renewable energy

- **Policy 5.3 Sustainable Design and Construction.** This states that development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and should ensure that they are considered at the beginning of the design process.

Sustainable Design and Construction Supplementary Planning Guidance (SPG) (April 2014)

4.11 This document provides guidance on the implementation of London Plan Policy 5.3 'Sustainable Design and Construction', as well as a range of policies relating to environmental sustainability. The document contains best practice and priority targets for a range of issues related to sustainable design and construction, grouped into three categories: resource management, adapting to climate change and greening the city, and pollution management.



LOCAL

Camden Local Plan (2017)

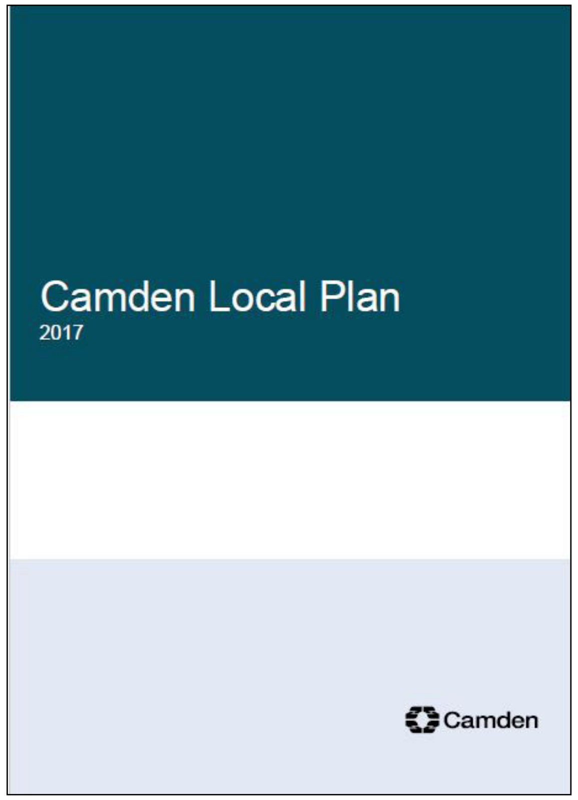
4.12 The Camden Local Plan sets out the Council's planning policies to ensure that Camden continues to have robust, effective and up-to-date planning policies that respond to changing circumstances and the borough's unique characteristics and contribute to delivering the Camden Plan and other local priorities.

4.13 The overall vision of the Camden Plan, and the Local Plan, is as follows:

We want to make Camden a better borough - a place where everyone has a chance to succeed and nobody gets left behind. A place that works for everyone.

4.14 Policies of relevance to the proposed development include:

- **Policy D1 Design.** This states that, in order to secure high quality design, the Council will require that development:
  - respects local context and character;
  - is sustainable in design and construction, incorporating best practice in resource management and climate change mitigation and adaptation;
  - is of sustainable and durable construction and adaptable to different activities and land uses;
  - comprises details and materials that are of high quality and complement the local character;
  - responds to natural features and preserves gardens and other open space;
  - incorporates high quality landscape design and maximises opportunity for greening for example through planting of trees and soft landscaping; and
  - for housing, provides a high standard of accommodation.
- **Policy CC1 Climate change mitigation.** This states that the Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation by:
  - requiring all development to reduce carbon dioxide emissions through following the steps in the Energy Hierarchy;
  - expecting all developments to optimise resource efficiency; and
  - requiring all new residential development to demonstrate a 19% CO_2 reduction below Part L:2013 Building Regulations.
- **Policy CC2 Adapting to Climate Change.** This states that, to ensure resilience to climate change, all development should adopt appropriate climate change adaptation measures such as:
  - not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and the use of Sustainable Drainage Systems;
  - incorporating biodiverse roofs, combination



green and blue roofs, and green walls where appropriate; and

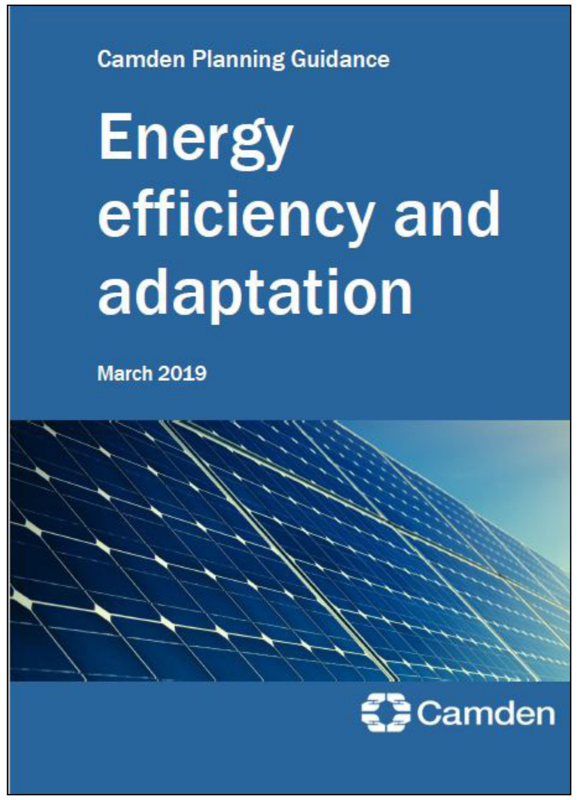
- measures to reduce the impact of urban and dwelling overheating, including application of the Cooling Hierarchy.

Camden Planning Guidance (CPG): Energy Efficiency and Adaptation (March 2019)

4.15 This document was published to support the policies set out within the Camden Local Plan (2017). It provides guidance on key energy and resource issues within the London Borough of Camden, and supports Local Plan Policies CC1Climate change and mitigation, and CC2 Adapting to climate change.

4.16 Other policies for which guidance is provided include: C1 Health and well-being; A1 Open space; A2 Biodiversity; D1 Design; D2 Heritage; CC3 Water and flooding; CC4 Air quality; and, CC5 Waste.

4.17 This CPG also outlines the requirements for producing Energy Assessments and Sustainability Statements.



Declaration of a Climate Emergency (April 2019)

4.18 On 8th April 2019, the London Borough of Camden's Cabinet Member for Improving Camden's Environment, Councillor Harrison, declared a climate emergency. As part of this declaration, the following full Council debate was to be dedicated to climate change. It was also noted that the Council would be convening a Citizens' Assembly with a special focus on climate change, and involving young people as much as possible.

Section 5

Sustainability Statement.

5 | Sustainability Statement

5.1 Although the proposed scheme is not referable to the Greater London Authority (GLA), the sustainability strategy for the proposed development has been assessed using the GLA supplementary planning guidance (SPG) 'Sustainable Design and Construction'. This enables a holistic sustainability approach for the proposed development. The principle of sustainable design and construction is referenced within the London Borough of Camden's Local Plan, and therefore the GLA's 'Sustainable Design and Construction' SPG represents best practice guidance to meet high standards of sustainable design and construction.

5.2 This Sustainability and Energy Statement for the proposed dwelling at 5B Prince Arthur Road is divided into two main parts:

- In line with the categories highlighted within the GLA's SPG on 'Sustainable Design and Construction', the sustainability features of the proposed development are outlined within this section.
- The carbon dioxide (CO_2) emissions reduction strategy for the proposed dwelling is based on the Energy Hierarchy to provide a rigorous methodology. This strategy, which maximises cost-effective opportunities for emissions reductions, is detailed in Section 6 of this report.

Land

5.3 The site, as shown in Figure 5.1, is currently occupied by a detached 2-3 storey, large residential dwelling with a private rear garden. It is currently in use as a single family residential dwelling (Use Class C3).

Figure 5.1 View of the existing site

5.4 The utilisation of this site will ensure that the proposed dwelling is constructed on a previously used (brownfield) site, thus reducing development on greenfield and Green Belt sites.

5.5 The proposed dwelling has been designed in line with the scale and massing of the neighbouring properties. This will ensure that the form of the proposed scheme will fit within the street scene, whilst also respecting the neighbouring buildings, as shown in Figure 5.2 below.

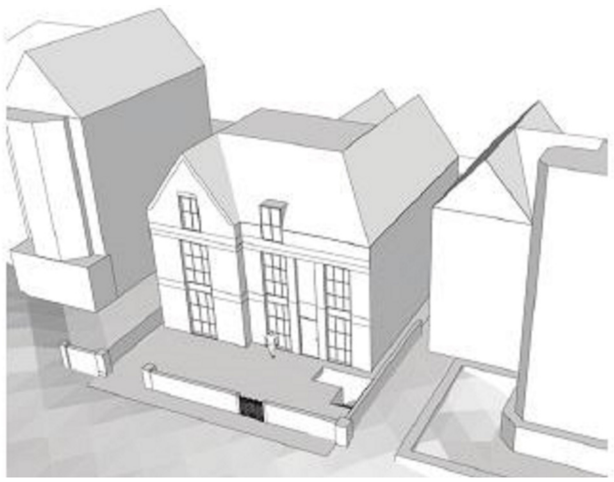


Figure 5.2 Massing model of the proposed dwelling (front)

Location and Transport

5.6 The site is located towards the western end of Prince Arthur Road, to the south of the main town centre around Hampstead station, and west of Hampstead High Street.

5.7 There are numerous public transport connections for London Underground, rail and the London bus network within the local area, with the site scoring a PTAL rating of 3, as shown in Figure 5.3.

5.8 Hampstead station, located approximately 5-minutes' walk to the north, is served by the London Underground Northern line. To the south west, Finchley Road and Frognal station, which is served by the London Overground line, is a 10-minute walk from the site.

5.9 In addition to this, the site is located within walking distance of two bus stops, served by the number 46 route between Lancaster Gate and the City of London.

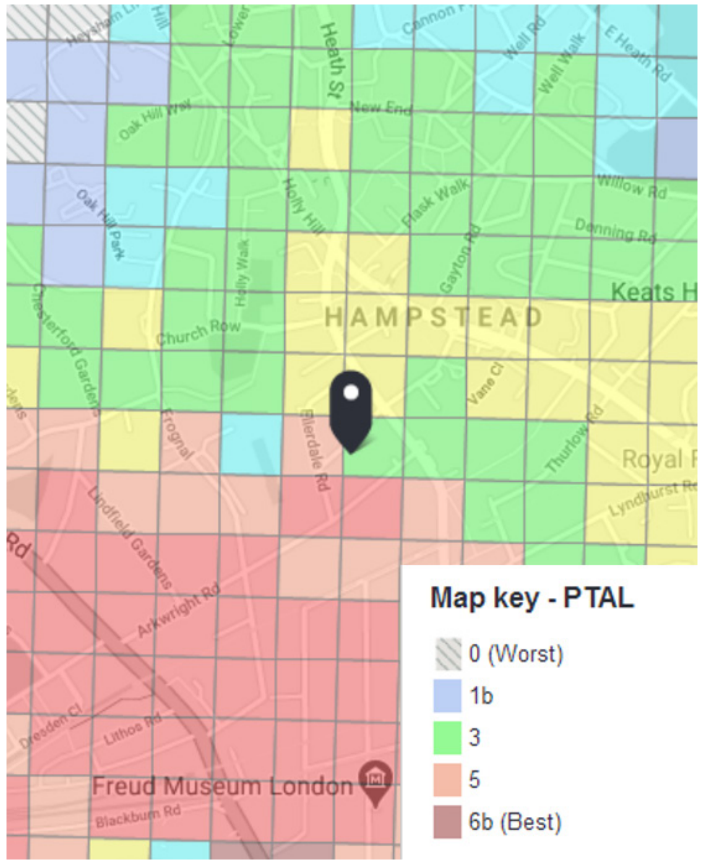


Figure 5.3 Extract from TfL PTAL map

Water Efficiency

5.10 The city often consumes more water than is available during dry weather. As the population of London grows, this situation will be further exacerbated, with increased pressure on the supply of potable water.

5.11 In order to actively mitigate against this, water saving fittings and appliances shall be installed to target a water consumption rate of 105 litres or less per person per day, based on the DCLG water efficiency calculator for residential dwellings. Full details of the water calculation are provided in Appendix A2.

5.12 Subject to changes at later detailed design stages, it is proposed that the following measures will be incorporated:

- Low volume, dual flush toilets of 6/3 litres.
- Water consumption levels no higher than 3 litres/minute in hand-wash basins, and 4 litres/minute in kitchen sinks.
- Bath with a capacity to overflow no higher than 180 litres.
- Showers with a flow rate of 8 litres/minute using a flow restrictor.
- Washing machine with water consumption no more than 18 litres/kg.
- Dishwasher with water consumption of no more than 4.5 litres per place setting.

5.13 It is intended that, to further reduce the consumption of water post-development, storage tanks to facilitate the recycling of grey- and/or rainwater will be provided. This will contribute to a reduction in the use of potable water.

5 | Sustainability Statement

Materials and Waste

5.14 The selection of materials is determined by a variety of factors, such as the architectural context, design rationale, embodied carbon and maintenance requirements. For the proposed dwelling, consideration will be given to the lifecycle environmental performance, with materials selected in consideration of the BRE's Green Guide to Specification, aiming for A or B rated materials wherever possible.

5.15 During the detailed design of the building fabric, consideration will be given to minimising the environmental impact of materials, by selecting non-toxic and robust materials to ensure longevity and a minimal impact on the health of the occupants.

5.16 Timber will be selected and purchased in consideration of sustainability certification. It is intended that all structural timber elements, along with any timber used for temporary uses such as scaffolding, will be sustainably sourced. This may include FSC and/or PEFC sources.

5.17 Where possible, it is intended that locally sourced materials will be employed during the construction of the proposed dwelling. This will aid in ensuring materials that are is in keeping with local vernacular are employed, whilst also contributing to the minimisation of the embodied carbon associated with these materials.

5.18 Furthermore, applying the principles of a circular economy, whereby the use of recycled and reused materials is prioritised, where feasible will also aid in minimising the embodied carbon associated with the dwelling.

5.19 During operation, a dedicated storage area will be incorporated for the storage of recycling and general waste, in line with the requirements of the London Borough of Camden policy.

Nature Conservation and Biodiversity

5.20 The site in its current state comprises an existing dwelling with a private rear garden. The rear garden currently comprises a significant area of hardstanding, as well as a network of retaining walls, including a garden house, all with concrete foundations.

5.21 An arboricultural survey has been undertaken and advice sought in relation to the existing trees, in particular the Copper Beech tree at the rear.

