project

The In-between House
9d the Grove | N6 6JU

Energy & Sustainability Assessment

August 2020 - Rev 00

Charlton Brown
Architecture & Interiors

2 Back Lane Hampstead London | NW3 1HL
www.charltonbrown.com
office@charltonbrown.com
+44(0)20 7794 1234

prepared by

NL

checked by

JM

---

notes

Charlton Brown Architects
The Belvedere 2 Back Lane Hampstead London NW3 1HL
www.charltonbrown.com | office@charltonbrown.com
+44(0)20 7794 1234

Content

1.0 Introduction

1.1 Project Brief..4
1.2 Existing Building...5
1.3 Existing Building Retrofit..............................6
1.4 Proposed Dwelling.................................... 10

2.0 Policy Context

3.0 Low Carbon Technologies

3.1 Renewable technologies assessment............
3.2 Renewable technologies matrix ....

4.0 Cooling Hierarchy

5.0 Annual CO2 Emission Calculations

5.1 Be Lean..
5.2 Be Clean..
5.3 Be Green...

6.0 Sustainability Statement

7.0 Conclusion

7.1 Conclusion..
7.2 Appendices ....

* Appendix 1 : SAP 2012 Calculations for the Dwelling as Existing and Refurbished

* Appendix 2 : SAP 2012 Calculations for the Proposed New Dwelling - Be Clean, Be Lean and Be Green Scenarios

* Appendix 3 : Water Calculations

1.0 Introduction

Introduction

The Mayor is committed to making London a zero carbon city and with almost 80% of the city's emissions coming from buildings, therefore, there is a big drive to tackle emissions starting with new build and major refurbishment projects.

The Camden Local Plan sets out the local council's planning policies which set out the various energy and sustainability targets for project's requiring planning consent. The Camden Local Plan is the name given to a group of policies that together form the development plan for Camden.

This energy assessment will look at the relevant policies within the Plan and shall demonstrate how this development plans to apply the principles of each policy in both the architectural and building services design.

The relevant sections in The Camden Local Plan are:

Policy CC1: Climate change Mitigation

1. The Energy Hierarchy
2. Sustainable Patterns of Development
3. Resource efficiency, demolition and retrofitting existing buildings
4. Decentralised Energy Generation

1.1 Brief

Charlton Brown Architects have been instructed by the clients to undertake this Energy and Sustainability Assessment to establish the carbon footprint of the proposed replacement dwelling at 9D The Grove, and to compare this with that of the existing house if refurbished to modern standards.

The new dwelling aims to achieve exemplary sustainability, to maximise energy efficiency and reduce carbon emissions through passive and active energy conservation methods, whilst providing a flexible home for longevity and a modern family life.

The proposal would be designed to greatly exceed the London Borough of Camden's energy reduction target to reduce carbon dioxide emissions by at least 19% compared with Building Regulations 2013 Part L1A requirements.

Aerial view of 9d the Grove.

1.2 The existing building

The site is located at 9D The Grove and lies within the Highgate Conservation Area within the administrative boundary of the London Borough of Camden.

The existing house was originally constructed in the post-war era of the 1950s and is in a clear need for renewal in order to better meet the needs and requirements of a liveable residential home. It has very poor energy efficiency, having no floor, wall or roof insulation, single glazing and building services that require upgrading to more energy efficient alternatives. The current Energy Performance Certificate shows a current rating of 59, which is below the average of Band D (scores between 55-68). This is lower than the average energy efficiency for a dwelling in England and Wales of 60.

The current envelope would need substantial overhauling only to raise the performance just above average, and the owner would have to rely on piecemeal measures for minimal performance gain.

The existing dwelling has been modelled using SAP 2012 to establish the current carbon emission rate both as it stands, and what could be achieved if it was refurbished within the bounds of viability, without the need to demolish and re-build.

Existing Building

Total Floor Area	Dwelling Emission Rate (DER) (CO^2 kg/m^2/year	Total CO^2 (kg/yr)
142.8	52.8	7541.74

The Dwelling Emission Rate (DER) of the existing house as it stands, taking into account the total regulated CO2 emissions due to heating, hot water, pumps and fans, and lighting for the house as existing has been calculated as 7541.7 kg/yr. The full SAP calculations confirming the DER can be found in Appendix 1.

Existing balcony

Existing Interiors

1.0 Introduction

1.3 The existing building retrofit

Retaining the existing building envelope proves to not provide adequate liveable space for a modern family of 4: 2 adults and 2 teenage children. As such to retain the existing form and provide the necessities for modern family life, without significant loss of the existing fabric, adding an additional level to the existing building would prove to be the least intrusive measure. It is understood, and agreed upon in the pre-application feedback from Camden Council, that increasing the height of 9D is not acceptable, as it changes the hierarchy along The Grove and the existing relationship between the listed Park House and The Stables. To retain the existing without increasing the floor space results in a home not fit for a modern family.

However, regardless of the space limitations, this analysis looks at the carbon comparison of retrofitting the existing building as is, if a second level was not added to the building Whilst there is no actual requirement to undertake any work to improve the existing property, if it was to be refurbished to modern standards, the following improvement measures could reasonably be implemented.

* The existing building would require to be stripped completely internally.
* The ground floor slab would require insulation above the existing concrete slab, decreasing and compromising the existing head height.
* The existing cavity walls will require blown insulation into the existing cavity, as already limited space requirements prohibit the use of internal or external insulation. There is a potential moisture risk with the implementation of insulation into the new cavity, via driving rain and rising damp if great consideration to thermal connections is not possible.
* New steels will be required to support the first floor to enable a new layout to the ground floor that is able to adapt to family life over time and ensure the longevity of the building.
* The roof covering will require replacement however the level is not possible to be raised to increase the thermal performance to modern standards as the parapet is low lying and as mentioned the internal floor to ceiling heights are already low for maximal light infiltration. Insulation will be introduced between the existing rafters, retaining a cold roof to minimise moisture risk.
* The windows and doors would all require replacement for increased thermal performance and where possible, relocation, to maximise available light / considered layout for modern family life.
* Thermal bridges will be present at wall and floor junctions with the inability to form continuous insulation layer without significant structural implications
* The retained form will affect the quality of light significantly as rooms will become more pokey and effect the ability for the light to penetrate to the depth of the structure.
* The low ceiling heights will affect the quality of light and space within 9D, as well as making it not possible to run services through ceiling voids.

As such it is evident that the retention of the existing fabric will see a small increase in thermal performance, barely meeting the lowest possible standard legally possible in the UK. These standards are not fit for the future and fall far short of the possible operational carbon savings available with a construction to the proposed new build.

Existing Building

Modelling Inputs	SAP 2012	Value	Unit
External Wall U Value	0.18	1.4	W/m²K
Ground Floor U Value	0.13	1.03-1.02	W/m²K
Roof U Value	0.13	1.5	W/m²K
Window U Value	1.4	5.8-5.9	W/m²K
Window g Value	0.63		
Air Permeability	5	>10	m³/h/m² @50Pa

Existing Building performance measured against Building Regulations Part L1A Standard Case.

Existing Building Retrofit

Modelling Inputs	SAP 2012	Value	Unit
External Wall U Value	0.18	0.55	W/m²K
Ground Floor U Value	0.13	0.2	W/m²K
Roof U Value	0.13	0.32	W/m²K
Window U Value	1.4	1.4	W/m²K
Window g Value	0.63		
Air Permeability	5	5	m³/h/m² @50Pa

Existing Building Retrofit performance measured against Building Regulations Part L1A Standard Case.

1.0 Introduction

1.3 The existing building retrofit

The consequential DER that could be achieved by incorporating these improvements has been calculated as below:

Existing Building - *Retrofit*

Total Floor Area	Dwelling Emission Rate (DER) (CO^2 kg/m^2/year	Total CO^2 (kg/yr)
142.8	26.5	3785.67

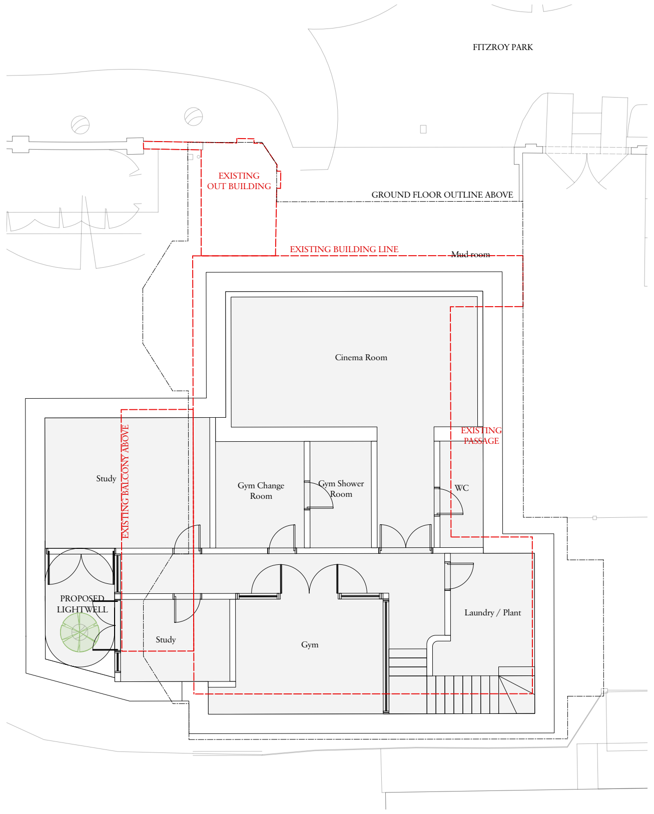
The Total related CO2 emissions for the existing house, following refurbishment, would be 3785.7 kg/yr. The full SAP calculations confirming the DER can be found in Appendix 1.

1.0 Introduction

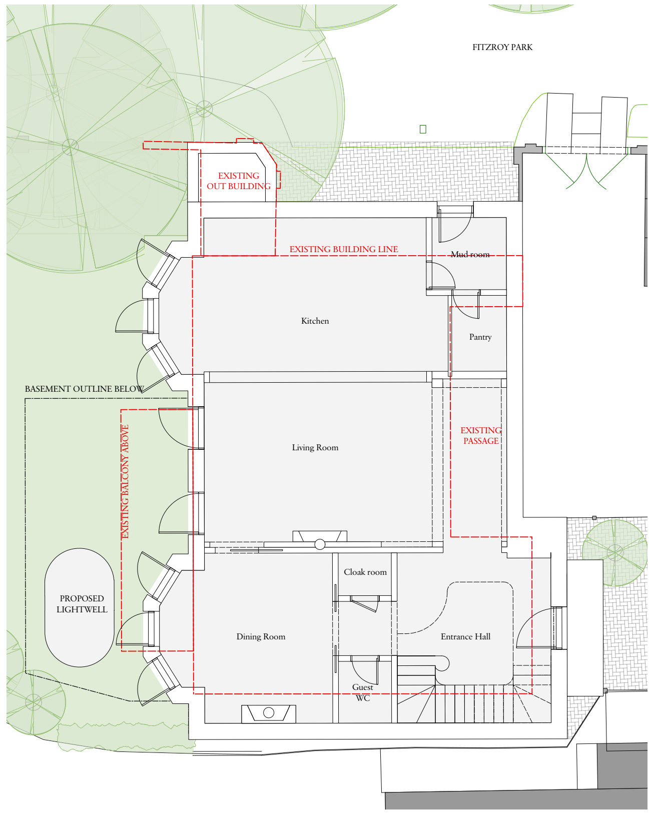
1.4 The proposed dwelling

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:

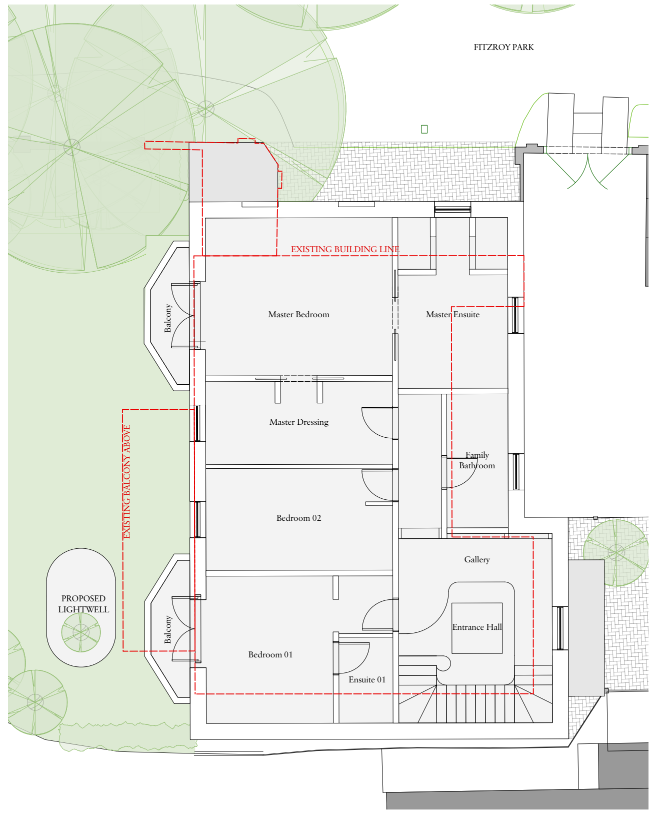
* better utilises space and light;
* has a strong connection between the outdoor and indoor;
* lateral rather than cellular living;
* benefits from enhanced sustainability and environmental credentials;
* positively contributes to the existing street scene and conservation area with architectural inspiration to be drawn from the surrounding character of the area.



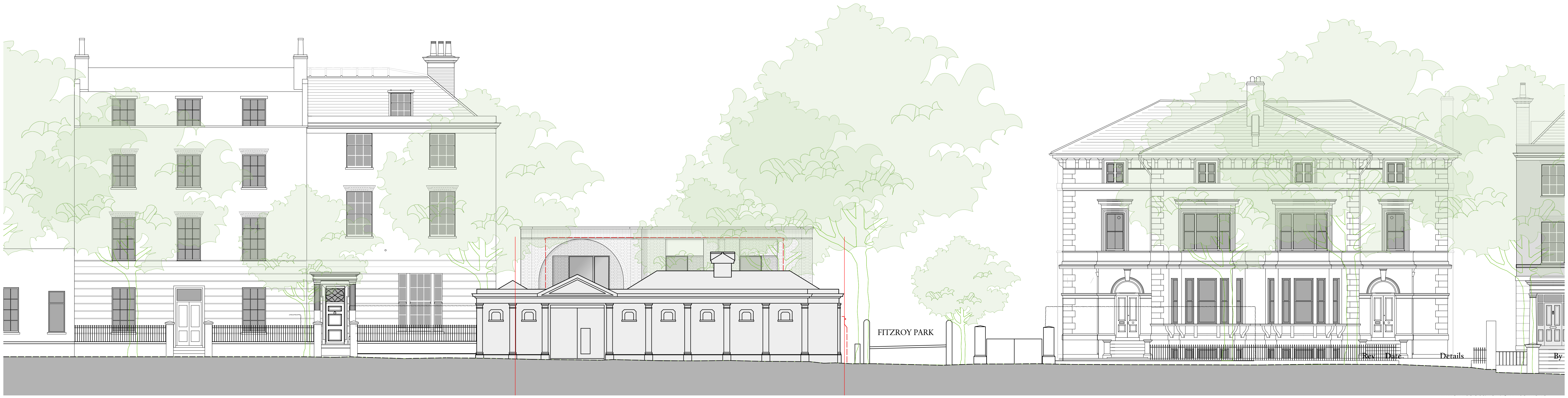
Proposed Basement Plan



Proposed Ground Floor Plan



Proposed First Floor Plan



2.0 Policy Context

Building Regulations Approved Document L1A 2013 – Conservation of fuel and power in new dwellings

The Regulations place a legal requirement for the Building CO2 Emission Rate (calculated using an approved software package) must be less than the Target Emission Rate for which there is prescribed method for calculating.

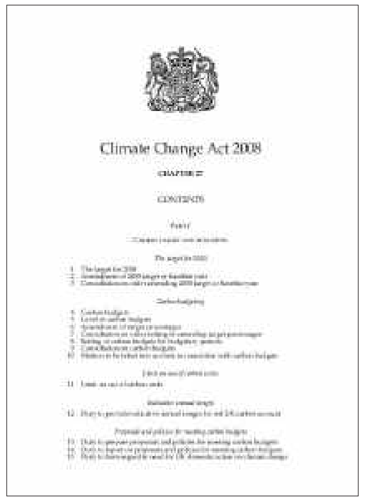
The intention of the Government is to reduce the regulated carbon emissions from buildings and in each amendment to the Regulations the requirement for CO2 reductions increases. The latest update came in 2013 and requires a c.a. 9% improvement from the previous Regulations set in 2010.

Climate Change Act 2008

Published 26th November 2008, the Uk Government set the world's first long-term legally binding framework to mitigate against climate change. The Act sets legally binding targets to reduce greenhouse gas emissions through action in the UK and abroad with a target of 80% reduction by 2050.

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.

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

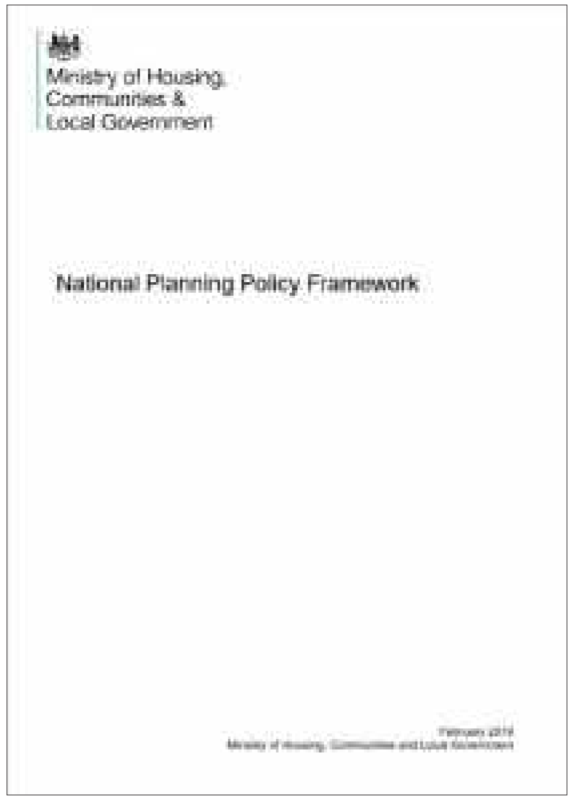

Climate Change Act 2008

National Planning Policy Framework (February 2019)

The department for communities and Local Government determines national policies on different aspects of planning 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.

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

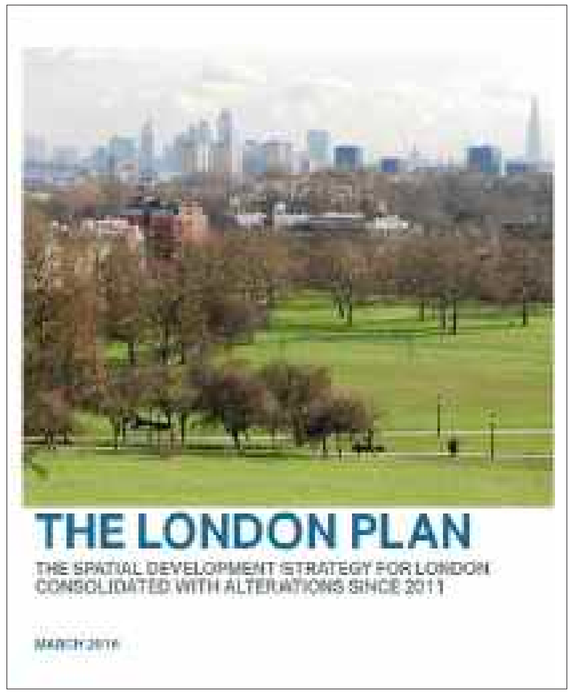
The London Plan

The Mayor's London Plan sets targets and provides guidance to the 32 London boroughs and the Corporation of the City of London for the spatial development of London to 2036. The current version was published in March 2015. First published in 2004 with revisions being made in line with the revised energy performance targets set out in the updated Building Regulations.

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:

* Be lean: use less energy
* Be clean: supply energy efficiently
* 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.


THE LONDON PLAN

THE SPATIAL DEVELOPMENT STRATEGY FOR LONDON CONSOLIDATED WITH ALTERATIONS SINCE 2011

MARCH 2016

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

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


SUSTAINABLE DESIGN AND CONSTRUCTION
SUPPLEMENTARY PLANNING GUIDANCE

APRIL 2014

LONDON PLAN 2011
IMPLEMENTATION FRAMEWORK

MAYOR OF LONDON

2.0 Policy Context

The Camden Local Plan

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.

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. Policies of relevance to the proposed development include the following outlined

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

* The Council aims to tackle the causes of climate change in the borough by ensuring developments use less energy and assess the feasibility of decentralised energy and renewable energy technologies
* Green Action for Change: Camden's environmental sustainability plan (2011-2020) commits Camden to a 27% borough wide Carbon Dioxide (CO2) reduction by 2017 and a 40% borough wide CO2 reduction by 2020 (London carbon reduction target). Over 90% of Camden's carbon dioxide emissions are produced by the operation of buildings.
* Camden Council commissioned two borough wide carbon reduction studies to ensure that local planning policy appropriately responds to the carbon emissions reduction challenge. The first study, 'Delivering a low carbon Camden', considered carbon reduction scenarios to 2050 to align with the long-term national 80% carbon dioxide reduction target within the Climate Change Act 2008. The 2010 study focused specifically on the challenges of achieving a carbon dioxide reduction target of 40% by 2020.

Both studies concluded that meeting borough carbon dioxide reduction targets depends on the growth of Combined Heat and Power (CHP) led decentralised energy networks; the extensive thermal improvement of existing housing stock; behaviour change; the significant deployment of appropriate renewable technologies; and the steady de-carbonisation of the national electricity grid.

Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

a. the protection of existing green spaces and promoting new appropriate green infrastructure;
b. not increasing, and wherever possible reducing, surface water run-off through increasing permeable surfaces and use of Sustainable Drainage Systems;
c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and
d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Sustainable design and construction measures

The Council will promote and measure sustainable design and construction by:

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;
f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;
g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and
h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.

2.0 Policy Context

Policy CC1: The Energy Hierarchy

The energy hierarchy is a sequence of steps that minimise the energy consumption of a building. Buildings designed in line with the energy hierarchy priorities lower cost passive design measures, such as improved fabric performance over higher cost active systems such as renewable energy technologies. The following diagram shows a simplified schematic of the energy hierarchy, which is explained further in supplementary planning document Camden Planning Guidance on sustainability.

Section 8.8 requires all developments involving five or more dwellings and/or more than 500 sqm of (gross internal) any floorspace will be required to submit an energy statement demonstrating how the energy hierarchy has been applied to make the fullest contribution to CO2 reduction. All new residential development will also be required to demonstrate a 19% CO2 reduction below Part L 2013 Building Regulations (in addition to any requirements for renewable energy).

The London plan references a 35% CO2 reduction below Part L 2013 Building regulations, Camden Local Authority require a 19% carbon reduction target, but for the purposes of this report a 35% reduction has been targeted.

Be Lean
Proposals should demonstrate how passive design measures including the development orientation, form, mass, and window sizes and positions have been taken into consideration to reduce energy demand, demonstrating that the minimum energy efficiency requirements required under building regulations will be met and where possible exceeded.

Be Clean
The second stage of the energy hierarchy 'be clean' should demonstrate how the development will supply energy efficiently through clean energy systems such as CHP or decentralised energy.

Be Green
The "be green" stage of the energy hierarchy requires that developments make use of renewable technologies to achieve the sites overall carbon dioxide emissions target.

2.0 Policy Context

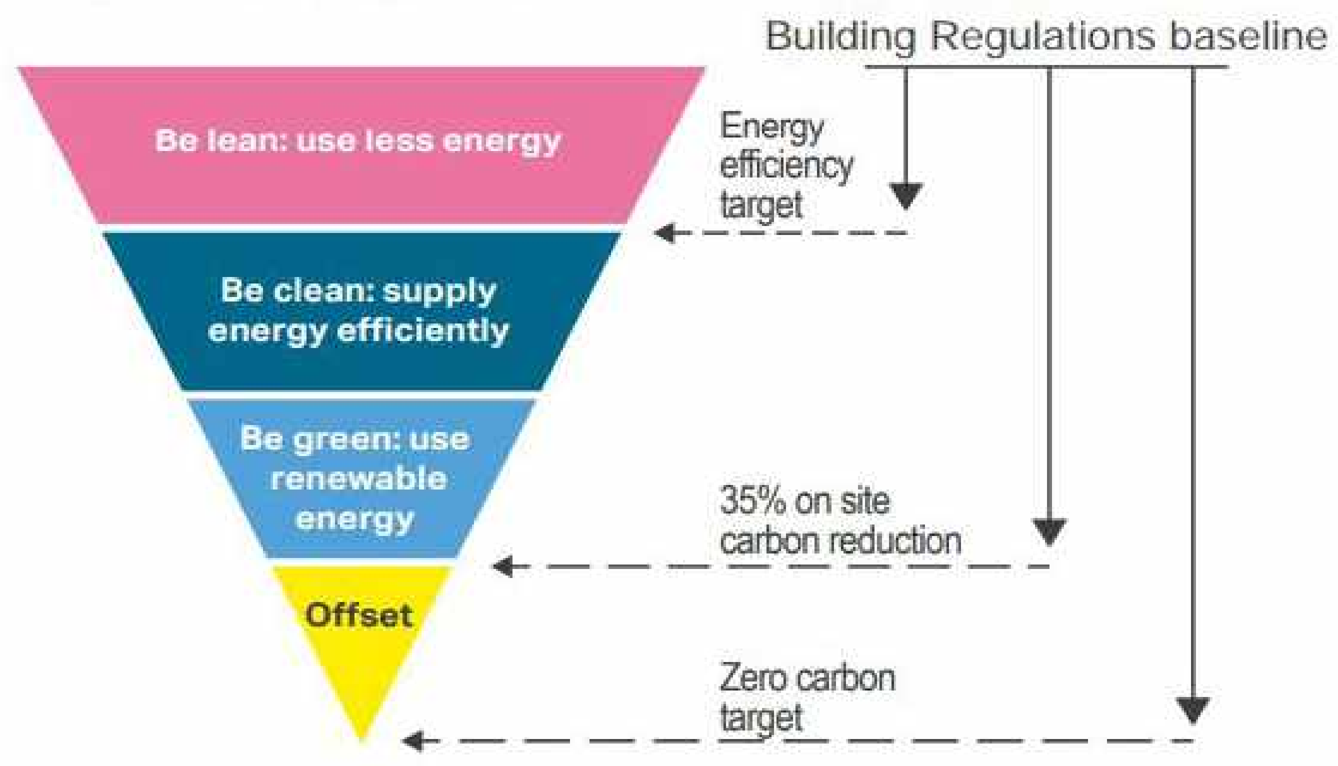
Policy CC1: The Energy Hierarchy

Section 8.41 requires all new developments to submit a statement describing how the project has applied The London Plan's cooling hierarchy and shall demonstrate how the risk of overheating has been mitigated.

The cooling hierarchy includes:

* Minimise internal heat gains
* Reduce external heat gains through consideration of; orientation, shading, fenestration, insulation etc.
* Manage internal heat through exposed thermal mass and high ceilings
* Passive ventilation
* Mechanical ventilation
* Active cooling

The Energy Hierarchy in the upcoming London Plan 2019



Source: Greater London Authority

2.0 Policy Context

Policy 5.2: Minimising Carbon Dioxide

The policy states that all major developments are to produce and issue an energy strategy that must follow the principles of "be lean", "be clean", and "be green" and as minimum must achieve an onsite carbon emission reduction of 35% beyond the current Building Regulations (2013).

The listed requirements are:

* Carbon emissions are to be minimised in accordance with the energy hierarchy

* Domestic buildings are to achieve a 40% carbon emission improvement over the 2010 Building Regulations (35% the 2013 Building Regulations)

* Strategy for achieving carbon dioxide emission reductions to be presented in a detailed energy assessment

* Energy assessments to include calculation results, proposed reductions through energy efficient designs, proposals to use decentralised energy where feasible (including CHP), proposal to include on-site renewable technologies

* Where carbon dioxide emission targets cannot be achieved on-site shortfalls are to be made-up off-site or through a cash in lieu contribution

The intention is to achieve 35% carbon emission savings on-site through the application of the energy hierarchy. Detailed information to be provided further in this report.

POLICY 5.2 MINIMISING CARBON DIOXIDE EMISSIONS

Planning decisions

A Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

1 Be lean: use less energy
2 Be clean: supply energy efficiently
3 Be green: use renewable energy

B The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Residential buildings:

Year	Improvement on 2010 Building Regulatons
2010 – 2013	25 per cent (Code for Sustainable Homes level 4)t
2013 – 2016	40 per cent
2016 – 2031	Zero Carbon

C Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

D As a minimum, energy assessments should include the following details:

a calculation of the energy demand and carbon dioxide emissions covered by Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the energy hierarchy

b proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services

c proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP)

d proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

E The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

2.0 Policy Context

Policy 5.7: Renewable Energy

The policy outlines the expectation to increase the amount of energy provided by on-site renewable technologies.

New developments will be expected to provide substantial carbon dioxide emission reductions through the use of on-site renewable energy generation.

The ambition for this project shall be to achieve a 10% carbon dioxide emission reduction through the installation of a photovoltaic system to be installed on the roof.

Details and results to be presented further in this report.