5.22 The proposals have been carefully considered around the Copper Beech tree, which is to be retained. Furthermore, it is proposed to remove the current hardstanding and concrete base structures within the garden, which are considered to currently be acting as a barrier to the root growth of the copper beech tree. This will aid in re-establishing the permeable ground around the roots of the tree.

5.23 In addition to this, soft landscaping will be incorporated within the rear garden, as shown in Figure 5.4 below.

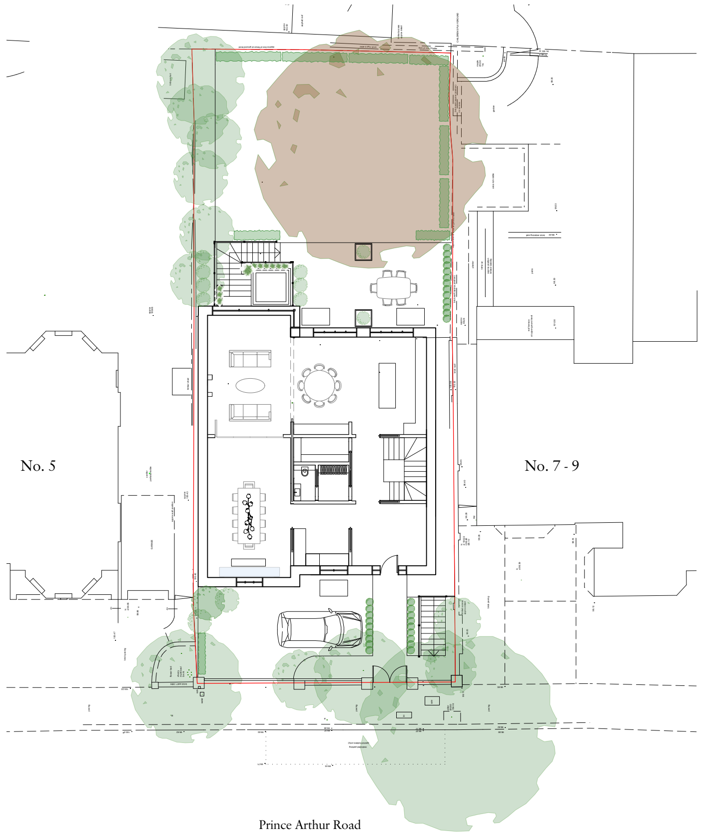


Figure 5.4 Proposed landscaping

Tackling Increased Temperatures and Drought

5.24 In order to protect the development against overheating in the future, a number of key design features have been proposed to ensure the new dwelling is resilient to increased temperatures which may be experienced as a result of climate change and the urban heat island effect. A summary of the measures included to reduce the risk of overheating is provided below.

5.25 The design of the proposed dwelling has been developed in line within the GLA's recommended 'Cooling Hierarchy' approach, detailed in London Plan Policy 5.9. This applies a similar principle to the thorough decision-making process of the Energy Hierarchy, with the aim of reducing CO_2 emissions from cooling, and minimising the risk of overheating where no cooling is present:

Minimisation of internal heat generation through energy efficient design

- Heat gain from lighting is kept to a minimum as a result of an energy-efficient lighting design solution.
- The availability of natural light is maximised by optimising the light transmittance of the glass elements of the façade.
- Heat gains from equipment will be minimised through the specification of low energy systems.
- The scheme will use an air source heat pump for heating and hot water. This is a low temperature distribution system, leading to lower internal heat gains from distribution pipework.

Reduction of the amount of heat entering the building in the summer

- The building's façades have a balanced amount of glazing to optimise daylight penetration, without increasing the risk of overheating arising from solar gain.

Management of the heat within the building

- The proposed dwelling will have high ceilings, promoting increased air movement and stratification, whereby warmer air rises, thus aiding to mitigate overheating.

Passive ventilation

- Openable windows on multiple aspects across all floors will provide a passive ventilation strategy that utilises cross-flow and stack ventilation to maximise the potential for natural ventilation within the proposed dwelling.

Mechanical and active cooling

- Cooling may potentially be provided by the proposed Nilan Compact P system, which includes a reversible cooling unit capable of cooling air used for ventilation only. Whilst this cooling will not be the equivalent of air conditioning, whereby the air within a space is cooled to a specified temperature, the use of a reversible cooling unit allows the specified system to cool incoming air by up to 10°C. In this way, supply air can be cooled during warm periods, without affecting the efficiency with which hot water is produced. The inclusion of this technology has been accounted for within the energy modelling detailed within the Energy Strategy section of this report.

Flooding

5.26 Figure 5.5 below confirms that the proposed site is located in Flood Zone 1, and is not at risk of flooding from rivers or the sea, reservoirs or surface water.

5.27 The proposed reduction in hardstanding area through the removal of the existing built structures in the rear garden, and the re-establishment of permeable ground around the roots of the Copper Beech tree, will aid in reducing the volume of surface water runoff on-site. Furthermore, the incorporation of soft landscaping will positively contribute to the management of the 5mm storm event, therefore limiting runoff for the typical everyday rainfall event.

5.28 The management of surface water in this way will reduce the burden on the existing Thames Water sewer network, as well as reducing the risk of flooding on-site and within the immediate surroundings.

Pollution

Air Pollution

5.29 The Environment Act 1995 requires all Local Authorities to review air quality within their districts. If it appears that any air quality 'Objective' prescribed in the regulations and in the National Air Quality Strategy is not likely to be achieved, then the Local Authority must designate the affected area as an Air Quality Management Area (AQMA).

5.30 The site location, and the whole of the London Borough of Camden, is specified as an AQMA, due to excessive levels of nitrogen dioxide (NO_2) and particulate matter (PM_{10}) arising from road transport.

5.31 Figure 5.6 below shows the levels of NO2 and PM10 measured at the site in 2016. These images indicate that the levels of NO_2 and PM_{10} present at the site in 2016 would have been below the annual mean objectives for both pollutants.

5.32 No fossil fuels will be used for the building systems proposed for the new dwelling, and it is anticipated that transport emissions may be mitigated by encouraging the occupants to cycle through the provision of bicycle storage within the new dwelling.

Noise Pollution

5.33 The development is not located within close proximity to transport noise sources. The closest road noise sources are Rosslyn Hill (A502) to the east, and Finchley Road (A41) to the west of the site. However, the below map (top) shows that noise from these roads will have no impact on the new dwelling.

5.34 The site is also not located within close enough proximity to any rail lines for noise from this source to impact on the occupants in the future, as demonstrated on the map below (bottom).

5.35 In addition to this, the air source heat pump (ASHP) system proposed to serve the space and water heating demand of the new dwelling is quiet in operation. As the design progresses, acoustic measures should be considered to further limit the noise generated by the outside unit of the system, should this be deemed necessary.

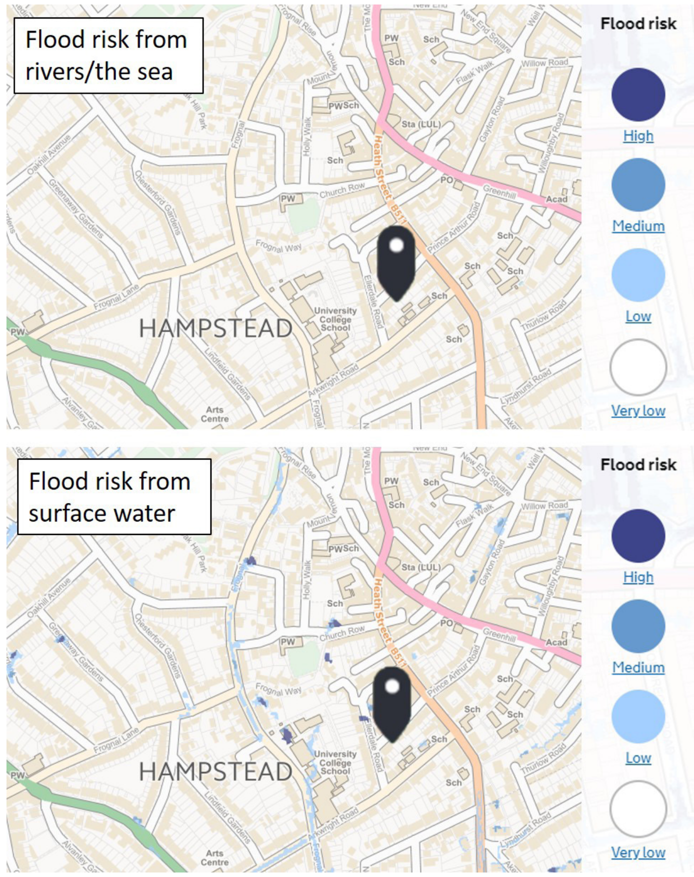


Figure 5.5 Extract from the Environment Agency's online flood map

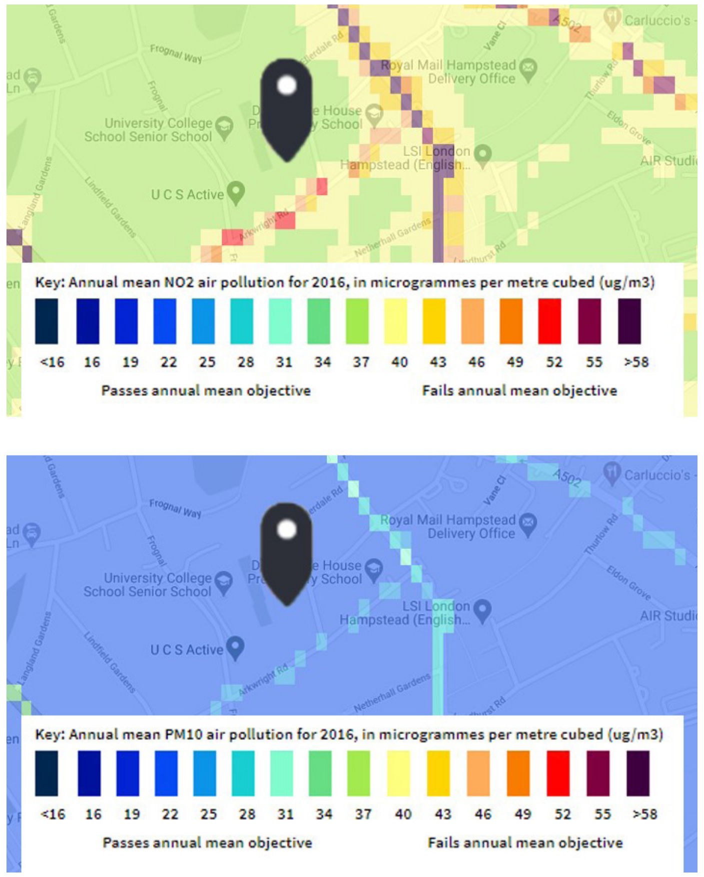


Figure 5.6 Maps indicating annual levels of NO_2 (top) and PM_{10} (bottom) exposure

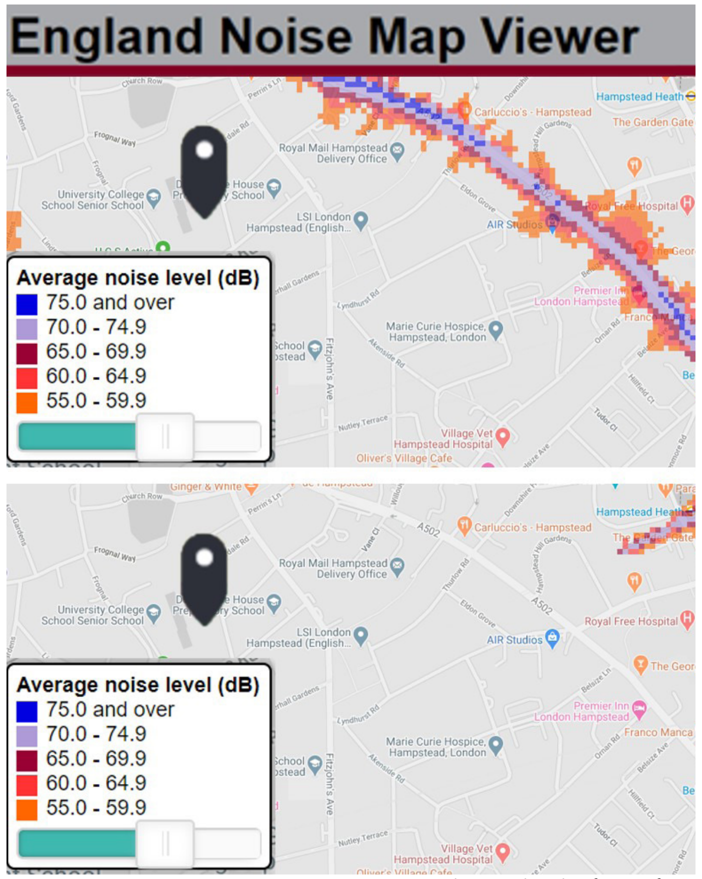


Figure 5.7 Maps indicating levels of noise from road (top) and rail (bottom) sources

Section 6

Energy Strategy.

6 | Energy Strategy

The Energy Hierarchy

6.1 With reference to the policy requirements, guidance and industry best practice detailed in Section 4, a comprehensive energy and carbon dioxide (CO_2) emissions assessment has been carried out for the proposed scheme. The energy performance of the scheme has been analysed and evaluated against the most up-to-date iteration of Part L of the Building Regulations and pertinent London Borough of Camden policies, accounting for economic, technical and functional feasibility.

6.2 The proposed energy strategy is based upon the principles of the Energy Hierarchy on the basis that it is preferable to reduce carbon dioxide emissions through reduced energy consumption above decarbonisation through alternative energy sources.

6.3 The tiers of the Energy Hierarchy are:

- Be Lean | Use less energy
- Be Clean | Supply energy efficiently
- Be Green | Use renewable energy

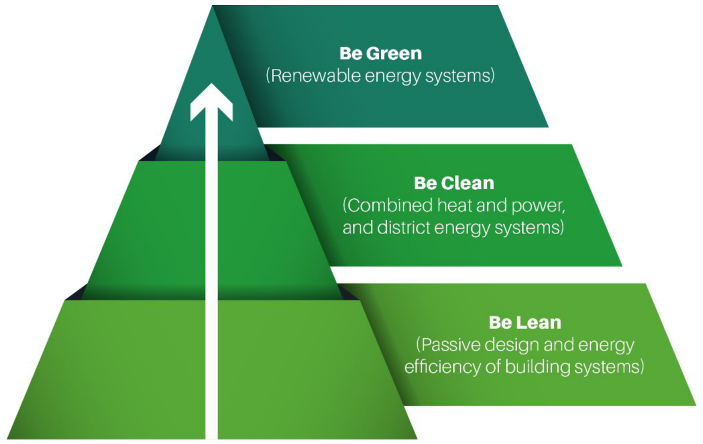


Figure 6.1 The Energy Hierarchy

6.4 Design recommendations were provided to Charlton Brown Architects, and preliminary design assessments were carried out to enable an energy strategy to develop from an early stage.