POLICY 5.7 RENEWABLE ENERGY

Strategic

A The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.

Planning decisions

B Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

LDF preparation

C Within LDFs boroughs should, and other agencies may wish to, develop more detailed policies and proposals to support the development of renewable energy in London – in particular, to identify broad areas where specific renewable energy technologies, including large scale systems and the large scale deployment of small scale systems, are appropriate. The identification of areas should be consistent with any guidelines and criteria outlined by the Mayor.

D All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets, and to avoid any adverse impacts on air quality.

3.0 Low and Zero Carbon Technologies

Before undertaking any energy assessment it is important to review the Low and Zero Carbon (LZC) technologies available and their suitability to the project. There are a number of factors influencing the decision to pursue any LZC installation and these include; location, local environment, political drivers, financial and technical feasibility, and marketability. In the following sections various available LZC technologies will be reviewed before presenting a decision matrix that will define which technologies will be pursued and tested.

Solar Thermal Collectors

Solar water heating (SWH) using solar thermal collectors is a well proven technology and payback periods are relatively short. The two main types of collector technology are flat plate collectors and evacuated tube collectors. Evacuated tubes are more efficient by around 20% (including better operation on cloudy days), and can produce higher temperature waters up to around 150°C. Annual outputs of around 450 – 600+ kWh/yr per m2 of collector (flat plate – evacuated) could be possible for a fully optimised installation.

SWH collection panels can achieve net efficiencies of around 50%, which is much higher than that of PVs. On the negative side they are typically sized to provide around 50-60% of hot water requirements to avoid the risk of overheating during the summer. This reduces the potential for carbon reduction, and therefore if roof space is limited, compete with PV systems for size.

Photovoltaics

Solar Pv panels would provide electrical generation for use on site. They are one of the few true zero carbon energy technologies available due to little maintenance requirements. Systems can be easily integrated into almost any surface at any point in a building's life (including fit-out) without too much intervention.

The annual solar availability in London is around 1000 kWh/m2 on an unobstructed / unshaded horizontal surface. PV's convert solar energy (sunlight) into electricity. They are commonly manufactured into glazed collectors which can be ground mounted, roof mounted or building-integrated. The performance of PVs is heavily influenced by over-shadowing. 10% shading could result in 80% loss in electrical performance.

PVs of course generate most electricity during the day, when sunlight is most present. Without a storage battery, this electricity is fed back into the grid when the site demand falls below generation. Many solar PV systems are eligible for the Feed in Tariff and export Tariff, generating a small income for the clients, to offset energy use at times when demand exceeds generation on site.


Solar thermal flat plate collectors.


Solar thermal vacuum tube collectors.

Solar PV panels

based on LG Neon R

3.0 Low and Zero Carbon Technologies

Wind turbines

Wind turbines convert kinetic energy in flowing air/wind into electrical energy using an electrical generator.

Visual impacts, noise, intermittent power production, local planning such as height restrictions, impacts on migratory paths of birds, interference with radio and/or TV signals and so on, all impact on the viability of wind production in a highly residential area.

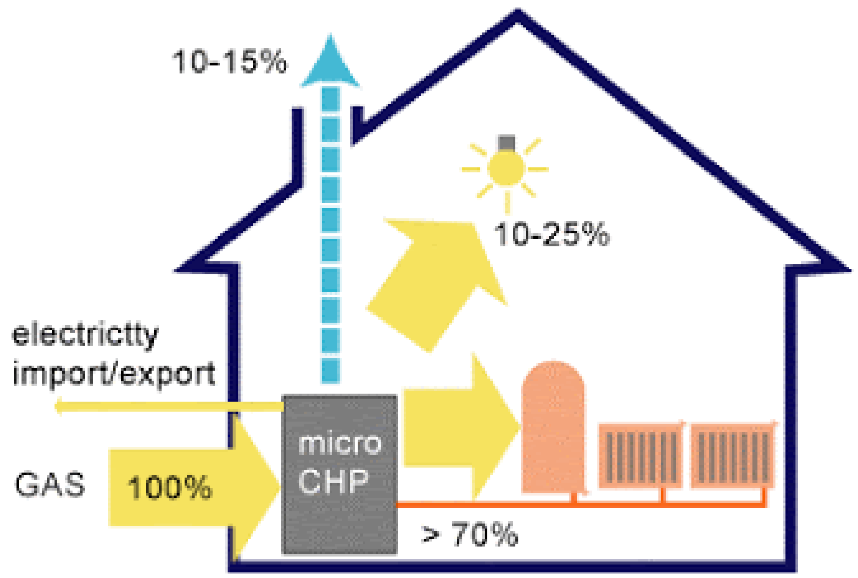
Wind turbines are also only appropriate where the average wind velocity is in excess of 6m/s.

Heat Pumps

Properly designed and installed heat pumps offer very low carbon space heating and can also provide low carbon cooling. The pumps are powered by electricity although there are variants such as gas-fired absorption units available - albeit with lower efficiencies. Heat pumps take low temperature heat and upgrade it to a higher more useful temperature. The heat source can be from the external ambient air, a nearby water source or the ground. Ambient air and ground as the source of renewable energy have been considered in this assessment.

Combined Heat and Power

There are various types of combined heat and power generation (i.e. CHP/CCHP), typically gas turbines, gas engines and fuel cells - or a mix thereof. It is possible that in a modular system some units could run on biomass (e.g. wood pellets), biofuels, bio-methane etc.
The Energy Hierarchy identifies combined heat and power (CHP) as a method of producing heat and electricity with much lower emissions than separate heat and power.
For maximum efficiency, a CHP system needs to operate for at least 5000 hours/year and requires a heat sink, a consistent base heating load requirement throughout the year where the waste heat from the electrical generation may be used constantly and efficiently while simultaneously providing electricity for the site. It is therefore more appropriate for hospitals, hotels etc. where demand is consistent. Domestic dwellings have variable occupation patterns resulting in inconsistent heating and electrical demand. For a development of this size and scale, it would not be appropriate to provide a new CHP plant.



3.0 Low and Zero Carbon Technologies

Low and Zero Carbon Technology Decision Matrix

	Technology	Lifecycle Carbon Saving Potential	Grants	Lifecycle Costs	Space Requirements	Planning Restrictions	Noise	Appropriate for the site	Reasons for exclusion
Solar Energy	Solar Hot Water	Low	Renewable Heat Insentive	Medium	Low	Suitable	Suitable	Suitable	Tested and shown to provide substantial CO² savings.
	Photovoltaics	Low-Medium	Feed-In-Tariff	High	Low	Suitable	Suitable	Suitable	Tested and shown to provide substantial CO² savings.
Wind Energy	Wind Turbines	Low-Medium	Feed-In-Tariff	Medium	Medium-High	Not Acceptable	Noise from gears and generator	Not Suitable	Noisy and not suitable in urban areas (due to turbulence coming from surrounding buildings)
Heat Pumps	Ground Source Heat Pumps	Medium	Renewable Heat Insentive	Medium-High	Medium	Suitable	Suitable	Not Suitable	Limited ground space due to small garden and tree root protection areas
	Air Source Heat Pumps	Low-Medium	Renewable Heat Insentive	Low	Medium-Low	Suitable	Fan & compressor noise	Not Suitable	Limited site / garden space and close proximity to neighbouring buildings finds space and noise an issue
Combined heat and power / alternative fuels	Biomass Boilers	Medium	Renewable Heat Insentive	Medium-Low	Medium	PM10 Particulate	Suitable	Not Suitable	Discounted due to concerns over emissions, air quality, noise from deliveries and fuel supply.
	Biomass CHP	High	Renewable Heat Insentive	Medium	Medium	PM10 Particulate	Suitable	Not Suitable	
	Gas Fired CHP	Medium	Feed-In-Tariff	Medium-Low	Low	Suitable	Suitable	Not Suitable	Discounted due to concerns over noise and required demand being too low to be cost effective.
	District Heating / Cooling	Medium-High	Renewable Heat Insentive	Medium	Low	Suitable	Suitable	Suitable	No networks or future networks planned for the area.
Hydro Power	Small Scale Hydro Power	Low	Feed-In-Tariff	Low	N/A	N/A	N/A	N/A	Not applicable due to geographical restrictions
	Tidal Power	Low	Feed-In-Tariff	Low	N/A	N/A	N/A	N/A	
	Wave Power	Low	Feed-In-Tariff	Low	N/A	N/A	N/A	N/A	

4.0 Cooling Hierarchy

The design of the proposal has been developed in line with the GLA's recommended 'Cooling Hierarchy' approach detailed in London Plan Policy 5.9.

With ever increasing temperatures, the earth is currently facing the effects of global warming and an ever changing climate. 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. A summary of the measures included to reduce the risk of overheating is provided below.

Passive design measures to prevent solar gains entering the building:

* Glazing ratio to surface area considered to prevent excessive internal gains, but maintain a good level of daylight penetration.
* Good form factor to minimise thermal transmission to reduce both heat loss in winter and heat gain in summer.
* Glazing location to suit site orientation / location.
* Glazing with very low u values and g values
* Retention of existing trees to provide natural shading in the summer months

Passive design measures that have been implemented to mitigate heat gain within the building:

* Internal heat gains reduced via specification of low heat emitting LED light fittings and equipment.
* Naturally ventilated living quarters with mechanical ventilation
* Green roof to reduce urban heat island effect and aid in rainwater harvesting.
* High ceilings to increase air movement and stratification, where warmer air rises aiding to mitigate overheating.
* Openable windows on multiple aspects across all floors will provide a passive ventilation strategy that utilises cross flow and stack ventilation. This will maximise the potential for natural ventilation within the proposed dwelling.

Mechanical and active cooling

* Mechanical ventilation with heat recovery will be implemented using the Nilan Compact P system. This unit allows for a summer bypass, whereby the heat recovered from internal air is expelled from the building with the stale air. This would be used when the air outside is cooler than the air inside. The Nilan Compact P system also includes an option for reversible cooling unit. This unit is capable of cooling the ventilation systems supply air by up to 10˚C during warmer periods.

Midday shading from the harsh southerly sun keeps the building cool in the middle of the day.

8am morning light from the East.

4pm afternoon/evening light from the West.

5.0 Annual CO2 Emission Calculations
- Standard case energy demand assessment

The dwelling has been modelled using SAP 2012 to establish both the Standard Case TER (Target Emission Rate) required to meet Building Regulations compliance for CO2 emissions and the Actual case DER (Dwelling Emission Rate) of the dwelling as proposed.

The standard Case TER has been calculated as below.

SAP 2012 - Standard Case

Total Floor Area	Standard Case (TER) (CO^2 kg/m²/year)	Total CO^2 (kg/yr)
380.0	14.0	5313.4

The total regulated CO2 emissions due to heating, hot water, pumps and fans and lighting for the development if built to Building Regulations Part L1A standard would be 8,222.53 kg/yr. The full SAP calculations confirming the TER can be found in Appendix B.

This figure has been used to calculate the 19% carbon off-set required and therefore the maximum CO2 emissions to be achieved to satisfy the London Borough of Camden's planning requirement.

The figures calculated are illustrated in the summary below.

SAP 2012 - Target 19% CO2 Savings

	Total CO^2 (kg/yr)
Building Regulations Compliant Case	5313.4
Minimum 19% Target Reduction Standard Case Emissions	1009.5
Maximum CO^2 emissions to be achieved	**4303.9**

The Building Regulations Compliant case has been calculated at 5313.4 kg CO2/yr. The calculated minimum 19% reduction in CO2 required = 5313.4 x 0.19= 1009.5 kg CO2/yr. The overall maximum CO2 emissions to be achieved for the development is 5313.4 – 1009.5 = 4303.9 kg CO2/yr.

SAP BASELINE PART L1A:2013

Modelling Inputs	Value	Unit	Notes
External Wall U Value	0.18	W/m²K	
Basement Wall U value	0.18	W/m²K	
Ground Floor U Value	0.13	W/m²K	
Basement Slab U Value	0.13	W/m²K	
Roof U Value	0.13	W/m²K	
Window U Value	1.4	W/m²K	
Window g Value	0.63		
Air Permeability	5	m³/h/m² @50Pa	
Lighting efficacies	100% low energy	lm/cW	
Lighting occupancy controls	No		
Lighting daylight controls	No		
Ventilation SFP	0.76	W/l/s	
Heating system efficiency	89%		- Mains Gas - Radiators - Fan Flue - Sedbuk 2009 89% efficient
Heating boiler efficiency	90%		- Heated by boiler 150L Cylinder
Controls			- Time & Temp zone controls
DHW efficiency	0.85 x (0.2 + 0.051 V2/3) kWh/day		

5.0 Annual CO2 Emission Calculations

- Be Lean

SAP Modelling Inputs

Be Lean

Modelling Inputs	Value	Unit	Notes
External Wall U Value	0.15	W/m²K	- Wall ties assumed to be stainless steel at 2.5 per m2 with a cross-sectional area assumed to be 60mm2.
Basement Wall U value	0.15	W/m²K	- FoamGlass / Perinsul blocks at basement wall floor junctions
Ground Floor U Value	0.10	W/m²K	- Where in contact with ground (no basement below)
Basement Slab U Value	0.10	W/m²K	
Roof U Value	0.12	W/m²K	- Extensive Green Roof of sedums herbs and grasses
Window U Value	0.8	W/m²K	- Triple Glazing
Window g Value	0.6-0.5		
Air Permeability	<3	m³/h/m² @50Pa	
Thermal Bridging	0.05	W/m²K	
Electricity power factor			
Lighting efficacies	90-100	lm/cW	
Lighting occupancy controls	Yes		
Lighting daylight controls	Yes		
Ventilation SFP	0.76	W/l/s	- MVHR
Heat exchanger efficiency	90%		- MVHR - Nilan Compact P system, which includes supply air electrical heating coil, summer bypass and a reversible cooling unit
Heating boiler efficiency	90%		- Gas fired boiler for back up space heating
DHW efficiency	90%		- Nilan Compact P system to provide sanitary hot water

The 'Be Lean' scenario is used to identify the building's demand reduction measures. High levels of passive and energy efficient design have been incorporated to reduce the development's energy consumption and associated CO^2 emissions. It is an expectation of the Greater London Authority (GLA) that new dwellings achieve at least a 10% reduction by the 'Be Lean' stage.

* Fabric First and glazing specification

The U-values indicated in the modelling inputs (shown left) have been improved from the minimum standards set out under Part L, as a means of limiting heat loss through the dwellings fabric. To maximise the passive energy savings, form, orientation, window location, high levels of insulation and window specification require considered attention. Whilst providing an initial uplift in initial capital costs, these are outweighed by the benefits and operational savings gained throughout the life of the building.

The glazing will be triple 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 0.8 W/m²K, with a g value between 0.6-0.5 and light transmission of around 70% to improve natural daylight penetration.

* Airtightness

A high level of airtightness is proposed, where a level equal to or below 3m³/h/m² shall be targeted, meaning that air infiltration between the internal and external environment will be largely controlled, and space heating / cooling demand further reduced.

* Thermal Bridges

Details of building junctions are an aspect of considerable importance when looking to reduce significant sources of heat loss from the building 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 of the thermal performance of a building and should therefore be designed out where possible. As this aspect of the building has not been detailed as yet, an assumed accredited construction detail of 0.05 (y value) has been use.

* High efficiency equipment

- High efficiency plant equipment and controls are proposed to limit the auxiliary energy consumed.
- Low energy LED lighting will be installed throughout.
- In order to assess the CO2 emissions reductions achieved through the 'Be Lean' stage, space and water heating demand is served by an individual gas-fired combustion boiler with an efficiency of 90%.
- The house will be provided with opening windows to mitigate overheating, however, outside air will be provided via mechanical ventilation with heat recovery (MVHR), with a specific fan power of 0.76 W/l/s.
- A heat exchanger with an efficiency of >90% has also been specified. These efficiencies are higher than set out in the Compliance Guide.
- Timed, sensored and temperature zones will be used to control heating and lighting consumption within the dwelling.

5.0 Annual CO2 Emission Calculations
- Be Lean

The ‘Be Lean’ inputs described for the proposed building have been captured in energy modelling using the Standard Assessment Procedure (SAP).

The CO2 emissions for the proposed under the ‘Be Lean’ tier of the Energy Hierarchy are shown below. DER and TER worksheets showing the ‘Be Lean’ performance of the dwelling are provided in Appendix 2.

This analysis demonstrates that the proposed will achieve a carbon dioxide emission saving of 12.9% through energy efficiency means alone, under the ‘Be Lean’ Scenario.

Be Lean Co2 Savings

Standard Case TER (Part L1A) (CO^2 kg/m²/year)	Proposed ‘Be Lean’ (DER) (CO^2 kg/m²/year)	Emissions Savings (CO^2 kg/m²/year)	Emissions Savings %
14.0	12.2	1.8	12.9

5.0 Annual CO2 Emission Calculations
- Be Clean

* Extract from London Heat Map

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:

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

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.

The image displayed (left) 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).

The extract displayed (left) 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.

Given the scale and density of the proposed development, the establishment of a new heat network is infeasible. 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.

5.0 Annual CO2 Emission Calculations
- Be Clean

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

The CO2 emissions for the proposed under the ‘Be Clean’ tier of the Energy Hierarchy are shown below. DER and TER worksheets showing the ‘Be Clean’ performance of the dwelling are provided in Appendix 2.

This analysis demonstrates that the proposed will achieve a carbon dioxide emission saving of 12.9% through energy efficiency means alone, under the ‘Be Clean’ Scenario.

Be Clean Co2 Savings

Standard Case TER (Part L1A) (CO^2 kg/m²/year)	Proposed ‘Be Clean’ (DER) (CO^2 kg/m²/year)	Emissions Savings (CO^2 kg/m²/year)	Emissions Savings %
14.0	12.2	1.8	12.9

SAP Modelling Inputs

Be Clean

Modelling Inputs	Value	Unit	Notes
External Wall U Value	0.15	W/m²K	- Wall ties assumed to be stainless steel at 2.5 per m2 with a cross-sectional area assumed to be 60mm2.
Basement Wall U value	0.15	W/m²K	- FoamGlass / Perinsul blocks at basement wall floor junctions
Ground Floor U Value	0.10	W/m²K	- Where in contact with ground (no basement below)
Basement Slab U Value	0.10	W/m²K	
Roof U Value	0.12	W/m²K	- Extensive Green Roof of sedums herbs and grasses
Window U Value	0.8	W/m²K	- Triple Glazing
Window g Value	0.6-0.5		
Air Permeability	<3	m³/h/m² @50Pa	
Thermal Bridging	0.05	W/m²K	
Electricity power factor			
Lighting efficacies	90-100	lm/cW	
Lighting occupancy controls	Yes		
Lighting daylight controls	Yes		
Ventilation SFP	0.76	W/l/s	- MVHR
Heat exchanger efficiency	90%		- MVHR - Nilan Compact P system, which includes supply air electrical heating coil, summer bypass and a reversible cooling unit
Heating boiler efficiency	90%		- Gas fired boiler for back up space heating
DHW efficiency	90%		- Nilan Compact P system to provide sanitary hot water

5.0 Annual CO2 Emission Calculations
- Be Green

SAP Modelling Inputs

Be Green

Modelling Inputs	Value	Unit	Notes
External Wall U Value	0.15	W/m²K	- Wall ties assumed to be stainless steel at 2.5 per m² with a cross-sectional area assumed to be 60mm².
Basement Wall U value	0.15	W/m²K	- FoamGlass / Perinsul blocks at basement wall floor junctions
Ground Floor U Value	0.10	W/m²K	- Where in contact with ground (no basement below)
Basement Slab U Value	0.10	W/m²K	
Roof U Value	0.12	W/m²K	- Extensive Green Roof of sedums herbs and grasses
Window U Value	0.8	W/m²K	- Triple Glazing
Window g Value	0.6-0.5		
Air Permeability	<3	m³/h/m² @50Pa	
Electricity power factor			
Lighting efficacies	90-100	lm/cW	
Lighting occupancy controls	Yes		
Lighting daylight controls	Yes		
Ventilation SFP	0.76	W/l/s	
Heat exchanger efficiency	90%		- MVHR - Nilan Compact P system, which includes supply air electrical heating coil, summer bypass and a reversible cooling unit
Heating boiler efficiency	90%		- Gas fired condensing boiler for back up space heating
DHW efficiency	90%		- Nilan Compact P system to provide sanitary hot water
PV efficiency	20.8%		- 360W PV panel = 1.6kWh per panel per day, this equates to 10 panels. - LG NeON® R LG360Q1C-A5 installed to be south facing at 30° -
Solar thermal collector efficiency	81%		- Lochinvar LSP20H+ flat plate installed to be south facing at 30° - Collector active area 1.79m² - Total 3no. Panels providing total area of 5.37m² - For additional space heating demand

The 'Be Green" stage of the energy hierarchy requires that developments make use of renewable technologies to achieve the sites overall carbon dioxide emissions target.

In this instance and within the context of the buildings form and location the most suitable renewable technology has been found to be photovoltaics and solar thermal panels (as seen in the LZC decision matrix) producing zero carbon electricity and hot water.

The overall carbon dioxide emissions reduction of 61.4% exceeds The London Plan's target of 35%.

The photovoltaics are to be installed on the flat the roof of the building. The panels are the be south facing and installed to an angle of 30°. The panels produce 1.6kWh per panel per day (relative to avg London sunshine hours), this equates to 10no. LG360Q1C - A5 panels.

Similarly, the solar thermal panel design has been based on the flat plate Lochinvar LSP20+ (Horizontal) solar collector with an active area of 1.79m² with 3no. panels providing a total area of 5.37m². The solar thermal panels will also be south facing, installed to an angle of 30°.

The panel layout ensures that overshading is minimised by placing the panels closest to the northern end of 9D, furthest from 9B Park House's shadow.

The roof will be freely accessible to allow easy maintenance and cleaning of the panels to ensure continued performance of the panels. The green roof will also reduce ambient heat, which will aid in maintaining increased efficiency of the solar therm and photovoltaic panels.

5.0 Annual CO2 Emission Calculations
- Be Green

The ‘Be Green’ inputs described for the proposed building have been captured in energy modelling using the Standard Assessment Procedure (SAP).

The CO2 emissions for the proposed under the ‘Be Green’ tier of the Energy Hierarchy are shown below. DER and TER worksheets showing the ‘Be Green’ performance of the dwelling are provided in Appendix 2.

This analysis demonstrates that the proposed will achieve a carbon dioxide emission saving of 61.4% through energy efficiency means alone, under the ‘Be Green’ Scenario, exceeding The London Borough of Camden’s 19% target requirement.

Be Green Co2 Savings

Standard Case TER (Part L1A) (CO^2 kg/m²/year)	Proposed ‘Be Green’ (DER) (CO^2 kg/m²/year)	Emissions Savings (CO^2 kg/m²/year)	Emissions Savings %
14.0	5.4	8.6	61.4

Comparison of Existing Retrofit vs New Build

The analysis has shown that by incorporating energy efficient construction and installations, there is a significant reduction in the development CO2 emissions based on the SAP calculation method.

The potential on-site low and zero carbon technologies have also been assessed taking into account the scale of this particular development and constraints such as location, visual impact, preventing additional vehicle movements and local pollution concerns.

The scheme therefore demonstrates a significant reduction in carbon emissions compared with both the existing house if it was to be refurbished and the London Borough of Camden Planning requirements for new build dwellings.

Existing Retrofit vs Proposed Co2 Savings

Existing Retrofit Total CO^2 (kg/yr)	Proposed New Build Total CO^2 (kg/yr)	Total Savings CO^2 (kg/yr)	Total Savings CO^2 (%)
3785.7	2046.8	**1738.9**	**45.9**

6.0 Sustainability Statement

Proposed Sustainability Measures

The sustainability strategy for the proposed development has been assessed using the Greater London Authority (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.

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water and lighting. Sustainability measures will include reduction in water use, waste and pollution as well as improvements in occupant health & wellbeing and ecology.

The following subsections detail the sustainability measures that will be incorporated into the design of the proposed dwellings.

View of the existing site

Land

The site, as shown in the image below (left), is currently occupied by a detached 2 storey, modest residential dwelling with a private rear garden. It is currently in use as a single family residential dwelling (Use Class C3).

The continued 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. The proposed dwelling retains the location of the existing dwelling, retaining the extent of the rear garden to ensure sufficient green space is retained.

The proposed dwelling has been designed to respect 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.

Extract from the TFL PTAL map

Location and Transport

The site is located on the corner where The Grove meets Fitzroy Park. The surrounding uses are purely residential with the nearest local shops located along Highgate High Street, approximately a 5 minute walk away.

The site has good public transport links. It is located within PTAL 2 and is a 15 minute walk from Highgate Underground Station which is on the Northern Line and in addition, there are various bus stops within an 8-10 minute walk.

Water Efficiency

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.

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 3.

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 5 litres/minute in hand-wash basins, and 8 litres/minute in kitchen sinks.
* Bath with a capacity to overflow no higher than 170 litres.
* Showers with a flow rate of 12 litres/minute using a flow restrictor.
* Washing machine with water consumption no more than 5 litres/kg.
* Dishwasher with water consumption of no more than 1 litres per place setting.

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.

6.0 Sustainability Statement

Materials and Waste

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.

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.

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.

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.

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.

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

The site in its current state comprises an existing dwelling with a private rear garden. The rear garden currently comprises a small proportion of hard-standing, as well as a network of retaining walls, including an outbuilding, all with concrete foundations.

An arboricultural survey has been undertaken and advice sought in relation to the existing trees, in particular the trees screening along Fitzroy Park.
The proposals have been carefully considered around the trees along Fitzroy Park, which are to be retained.

In addition to this, soft landscaping will be incorporated within the rear garden, additional planting to the front garden and a green roof to improve the extent of permeable surface area.

Tackling Increased Temperatures and Drought

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.

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 CO2 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.

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.

6.0 Sustainability Statement

Flooding

The image 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.

The proposed green roof has been included to promote species biodiversity, local wildlife and improve air quality. The green roof will also provide rainwater attenuation, reducing the volume of surface water runoff on-site and impact on local sewers. 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.

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.

Extract from the Environment Agency's online flood map

Pollution

Air Pollution

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).

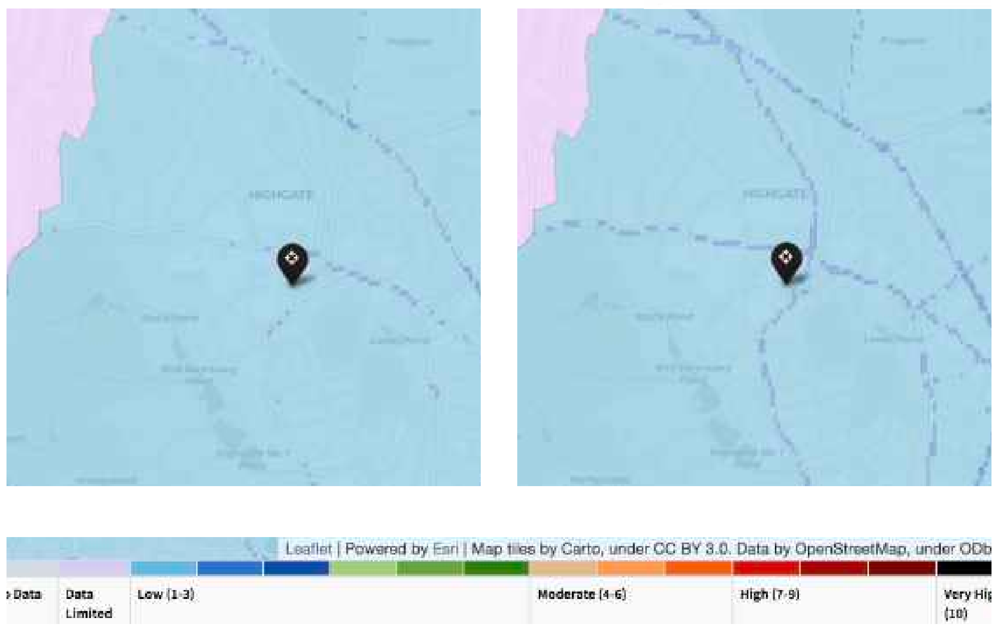
The site location, and the whole of the London Borough of Camden, is specified as an AQMA, due to excessive levels of nitrogen dioxide (NO^2) and particulate matter (PM_{10}) arising from road transport.

The images below shows the levels of NO^2 and PM_{10} measured at the site in 2020. These images indicate that the levels of NO^2 and PM_{10} present at the site in 2020 would have been below the annual mean objectives for both pollutants.

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.

Index at Current Location

	NO_2	O_3	PM10	PM2.5
Index	1	2	1	1



Extract from London Air Online pollution map.
Left indicating annual levels of NO^2 and right PM_{10} exposure

Noise Pollution

The development is not located within close proximity to transport noise sources. The closest road noise sources are Highgate Hill (B519) and Holloway Road (A1) to the east of the site. However, the below map (bottom) shows that noise from these roads will have no impact on the new dwelling.

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 (top).

Extract from England Noise and Air Quality Viewer.
Top indicating rail sources and bottom road sources.

7.0 Conclusion

Conclusion

Every effort has been made to prioritise energy savings and carbon dioxide emission reductions through early engagement with the design team during concept development and extensive energy modelling.

Ambitious levels of thermal performance have been set for the building fabric with triple glazing specified for all new windows and the target u-values for all external elements have been set well below the limits set by The Building Regulations.