'Be Lean' | Use Less Energy

6.5 Within the first stage of the energy hierarchy, it is proposed to incorporate high levels of passive and energy efficient design measures in order to reduce the development's energy consumption and associated CO_2 emissions.

6.6 It is technically possible to exceed Building Regulations requirements through demand reduction measures alone, and it is an expectation of the Greater London Authority (GLA) that new dwellings achieve at least 10% reduction via the 'Be Lean' stage.

6.7 The proposed development includes a wide range of energy efficiency measures, intended to reduce energy demand.

6.8 The following U-values are proposed as a means of limiting heat loss through the dwelling's building fabric:

Building Fabric Element	Part L1A:2013 backstop U-values (W/m²K)	Proposed U-values (W/m²K)
Ground floor	0.25	0.08 - 0.10
External wall	0.30	0.13 - 0.15
Roof	0.20	0.10 - 0.12
Exposed ceilings/floors	0.25	0.13 - 0.18
Windows	2.00 (including frame)	1.30 (including frame)
Doors	2.00	1.00

6.9 The glazing will be double glazed, argon filled with a low emissivity coating. Although this has yet to be formally specified, it is expected that window U-values will be 1.3 W/m²K or better (including frame), with a g-value of 0.63, and light transmission of ~70% to improve natural daylight penetration.

6.10 A high level of airtightness is proposed, where a level equal to or below 3 m³/h/m³ shall be targeted, meaning that air infiltration between the internal and the external environment will be largely controlled, and space heating/cooling demand further reduced.

6.11 The other significant means of heat loss from dwellings is due to thermal (cold) bridging. This is typically a construction detail which has higher thermal conductivity than the surrounding materials, creating a path of least resistance for heat transfer. Thermal bridges result in an overall reduction in thermal resistance of the building elements and should be designed out where possible to minimise unwanted heat loss. In order to minimise heat loss through thermal bridges, accredited construction details have been assumed, with an equivalent y-value of 0.05.

6.12 High efficiency plant, equipment and controls are proposed to limit the energy consumed in order to provide the required level of indoor environmental performance and control. Performance efficiency values were tested and improved in energy models to benchmark the resulting predicted CO_2 reduction.

- Low energy LED lighting will be installed throughout the dwelling.
- In order to assess the CO_2 emissions reductions achieved through the 'Be Lean' stage, space and water heating demand is served by an individual gas-fired boiler with an efficiency of 90%.
- Although the dwelling will be provided with opening windows to mitigate against overheating, outside air will be provided via mechanical ventilation with heat recovery (MVHR), with a specific fan power (SFP) of 0.76 W/l/s. A heat exchanger with an efficiency of >90% has also been specified. These efficiencies are higher than those set out in the Domestic Building Services Compliance Guide.
- Time and temperature zones, controlled by the suitable arrangement of plumbing and electrical services, will be employed to control heating consumption within the dwelling.

6.13 Energy modelling of the proposed dwelling has been undertaken using the Standard Assessment Procedure (SAP).

6.14 The carbon dioxide emissions for the dwelling under the 'Be Lean' tier of the Energy Hierarchy are shown to the right. DER and TER worksheets showing the 'Be Lean' performance of the dwelling are provided in Appendix A3.

6.15 The analysis presented below shows that the proposed dwelling will achieve a carbon dioxide emissions saving of 15.6% through energy efficiency means alone, under the 'Be Lean' scenario.

TER: Baseline Part L1A:2013 Emissions ($kgCO_2$ per annum)	DER: Proposed 'Be Lean' Emissions ($kgCO_2$ per annum)	Emissions Savings ($kgCO_2$ per annum)	Emissions Savings (%)
13.1	11.1	2.0	15.6%

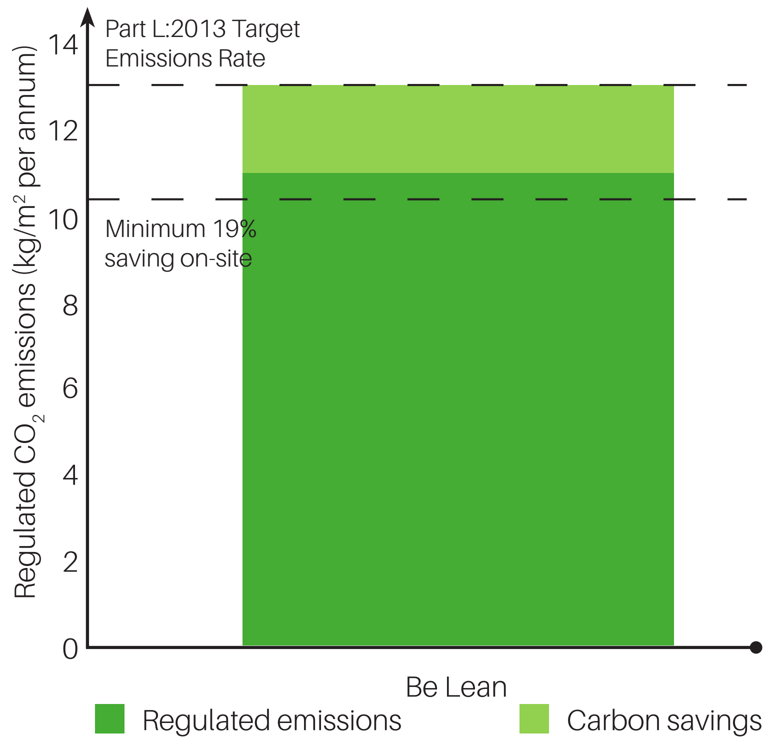


Figure 6.2 Carbon dioxide emissions ('Be Lean')

6 | Energy Strategy

'Be Clean' | Supply Energy Efficiently

6.16 The potential for the proposed dwelling to incorporate a low carbon heating/cooling system has been reviewed, in line with the hierarchy presented in London Plan Policy 5.6:

1. Connection to existing heating or cooling networks;
2. Site-wide CHP network; and
3. Communal heating and cooling.

6.17 The London Heat Map is a tool provided by the Mayor of London to identify opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study.

6.18 The image displayed in Figure 6.3 is an extract from the London Heat Map, showing the area in the vicinity of the site. It illustrates;

- Heat demand (areas of higher heat demand are shown in red);
- Existing heat networks (shown as red lines);
- Proposed heat networks (shown as orange lines); and
- Heat network priority areas (white with black borders).

6.19 The extract displayed in Figure 6.3 indicates that the site of the proposed dwelling is located within an area of low heat demand, with no planned or existing heat networks within the vicinity. It is also located outside local heat network priority areas.

6.20 Given the scale and density of the proposed development, the establishment of a new heat network is unfeasible. Furthermore, the use of combined heat and power (CHP) is also considered to be unviable for the proposed site, based on the most up-to-date GLA energy guidance, which looks to move away from the use of natural gas to meet space and water heating demands. It is therefore recommended that an air source heat pump (ASHP) system is employed to service the space and water heat demand of the new dwelling. The incorporation of heat pump technology is discussed in greater detail in the 'Be Green' section.

6.21 The "Be Clean" carbon dioxide emissions are therefore identical to those set out in the "Be Lean" scenario.

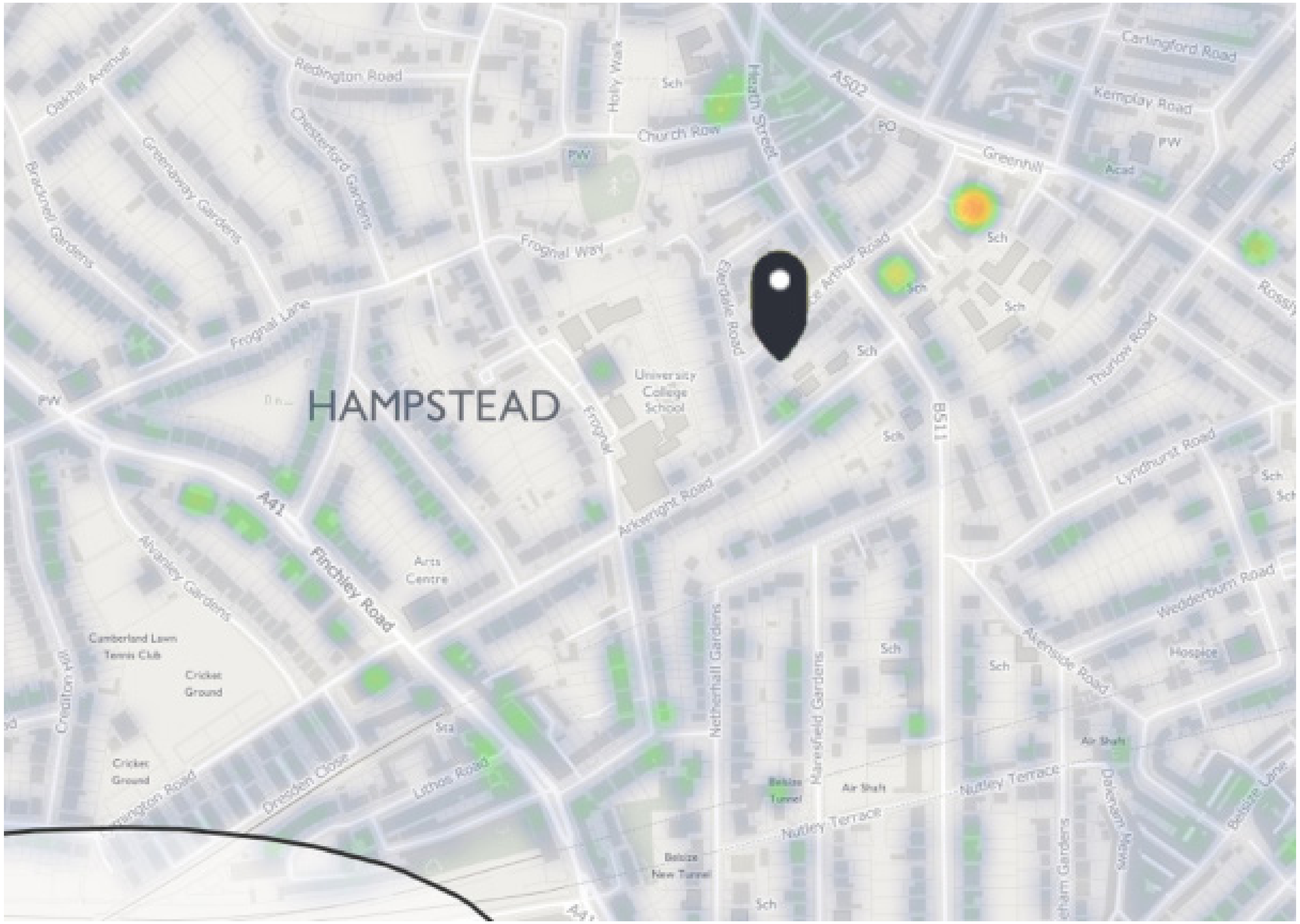


Figure 6.3 Extract from the London Heat Map

'Be Green' | Utilise Renewable Technologies

6.22 The proposed development has given consideration to renewable energy technologies that may be applicable to deliver the required level of carbon dioxide savings over the Part L1A:2013 baseline, and the likely local effects on the environment.

6.23 In determining the appropriate renewable technology for the site, a number of factors including carbon dioxide savings, site constraints, and potential visual impacts have been considered. Further details of each technology and its associated assessment in relation to the proposed new dwelling are provided below.

- **Biomass** - This technology is not considered a practical solution for reducing carbon dioxide, in the view of limited options for domestic scale installations, storage space requirements for the combustible material, and the transport related carbon dioxide emissions which are not normally accounted for within energy modelling. Furthermore, high levels of nitrous oxide (NOx) and particulate matter (PMx) emissions are associated with the use of biomass fuel. As the proposed dwelling is located within a dense, urban area, permitted emissions will be restricted.
- **Air Source Heat Pumps (ASHP)** - given the site location and lack of existing or proposed heat networks, it is proposed that air source heat pump (ASHP) technology is incorporated within the development. It is expected that a highly efficient system, such as the Nilan Compact P, will be employed to serve both the space and water heating demands of the proposed dwelling. This system also provides mechanical ventilation with heat recovery (MVHR) and includes a reversible cooling unit, allowing for the provision of comfort cooling. Typical manufacturer specifications for the proposed Nilan Compact P system quote a heating coefficient of performance of approximately 4.2. The specified system is quiet in operation, though it is recommended that measures to further mitigate the sound produced by the external component of the proposed system are considered during detailed design. In addition to this, the proposed system provides an element of cooling, which has been accounted for within the SAP calculations by assuming an Energy Efficiency Ration (EER) of 3.
- **Ground Source Heat Pumps (GSHP)** - Due to the nature of the proposed development, the site is not suitable for a horizontal ground collection loop. Furthermore, ground investigation and borehole drilling are likely to be cost prohibitive, and may not yield a suitable energy source. The use of ground source heat pumps for the proposed scheme is therefore not considered viable.
- **Photovoltaics (PV)** - Whilst the orientation of the site faces south-east, the proposed form of the roof means that areas of roof facing south-east would not offer a large enough area to house PV panels. Furthermore, the significant size of the copper beech tree in the southern corner of the rear garden may cause the south-east facing portion of the roof to become overshadowed. This would result in the output of PV panels being significantly reduced. Based on this, it is considered that the employment of PV panels would not be suitable for the proposed development.
- **Solar Thermal Hot Water (STHW)** - This technology is presently rejected, as domestic hot water is proposed to be provided by a highly efficient air source heat pump system. In addition to this, hot water demand is considered to be outside the energy generating period for the solar thermal panels, meaning its ability to significantly reduce carbon emissions during operation is limited. Furthermore, as outlined above with regards to photovoltaic (PV) technology, the area of south-east facing roofspace available will not be of a sufficient size to house the solar thermal panels, and the potential overshadowing caused by the copper beech tree would significantly reduce the efficiency of this technology.
- **Wind Turbines** - This technology is rejected on the basis of its potential impact on visual amenity and relatively low efficiency from unpredictable, turbulent wind conditions associated with urban locations.