With this strategy the thermal modelling exercise demonstrating the three levels of The Energy Hierarchy show the following progressing reductions in annual carbon dioxide emissions:

* Be Lean –12.9%
* Be Clean – 12.9%
* Be Green – 61.4%

This demonstrates that the building will achieve the 35% carbon dioxide reductions targets as set by The Camden Local Plan and The London Plan.

This document 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 screening trees along Fitzroy Park, and provide a new green roof 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 renewable systems to reduce 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.

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

Appendix 1 : SAP 2012 Calculations for the Dwelling as Existing and Refurbished

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.26

Property Address: 9D The Grove_Existing Building

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.92	(1a)	x	2.46	(2a)	=	149.86	(3a)
First floor	81.92	(1b)	x	2.42	(2b)	=	198.26	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	142.84	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	348.11	(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							1	x 10 =	10	(7a)
Number of passive vents							2	x 10 =	20	(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) =	30	÷ (5) =	0.09	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.84	(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) =	0.71	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

	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

0.91	0.89	0.87	0.78	0.76	0.68	0.68	0.66	0.71	0.76	0.8	0.84

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=	0.91	0.89	0.88	0.81	0.79	0.73	0.73	0.72	0.75	0.79	0.82	0.85	(24d)

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

(25)m=	0.91	0.89	0.88	0.81	0.79	0.73	0.73	0.72	0.75	0.79	0.82	0.85	(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 Type 1			2.14	x	1	=	2.135698			(26)
Doors Type 2			1.84	x	1	=	1.835946			(26)
Doors Type 3			3.92	x	1	=	3.917567			(26)
Windows Type 1			6.9361	x1/[1/(5.9)+ 0.04]		=	33.11			(27)
Windows Type 2			8.248323	x1/[1/(5.9)+ 0.04]		=	39.37			(27)
Windows Type 3			16.92103	x1/[1/(5.9)+ 0.04]		=	80.77			(27)
Floor			60.917	x	1.03	=	62.74451			(28)
Walls Type1	182.37	39.99	142.37	x	1.4	=	199.32			(29)
Walls Type2	23.87	0	23.87	x	0.72	=	17.12			(29)
Roof	81.92	0	81.92	x	1.5	=	122.89			(30)
Total area of elements, m²			349.08							(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) = 563.22 (33)

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.

DER WorkSheet: New dwelling design stage

Thermal bridges : S (L x Y) calculated using Appendix K | 52.36 | (36)

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

Total fabric heat loss (33) + (36) = | 615.58 | (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=	104.61	102.78	100.98	92.55	90.97	83.63	83.63	82.27	86.45	90.97	94.16	97.5	(38)

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

(39)m=	720.19	718.36	716.56	708.13	706.55	699.21	699.21	697.85	702.04	706.55	709.74	713.08	

Average = $Sum(39)_{1...12}$ /12= | 708.12 | (39)

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

(40)m=	5.04	5.03	5.02	4.96	4.95	4.9	4.9	4.89	4.91	4.95	4.97	4.99	

Average = $Sum(40)_{1...12}$ /12= | 4.96 | (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 | 2.92 | (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 | 103.6 | (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)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	113.97	109.82	105.68	101.53	97.39	93.24	93.24	97.39	101.53	105.68	109.82	113.97	

Total = $Sum(44)_{1...12}$ = | 1243.26 | (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=	169.01	147.81	152.53	132.98	127.6	110.11	102.03	117.08	118.48	138.08	150.72	163.67	

Total = $Sum(45)_{1...12}$ = | 1630.11 | (45)

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

(46)m=	25.35	22.17	22.88	19.95	19.14	16.52	15.3	17.56	17.77	20.71	22.61	24.55	(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:

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=	224.91	198.31	208.44	187.08	183.5	164.21	157.94	172.99	172.58	193.98	204.82	219.58	(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=	224.91	198.31	208.44	187.08	183.5	164.21	157.94	172.99	172.58	193.98	204.82	219.58	

Output from water heater (annual)$_{1…12}$ — 2288.35 (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=	100.92	89.54	95.44	87.5	87.15	79.89	78.65	83.65	82.68	90.64	93.4	99.15	(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=	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	41.8	37.13	30.19	22.86	17.09	14.43	15.59	20.26	27.19	34.53	40.3	42.96	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	312.62	315.86	307.69	290.29	268.32	247.67	233.88	230.63	238.81	256.21	278.18	298.83	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	(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=	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	(71)
Water heating gains (Table 5)													
(72)m=	135.64	133.25	128.28	121.52	117.14	110.96	105.71	112.44	114.83	121.82	129.72	133.26	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	559.9	556.08	536	504.5	472.38	442.89	425.01	433.17	450.66	482.4	518.03	544.88	(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.94	x	19.64	x	0.63	x	0.7	=	41.63	(76)
East	0.9x	0.77	x	6.94	x	38.42	x	0.63	x	0.7	=	81.44	(76)
East	0.9x	0.77	x	6.94	x	63.27	x	0.63	x	0.7	=	134.12	(76)
East	0.9x	0.77	x	6.94	x	92.28	x	0.63	x	0.7	=	195.61	(76)
East	0.9x	0.77	x	6.94	x	113.09	x	0.63	x	0.7	=	239.73	(76)
East	0.9x	0.77	x	6.94	x	115.77	x	0.63	x	0.7	=	245.41	(76)
East	0.9x	0.77	x	6.94	x	110.22	x	0.63	x	0.7	=	233.64	(76)
East	0.9x	0.77	x	6.94	x	94.68	x	0.63	x	0.7	=	200.69	(76)
East	0.9x	0.77	x	6.94	x	73.59	x	0.63	x	0.7	=	155.99	(76)
East	0.9x	0.77	x	6.94	x	45.59	x	0.63	x	0.7	=	96.64	(76)
East	0.9x	0.77	x	6.94	x	24.49	x	0.63	x	0.7	=	51.91	(76)
East	0.9x	0.77	x	6.94	x	16.15	x	0.63	x	0.7	=	34.24	(76)
South	0.9x	0.77	x	8.25	x	46.75	x	0.63	x	0.7	=	117.85	(78)
South	0.9x	0.77	x	8.25	x	76.57	x	0.63	x	0.7	=	193.01	(78)
South	0.9x	0.77	x	8.25	x	97.53	x	0.63	x	0.7	=	245.86	(78)
South	0.9x	0.77	x	8.25	x	110.23	x	0.63	x	0.7	=	277.88	(78)
South	0.9x	0.77	x	8.25	x	114.87	x	0.63	x	0.7	=	289.57	(78)
South	0.9x	0.77	x	8.25	x	110.55	x	0.63	x	0.7	=	278.67	(78)
South	0.9x	0.77	x	8.25	x	108.01	x	0.63	x	0.7	=	272.28	(78)
South	0.9x	0.77	x	8.25	x	104.89	x	0.63	x	0.7	=	264.42	(78)
South	0.9x	0.77	x	8.25	x	101.89	x	0.63	x	0.7	=	256.83	(78)
South	0.9x	0.77	x	8.25	x	82.59	x	0.63	x	0.7	=	208.18	(78)
South	0.9x	0.77	x	8.25	x	55.42	x	0.63	x	0.7	=	139.7	(78)
South	0.9x	0.77	x	8.25	x	40.4	x	0.63	x	0.7	=	101.84	(78)
West	0.9x	0.77	x	16.92	x	19.64	x	0.63	x	0.7	=	101.57	(80)
West	0.9x	0.77	x	16.92	x	38.42	x	0.63	x	0.7	=	198.68	(80)
West	0.9x	0.77	x	16.92	x	63.27	x	0.63	x	0.7	=	327.2	(80)
West	0.9x	0.77	x	16.92	x	92.28	x	0.63	x	0.7	=	477.21	(80)
West	0.9x	0.77	x	16.92	x	113.09	x	0.63	x	0.7	=	584.83	(80)
West	0.9x	0.77	x	16.92	x	115.77	x	0.63	x	0.7	=	598.68	(80)
West	0.9x	0.77	x	16.92	x	110.22	x	0.63	x	0.7	=	569.97	(80)
West	0.9x	0.77	x	16.92	x	94.68	x	0.63	x	0.7	=	489.6	(80)
West	0.9x	0.77	x	16.92	x	73.59	x	0.63	x	0.7	=	380.55	(80)
West	0.9x	0.77	x	16.92	x	45.59	x	0.63	x	0.7	=	235.75	(80)
West	0.9x	0.77	x	16.92	x	24.49	x	0.63	x	0.7	=	126.64	(80)
West	0.9x	0.77	x	16.92	x	16.15	x	0.63	x	0.7	=	83.52	(80)

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

(83)m=	261.05	473.14	707.19	950.7	1114.13	1122.76	1075.88	954.7	793.38	540.57	318.25	219.59	(83)

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

(84)m=	820.95	1029.21	1243.19	1455.2	1586.51	1565.65	1500.89	1387.87	1244.04	1022.97	836.28	764.48	(84)

DER WorkSheet: New dwelling design stage

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=	0.99	0.99	0.99	0.97	0.95	0.91	0.86	0.88	0.95	0.98	0.99	1	(86)

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

(87)m=	16.7	16.95	17.47	18.23	19.04	19.81	20.3	20.22	19.57	18.54	17.51	16.67	(87)

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

(88)m=	18.08	18.08	18.08	18.09	18.09	18.1	18.1	18.1	18.1	18.09	18.09	18.08	(88)

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

(89)m=	0.99	0.99	0.98	0.96	0.91	0.79	0.54	0.61	0.87	0.97	0.99	0.99	(89)

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

(90)m=	13.04	13.4	14.15	15.23	16.37	17.42	17.97	17.91	17.13	15.68	14.2	13	(90)

fLA = Living area ÷ (4) = | 0.33 | (91)

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

(92)m=	14.24	14.56	15.24	16.21	17.24	18.2	18.73	18.67	17.93	16.62	15.28	14.2	(92)

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

(93)m=	14.09	14.41	15.09	16.06	17.09	18.05	18.58	18.52	17.78	16.47	15.13	14.05	(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=	0.99	0.98	0.96	0.93	0.88	0.79	0.63	0.68	0.86	0.95	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	809.2	1006.06	1196.96	1359.97	1402.73	1236.99	950.62	945.08	1067.41	970.79	818.7	754.98	(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=	7048.72	6831.11	6153.89	5071.36	3811.01	2414.63	1383.72	1476.38	2583.31	4145.24	5698.31	7023.39	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	4642.2	3914.43	3687.96	2672.2	1791.76	0	0	0	0	2361.8	3513.32	4663.7	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 27247.36 | (98)

Space heating requirement in kWh/m²/year | 190.75 | (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	6572.55	5174.13	5303.64	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.28	0.33	0.3	0	0	0	0	(101)

DER WorkSheet: New dwelling design stage

Useful loss, hmLm (Watts) = (100)m x (101)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(102)m=	0	0	0	0	0	1811.51	1692.83	1599.11	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	1942.9	1865.18	1737.11	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	0	0	0	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (104)

Cooled fraction — f C = cooled area ÷ (4) = 4.17 (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)$_{6...8}$ = 0 (106)

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

(107)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total = Sum(107)$_{6...8}$ = 0 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0 (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		89.9	(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)	4642.2	3914.43	3687.96	2672.2	1791.76	0	0	0	0	2361.8	3513.32	4663.7	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	5163.74	4354.21	4102.29	2972.41	1993.06	0	0	0	0	2627.14	3908.03	5187.65	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 30308.52 (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)

	224.91	198.31	208.44	187.08	183.5	164.21	157.94	172.99	172.58	193.98	204.82	219.58

Efficiency of water heater — 79.8 (216)

(217)m=	89.38	89.35	89.3	89.16	88.86	79.8	79.8	79.8	79.8	89.04	89.28	89.39	(217)

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

(219)m=	251.64	221.94	233.42	209.82	206.52	205.78	197.92	216.78	216.27	217.85	229.42	245.64

Total = Sum(219a)$_{1...12}$ = 2653 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		30308.52

DER WorkSheet: New dwelling design stage

Water heating fuel used			2653	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			738.2	(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	=	6546.64	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	573.05	(264)
Space and water heating	(261) + (262) + (263) + (264) =				7119.69	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	383.13	(268)
Total CO2, kg/year			sum of (265)…(271) =		7541.74	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		52.8	(273)
El rating (section 14)					48	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: 9D The Grove_Existing Building

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.92	(1a)	x	2.46	(2a)	=	149.86	(3a)
First floor	81.92	(1b)	x	2.42	(2b)	=	198.26	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	142.84	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	348.11	(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) =	0.11	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *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*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.36	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

TER WorkSheet: New dwelling design stage

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

0.4	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(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 Type 1			2.14	x	1	=	2.135698			(26)
Doors Type 2			1.84	x	1	=	1.835946			(26)
Doors Type 3			3.92	x	1	=	3.917567			(26)
Windows Type 1			6.01	x1/[1/(1.4)+ 0.04]		=	7.97			(27)
Windows Type 2			7.15	x1/[1/(1.4)+ 0.04]		=	9.48			(27)
Windows Type 3			14.66	x1/[1/(1.4)+ 0.04]		=	19.44			(27)
Floor			60.917	x	0.13	=	7.919209			(28)
Walls Type1	182.37	35.71	146.66	x	0.18	=	26.4			(29)
Walls Type2	23.87	0	23.87	x	0.18	=	4.3			(29)
Roof	81.92	0	81.92	x	0.13	=	10.65			(30)
Total area of elements, m²			349.08							(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) = 94.04 (33)

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.