6.24 As for the 'Be Lean' stage, 'Be Green' energy analysis has been carried out for the proposed development using the Standard Assessment Procedure (SAP).

6.25 The carbon dioxide emissions for the proposed development, under each tier of the Energy Hierarchy, are shown in Figure 6.4. DER and TER worksheets showing the 'Be Green' performance of the proposed dwelling are provided in Appendix A3.

6.26 The Energy Performance Certificate (EPC) for the dwelling that currently stands on the site indicates that it achieves a rating of 56, which is only marginally within band D (scores between 55 and 68). The EPC for the proposed dwelling, provided in Appendix A4, shows it will achieve a rating of 88, which is within band B (scores between 81 and 91). This is higher than the average energy efficiency of 60 for a dwelling in England and Wales.

6.27 The energy analysis carried out shows that the proposed development achieves a carbon dioxide emissions saving of 27.9% through energy efficiency measures and renewable technologies. This exceeds the 19% target necessary to meet the requirements of the London Borough of Camden.

TER: Baseline Part L1A:2013 Emissions ($kgCO_2$ per annum)	DER: Proposed 'Be Green' Emissions ($kgCO_2$ per annum)	Emissions Savings ($kgCO_2$ per annum)	Emissions Savings (%)
13.1	9.5	3.7	27.9%

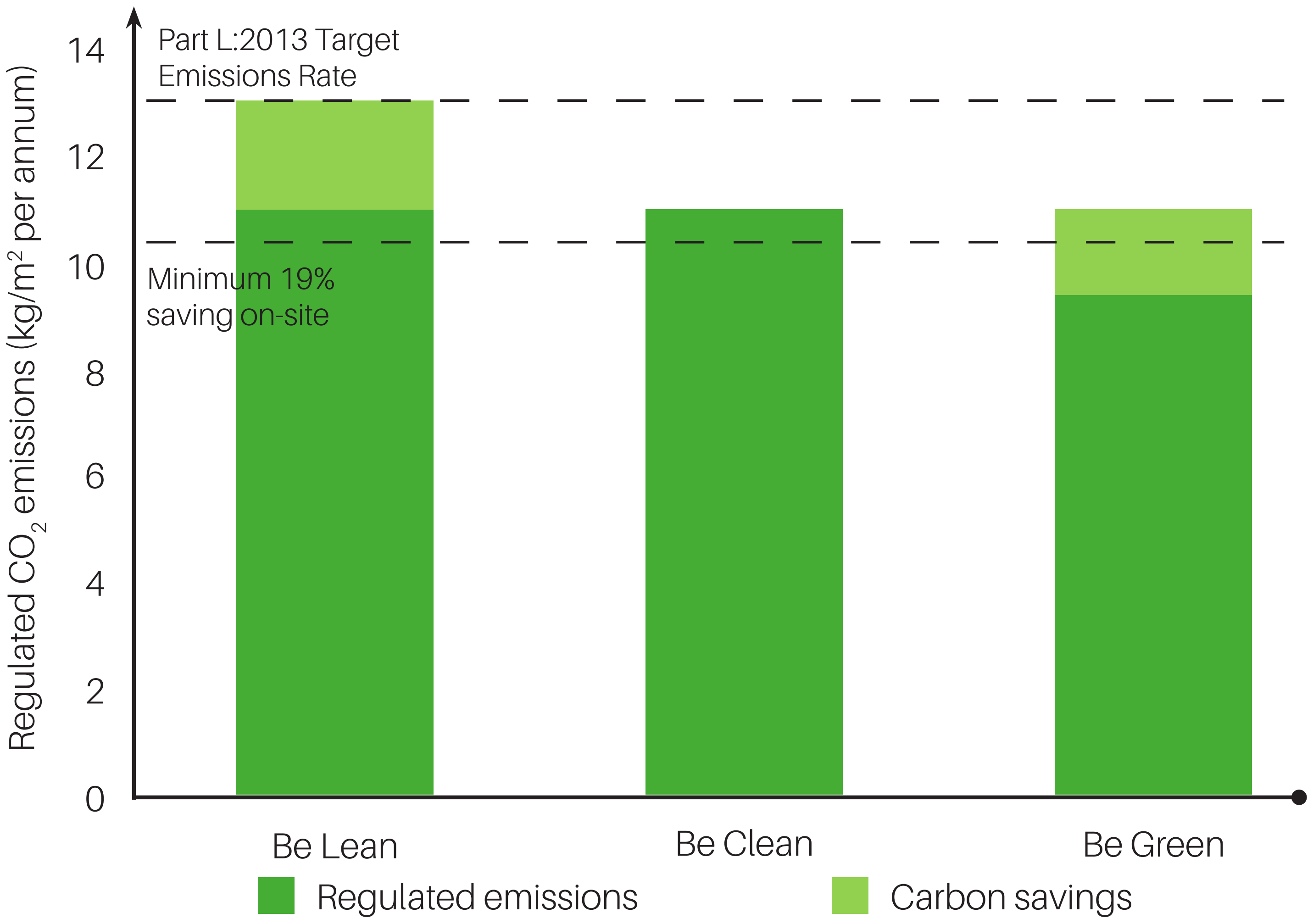


Figure 6.4 Carbon dioxide emissions ('Be Green')

Section 7

Conclusion.

7 | Conclusion

7.1 This Sustainability and Energy Statement provides an overview as to how the proposed development at 5B Prince Arthur Road contributes to sustainable development in the context of national, regional and local considerations.

7.2 Consideration has been given to the London Borough of Camden's Local Plan, and the Greater London Authority's (GLA) London Plan in the formulation of this statement. The overall development has been assessed using the GLA's supplementary planning guidance (SPG) 'Sustainable Design and Construction', providing a holistic sustainability approach for the building.

7.3 Sections 5 and 6 of this statement demonstrate that the siting and design of the proposals support relevant policy relating to sustainable development. This shows that the proposed development:

- will provide a new family home to replace the existing dwelling on-site;
- will give consideration to the lifecycle environmental performance of the new dwelling when selecting materials to reduce embodied carbon;
- will minimise internal water consumption to 105 litres per person per day;
- will retain the existing copper beech tree, and provide new planting to maintain and enhance the biodiversity of the site;
- will manage surface water runoff through the incorporation of soft landscaping;
- will minimise energy demand through the specification of low u-values, low air permeability and low thermal bridging to reduce heat loss; and
- will utilise a highly efficient air source heat pump system to eliminate the need for on-site fossil fuel combustion to provide space and water heating, mechanical ventilation with heat recovery, and a degree of comfort cooling.

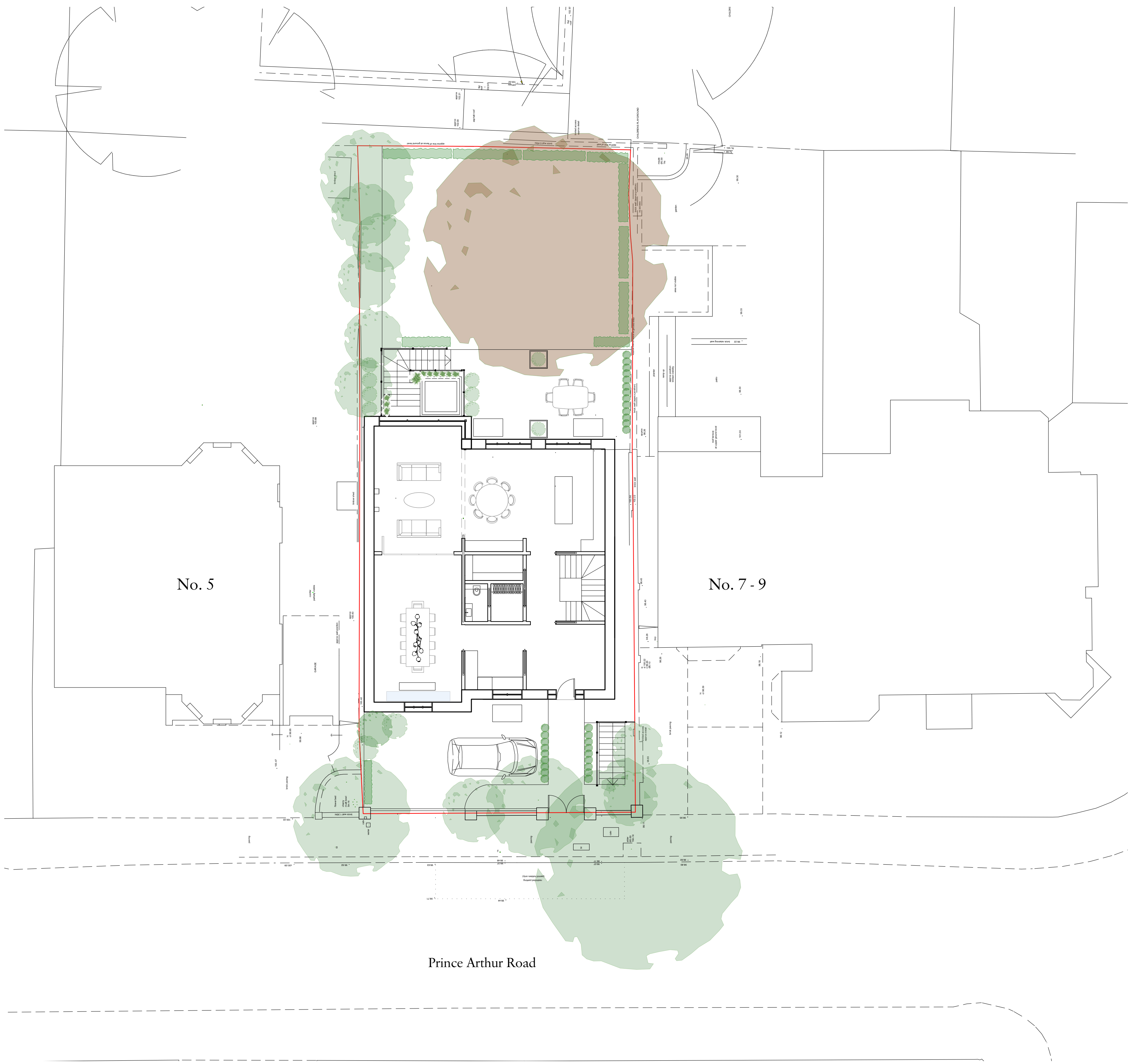
7.4 By designing to rigorous energy standards, and omitting the use of fossil fuels for space and water heating through the employment of an air source heat pump system, the application will respond directly to the Climate Emergency declared by the Council in April 2019. These measures combine to provide a carbon dioxide emissions saving of 27.9%, compared to the Part L:2013 baseline, meeting and exceeding the requirements of the London Borough of Camden's policies to achieve a 19% reduction through on-site means alone.

7.5 Overall, the proposals for the scheme are in line with the principles of sustainable development, as well as the policy requirements of the NPPF and the London Borough of Camden, and will provide a new dwelling that seeks to promote these principles in operation.

Appendix A1

Site Layout.

A1 | Site Layout



Rev	Date	Details	By

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Client
Mr & Mrs Palsson

Project
Copper Beech House, 5b Prince Arthur Rd.

Drawing Title
Proposed Site Plan

Date	Drawn	Checked
02/04/2020	SI	CP

Scale
1:100 @A1 / 1:200 @ A3

Issue Status
FOR PLANNING

Appendix A2
Water Usage Calculator.

CSH Wat tool May 09

breglobal

Job no: 20-S011
Date: 03/04/2020
Assessor name:
Registration no: N/A
Development name: 5B Prince Arthur Road

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

WATER EFFICIENCY CALCULATOR FOR NEW DWELLINGS - (BASIC CALCULATOR)

	House Type:	Type 1		Type 2		Type 3		Type 4		Type 5		Type 6		Type 7		Type 8		Type 9		Type 10	
	Description:	Typical Unit																			
Installation Type	Unit of measure	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day
Is a dual or single flush WC specified?		Dual		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Click to Select		Click to Select		Click to Select	
WC	Full flush volume	6	8.76		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
	Part flush volume	3	8.88		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Taps (excluding kitchen and external taps)	Flow rate (litres / minute)	3	6.32		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Are both a Bath & Shower Present?		Bath & Shower		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:	
Bath	Capacity to overflow	180	19.80		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Shower	Flow rate (litres / minute)	8	34.96		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Kitchen sink taps	Flow rate (litres / minute)	4	12.12		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a washing machine been specified?		Yes		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:	
Washing Machine	Litres / kg	8.17	17.16		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a dishwasher been specified?		Yes		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:		Select option:	
Dishwasher	Litres / place setting	1.25	4.50		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a waste disposal unit been specified?		No	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00	Select option:	0.00
Water Softener	Litres / person / day		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Calculated Use			112.5		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
Normalisation factor			0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91
Code for Sustainable Homes	Total Consumption		102.4		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
	Mandatory level		Level 3/4		-		-		-		-		-		-		-		-		-
Building Regulations 17.K	External use		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0
	Total Consumption		107.4		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
	17.K Compliance?		Yes		-		-		-		-		-		-		-		-		-

(BASIC CALC.)

1 of 1

Appendix A3

DER/TER Worksheets.

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.25

Property Address: 5B Prince Arthur Road_Be Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	177.5	(1a) x	4	(2a) =	710	(3a)
Ground floor	155	(1b) x	3.1	(2b) =	480.5	(3b)
First floor	131.9	(1c) x	2.7	(2c) =	356.13	(3c)
Second floor	131.9	(1d) x	2.6	(2d) =	342.94	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	596.3	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		1889.57	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(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) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling design stage

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

	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.1	(23c)

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

(24a)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(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	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(25)

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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			5.7	x	1	=	5.7			(26)
Windows Type 1			20.3	x1/[1/(1.3)+ 0.04]		=	25.09			(27)
Windows Type 2			53.4	x1/[1/(1.3)+ 0.04]		=	65.99			(27)
Rooflights Type 1			0.8	x1/[1/(1.3) + 0.04]		=	1.04			(27b)
Rooflights Type 2			1.3	x1/[1/(1.3) + 0.04]		=	1.69			(27b)
Floor			177.5	x	0.1	=	17.75			(28)
Walls Type1	295.4	79.4	216	x	0.15	=	32.4			(29)
Walls Type2	129.22	0	129.22	x	0.14	=	18.03			(29)
Walls Type3	226.4	0	226.4	x	0.15	=	33.96			(29)
Roof Type1	136.1	2.1	134	x	0.13	=	17.42			(30)
Roof Type2	18.9	0	18.9	x	0.13	=	2.46			(30)
Total area of elements, m²			983.52							(31)

** 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) =	221.39	(33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(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 can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		49.2	(36)

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

Total fabric heat loss	(33) + (36) =	270.59	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	185.24	183.25	181.26	171.32	169.33	159.4	159.4	157.41	163.37	169.33	173.31	177.29	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	455.82	453.84	451.85	441.91	439.92	429.98	429.98	428	433.96	439.92	443.9	447.87

Average = Sum(39)1…12 /12= 441.41 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.76	0.76	0.76	0.74	0.74	0.72	0.72	0.72	0.73	0.74	0.74	0.75

Average = Sum(40)1…12 /12= 0.74 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 3.52 (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

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 117.73 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	129.5	124.8	120.09	115.38	110.67	105.96	105.96	110.67	115.38	120.09	124.8	129.5

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Total = Sum(44)1…12 = 1412.78 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	192.05	167.97	173.33	151.11	145	125.12	115.94	133.05	134.64	156.9	171.27	185.99

Total = Sum(45)1…12 = 1852.38 (45)

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

(46)m=	28.81	25.2	26	22.67	21.75	18.77	17.39	19.96	20.2	23.54	25.69	27.9	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		150	(47)

If community heating 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):		1.95	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	1.05	(50)

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

DER WorkSheet: New dwelling design stage

Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating 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)		1.05	(55)

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

(56)m=	32.64	29.48	32.64	31.59	32.64	31.59	32.64	32.64	31.59	32.64	31.59	32.64	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.64	29.48	32.64	31.59	32.64	31.59	32.64	32.64	31.59	32.64	31.59	32.64	(57)

Primary circuit loss (annual) from Table 3		0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (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 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	247.96	218.46	229.24	205.22	200.9	179.22	171.85	188.95	188.74	212.81	225.38	241.9	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	247.96	218.46	229.24	205.22	200.9	179.22	171.85	188.95	188.74	212.81	225.38	241.9

Output from water heater (annual)1…12 2510.62 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	108.58	96.25	102.36	93.53	92.94	84.88	83.28	88.96	88.05	96.9	100.23	106.57	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	(66)

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

(67)m=	65.29	57.99	47.16	35.7	26.69	22.53	24.35	31.65	42.48	53.93	62.95	67.1	(67)

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

(68)m=	669.12	676.06	658.56	621.31	574.29	530.1	500.58	493.64	511.13	548.38	595.4	639.59	(68)

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

(69)m=	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	(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=	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	(71)

Water heating gains (Table 5)

(72)m=	145.94	143.22	137.58	129.9	124.91	117.89	111.93	119.57	122.29	130.24	139.21	143.23	(72)

DER WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(73)m=	959.11	956.03	922.06	865.67	804.65	749.29	715.61	723.61	754.65	811.31	876.31	928.69	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	53.4	x	36.79	x	0.63	x	0.7	=	600.47	(77)
Southeast 0.9x	0.77	x	53.4	x	62.67	x	0.63	x	0.7	=	1022.81	(77)
Southeast 0.9x	0.77	x	53.4	x	85.75	x	0.63	x	0.7	=	1399.46	(77)
Southeast 0.9x	0.77	x	53.4	x	106.25	x	0.63	x	0.7	=	1734	(77)
Southeast 0.9x	0.77	x	53.4	x	119.01	x	0.63	x	0.7	=	1942.22	(77)
Southeast 0.9x	0.77	x	53.4	x	118.15	x	0.63	x	0.7	=	1928.18	(77)
Southeast 0.9x	0.77	x	53.4	x	113.91	x	0.63	x	0.7	=	1858.97	(77)
Southeast 0.9x	0.77	x	53.4	x	104.39	x	0.63	x	0.7	=	1703.62	(77)
Southeast 0.9x	0.77	x	53.4	x	92.85	x	0.63	x	0.7	=	1515.32	(77)
Southeast 0.9x	0.77	x	53.4	x	69.27	x	0.63	x	0.7	=	1130.43	(77)
Southeast 0.9x	0.77	x	53.4	x	44.07	x	0.63	x	0.7	=	719.22	(77)
Southeast 0.9x	0.77	x	53.4	x	31.49	x	0.63	x	0.7	=	513.87	(77)
Southwest 0.9x	0.77	x	20.3	x	36.79	x	0.63	x	0.7	=	228.27	(79)
Southwest 0.9x	0.77	x	20.3	x	62.67	x	0.63	x	0.7	=	388.82	(79)
Southwest 0.9x	0.77	x	20.3	x	85.75	x	0.63	x	0.7	=	532	(79)
Southwest 0.9x	0.77	x	20.3	x	106.25	x	0.63	x	0.7	=	659.18	(79)
Southwest 0.9x	0.77	x	20.3	x	119.01	x	0.63	x	0.7	=	738.34	(79)
Southwest 0.9x	0.77	x	20.3	x	118.15	x	0.63	x	0.7	=	733	(79)
Southwest 0.9x	0.77	x	20.3	x	113.91	x	0.63	x	0.7	=	706.69	(79)
Southwest 0.9x	0.77	x	20.3	x	104.39	x	0.63	x	0.7	=	647.63	(79)
Southwest 0.9x	0.77	x	20.3	x	92.85	x	0.63	x	0.7	=	576.05	(79)
Southwest 0.9x	0.77	x	20.3	x	69.27	x	0.63	x	0.7	=	429.73	(79)
Southwest 0.9x	0.77	x	20.3	x	44.07	x	0.63	x	0.7	=	273.41	(79)
Southwest 0.9x	0.77	x	20.3	x	31.49	x	0.63	x	0.7	=	195.35	(79)
Rooflights 0.9x	1	x	0.8	x	26	x	0.3	x	0.7	=	3.93	(82)
Rooflights 0.9x	1	x	1.3	x	37.03	x	0.3	x	0.7	=	9.1	(82)
Rooflights 0.9x	1	x	0.8	x	54	x	0.3	x	0.7	=	8.16	(82)
Rooflights 0.9x	1	x	1.3	x	70.28	x	0.3	x	0.7	=	17.27	(82)
Rooflights 0.9x	1	x	0.8	x	96	x	0.3	x	0.7	=	14.52	(82)
Rooflights 0.9x	1	x	1.3	x	111.87	x	0.3	x	0.7	=	27.49	(82)
Rooflights 0.9x	1	x	0.8	x	150	x	0.3	x	0.7	=	22.68	(82)
Rooflights 0.9x	1	x	1.3	x	159.33	x	0.3	x	0.7	=	39.15	(82)
Rooflights 0.9x	1	x	0.8	x	192	x	0.3	x	0.7	=	29.03	(82)
Rooflights 0.9x	1	x	1.3	x	193.3	x	0.3	x	0.7	=	47.49	(82)

DER WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	0.8	x	200	x	0.3	x	0.7	=	30.24	(82)
Rooflights 0.9x	1	x	1.3	x	197.35	x	0.3	x	0.7	=	48.49	(82)
Rooflights 0.9x	1	x	0.8	x	189	x	0.3	x	0.7	=	28.58	(82)
Rooflights 0.9x	1	x	1.3	x	188.08	x	0.3	x	0.7	=	46.21	(82)
Rooflights 0.9x	1	x	0.8	x	157	x	0.3	x	0.7	=	23.74	(82)
Rooflights 0.9x	1	x	1.3	x	162.62	x	0.3	x	0.7	=	39.95	(82)
Rooflights 0.9x	1	x	0.8	x	115	x	0.3	x	0.7	=	17.39	(82)
Rooflights 0.9x	1	x	1.3	x	128.66	x	0.3	x	0.7	=	31.61	(82)
Rooflights 0.9x	1	x	0.8	x	66	x	0.3	x	0.7	=	9.98	(82)
Rooflights 0.9x	1	x	1.3	x	82.24	x	0.3	x	0.7	=	20.21	(82)
Rooflights 0.9x	1	x	0.8	x	33	x	0.3	x	0.7	=	4.99	(82)
Rooflights 0.9x	1	x	1.3	x	45.75	x	0.3	x	0.7	=	11.24	(82)
Rooflights 0.9x	1	x	0.8	x	21	x	0.3	x	0.7	=	3.18	(82)
Rooflights 0.9x	1	x	1.3	x	30.74	x	0.3	x	0.7	=	7.55	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m=	841.76	1437.07	1973.47	2455	2757.08	2739.9	2640.44	2414.95	2140.37	1590.35	1008.86	719.95	(83)
(84)m=	1800.87	2393.1	2895.52	3320.68	3561.74	3489.19	3356.05	3138.56	2895.02	2401.65	1885.17	1648.64	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, h1,m (see Table 9a) (86)m=	1	1	1	0.99	0.93	0.76	0.56	0.62	0.89	1	1	1	(86)
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c) (87)m=	20.02	20.17	20.38	20.65	20.87	20.98	21	21	20.93	20.63	20.27	20	(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m=	20.28	20.29	20.29	20.3	20.31	20.32	20.32	20.33	20.32	20.31	20.3	20.3	(88)
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a) (89)m=	1	1	1	0.98	0.9	0.69	0.48	0.53	0.85	0.99	1	1	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) (90)m=	18.92	19.15	19.46	19.86	20.17	20.31	20.32	20.32	20.26	19.84	19.31	18.91	(90)

fLA = Living area ÷ (4) = 0.13 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2 (92)m=	19.06	19.27	19.57	19.96	20.25	20.39	20.41	20.41	20.34	19.94	19.43	19.05	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate (93)m=	18.91	19.12	19.42	19.81	20.1	20.24	20.26	20.26	20.19	19.79	19.28	18.9	(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	1	1	0.98	0.89	0.68	0.47	0.52	0.84	0.99	1	1	(94)

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains, hmGm , W = (94)m x (84)m (95)m=	1800.74	2391.77	2885.53	3248.02	3187.45	2373.68	1569.02	1644.42	2422.05	2379.25	1884.56	1648.58	(95)
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, Lm , W =[(39)m x [(93)m– (96)m] (97)m=	6659.58	6455.79	5840.04	4821.4	3697.21	2425.97	1572.03	1650.98	2642.66	4041.29	5407.39	6583.3	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m (98)m=	3614.98	2731.02	2198.15	1132.83	379.26	0	0	0	0	1236.56	2536.44	3671.43	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 17500.67 (98)

Space heating requirement in kWh/m²/year 29.35 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10) (100)m=	0	0	0	0	0	4041.85	3181.88	3252.77	0	0	0	0	(100)
Utilisation factor for loss hm (101)m=	0	0	0	0	0	0.91	0.96	0.94	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m (102)m=	0	0	0	0	0	3659.04	3062.25	3069.69	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10) (103)m=	0	0	0	0	0	4284.57	4123.49	3877.33	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m (104)m=	0	0	0	0	0	450.39	789.56	600.89	0	0	0	0	

Total = Sum(104) = 1840.84 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Intermittency factor (Table 10b) (106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104) = 0 (106)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space cooling requirement for month = (104)m × (105) × (106)m (107)m=	0	0	0	0	0	112.6	197.39	150.22	0	0	0	0

Total = Sum(107) = 460.21 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.77 (108)

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) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.05	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	3614.98	2731.02	2198.15	1132.83	379.26	0	0	0	0	1236.56	2536.44	3671.43	

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	3976.87	3004.43	2418.21	1246.24	417.23	0	0	0	0	1360.35	2790.36	4038.98

Total (kWh/year) =Sum(211)1...5,10...12 = 19252.66 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

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

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Output from water heater (calculated above)	247.96	218.46	229.24	205.22	200.9	179.22	171.85	188.95	188.74	212.81	225.38	241.9

Efficiency of water heater 80.8 (216)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(217)m=	90.18	90.07	89.84	89.19	87.13	80.8	80.8	80.8	80.8	89.26	89.98	90.2	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	274.97	242.56	255.16	230.09	230.58	221.81	212.68	233.85	233.59	238.41	250.47	268.17	

Total = Sum(219a)1...12 = 2892.34 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(221)m=	0	0	0	0	0	27.8	48.74	37.09	0	0	0	0

Total = Sum(221)6...8 = 113.63 (221)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			19252.66	
Water heating fuel used			2892.34	
Space cooling fuel used			113.63	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		2190.01		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		2220.01	(231)
Electricity for lighting			1153.03	(232)

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	0.216	=	4158.57	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	624.74	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4783.32	(265)
Space cooling	(221)	x	0.519	=	58.98	(266)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	1152.19	(267)
Electricity for lighting	(232)	x	0.519	=	598.42	(268)
Total CO2, kg/year			sum of (265)…(271) =		6592.9	(272)

DER WorkSheet: New dwelling design stage

Dwelling CO2 Emission Rate	(272) ÷ (4) =	11.06	(273)
EI rating (section 14)		86	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.25

Property Address: 5B Prince Arthur Road_Be Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	177.5	(1a)	x	4	(2a)	=	710	(3a)
Ground floor	155	(1b)	x	3.1	(2b)	=	480.5	(3b)
First floor	131.9	(1c)	x	2.7	(2c)	=	356.13	(3c)
Second floor	131.9	(1d)	x	2.6	(2d)	=	342.94	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	596.3	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			1889.57	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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)
Number of intermittent fans							4	x 10 =	40	(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 and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.02	(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)	0.27	(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) =	0.23	(21)

Infiltration rate modified for monthly wind speed

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

TER WorkSheet: New dwelling design stage

Monthly average wind speed from Table 7

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

	0.29	0.29	0.28	0.25	0.25	0.22	0.22	0.21	0.23	0.25	0.26	0.27

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	0.53	0.53	0.53	0.54	(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	0.53	0.53	0.53	0.54	(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			5.7	x	1	=	5.7			(26)
Windows Type 1			20.3	x1/[1/(1.4)+ 0.04]		=	26.91			(27)
Windows Type 2			53.4	x1/[1/(1.4)+ 0.04]		=	70.8			(27)
Rooflights Type 1			0.8	x1/[1/(1.7) + 0.04]		=	1.36			(27b)
Rooflights Type 2			1.3	x1/[1/(1.7) + 0.04]		=	2.21			(27b)
Floor			177.5	x	0.13	=	23.075			(28)
Walls Type1	295.4	79.4	216	x	0.18	=	38.88			(29)
Walls Type2	129.22	0	129.22	x	0.18	=	23.26			(29)
Walls Type3	226.4	0	226.4	x	0.18	=	40.75			(29)
Roof Type1	136.1	2.1	134	x	0.13	=	17.42			(30)
Roof Type2	18.9	0	18.9	x	0.13	=	2.46			(30)
Total area of elements, m²			983.52							(31)