TER WorkSheet: New dwelling design stage

Thermal bridges : S (L x Y) calculated using Appendix K		17.45	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	111.49	(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=	66.42	66.07	65.73	64.12	63.82	62.43	62.43	62.17	62.96	63.82	64.43	65.07	(38)

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

(39)m=	177.91	177.56	177.22	175.62	175.32	173.92	173.92	173.66	174.46	175.32	175.92	176.56	

Average = Sum(39)$_{1…12}$ /12= 175.61 (39)

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

(40)m=	1.25	1.24	1.24	1.23	1.23	1.22	1.22	1.22	1.22	1.23	1.23	1.24	

Average = Sum(40)$_{1…12}$ /12= 1.23 (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 2.92 (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) + 36 103.6 (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=	113.97	109.82	105.68	101.53	97.39	93.24	93.24	97.39	101.53	105.68	109.82	113.97	

Total = Sum(44)$_{1…12}$ = 1243.26 (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=	169.01	147.81	152.53	132.98	127.6	110.11	102.03	117.08	118.48	138.08	150.72	163.67	

Total = Sum(45)$_{1…12}$ = 1630.11 (45)

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

(46)m=	25.35	22.17	22.88	19.95	19.14	16.52	15.3	17.56	17.77	20.71	22.61	24.55	(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:			
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)

TER WorkSheet: New dwelling design stage

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=	215.6	189.9	199.13	178.07	174.19	155.2	148.63	163.68	163.57	184.67	195.81	210.27	(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=	215.6	189.9	199.13	178.07	174.19	155.2	148.63	163.68	163.57	184.67	195.81	210.27

Output from water heater (annual)$_{1…12}$ 2178.72 (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=	93.47	82.82	87.99	80.29	79.7	72.68	71.2	76.21	75.47	83.19	86.19	91.7	(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=	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	(66)

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

(67)m=	28.15	25	20.33	15.39	11.51	9.71	10.5	13.64	18.31	23.25	27.14	28.93	(67)

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

(68)m=	312.62	315.86	307.69	290.29	268.32	247.67	233.88	230.63	238.81	256.21	278.18	298.83	(68)

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

(69)m=	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	(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=	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	(71)

Water heating gains (Table 5)

(72)m=	125.63	123.24	118.27	111.51	107.13	100.95	95.7	102.43	104.82	111.81	119.71	123.25	(72)

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

(73)m=	536.24	533.94	516.13	487.03	456.79	428.17	409.91	416.54	431.77	461.11	494.86	520.84	(73)

6. Solar gains:

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

TER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.01	x	19.64	x	0.63	x	0.7	=	36.07	(76)
East	0.9x	0.77	x	6.01	x	38.42	x	0.63	x	0.7	=	70.57	(76)
East	0.9x	0.77	x	6.01	x	63.27	x	0.63	x	0.7	=	116.22	(76)
East	0.9x	0.77	x	6.01	x	92.28	x	0.63	x	0.7	=	169.49	(76)
East	0.9x	0.77	x	6.01	x	113.09	x	0.63	x	0.7	=	207.72	(76)
East	0.9x	0.77	x	6.01	x	115.77	x	0.63	x	0.7	=	212.64	(76)
East	0.9x	0.77	x	6.01	x	110.22	x	0.63	x	0.7	=	202.44	(76)
East	0.9x	0.77	x	6.01	x	94.68	x	0.63	x	0.7	=	173.89	(76)
East	0.9x	0.77	x	6.01	x	73.59	x	0.63	x	0.7	=	135.16	(76)
East	0.9x	0.77	x	6.01	x	45.59	x	0.63	x	0.7	=	83.74	(76)
East	0.9x	0.77	x	6.01	x	24.49	x	0.63	x	0.7	=	44.98	(76)
East	0.9x	0.77	x	6.01	x	16.15	x	0.63	x	0.7	=	29.67	(76)
South	0.9x	0.77	x	7.15	x	46.75	x	0.63	x	0.7	=	102.16	(78)
South	0.9x	0.77	x	7.15	x	76.57	x	0.63	x	0.7	=	167.31	(78)
South	0.9x	0.77	x	7.15	x	97.53	x	0.63	x	0.7	=	213.12	(78)
South	0.9x	0.77	x	7.15	x	110.23	x	0.63	x	0.7	=	240.88	(78)
South	0.9x	0.77	x	7.15	x	114.87	x	0.63	x	0.7	=	251.01	(78)
South	0.9x	0.77	x	7.15	x	110.55	x	0.63	x	0.7	=	241.56	(78)
South	0.9x	0.77	x	7.15	x	108.01	x	0.63	x	0.7	=	236.02	(78)
South	0.9x	0.77	x	7.15	x	104.89	x	0.63	x	0.7	=	229.21	(78)
South	0.9x	0.77	x	7.15	x	101.89	x	0.63	x	0.7	=	222.63	(78)
South	0.9x	0.77	x	7.15	x	82.59	x	0.63	x	0.7	=	180.46	(78)
South	0.9x	0.77	x	7.15	x	55.42	x	0.63	x	0.7	=	121.09	(78)
South	0.9x	0.77	x	7.15	x	40.4	x	0.63	x	0.7	=	88.28	(78)
West	0.9x	0.77	x	14.66	x	19.64	x	0.63	x	0.7	=	87.99	(80)
West	0.9x	0.77	x	14.66	x	38.42	x	0.63	x	0.7	=	172.13	(80)
West	0.9x	0.77	x	14.66	x	63.27	x	0.63	x	0.7	=	283.48	(80)
West	0.9x	0.77	x	14.66	x	92.28	x	0.63	x	0.7	=	413.44	(80)
West	0.9x	0.77	x	14.66	x	113.09	x	0.63	x	0.7	=	506.69	(80)
West	0.9x	0.77	x	14.66	x	115.77	x	0.63	x	0.7	=	518.69	(80)
West	0.9x	0.77	x	14.66	x	110.22	x	0.63	x	0.7	=	493.81	(80)
West	0.9x	0.77	x	14.66	x	94.68	x	0.63	x	0.7	=	424.17	(80)
West	0.9x	0.77	x	14.66	x	73.59	x	0.63	x	0.7	=	329.7	(80)
West	0.9x	0.77	x	14.66	x	45.59	x	0.63	x	0.7	=	204.25	(80)
West	0.9x	0.77	x	14.66	x	24.49	x	0.63	x	0.7	=	109.72	(80)
West	0.9x	0.77	x	14.66	x	16.15	x	0.63	x	0.7	=	72.36	(80)

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

(83)m=	226.23	410.01	612.82	823.81	965.42	972.89	932.27	827.28	687.5	468.45	275.79	190.3	(83)

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

(84)m=	762.47	943.96	1128.95	1310.84	1422.2	1401.06	1342.18	1243.82	1119.27	929.56	770.65	711.15	(84)

TER WorkSheet: New dwelling design stage

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.88	0.72	0.55	0.61	0.86	0.98	1	1	(86)

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

(87)m=	19.57	19.76	20.06	20.44	20.75	20.93	20.99	20.98	20.84	20.41	19.91	19.54	(87)

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

(88)m=	19.88	19.89	19.89	19.9	19.9	19.91	19.91	19.91	19.9	19.9	19.89	19.89	(88)

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

(89)m=	1	1	0.98	0.94	0.83	0.63	0.42	0.48	0.78	0.97	1	1	(89)

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

(90)m=	17.98	18.26	18.69	19.24	19.66	19.86	19.9	19.9	19.77	19.21	18.49	17.94	(90)

fLA = Living area ÷ (4) = | 0.33 | (91)

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

(92)m=	18.5	18.75	19.14	19.63	20.01	20.21	20.26	20.25	20.12	19.6	18.95	18.46	(92)

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

(93)m=	18.5	18.75	19.14	19.63	20.01	20.21	20.26	20.25	20.12	19.6	18.95	18.46	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.84	0.65	0.47	0.52	0.8	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	760.59	937.61	1106.62	1230.1	1190.04	916.54	626.32	652.55	895.59	897.45	766.38	709.88	(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=	2526.44	2458.77	2239.99	1884.27	1457.62	976.02	635.68	668.62	1050.69	1577.66	2085.32	2518.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1313.79	1022.22	843.22	471	199.08	0	0	0	0	506.08	949.63	1345.25	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 6650.27 | (98)

Space heating requirement in kWh/m²/year | 46.56 | (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)

TER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	1313.79	1022.22	843.22	471	199.08	0	0	0	0	506.08	949.63	1345.25		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1405.12	1093.28	901.84	503.75	212.92	0	0	0	0	541.26	1015.65	1438.78		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													7112.59	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	215.6	189.9	199.13	178.07	174.19	155.2	148.63	163.68	163.57	184.67	195.81	210.27		
Efficiency of water heater													79.8	(216)
(217)m=	88.82	88.64	88.24	87.29	85.17	79.8	79.8	79.8	79.8	87.37	88.47	88.89		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	242.74	214.24	225.67	204	204.52	194.49	186.25	205.11	204.98	211.37	221.33	236.55		
Total = Sum(219a)$_{1...12}$ =													2551.25	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			7112.59	
Water heating fuel used			2551.25	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			497.15	(232)

DRAFT

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	=	1536.32	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	551.07	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2087.39	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	258.02	(268)
Total CO2, kg/year			sum of (265)…(271) =		2384.33	(272)

TER = 16.69 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: 9D The Grove_Retrofit

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.92	(1a)	x	2.46	(2a)	=	149.86	(3a)
First floor	81.92	(1b)	x	2.42	(2b)	=	198.26	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	142.84	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	348.11	(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							1	x 10 =	10	(7a)
Number of passive vents							2	x 10 =	20	(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) =	30	÷ (5) =	0.09	(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)	0.34	(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) =	0.29	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling design stage

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

0.36	0.36	0.35	0.31	0.31	0.27	0.27	0.26	0.29	0.31	0.32	0.34

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=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56	(24d)

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

(25)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56	(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 Type 1			2.14	x	1	=	2.135698			(26)
Doors Type 2			1.84	x	1	=	1.835946			(26)
Doors Type 3			3.92	x	1	=	3.917567			(26)
Windows Type 1			6.9361	x1/[1/(1.4)+ 0.04]		=	9.2			(27)
Windows Type 2			8.248323	x1/[1/(1.4)+ 0.04]		=	10.94			(27)
Windows Type 3			16.92103	x1/[1/(1.4)+ 0.04]		=	22.43			(27)
Floor			60.917	x	0.2	=	12.1834			(28)
Walls Type1	182.37	39.99	142.37	x	0.55	=	78.31			(29)
Walls Type2	23.87	0	23.87	x	0.4	=	9.56			(29)
Roof	81.92	0	81.92	x	0.32	=	26.22			(30)
Total area of elements, m²			349.08							(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) =	176.71	(33)
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.

DER WorkSheet: New dwelling design stage

Thermal bridges : S (L x Y) calculated using Appendix K | 52.36 | (36)

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

Total fabric heat loss (33) + (36) = | 229.08 | (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=	65.06	64.77	64.48	63.11	62.86	61.67	61.67	61.45	62.13	62.86	63.37	63.91	(38)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(39)m=	294.14	293.84	293.55	292.19	291.94	290.75	290.75	290.53	291.21	291.94	292.45	292.99

Average = $Sum(39)_{1...12}$ /12= | 292.19 | (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=	2.06	2.06	2.06	2.05	2.04	2.04	2.04	2.03	2.04	2.04	2.05	2.05

Average = $Sum(40)_{1...12}$ /12= | 2.05 | (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 | 2.92 | (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 | 103.6 | (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)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	113.97	109.82	105.68	101.53	97.39	93.24	93.24	97.39	101.53	105.68	109.82	113.97

Total = $Sum(44)_{1...12}$ = | 1243.26 | (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=	169.01	147.81	152.53	132.98	127.6	110.11	102.03	117.08	118.48	138.08	150.72	163.67

Total = $Sum(45)_{1...12}$ = | 1630.11 | (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=	25.35	22.17	22.88	19.95	19.14	16.52	15.3	17.56	17.77	20.71	22.61	24.55	(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:

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)

DER WorkSheet: New dwelling design stage

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=	224.91	198.31	208.44	187.08	183.5	164.21	157.94	172.99	172.58	193.98	204.82	219.58	(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=	224.91	198.31	208.44	187.08	183.5	164.21	157.94	172.99	172.58	193.98	204.82	219.58	

Output from water heater (annual)$_{1...12}$ | 2288.35 | (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=	100.92	89.54	95.44	87.5	87.15	79.89	78.65	83.65	82.68	90.64	93.4	99.15	(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=	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	(66)

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

(67)m=	27.87	24.75	20.13	15.24	11.39	9.62	10.39	13.51	18.13	23.02	26.87	28.64	(67)

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

(68)m=	312.62	315.86	307.69	290.29	268.32	247.67	233.88	230.63	238.81	256.21	278.18	298.83	(68)

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

(69)m=	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	(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=	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	(71)

Water heating gains (Table 5)

(72)m=	135.64	133.25	128.28	121.52	117.14	110.96	105.71	112.44	114.83	121.82	129.72	133.26	(72)

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

(73)m=	545.97	543.7	525.93	496.88	466.68	438.08	419.81	426.41	441.6	470.89	504.6	530.56	(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.94	x	19.64	x	0.63	x	0.7	=	41.63	(76)
East	0.9x	0.77	x	6.94	x	38.42	x	0.63	x	0.7	=	81.44	(76)
East	0.9x	0.77	x	6.94	x	63.27	x	0.63	x	0.7	=	134.12	(76)
East	0.9x	0.77	x	6.94	x	92.28	x	0.63	x	0.7	=	195.61	(76)
East	0.9x	0.77	x	6.94	x	113.09	x	0.63	x	0.7	=	239.73	(76)
East	0.9x	0.77	x	6.94	x	115.77	x	0.63	x	0.7	=	245.41	(76)
East	0.9x	0.77	x	6.94	x	110.22	x	0.63	x	0.7	=	233.64	(76)
East	0.9x	0.77	x	6.94	x	94.68	x	0.63	x	0.7	=	200.69	(76)
East	0.9x	0.77	x	6.94	x	73.59	x	0.63	x	0.7	=	155.99	(76)
East	0.9x	0.77	x	6.94	x	45.59	x	0.63	x	0.7	=	96.64	(76)
East	0.9x	0.77	x	6.94	x	24.49	x	0.63	x	0.7	=	51.91	(76)
East	0.9x	0.77	x	6.94	x	16.15	x	0.63	x	0.7	=	34.24	(76)
South	0.9x	0.77	x	8.25	x	46.75	x	0.63	x	0.7	=	117.85	(78)
South	0.9x	0.77	x	8.25	x	76.57	x	0.63	x	0.7	=	193.01	(78)
South	0.9x	0.77	x	8.25	x	97.53	x	0.63	x	0.7	=	245.86	(78)
South	0.9x	0.77	x	8.25	x	110.23	x	0.63	x	0.7	=	277.88	(78)
South	0.9x	0.77	x	8.25	x	114.87	x	0.63	x	0.7	=	289.57	(78)
South	0.9x	0.77	x	8.25	x	110.55	x	0.63	x	0.7	=	278.67	(78)
South	0.9x	0.77	x	8.25	x	108.01	x	0.63	x	0.7	=	272.28	(78)
South	0.9x	0.77	x	8.25	x	104.89	x	0.63	x	0.7	=	264.42	(78)
South	0.9x	0.77	x	8.25	x	101.89	x	0.63	x	0.7	=	256.83	(78)
South	0.9x	0.77	x	8.25	x	82.59	x	0.63	x	0.7	=	208.18	(78)
South	0.9x	0.77	x	8.25	x	55.42	x	0.63	x	0.7	=	139.7	(78)
South	0.9x	0.77	x	8.25	x	40.4	x	0.63	x	0.7	=	101.84	(78)
West	0.9x	0.77	x	16.92	x	19.64	x	0.63	x	0.7	=	101.57	(80)
West	0.9x	0.77	x	16.92	x	38.42	x	0.63	x	0.7	=	198.68	(80)
West	0.9x	0.77	x	16.92	x	63.27	x	0.63	x	0.7	=	327.2	(80)
West	0.9x	0.77	x	16.92	x	92.28	x	0.63	x	0.7	=	477.21	(80)
West	0.9x	0.77	x	16.92	x	113.09	x	0.63	x	0.7	=	584.83	(80)
West	0.9x	0.77	x	16.92	x	115.77	x	0.63	x	0.7	=	598.68	(80)
West	0.9x	0.77	x	16.92	x	110.22	x	0.63	x	0.7	=	569.97	(80)
West	0.9x	0.77	x	16.92	x	94.68	x	0.63	x	0.7	=	489.6	(80)
West	0.9x	0.77	x	16.92	x	73.59	x	0.63	x	0.7	=	380.55	(80)
West	0.9x	0.77	x	16.92	x	45.59	x	0.63	x	0.7	=	235.75	(80)
West	0.9x	0.77	x	16.92	x	24.49	x	0.63	x	0.7	=	126.64	(80)
West	0.9x	0.77	x	16.92	x	16.15	x	0.63	x	0.7	=	83.52	(80)

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

(83)m=	261.05	473.14	707.19	950.7	1114.13	1122.76	1075.88	954.7	793.38	540.57	318.25	219.59	(83)

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

(84)m=	807.02	1016.84	1233.12	1447.58	1580.81	1560.84	1495.7	1381.12	1234.97	1011.46	822.84	750.16	(84)

DER WorkSheet: New dwelling design stage

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	0.99	0.99	0.97	0.92	0.83	0.7	0.75	0.91	0.98	1	1	(86)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(87)m=	18.68	18.9	19.28	19.79	20.29	20.68	20.87	20.83	20.5	19.84	19.17	18.64	(87)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(88)m=	19.29	19.3	19.3	19.3	19.3	19.31	19.31	19.31	19.31	19.3	19.3	19.3	(88)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(89)m=	1	0.99	0.98	0.95	0.88	0.71	0.49	0.56	0.84	0.97	0.99	1	(89)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(90)m=	16.31	16.63	17.19	17.93	18.61	19.1	19.27	19.25	18.91	18.01	17.02	16.26	(90)

fLA = Living area ÷ (4) = | 0.33 | (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=	17.09	17.38	17.88	18.54	19.16	19.61	19.79	19.77	19.43	18.61	17.72	17.04	(92)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(93)m=	16.94	17.23	17.73	18.39	19.01	19.46	19.64	19.62	19.28	18.46	17.57	16.89	(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=	0.99	0.99	0.97	0.94	0.87	0.73	0.54	0.6	0.84	0.96	0.99	1	(94)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(95)m=	802.59	1005.01	1201.1	1359.01	1367.73	1134.75	812.28	830.95	1032.23	971.27	814.54	746.89	(95)

Monthly average external temperature from Table 8

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(97)m=	3717.68	3621.63	3295.51	2771.94	2134.07	1414.39	884.72	934.45	1507.93	2294.94	3063.36	3717.51	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m=	2168.83	1758.37	1558.24	1017.31	570.15	0	0	0	0	984.81	1619.15	2210.14	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 11887 | (98)

Space heating requirement in kWh/m²/year | 83.22 | (99)

8c. Space cooling requirement

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

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(100)m=	0	0	0	0	0	2733.03	2151.53	2208.01	0	0	0	0	(100)

Utilisation factor for loss hm

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(101)m=	0	0	0	0	0	0.62	0.71	0.66	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	1696.02	1518.54	1464.58	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	1930.88	1852.19	1720.22	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	0	248.23	190.2	0	0	0	0

Total = Sum(104)$_{6...8}$ = 438.43 (104)

Cooled fraction — f C = cooled area ÷ (4) = 4.17 (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)$_{6...8}$ = 0 (106)

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

(107)m=	0	0	0	0	0	0	259.07	198.5	0	0	0	0

Total = Sum(107)$_{6...8}$ = 457.56 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 3.2 (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		89.9	(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)	2168.83	1758.37	1558.24	1017.31	570.15	0	0	0	0	984.81	1619.15	2210.14	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	2412.49	1955.92	1733.31	1131.6	634.21	0	0	0	0	1095.45	1801.06	2458.44	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 13222.47 (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)

224.91	198.31	208.44	187.08	183.5	164.21	157.94	172.99	172.58	193.98	204.82	219.58

Efficiency of water heater 79.8 (216)

(217)m=	88.84	88.76	88.58	88.17	87.21	79.8	79.8	79.8	79.8	88.07	88.64	88.88	(217)

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

(219)m=	253.16	223.42	235.32	212.19	210.41	205.78	197.92	216.78	216.27	220.27	231.07	247.04

Total = Sum(219a)$_{1...12}$ = 2669.62 (219)

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

(221)m=	0	0	0	0	0	0	63.97	49.01	0	0	0	0

Total = Sum(221)$_{6...8}$ = 112.98 (221)

DER WorkSheet: New dwelling design stage

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			13222.47	
Water heating fuel used			2669.62	
Space cooling fuel used			112.98	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			492.13	(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	=	2856.05	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	576.64	(264)
Space and water heating	(261) + (262) + (263) + (264) =				3432.69	(265)
Space cooling	(221)	x	0.519	=	58.64	(266)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	255.42	(268)
Total CO2, kg/year			sum of (265)…(271) =		3785.67	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		26.5	(273)
EI rating (section 14)					73	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.26

Property Address: 9D The Grove_Retrofit

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	60.92	(1a) x	2.46	(2a) =	149.86	(3a)
First floor	81.92	(1b) x	2.42	(2b) =	198.26	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	142.84	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		348.11	(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)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.11	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.36	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

TER WorkSheet: New dwelling design stage

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

0.4	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(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 Type 1			2.14	x	1	=	2.135698			(26)
Doors Type 2			1.84	x	1	=	1.835946			(26)
Doors Type 3			3.92	x	1	=	3.917567			(26)
Windows Type 1			6.01	x1/[1/(1.4)+ 0.04]		=	7.97			(27)
Windows Type 2			7.15	x1/[1/(1.4)+ 0.04]		=	9.48			(27)
Windows Type 3			14.66	x1/[1/(1.4)+ 0.04]		=	19.44			(27)
Floor			60.917	x	0.13	=	7.919209			(28)
Walls Type1	182.37	35.71	146.66	x	0.18	=	26.4			(29)
Walls Type2	23.87	0	23.87	x	0.18	=	4.3			(29)
Roof	81.92	0	81.92	x	0.13	=	10.65			(30)
Total area of elements, m²			349.08							(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) =	94.04	(33)
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.

TER WorkSheet: New dwelling design stage

Thermal bridges : S (L x Y) calculated using Appendix K | 17.45 | (36)

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

Total fabric heat loss (33) + (36) = | 111.49 | (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=	66.42	66.07	65.73	64.12	63.82	62.43	62.43	62.17	62.96	63.82	64.43	65.07	(38)

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

(39)m=	177.91	177.56	177.22	175.62	175.32	173.92	173.92	173.66	174.46	175.32	175.92	176.56	

Average = Sum(39)$_{1...12}$ /12= | 175.61 | (39)

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

(40)m=	1.25	1.24	1.24	1.23	1.23	1.22	1.22	1.22	1.22	1.23	1.23	1.24

Average = Sum(40)$_{1...12}$ /12= | 1.23 | (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 | 2.92 | (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 | 103.6 | (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=	113.97	109.82	105.68	101.53	97.39	93.24	93.24	97.39	101.53	105.68	109.82	113.97

Total = Sum(44)$_{1...12}$ = | 1243.26 | (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=	169.01	147.81	152.53	132.98	127.6	110.11	102.03	117.08	118.48	138.08	150.72	163.67

Total = Sum(45)$_{1...12}$ = | 1630.11 | (45)

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

(46)m=	25.35	22.17	22.88	19.95	19.14	16.52	15.3	17.56	17.77	20.71	22.61	24.55	(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:

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)

TER WorkSheet: New dwelling design stage

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=	215.6	189.9	199.13	178.07	174.19	155.2	148.63	163.68	163.57	184.67	195.81	210.27	(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=	215.6	189.9	199.13	178.07	174.19	155.2	148.63	163.68	163.57	184.67	195.81	210.27	

Output from water heater (annual)$_{1...12}$ — 2178.72 (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=	93.47	82.82	87.99	80.29	79.7	72.68	71.2	76.21	75.47	83.19	86.19	91.7	(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=	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	146.12	(66)

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

(67)m=	28.15	25	20.33	15.39	11.51	9.71	10.5	13.64	18.31	23.25	27.14	28.93	(67)

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

(68)m=	312.62	315.86	307.69	290.29	268.32	247.67	233.88	230.63	238.81	256.21	278.18	298.83	(68)

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

(69)m=	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	37.61	(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=	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	-116.89	(71)

Water heating gains (Table 5)

(72)m=	125.63	123.24	118.27	111.51	107.13	100.95	95.7	102.43	104.82	111.81	119.71	123.25	(72)

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

(73)m=	536.24	533.94	516.13	487.03	456.79	428.17	409.91	416.54	431.77	461.11	494.86	520.84	(73)

6. Solar gains:

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

TER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	6.01	x	19.64	x	0.63	x	0.7	=	36.07	(76)
East	0.9x	0.77	x	6.01	x	38.42	x	0.63	x	0.7	=	70.57	(76)
East	0.9x	0.77	x	6.01	x	63.27	x	0.63	x	0.7	=	116.22	(76)
East	0.9x	0.77	x	6.01	x	92.28	x	0.63	x	0.7	=	169.49	(76)
East	0.9x	0.77	x	6.01	x	113.09	x	0.63	x	0.7	=	207.72	(76)
East	0.9x	0.77	x	6.01	x	115.77	x	0.63	x	0.7	=	212.64	(76)
East	0.9x	0.77	x	6.01	x	110.22	x	0.63	x	0.7	=	202.44	(76)
East	0.9x	0.77	x	6.01	x	94.68	x	0.63	x	0.7	=	173.89	(76)
East	0.9x	0.77	x	6.01	x	73.59	x	0.63	x	0.7	=	135.16	(76)
East	0.9x	0.77	x	6.01	x	45.59	x	0.63	x	0.7	=	83.74	(76)
East	0.9x	0.77	x	6.01	x	24.49	x	0.63	x	0.7	=	44.98	(76)
East	0.9x	0.77	x	6.01	x	16.15	x	0.63	x	0.7	=	29.67	(76)
South	0.9x	0.77	x	7.15	x	46.75	x	0.63	x	0.7	=	102.16	(78)
South	0.9x	0.77	x	7.15	x	76.57	x	0.63	x	0.7	=	167.31	(78)
South	0.9x	0.77	x	7.15	x	97.53	x	0.63	x	0.7	=	213.12	(78)
South	0.9x	0.77	x	7.15	x	110.23	x	0.63	x	0.7	=	240.88	(78)
South	0.9x	0.77	x	7.15	x	114.87	x	0.63	x	0.7	=	251.01	(78)
South	0.9x	0.77	x	7.15	x	110.55	x	0.63	x	0.7	=	241.56	(78)
South	0.9x	0.77	x	7.15	x	108.01	x	0.63	x	0.7	=	236.02	(78)
South	0.9x	0.77	x	7.15	x	104.89	x	0.63	x	0.7	=	229.21	(78)
South	0.9x	0.77	x	7.15	x	101.89	x	0.63	x	0.7	=	222.63	(78)
South	0.9x	0.77	x	7.15	x	82.59	x	0.63	x	0.7	=	180.46	(78)
South	0.9x	0.77	x	7.15	x	55.42	x	0.63	x	0.7	=	121.09	(78)
South	0.9x	0.77	x	7.15	x	40.4	x	0.63	x	0.7	=	88.28	(78)
West	0.9x	0.77	x	14.66	x	19.64	x	0.63	x	0.7	=	87.99	(80)
West	0.9x	0.77	x	14.66	x	38.42	x	0.63	x	0.7	=	172.13	(80)
West	0.9x	0.77	x	14.66	x	63.27	x	0.63	x	0.7	=	283.48	(80)
West	0.9x	0.77	x	14.66	x	92.28	x	0.63	x	0.7	=	413.44	(80)
West	0.9x	0.77	x	14.66	x	113.09	x	0.63	x	0.7	=	506.69	(80)
West	0.9x	0.77	x	14.66	x	115.77	x	0.63	x	0.7	=	518.69	(80)
West	0.9x	0.77	x	14.66	x	110.22	x	0.63	x	0.7	=	493.81	(80)
West	0.9x	0.77	x	14.66	x	94.68	x	0.63	x	0.7	=	424.17	(80)
West	0.9x	0.77	x	14.66	x	73.59	x	0.63	x	0.7	=	329.7	(80)
West	0.9x	0.77	x	14.66	x	45.59	x	0.63	x	0.7	=	204.25	(80)
West	0.9x	0.77	x	14.66	x	24.49	x	0.63	x	0.7	=	109.72	(80)
West	0.9x	0.77	x	14.66	x	16.15	x	0.63	x	0.7	=	72.36	(80)

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

(83)m=	226.23	410.01	612.82	823.81	965.42	972.89	932.27	827.28	687.5	468.45	275.79	190.3	(83)

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

(84)m=	762.47	943.96	1128.95	1310.84	1422.2	1401.06	1342.18	1243.82	1119.27	929.56	770.65	711.15	(84)

TER WorkSheet: New dwelling design stage

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.88	0.72	0.55	0.61	0.86	0.98	1	1	(86)

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

(87)m=	19.57	19.76	20.06	20.44	20.75	20.93	20.99	20.98	20.84	20.41	19.91	19.54	(87)

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

(88)m=	19.88	19.89	19.89	19.9	19.9	19.91	19.91	19.91	19.9	19.9	19.89	19.89	(88)

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

(89)m=	1	1	0.98	0.94	0.83	0.63	0.42	0.48	0.78	0.97	1	1	(89)

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

(90)m=	17.98	18.26	18.69	19.24	19.66	19.86	19.9	19.9	19.77	19.21	18.49	17.94	(90)

fLA = Living area ÷ (4) = | 0.33 | (91)

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

(92)m=	18.5	18.75	19.14	19.63	20.01	20.21	20.26	20.25	20.12	19.6	18.95	18.46	(92)

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

(93)m=	18.5	18.75	19.14	19.63	20.01	20.21	20.26	20.25	20.12	19.6	18.95	18.46	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.84	0.65	0.47	0.52	0.8	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	760.59	937.61	1106.62	1230.1	1190.04	916.54	626.32	652.55	895.59	897.45	766.38	709.88	(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=	2526.44	2458.77	2239.99	1884.27	1457.62	976.02	635.68	668.62	1050.69	1577.66	2085.32	2518.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1313.79	1022.22	843.22	471	199.08	0	0	0	0	506.08	949.63	1345.25	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 6650.27 | (98)

Space heating requirement in kWh/m²/year | 46.56 | (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)