** 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) =	252.59	(33)

TER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(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 can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		49.2	(36)

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

Total fabric heat loss	(33) + (36) =	301.79	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	338.71	337.66	336.64	331.82	330.92	326.73	326.73	325.95	328.34	330.92	332.74	334.65	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	640.5	639.45	638.43	633.62	632.72	628.52	628.52	627.75	630.14	632.72	634.54	636.44	

Average = Sum(39)1…12 /12= 633.61 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.07	1.06	1.06	1.05	1.05	1.05	1.06	1.06	1.06	1.07

Average = Sum(40)1…12 /12= 1.06 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N	3.52	(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

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	117.73	(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	129.5	124.8	120.09	115.38	110.67	105.96	105.96	110.67	115.38	120.09	124.8	129.5

Total = Sum(44)1…12 = 1412.78 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	192.05	167.97	173.33	151.11	145	125.12	115.94	133.05	134.64	156.9	171.27	185.99

Total = Sum(45)1…12 = 1852.38 (45)

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

(46)m=	28.81	25.2	26	22.67	21.75	18.77	17.39	19.96	20.2	23.54	25.69	27.9	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		150	(47)

If community heating 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):		1.39	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.75	(50)

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

A3 | DER/TER Worksheets

TER WorkSheet: New dwelling design stage

Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If community heating 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)	0.75	(55)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3: 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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 × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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 × (45)m + (46)m + (57)m + (59)m + (61)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(62)m=	238.65	210.06	219.92	196.2	191.59	170.21	162.54	179.64	179.73	203.5	216.37	232.59	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)
(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(64)m=	238.65	210.06	219.92	196.2	191.59	170.21	162.54	179.64	179.73	203.5	216.37	232.59	

Output from water heater (annual)$_{1...12}$: 2400.99 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(65)m=	101.13	89.52	94.91	86.32	85.49	77.68	75.83	81.51	80.84	89.45	93.02	99.12	(65)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	65.29	57.99	47.16	35.7	26.69	22.53	24.35	31.65	42.48	53.93	62.95	67.1	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	669.12	676.06	658.56	621.31	574.29	530.1	500.58	493.64	511.13	548.38	595.4	639.59	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	(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=	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	(71)
Water heating gains (Table 5)													
(72)m=	135.93	133.21	127.56	119.89	114.9	107.88	101.92	109.56	112.28	120.22	129.2	133.22	(72)

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Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 4 of 8

TER WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(73)m=	949.09	946.02	912.05	855.66	794.64	739.27	705.6	713.6	744.64	801.29	866.3	918.68	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	53.4	x	36.79	x	0.63	x	0.7	=	600.47	(77)
Southeast 0.9x	0.77	x	53.4	x	62.67	x	0.63	x	0.7	=	1022.81	(77)
Southeast 0.9x	0.77	x	53.4	x	85.75	x	0.63	x	0.7	=	1399.46	(77)
Southeast 0.9x	0.77	x	53.4	x	106.25	x	0.63	x	0.7	=	1734	(77)
Southeast 0.9x	0.77	x	53.4	x	119.01	x	0.63	x	0.7	=	1942.22	(77)
Southeast 0.9x	0.77	x	53.4	x	118.15	x	0.63	x	0.7	=	1928.18	(77)
Southeast 0.9x	0.77	x	53.4	x	113.91	x	0.63	x	0.7	=	1858.97	(77)
Southeast 0.9x	0.77	x	53.4	x	104.39	x	0.63	x	0.7	=	1703.62	(77)
Southeast 0.9x	0.77	x	53.4	x	92.85	x	0.63	x	0.7	=	1515.32	(77)
Southeast 0.9x	0.77	x	53.4	x	69.27	x	0.63	x	0.7	=	1130.43	(77)
Southeast 0.9x	0.77	x	53.4	x	44.07	x	0.63	x	0.7	=	719.22	(77)
Southeast 0.9x	0.77	x	53.4	x	31.49	x	0.63	x	0.7	=	513.87	(77)
Southwest 0.9x	0.77	x	20.3	x	36.79		0.63	x	0.7	=	228.27	(79)
Southwest 0.9x	0.77	x	20.3	x	62.67		0.63	x	0.7	=	388.82	(79)
Southwest 0.9x	0.77	x	20.3	x	85.75		0.63	x	0.7	=	532	(79)
Southwest 0.9x	0.77	x	20.3	x	106.25		0.63	x	0.7	=	659.18	(79)
Southwest 0.9x	0.77	x	20.3	x	119.01		0.63	x	0.7	=	738.34	(79)
Southwest 0.9x	0.77	x	20.3	x	118.15		0.63	x	0.7	=	733	(79)
Southwest 0.9x	0.77	x	20.3	x	113.91		0.63	x	0.7	=	706.69	(79)
Southwest 0.9x	0.77	x	20.3	x	104.39		0.63	x	0.7	=	647.63	(79)
Southwest 0.9x	0.77	x	20.3	x	92.85		0.63	x	0.7	=	576.05	(79)
Southwest 0.9x	0.77	x	20.3	x	69.27		0.63	x	0.7	=	429.73	(79)
Southwest 0.9x	0.77	x	20.3	x	44.07		0.63	x	0.7	=	273.41	(79)
Southwest 0.9x	0.77	x	20.3	x	31.49		0.63	x	0.7	=	195.35	(79)
Rooflights 0.9x	1	x	0.8	x	26	x	0.63	x	0.7	=	8.26	(82)
Rooflights 0.9x	1	x	1.3	x	37.03	x	0.63	x	0.7	=	19.11	(82)
Rooflights 0.9x	1	x	0.8	x	54	x	0.63	x	0.7	=	17.15	(82)
Rooflights 0.9x	1	x	1.3	x	70.28	x	0.63	x	0.7	=	36.26	(82)
Rooflights 0.9x	1	x	0.8	x	96	x	0.63	x	0.7	=	30.48	(82)
Rooflights 0.9x	1	x	1.3	x	111.87	x	0.63	x	0.7	=	57.72	(82)
Rooflights 0.9x	1	x	0.8	x	150	x	0.63	x	0.7	=	47.63	(82)
Rooflights 0.9x	1	x	1.3	x	159.33	x	0.63	x	0.7	=	82.21	(82)
Rooflights 0.9x	1	x	0.8	x	192	x	0.63	x	0.7	=	60.96	(82)
Rooflights 0.9x	1	x	1.3	x	193.3	x	0.63	x	0.7	=	99.74	(82)

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Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 5 of 8

TER WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	0.8	x	200	x	0.63	x	0.7	=	63.5	(82)
Rooflights 0.9x	1	x	1.3	x	197.35	x	0.63	x	0.7	=	101.82	(82)
Rooflights 0.9x	1	x	0.8	x	189	x	0.63	x	0.7	=	60.01	(82)
Rooflights 0.9x	1	x	1.3	x	188.08	x	0.63	x	0.7	=	97.04	(82)
Rooflights 0.9x	1	x	0.8	x	157	x	0.63	x	0.7	=	49.85	(82)
Rooflights 0.9x	1	x	1.3	x	162.62	x	0.63	x	0.7	=	83.9	(82)
Rooflights 0.9x	1	x	0.8	x	115	x	0.63	x	0.7	=	36.51	(82)
Rooflights 0.9x	1	x	1.3	x	128.66	x	0.63	x	0.7	=	66.39	(82)
Rooflights 0.9x	1	x	0.8	x	66	x	0.63	x	0.7	=	20.96	(82)
Rooflights 0.9x	1	x	1.3	x	82.24	x	0.63	x	0.7	=	42.44	(82)
Rooflights 0.9x	1	x	0.8	x	33	x	0.63	x	0.7	=	10.48	(82)
Rooflights 0.9x	1	x	1.3	x	45.75	x	0.63	x	0.7	=	23.61	(82)
Rooflights 0.9x	1	x	0.8	x	21	x	0.63	x	0.7	=	6.67	(82)
Rooflights 0.9x	1	x	1.3	x	30.74	x	0.63	x	0.7	=	15.86	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m ...(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m=	856.09	1465.05	2019.67	2523.01	2841.26	2826.5	2722.71	2485.01	2194.27	1623.55	1026.71	731.75	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m=	1805.19	2411.07	2931.71	3378.67	3635.9	3565.78	3428.31	3198.61	2938.91	2424.85	1893.02	1650.43	(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	1	0.99	0.97	0.89	0.74	0.8	0.96	1	1	1	(86)
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)													
(87)m=	19.58	19.74	19.99	20.31	20.62	20.86	20.96	20.95	20.75	20.33	19.89	19.55	(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)													
(88)m=	20.02	20.02	20.02	20.03	20.03	20.04	20.04	20.04	20.04	20.03	20.03	20.03	(88)
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)													
(89)m=	1	1	1	0.99	0.95	0.83	0.61	0.68	0.93	1	1	1	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m=	18.09	18.32	18.69	19.16	19.61	19.93	20.02	20.01	19.8	19.2	18.55	18.05	(90)

fLA = Living area ÷ (4) = 0.13 (91)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(92)m=	18.28	18.5	18.85	19.31	19.74	20.04	20.14	20.13	19.92	19.34	18.72	18.24	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m=	18.28	18.5	18.85	19.31	19.74	20.04	20.14	20.13	19.92	19.34	18.72	18.24	(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	1	1	0.99	0.95	0.83	0.63	0.69	0.92	0.99	1	1	(94)

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Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 6 of 8

TER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1804.9	2409.17	2922.2	3332.16	3441.38	2944.1	2143.94	2205.89	2704.08	2408.41	1892.04	1650.27	(95)
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, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	8951.2	8697.64	7885.38	6593.22	5084.51	3421.71	2224.93	2340.45	3665.22	5530.64	7372.51	8937.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	5316.85	4225.85	3692.6	2347.97	1222.48	0	0	0	0	2322.94	3945.94	5421.49	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 28496.12 (98)

Space heating requirement in kWh/m²/year: 47.79 (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) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)	5316.85	4225.85	3692.6	2347.97	1222.48	0	0	0	0	2322.94	3945.94	5421.49	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	5686.47	4519.63	3949.31	2511.19	1307.47	0	0	0	0	2484.43	4220.25	5798.38	(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 30477.13 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	

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

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from water heater (calculated above)	238.65	210.06	219.92	196.2	191.59	170.21	162.54	179.64	179.73	203.5	216.37	232.59	

Efficiency of water heater: 79.8 (216)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(217)m=	89.98	89.93	89.82	89.57	88.89	79.8	79.8	79.8	79.8	89.53	89.87	90	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	265.22	233.58	244.84	219.04	215.55	213.3	203.68	225.11	225.22	227.29	240.74	258.42	

Total = Sum(219a)$_{1...12}$ = 2772 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		30477.13	
Water heating fuel used		2772	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)

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Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 7 of 8

TER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		1153.03	(232)

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	0.216	=	6583.06	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	598.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7181.81	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	598.42	(268)
Total CO2, kg/year	sum of (265)…(271) =			7819.16	(272)

TER = 13.11 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.25

Property Address: 5B Prince Arthur Road_Be Green

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	177.5	(1a) x	4	(2a) =	710	(3a)
Ground floor	155	(1b) x	3.1	(2b) =	480.5	(3b)
First floor	131.9	(1c) x	2.7	(2c) =	356.13	(3c)
Second floor	131.9	(1d) x	2.6	(2d) =	342.94	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	596.3	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	1889.57	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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)
Number of intermittent fans							0	x 10 =	0	(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 and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) = 0	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(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) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling design stage

	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													
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.1	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]													
(24a)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(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	0	0	0	0	0	0	0	0	0	0	0	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)													
(25)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(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			5.7	x	1	=	5.7			(26)
Windows Type 1			20.3	x1/[1/(1.3)+ 0.04]		=	25.09			(27)
Windows Type 2			53.4	x1/[1/(1.3)+ 0.04]		=	65.99			(27)
Rooflights Type 1			0.8	x1/[1/(1.3) + 0.04]		=	1.04			(27b)
Rooflights Type 2			1.3	x1/[1/(1.3) + 0.04]		=	1.69			(27b)
Floor			177.5	x	0.1	=	17.75			(28)
Walls Type1	295.4	79.4	216	x	0.15	=	32.4			(29)
Walls Type2	129.22	0	129.22	x	0.14	=	18.03			(29)
Walls Type3	226.4	0	226.4	x	0.15	=	33.96			(29)
Roof Type1	136.1	2.1	134	x	0.13	=	17.42			(30)
Roof Type2	18.9	0	18.9	x	0.13	=	2.46			(30)
Total area of elements, m²			983.52							(31)

* 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) = 221.39 (33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(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 can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		49.2	(36)

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

Total fabric heat loss	(33) + (36) =	270.59	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	185.24	183.25	181.26	171.32	169.33	159.4	159.4	157.41	163.37	169.33	173.31	177.29	(38)
Heat transfer coefficient, W/K (39)m = (37) + (38)m													
(39)m=	455.82	453.84	451.85	441.91	439.92	429.98	429.98	428	433.96	439.92	443.9	447.87	

Average = Sum(39)1…12 /12= 441.41 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(40)m=	0.76	0.76	0.76	0.74	0.74	0.72	0.72	0.72	0.73	0.74	0.74	0.75

Average = Sum(40)1…12 /12= 0.74 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.52 (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

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 117.73 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	129.5	124.8	120.09	115.38	110.67	105.96	105.96	110.67	115.38	120.09	124.8	129.5	

Total = Sum(44)1…12 = 1412.78 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	192.05	167.97	173.33	151.11	145	125.12	115.94	133.05	134.64	156.9	171.27	185.99

Total = Sum(45)1…12 = 1852.38 (45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	28.81	25.2	26	22.67	21.75	18.77	17.39	19.96	20.2	23.54	25.69	27.9	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		150	(47)

If community heating 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):		1.95	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	1.05	(50)

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

DER WorkSheet: New dwelling design stage

Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If community heating 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)	1.05	(55)

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

(56)m=	32.64	29.48	32.64	31.59	32.64	31.59	32.64	32.64	31.59	32.64	31.59	32.64	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.64	29.48	32.64	31.59	32.64	31.59	32.64	32.64	31.59	32.64	31.59	32.64	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (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 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	247.96	218.46	229.24	205.22	200.9	179.22	171.85	188.95	188.74	212.81	225.38	241.9	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)
(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	247.96	218.46	229.24	205.22	200.9	179.22	171.85	188.95	188.74	212.81	225.38	241.9	

Output from water heater (annual)₁…₁₂ 2510.62 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	108.58	96.25	102.36	93.53	92.94	84.88	83.28	88.96	88.05	96.9	100.23	106.57	(65)

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

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=	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	65.29	57.99	47.16	35.7	26.69	22.53	24.35	31.65	42.48	53.93	62.95	67.1	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	669.12	676.06	658.56	621.31	574.29	530.1	500.58	493.64	511.13	548.38	595.4	639.59	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	(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=	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	(71)
Water heating gains (Table 5)													
(72)m=	145.94	143.22	137.58	129.9	124.91	117.89	111.93	119.57	122.29	130.24	139.21	143.23	(72)

Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 4 of 9

DER WorkSheet: New dwelling design stage

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

(73)m=	956.11	953.03	919.06	862.67	801.65	746.29	712.61	720.61	751.65	808.31	873.31	925.69	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.77	x	53.4	x	36.79	x	0.63	x	0.7	=	600.47	(77)
Southeast	0.9x	0.77	x	53.4	x	62.67	x	0.63	x	0.7	=	1022.81	(77)
Southeast	0.9x	0.77	x	53.4	x	85.75	x	0.63	x	0.7	=	1399.46	(77)
Southeast	0.9x	0.77	x	53.4	x	106.25	x	0.63	x	0.7	=	1734	(77)
Southeast	0.9x	0.77	x	53.4	x	119.01	x	0.63	x	0.7	=	1942.22	(77)
Southeast	0.9x	0.77	x	53.4	x	118.15	x	0.63	x	0.7	=	1928.18	(77)
Southeast	0.9x	0.77	x	53.4	x	113.91	x	0.63	x	0.7	=	1858.97	(77)
Southeast	0.9x	0.77	x	53.4	x	104.39	x	0.63	x	0.7	=	1703.62	(77)
Southeast	0.9x	0.77	x	53.4	x	92.85	x	0.63	x	0.7	=	1515.32	(77)
Southeast	0.9x	0.77	x	53.4	x	69.27	x	0.63	x	0.7	=	1130.43	(77)
Southeast	0.9x	0.77	x	53.4	x	44.07	x	0.63	x	0.7	=	719.22	(77)
Southeast	0.9x	0.77	x	53.4	x	31.49	x	0.63	x	0.7	=	513.87	(77)
Southwest	0.9x	0.77	x	20.3	x	36.79		0.63	x	0.7	=	228.27	(79)
Southwest	0.9x	0.77	x	20.3	x	62.67		0.63	x	0.7	=	388.82	(79)
Southwest	0.9x	0.77	x	20.3	x	85.75		0.63	x	0.7	=	532	(79)
Southwest	0.9x	0.77	x	20.3	x	106.25		0.63	x	0.7	=	659.18	(79)
Southwest	0.9x	0.77	x	20.3	x	119.01		0.63	x	0.7	=	738.34	(79)
Southwest	0.9x	0.77	x	20.3	x	118.15		0.63	x	0.7	=	733	(79)
Southwest	0.9x	0.77	x	20.3	x	113.91		0.63	x	0.7	=	706.69	(79)
Southwest	0.9x	0.77	x	20.3	x	104.39		0.63	x	0.7	=	647.63	(79)
Southwest	0.9x	0.77	x	20.3	x	92.85		0.63	x	0.7	=	576.05	(79)
Southwest	0.9x	0.77	x	20.3	x	69.27		0.63	x	0.7	=	429.73	(79)
Southwest	0.9x	0.77	x	20.3	x	44.07		0.63	x	0.7	=	273.41	(79)
Southwest	0.9x	0.77	x	20.3	x	31.49		0.63	x	0.7	=	195.35	(79)
Rooflights	0.9x	1	x	0.8	x	26	x	0.3	x	0.7	=	3.93	(82)
Rooflights	0.9x	1	x	1.3	x	37.03	x	0.3	x	0.7	=	9.1	(82)
Rooflights	0.9x	1	x	0.8	x	54	x	0.3	x	0.7	=	8.16	(82)
Rooflights	0.9x	1	x	1.3	x	70.28	x	0.3	x	0.7	=	17.27	(82)
Rooflights	0.9x	1	x	0.8	x	96	x	0.3	x	0.7	=	14.52	(82)
Rooflights	0.9x	1	x	1.3	x	111.87	x	0.3	x	0.7	=	27.49	(82)
Rooflights	0.9x	1	x	0.8	x	150	x	0.3	x	0.7	=	22.68	(82)
Rooflights	0.9x	1	x	1.3	x	159.33	x	0.3	x	0.7	=	39.15	(82)
Rooflights	0.9x	1	x	0.8	x	192	x	0.3	x	0.7	=	29.03	(82)
Rooflights	0.9x	1	x	1.3	x	193.3	x	0.3	x	0.7	=	47.49	(82)

Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 5 of 9

DER WorkSheet: New dwelling design stage

Rooflights	0.9x	1	x	0.8	x	200	x	0.3	x	0.7	=	30.24	(82)
Rooflights	0.9x	1	x	1.3	x	197.35	x	0.3	x	0.7	=	48.49	(82)
Rooflights	0.9x	1	x	0.8	x	189	x	0.3	x	0.7	=	28.58	(82)
Rooflights	0.9x	1	x	1.3	x	188.08	x	0.3	x	0.7	=	46.21	(82)
Rooflights	0.9x	1	x	0.8	x	157	x	0.3	x	0.7	=	23.74	(82)
Rooflights	0.9x	1	x	1.3	x	162.62	x	0.3	x	0.7	=	39.95	(82)
Rooflights	0.9x	1	x	0.8	x	115	x	0.3	x	0.7	=	17.39	(82)
Rooflights	0.9x	1	x	1.3	x	128.66	x	0.3	x	0.7	=	31.61	(82)
Rooflights	0.9x	1	x	0.8	x	66	x	0.3	x	0.7	=	9.98	(82)
Rooflights	0.9x	1	x	1.3	x	82.24	x	0.3	x	0.7	=	20.21	(82)
Rooflights	0.9x	1	x	0.8	x	33	x	0.3	x	0.7	=	4.99	(82)
Rooflights	0.9x	1	x	1.3	x	45.75	x	0.3	x	0.7	=	11.24	(82)
Rooflights	0.9x	1	x	0.8	x	21	x	0.3	x	0.7	=	3.18	(82)
Rooflights	0.9x	1	x	1.3	x	30.74	x	0.3	x	0.7	=	7.55	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	841.76	1437.07	1973.47	2455	2757.08	2739.9	2640.44	2414.95	2140.37	1590.35	1008.86	719.95	(83)

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

(84)m=	1797.87	2390.1	2892.52	3317.68	3558.74	3486.19	3353.05	3135.56	2892.02	2398.65	1882.17	1645.64	(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	1	0.99	0.93	0.76	0.56	0.62	0.9	1	1	1	(86)
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)													
(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)													
(88)m=	20.28	20.29	20.29	20.3	20.31	20.32	20.32	20.33	20.32	20.31	20.3	20.3	(88)
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)													
(89)m=	1	1	1	0.98	0.9	0.69	0.48	0.53	0.85	0.99	1	1	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m=	20.28	20.29	20.29	20.3	20.31	20.32	20.32	20.33	20.32	20.31	20.3	20.3	(90)

fLA = Living area ÷ (4) = 0.13 (91)

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

(92)m=	20.37	20.38	20.38	20.39	20.39	20.41	20.41	20.41	20.4	20.39	20.39	20.38	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m=	20.37	20.38	20.38	20.39	20.39	20.41	20.41	20.41	20.4	20.39	20.39	20.38	(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	1	1	0.98	0.91	0.7	0.49	0.54	0.85	0.99	1	1	(94)

Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 6 of 9

DER WorkSheet: New dwelling design stage

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

(95)m=	1797.8	2389.34	2886.15	3263.46	3232.68	2433.58	1632.86	1707.33	2470.91	2383.54	1881.84	1645.61	(95)
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, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	7326.81	7023.72	6271.15	5078.28	3824.78	2496.93	1636.96	1716.09	2734.77	4308.69	5899	7248.37	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	4113.58	3114.3	2518.44	1306.67	440.52	0	0	0	0	1432.32	2892.36	4168.45	

Total per year (kWh/year) = Sum(98)₁…₅,₁₀…₁₂ = 19986.63 (98)

Space heating requirement in kWh/m²/year 33.52 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	4041.85	3181.88	3252.77	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.91	0.96	0.94	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	3659.04	3062.25	3069.69	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	4284.57	4123.49	3877.33	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	450.39	789.56	600.89	0	0	0	0	

Total = Sum(104) = 1840.84 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	

Total = Sum(104) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	112.6	197.39	150.22	0	0	0	0	

Total = Sum(107) = 460.21 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.77 (108)

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) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		377.16	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.05	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	4113.58	3114.3	2518.44	1306.67	440.52	0	0	0	0	1432.32	2892.36	4168.45	

Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 7 of 9

DER WorkSheet: New dwelling design stage

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

	1090.67	825.72	667.73	346.45	116.8	0	0	0	0	379.76	766.87	1105.21

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 5299.21 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)

	247.96	218.46	229.24	205.22	200.9	179.22	171.85	188.95	188.74	212.81	225.38	241.9

Efficiency of water heater 119.34 (216)

(217)m=	119.34	119.34	119.34	119.34	119.34	119.34	119.34	119.34	119.34	119.34	119.34	119.34	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	207.77	183.06	192.09	171.96	168.34	150.18	144	158.33	158.15	178.32	188.85	202.7

Total = Sum(219a)$_{1...12}$ = 2103.75 (219)

Space cooling fuel, kWh/month.
(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	27.8	48.74	37.09	0	0	0	0

Total = Sum(221)$_{6...8}$ = 113.63 (221)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		5299.21	
Water heating fuel used		2103.75	
Space cooling fuel used		113.63	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	2190.01		(230a)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		2190.01	(231)
Electricity for lighting		1153.03	(232)

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	0.519 =	2750.29	(261)
Space heating (secondary)	(215) x	0.519 =	0	(263)
Water heating	(219) x	0.519 =	1091.85	(264)
Space and water heating	(261) + (262) + (263) + (264) =		3842.14	(265)
Space cooling	(221) x	0.519 =	58.98	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	1136.62	(267)
Electricity for lighting	(232) x	0.519 =	598.42	(268)
Total CO2, kg/year		sum of (265)…(271) =	5636.15	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	9.45	(273)

Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 8 of 9

DRAFT

DER WorkSheet: New dwelling design stage

EI rating (section 14) 88 (274)

Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 9 of 9

DRAFT

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Property Address: 5B Prince Arthur Road_Be Green

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	177.5	(1a) x	4	(2a) =	710	(3a)
Ground floor	155	(1b) x	3.1	(2b) =	480.5	(3b)
First floor	131.9	(1c) x	2.7	(2c) =	356.13	(3c)
Second floor	131.9	(1d) x	2.6	(2d) =	342.94	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	596.3	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		1889.57	(5)

2. Ventilation rate:

	main heating	secondary heating	other	total		m³ 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)
Number of intermittent fans				4	x 10 =	40	(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 and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40 ÷ (5) =	0.02	(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)	0.27	(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) =	0.23	(21)

Infiltration rate modified for monthly wind speed

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

Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 1 of 8

DRAFT

TER WorkSheet: New dwelling design stage

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

	0.29	0.29	0.28	0.25	0.25	0.22	0.22	0.21	0.23	0.25	0.26	0.27

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	0.53	0.53	0.53	0.54	(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	0.53	0.53	0.53	0.54	(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			5.7	x 1	= 5.7			(26)
Windows Type 1			20.3	x1/[1/(1.4)+ 0.04]	= 26.91			(27)
Windows Type 2			53.4	x1/[1/(1.4)+ 0.04]	= 70.8			(27)
Rooflights Type 1			0.8	x1/[1/(1.7) + 0.04]	= 1.36			(27b)
Rooflights Type 2			1.3	x1/[1/(1.7) + 0.04]	= 2.21			(27b)
Floor			177.5	x 0.13	= 23.075			(28)
Walls Type1	295.4	79.4	216	x 0.18	= 38.88			(29)
Walls Type2	129.22	0	129.22	x 0.18	= 23.26			(29)
Walls Type3	226.4	0	226.4	x 0.18	= 40.75			(29)
Roof Type1	136.1	2.1	134	x 0.13	= 17.42			(30)
Roof Type2	18.9	0	18.9	x 0.13	= 2.46			(30)
Total area of elements, m²			983.52					(31)

* *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) = 252.59 (33)

Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 2 of 8

TER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(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 can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		49.2	(36)

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

Total fabric heat loss	(33) + (36) =	301.79	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	338.71	337.66	336.64	331.82	330.92	326.73	326.73	325.95	328.34	330.92	332.74	334.65	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	640.5	639.45	638.43	633.62	632.72	628.52	628.52	627.75	630.14	632.72	634.54	636.44	

Average = Sum(39)1…12 /12= 633.61 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.07	1.06	1.06	1.05	1.05	1.05	1.06	1.06	1.06	1.07	

Average = Sum(40)1…12 /12= 1.06 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 3.52 (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

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 117.73 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	129.5	124.8	120.09	115.38	110.67	105.96	105.96	110.67	115.38	120.09	124.8	129.5	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Total = Sum(44)1…12 = 1412.78 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	192.05	167.97	173.33	151.11	145	125.12	115.94	133.05	134.64	156.9	171.27	185.99	

Total = Sum(45)1…12 = 1852.38 (45)

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

(46)m=	28.81	25.2	26	22.67	21.75	18.77	17.39	19.96	20.2	23.54	25.69	27.9	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

If community heating 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):		1.39	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.75	(50)

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

Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 3 of 8

TER WorkSheet: New dwelling design stage

Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating 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)		0.75	(55)

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (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 × (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 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	238.65	210.06	219.92	196.2	191.59	170.21	162.54	179.64	179.73	203.5	216.37	232.59	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	238.65	210.06	219.92	196.2	191.59	170.21	162.54	179.64	179.73	203.5	216.37	232.59	

Output from water heater (annual)1…12 2400.99 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	101.13	89.52	94.91	86.32	85.49	77.68	75.83	81.51	80.84	89.45	93.02	99.12	(65)

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

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=	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	175.86	(66)

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

(67)m=	65.29	57.99	47.16	35.7	26.69	22.53	24.35	31.65	42.48	53.93	62.95	67.1	(67)

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

(68)m=	669.12	676.06	658.56	621.31	574.29	530.1	500.58	493.64	511.13	548.38	595.4	639.59	(68)

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

(69)m=	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	40.59	(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=	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	-140.68	(71)

Water heating gains (Table 5)

(72)m=	135.93	133.21	127.56	119.89	114.9	107.88	101.92	109.56	112.28	120.22	129.2	133.22	(72)

Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 4 of 8

TER WorkSheet: New dwelling design stage

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

(73)m=	949.09	946.02	912.05	855.66	794.64	739.27	705.6	713.6	744.64	801.29	866.3	918.68	(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 m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)	
Southeast 0.9x	0.77	53.4	36.79	0.63	0.7	600.47	(77)
Southeast 0.9x	0.77	53.4	62.67	0.63	0.7	1022.81	(77)
Southeast 0.9x	0.77	53.4	85.75	0.63	0.7	1399.46	(77)
Southeast 0.9x	0.77	53.4	106.25	0.63	0.7	1734	(77)
Southeast 0.9x	0.77	53.4	119.01	0.63	0.7	1942.22	(77)
Southeast 0.9x	0.77	53.4	118.15	0.63	0.7	1928.18	(77)
Southeast 0.9x	0.77	53.4	113.91	0.63	0.7	1858.97	(77)
Southeast 0.9x	0.77	53.4	104.39	0.63	0.7	1703.62	(77)
Southeast 0.9x	0.77	53.4	92.85	0.63	0.7	1515.32	(77)
Southeast 0.9x	0.77	53.4	69.27	0.63	0.7	1130.43	(77)
Southeast 0.9x	0.77	53.4	44.07	0.63	0.7	719.22	(77)
Southeast 0.9x	0.77	53.4	31.49	0.63	0.7	513.87	(77)
Southwest 0.9x	0.77	20.3	36.79	0.63	0.7	228.27	(79)
Southwest 0.9x	0.77	20.3	62.67	0.63	0.7	388.82	(79)
Southwest 0.9x	0.77	20.3	85.75	0.63	0.7	532	(79)
Southwest 0.9x	0.77	20.3	106.25	0.63	0.7	659.18	(79)
Southwest 0.9x	0.77	20.3	119.01	0.63	0.7	738.34	(79)
Southwest 0.9x	0.77	20.3	118.15	0.63	0.7	733	(79)
Southwest 0.9x	0.77	20.3	113.91	0.63	0.7	706.69	(79)
Southwest 0.9x	0.77	20.3	104.39	0.63	0.7	647.63	(79)
Southwest 0.9x	0.77	20.3	92.85	0.63	0.7	576.05	(79)
Southwest 0.9x	0.77	20.3	69.27	0.63	0.7	429.73	(79)
Southwest 0.9x	0.77	20.3	44.07	0.63	0.7	273.41	(79)
Southwest 0.9x	0.77	20.3	31.49	0.63	0.7	195.35	(79)
Rooflights 0.9x	1	0.8	26	0.63	0.7	8.26	(82)
Rooflights 0.9x	1	1.3	37.03	0.63	0.7	19.11	(82)
Rooflights 0.9x	1	0.8	54	0.63	0.7	17.15	(82)
Rooflights 0.9x	1	1.3	70.28	0.63	0.7	36.26	(82)
Rooflights 0.9x	1	0.8	96	0.63	0.7	30.48	(82)
Rooflights 0.9x	1	1.3	111.87	0.63	0.7	57.72	(82)
Rooflights 0.9x	1	0.8	150	0.63	0.7	47.63	(82)
Rooflights 0.9x	1	1.3	159.33	0.63	0.7	82.21	(82)
Rooflights 0.9x	1	0.8	192	0.63	0.7	60.96	(82)
Rooflights 0.9x	1	1.3	193.3	0.63	0.7	99.74	(82)

Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 5 of 8

TER WorkSheet: New dwelling design stage

Rooflights 0.9x	1	0.8	200	0.63	0.7	63.5	(82)
Rooflights 0.9x	1	1.3	197.35	0.63	0.7	101.82	(82)
Rooflights 0.9x	1	0.8	189	0.63	0.7	60.01	(82)
Rooflights 0.9x	1	1.3	188.08	0.63	0.7	97.04	(82)
Rooflights 0.9x	1	0.8	157	0.63	0.7	49.85	(82)
Rooflights 0.9x	1	1.3	162.62	0.63	0.7	83.9	(82)
Rooflights 0.9x	1	0.8	115	0.63	0.7	36.51	(82)
Rooflights 0.9x	1	1.3	128.66	0.63	0.7	66.39	(82)
Rooflights 0.9x	1	0.8	66	0.63	0.7	20.96	(82)
Rooflights 0.9x	1	1.3	82.24	0.63	0.7	42.44	(82)
Rooflights 0.9x	1	0.8	33	0.63	0.7	10.48	(82)
Rooflights 0.9x	1	1.3	45.75	0.63	0.7	23.61	(82)
Rooflights 0.9x	1	0.8	21	0.63	0.7	6.67	(82)
Rooflights 0.9x	1	1.3	30.74	0.63	0.7	15.86	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	856.09	1465.05	2019.67	2523.01	2841.26	2826.5	2722.71	2485.01	2194.27	1623.55	1026.71	731.75	(83)

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

(84)m=	1805.19	2411.07	2931.71	3378.67	3635.9	3565.78	3428.31	3198.61	2938.91	2424.85	1893.02	1650.43	(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	1	0.99	0.97	0.89	0.74	0.8	0.96	1	1	1	(86)

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

(87)m=	19.58	19.74	19.99	20.31	20.62	20.86	20.96	20.95	20.75	20.33	19.89	19.55	(87)

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

(88)m=	20.02	20.02	20.02	20.03	20.03	20.04	20.04	20.04	20.04	20.03	20.03	20.03	(88)

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

(89)m=	1	1	1	0.99	0.95	0.83	0.61	0.68	0.93	1	1	1	(89)

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

(90)m=	18.09	18.32	18.69	19.16	19.61	19.93	20.02	20.01	19.8	19.2	18.55	18.05	(90)

fLA = Living area ÷ (4) = 0.13 (91)

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

(92)m=	18.28	18.5	18.85	19.31	19.74	20.04	20.14	20.13	19.92	19.34	18.72	18.24	(92)

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

(93)m=	18.28	18.5	18.85	19.31	19.74	20.04	20.14	20.13	19.92	19.34	18.72	18.24	(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

Utilisation factor for gains, hm:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	1	1	1	0.99	0.95	0.83	0.63	0.69	0.92	0.99	1	1	(94)

Stroma FSAP 2012 Version: 1.0.4.25 (SAP 9.92) - http://www.stroma.com Page 6 of 8

TER WorkSheet: New dwelling design stage

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

Monthly average external temperature from Table 8

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(95)m=	1804.9	2409.17	2922.2	3332.16	3441.38	2944.1	2143.94	2205.89	2704.08	2408.41	1892.04	1650.27	(95)
(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)
(97)m=	8951.2	8697.64	7885.38	6593.22	5084.51	3421.71	2224.93	2340.45	3665.22	5530.64	7372.51	8937.21	(97)
(98)m=	5316.85	4225.85	3692.6	2347.97	1222.48	0	0	0	0	2322.94	3945.94	5421.49	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 28496.12 (98)

Space heating requirement in kWh/m²/year 47.79 (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) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)	5316.85	4225.85	3692.6	2347.97	1222.48	0	0	0	0	2322.94	3945.94	5421.49	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	5686.47	4519.63	3949.31	2511.19	1307.47	0	0	0	0	2484.43	4220.25	5798.38	(211)

Total (kWh/year) =Sum(211)1...5,10...12= 30477.13 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)

	238.65	210.06	219.92	196.2	191.59	170.21	162.54	179.64	179.73	203.5	216.37	232.59	

Efficiency of water heater 79.8 (216)

(217)m=	89.98	89.93	89.82	89.57	88.89	79.8	79.8	79.8	79.8	89.53	89.87	90	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	265.22	233.58	244.84	219.04	215.55	213.3	203.68	225.11	225.22	227.29	240.74	258.42

Total = Sum(219a)1...12 = 2772 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		30477.13	
Water heating fuel used		2772	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)

TER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
Electricity for lighting		1153.03	(232)

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	0.216	=	6583.06	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	598.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7181.81	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	598.42	(268)
Total CO2, kg/year		sum of (265)...(271) =		7819.16	(272)

TER = 19.74 (273)

Appendix A4

Energy Performance Certificate (EPC).

A4 | Energy Performance Certificate (EPC)

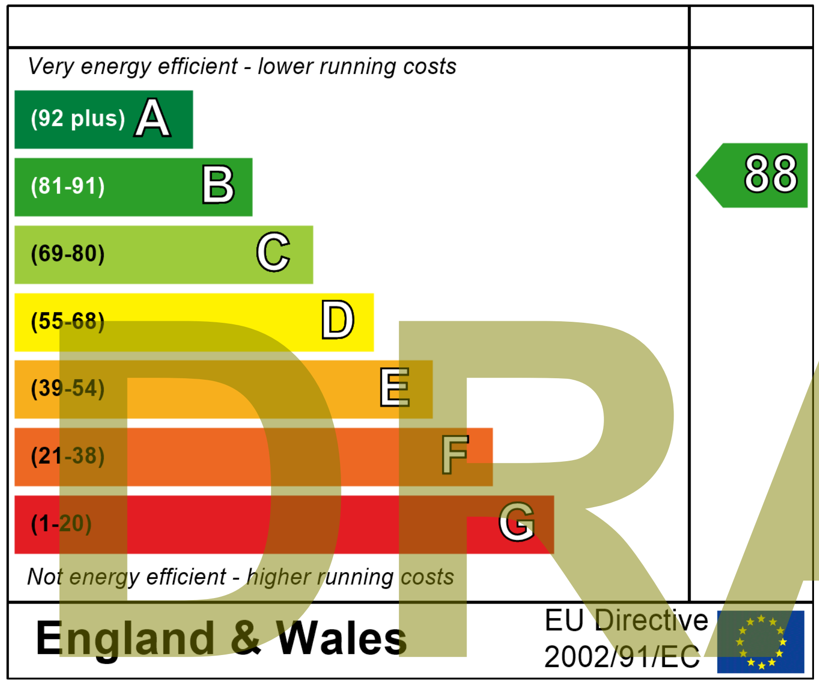
Predicted Energy Assessment

Dwelling type:	Detached House
Date of assessment:	27 April 2020
Produced by:	Stroma Certification
Total floor area:	596.3 m²

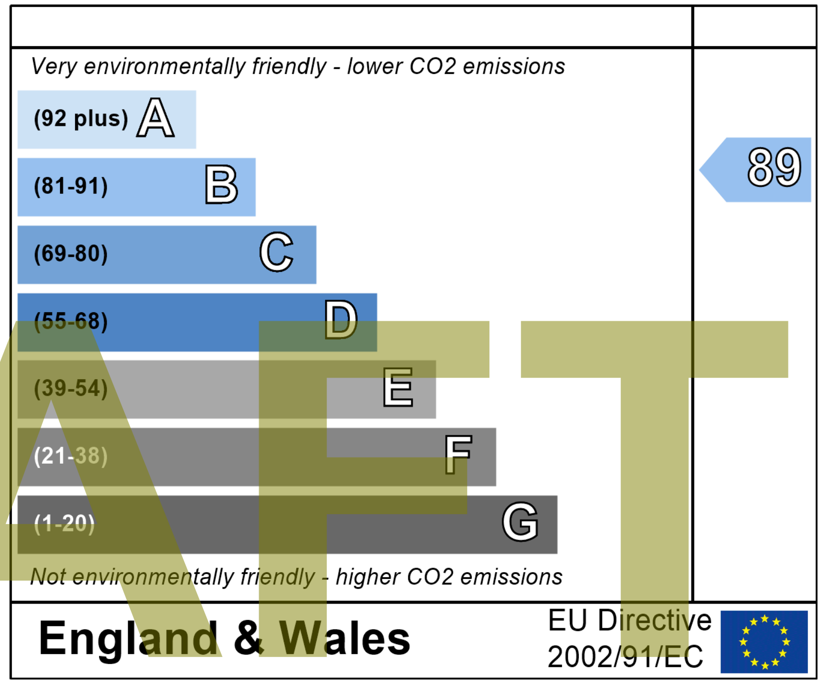
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



Environmental Impact (CO_2) Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

Appendix A5

General Notes.

A5 | General Notes

A5.1 The report is based on information available at the time of the writing and discussions with the client during any project meetings. Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by Iceni Projects Ltd for inaccuracies in the data supplied by any other party.

A5.2 The review of planning policy and other requirements does not constitute a detailed review. Its purpose is as a guide to provide the context for the development and to determine the likely requirements of the Local Authority.

A5.3 No site visits have been carried out, unless otherwise specified.

A5.4 This report is prepared and written in the context of an agreed scope of work and should not be used in a different context. Furthermore, new information, improved practices and changes in guidance may necessitate a re-interpretation of the report in whole or in part after its original submission.

A5.5 The copyright in the written materials shall remain the property of Iceni Projects Ltd but with a royalty-free perpetual licence to the client deemed to be granted on payment in full to Iceni Projects Ltd by the client of outstanding amounts.

A5.6 The report is provided for sole use by the client and is confidential to them and their professional advisors. No responsibility whatsoever for the contents of the report will be accepted to any person other than the client, unless otherwise agreed.

A5.7 These terms apply in addition to the Iceni Projects Ltd "Standard Terms of Business" (or in addition to another written contract which may be in place instead thereof) unless specifically agreed in writing. (In the event of a conflict between these terms and the said Standard Terms of Business, the said Standard Terms of Business shall prevail). In the absence of such a written contract, the Standard Terms of Business will apply.

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