TER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	1313.79	1022.22	843.22	471	199.08	0	0	0	0	506.08	949.63	1345.25		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	1405.12	1093.28	901.84	503.75	212.92	0	0	0	0	541.26	1015.65	1438.78		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													7112.59	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	215.6	189.9	199.13	178.07	174.19	155.2	148.63	163.68	163.57	184.67	195.81	210.27		
Efficiency of water heater													79.8	(216)
(217)m=	88.82	88.64	88.24	87.29	85.17	79.8	79.8	79.8	79.8	87.37	88.47	88.89		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	242.74	214.24	225.67	204	204.52	194.49	186.25	205.11	204.98	211.37	221.33	236.55		
Total = Sum(219a)$_{1...12}$ =													2551.25	(219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			7112.59	
Water heating fuel used			2551.25	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			497.15	(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	=	1536.32	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	551.07	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2087.39	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	258.02	(268)
Total CO2, kg/year			sum of (265)…(271) =		2384.33	(272)

TER =	16.69	(273)

Appendix

Appendix 2 : SAP 2012 Calculations for the Proposed New Dwelling - Be Clean, Be Lean and Be Green Scenarios

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: 9D The Grove_Proposed_Be Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	126.23	(1a)	x	3	(2a)	=	378.69	(3a)
Ground floor	129.92	(1b)	x	3	(2b)	=	389.76	(3b)
First floor	123.86	(1c)	x	2.7	(2c)	=	334.42	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	380.01	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	1102.87	(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)

DRAFT

			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 *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*		0	(11)
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

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

DER WorkSheet: New dwelling design stage

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)

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 Type 1			2.89	x	1	=	2.887727			(26)
Doors Type 2			2.82	x	1	=	2.815407			(26)
Windows Type 1			3.444768	x1/[1/(0.8)+ 0.04]		=	2.67			(27)
Windows Type 2			19.87223	x1/[1/(0.8)+ 0.04]		=	15.4			(27)
Windows Type 3			0.871749	x1/[1/(0.8)+ 0.04]		=	0.68			(27)
Windows Type 4			31.8067	x1/[1/(0.8)+ 0.04]		=	24.66			(27)
Floor Type 1			126.23	x	0.1	=	12.623			(28)
Floor Type 2			3.6905	x	0.1	=	0.36905			(28)
Walls Type1	278.86	61.7	217.17	x	0.15	=	32.57			(29)
Walls Type2	148.43	0	148.43	x	0.15	=	22.26			(29)
Roof Type1	123.86	0	123.86	x	0.12	=	14.86			(30)
Roof Type2	6.46	0	6.46	x	0.12	=	0.77			(30)
Total area of elements, m²			687.53							(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) = 132.58 (33)

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 | 34.35 | (36)

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

Total fabric heat loss (33) + (36) = | 166.93 | (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=	108.12	106.96	105.8	99.99	98.83	93.03	93.03	91.87	95.35	98.83	101.15	103.47	(38)

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

(39)m=	275.04	273.88	272.72	266.92	265.76	259.96	259.96	258.8	262.28	265.76	268.08	270.4	

Average = $Sum(39)_{1...12}$ /12= | 266.63 | (39)

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

(40)m=	0.72	0.72	0.72	0.7	0.7	0.68	0.68	0.68	0.69	0.7	0.71	0.71

Average = $Sum(40)_{1...12}$ /12= | 0.7 | (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 | 3.24 | (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 | 111.05 | (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)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	122.16	117.72	113.27	108.83	104.39	99.95	99.95	104.39	108.83	113.27	117.72	122.16

Total = $Sum(44)_{1...12}$ = | 1332.64 | (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=	181.16	158.44	163.5	142.54	136.77	118.02	109.37	125.5	127	148	161.56	175.44

Total = $Sum(45)_{1...12}$ = | 1747.31 | (45)

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

(46)m=	27.17	23.77	24.52	21.38	20.52	17.7	16.4	18.82	19.05	22.2	24.23	26.32	(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:

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)

DER WorkSheet: New dwelling design stage

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=	237.06	208.94	219.4	196.64	192.68	172.13	165.27	181.41	181.1	203.91	215.66	231.35	(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=	237.06	208.94	219.4	196.64	192.68	172.13	165.27	181.41	181.1	203.91	215.66	231.35	

Output from water heater (annual)$_{1...12}$ | 2405.55 | (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=	104.96	93.08	99.09	90.68	90.2	82.52	81.09	86.45	85.51	93.94	97	103.06	(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=	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	50.67	45	36.6	27.71	20.71	17.49	18.89	24.56	32.96	41.85	48.85	52.08	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	520.24	525.64	512.04	483.07	446.52	412.16	389.2	383.8	397.41	426.37	462.93	497.29	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	(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=	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	(71)
Water heating gains (Table 5)													
(72)m=	141.07	138.51	133.18	125.94	121.24	114.62	108.99	116.2	118.76	126.26	134.72	138.52	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	786.52	783.69	756.36	711.26	663	618.8	591.63	599.1	623.67	669.02	721.04	762.42	(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.44	x	10.63	x	0.6	x	0.7	=	10.66	(74)
North	0.9x	0.77	x	3.44	x	20.32	x	0.6	x	0.7	=	20.37	(74)
North	0.9x	0.77	x	3.44	x	34.53	x	0.6	x	0.7	=	34.62	(74)
North	0.9x	0.77	x	3.44	x	55.46	x	0.6	x	0.7	=	55.61	(74)
North	0.9x	0.77	x	3.44	x	74.72	x	0.6	x	0.7	=	74.91	(74)
North	0.9x	0.77	x	3.44	x	79.99	x	0.6	x	0.7	=	80.2	(74)
North	0.9x	0.77	x	3.44	x	74.68	x	0.6	x	0.7	=	74.87	(74)
North	0.9x	0.77	x	3.44	x	59.25	x	0.6	x	0.7	=	59.4	(74)
North	0.9x	0.77	x	3.44	x	41.52	x	0.6	x	0.7	=	41.63	(74)
North	0.9x	0.77	x	3.44	x	24.19	x	0.6	x	0.7	=	24.25	(74)
North	0.9x	0.77	x	3.44	x	13.12	x	0.6	x	0.7	=	13.15	(74)
North	0.9x	0.77	x	3.44	x	8.86	x	0.6	x	0.7	=	8.89	(74)
East	0.9x	0.77	x	19.87	x	19.64	x	0.6	x	0.7	=	113.6	(76)
East	0.9x	0.77	x	19.87	x	38.42	x	0.6	x	0.7	=	222.22	(76)
East	0.9x	0.77	x	19.87	x	63.27	x	0.6	x	0.7	=	365.97	(76)
East	0.9x	0.77	x	19.87	x	92.28	x	0.6	x	0.7	=	533.75	(76)
East	0.9x	0.77	x	19.87	x	113.09	x	0.6	x	0.7	=	654.13	(76)
East	0.9x	0.77	x	19.87	x	115.77	x	0.6	x	0.7	=	669.62	(76)
East	0.9x	0.77	x	19.87	x	110.22	x	0.6	x	0.7	=	637.5	(76)
East	0.9x	0.77	x	19.87	x	94.68	x	0.6	x	0.7	=	547.61	(76)
East	0.9x	0.77	x	19.87	x	73.59	x	0.6	x	0.7	=	425.64	(76)
East	0.9x	0.77	x	19.87	x	45.59	x	0.6	x	0.7	=	263.69	(76)
East	0.9x	0.77	x	19.87	x	24.49	x	0.6	x	0.7	=	141.65	(76)
East	0.9x	0.77	x	19.87	x	16.15	x	0.6	x	0.7	=	93.42	(76)
South	0.9x	0.77	x	0.87	x	46.75	x	0.6	x	0.7	=	11.86	(78)
South	0.9x	0.77	x	0.87	x	76.57	x	0.6	x	0.7	=	19.43	(78)
South	0.9x	0.77	x	0.87	x	97.53	x	0.6	x	0.7	=	24.75	(78)
South	0.9x	0.77	x	0.87	x	110.23	x	0.6	x	0.7	=	27.97	(78)
South	0.9x	0.77	x	0.87	x	114.87	x	0.6	x	0.7	=	29.15	(78)
South	0.9x	0.77	x	0.87	x	110.55	x	0.6	x	0.7	=	28.05	(78)
South	0.9x	0.77	x	0.87	x	108.01	x	0.6	x	0.7	=	27.41	(78)
South	0.9x	0.77	x	0.87	x	104.89	x	0.6	x	0.7	=	26.62	(78)
South	0.9x	0.77	x	0.87	x	101.89	x	0.6	x	0.7	=	25.85	(78)
South	0.9x	0.77	x	0.87	x	82.59	x	0.6	x	0.7	=	20.95	(78)
South	0.9x	0.77	x	0.87	x	55.42	x	0.6	x	0.7	=	14.06	(78)
South	0.9x	0.77	x	0.87	x	40.4	x	0.6	x	0.7	=	10.25	(78)
West	0.9x	0.77	x	31.81	x	19.64	x	0.6	x	0.7	=	181.82	(80)
West	0.9x	0.77	x	31.81	x	38.42	x	0.6	x	0.7	=	355.68	(80)
West	0.9x	0.77	x	31.81	x	63.27	x	0.6	x	0.7	=	585.76	(80)

West	0.9x	0.77	x	31.81	x	92.28	x	0.6	x	0.7	=	854.3	(80)
West	0.9x	0.77	x	31.81	x	113.09	x	0.6	x	0.7	=	1046.97	(80)
West	0.9x	0.77	x	31.81	x	115.77	x	0.6	x	0.7	=	1071.76	(80)
West	0.9x	0.77	x	31.81	x	110.22	x	0.6	x	0.7	=	1020.36	(80)
West	0.9x	0.77	x	31.81	x	94.68	x	0.6	x	0.7	=	876.48	(80)
West	0.9x	0.77	x	31.81	x	73.59	x	0.6	x	0.7	=	681.26	(80)
West	0.9x	0.77	x	31.81	x	45.59	x	0.6	x	0.7	=	422.05	(80)
West	0.9x	0.77	x	31.81	x	24.49	x	0.6	x	0.7	=	226.71	(80)
West	0.9x	0.77	x	31.81	x	16.15	x	0.6	x	0.7	=	149.52	(80)

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

(83)m=	317.95	617.71	1011.1	1471.63	1805.16	1849.63	1760.15	1510.1	1174.38	730.95	395.57	262.08	(83)

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

(84)m=	1104.47	1401.4	1767.46	2182.89	2468.17	2468.43	2351.77	2109.2	1798.05	1399.96	1116.61	1024.5	(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	0.98	0.88	0.66	0.49	0.56	0.89	1	1	1	(86)

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

(87)m=	20.66	20.69	20.74	20.82	20.87	20.89	20.89	20.89	20.88	20.8	20.72	20.65	(87)

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

(88)m=	20.32	20.32	20.33	20.34	20.34	20.35	20.35	20.36	20.35	20.34	20.34	20.33	(88)

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

(89)m=	1	1	1	0.98	0.85	0.6	0.41	0.48	0.84	1	1	1	(89)

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

(90)m=	19.83	19.88	19.97	20.09	20.16	20.2	20.2	20.2	20.18	20.07	19.94	19.84	(90)

fLA = Living area ÷ (4) = | 0.07 | (91)

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

(92)m=	19.89	19.94	20.02	20.14	20.22	20.25	20.25	20.25	20.23	20.12	20	19.9	(92)

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

(93)m=	19.74	19.79	19.87	19.99	20.07	20.1	20.1	20.1	20.08	19.97	19.85	19.75	(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	0.97	0.83	0.58	0.39	0.45	0.82	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1104.43	1401.07	1763.33	2121.76	2055.86	1421.17	909.93	957.63	1468.45	1392.3	1116.45	1024.48	(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=	4247.9	4079.01	3647.53	2961.16	2223.54	1429.9	910.28	958.74	1569.16	2490.29	3416.82	4205.46	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(98)m=	2338.74	1799.58	1401.85	604.37	124.76	0	0	0	0	816.91	1656.27	2366.65

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 11109.11 (98)

Space heating requirement in kWh/m²/year 29.23 (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	2443.66	1923.73	1966.91	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.96	0.99	0.97	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	2343.62	1897.21	1912.03	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	3057.76	2916.81	2637.86	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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(104)m=	0	0	0	0	0	514.18	758.58	540.02	0	0	0	0

Total = Sum(104)$_{6...8}$ = 1812.78 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1.57 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	201.71	297.59	211.85	0	0	0	0

Total = Sum(107)$_{6...8}$ = 711.14 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.87 (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		89.9	(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)													
	2338.74	1799.58	1401.85	604.37	124.76	0	0	0	0	816.91	1656.27	2366.65	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	2601.49	2001.75	1559.34	672.27	138.77	0	0	0	0	908.68	1842.34	2632.53	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 12357.19 (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)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

237.06	208.94	219.4	196.64	192.68	172.13	165.27	181.41	181.1	203.91	215.66	231.35

Efficiency of water heater 79.8 (216)

(217)m=	88.86	88.73	88.39	87.19	83.49	79.8	79.8	79.8	79.8	87.68	88.61	88.9	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	266.77	235.47	248.23	225.53	230.79	215.7	207.11	227.32	226.94	232.55	243.39	260.24

Total = Sum(219a)$_{1...12}$ = 2820.05 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	49.8	73.48	52.31	0	0	0	0

Total = Sum(221)$_{6...8}$ = 175.59 (221)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		12357.19	
Water heating fuel used		2820.05	
Space cooling fuel used		175.59	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	1480.05		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	1510.05	(231)
Electricity for lighting		894.79	(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	=	2669.15	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	609.13	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3278.28	(265)
Space cooling	(221) x	0.519	=	91.13	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	783.72	(267)
Electricity for lighting	(232) x	0.519	=	464.4	(268)
Total CO2, kg/year		sum of (265)…(271) =		4617.53	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		12.15	(273)
EI rating (section 14)				85	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: 9D The Grove_Proposed_Be Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	126.23	(1a)	x	3	(2a)	=	378.69	(3a)
Ground floor	129.92	(1b)	x	3	(2b)	=	389.76	(3b)
First floor	123.86	(1c)	x	2.7	(2c)	=	334.42	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	380.01	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	1102.87	(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) =	0.04	(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)	0.29	(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) =	0.24	(21)

Infiltration rate modified for monthly wind speed

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

TER WorkSheet: New dwelling design stage

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

0.31	0.3	0.3	0.27	0.26	0.23	0.23	0.23	0.24	0.26	0.27	0.29

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=	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	(24d)

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

(25)m=	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	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 Type 1			2.89	x	1	=	2.887727			(26)
Doors Type 2			2.82	x	1	=	2.815407			(26)
Windows Type 1			3.444768	x1/[1/(1.4)+ 0.04]		=	4.57			(27)
Windows Type 2			19.87223	x1/[1/(1.4)+ 0.04]		=	26.35			(27)
Windows Type 3			0.871749	x1/[1/(1.4)+ 0.04]		=	1.16			(27)
Windows Type 4			31.8067	x1/[1/(1.4)+ 0.04]		=	42.17			(27)
Floor Type 1			126.23	x	0.13	=	16.4099			(28)
Floor Type 2			3.6905	x	0.13	=	0.479765			(28)
Walls Type1	278.86	61.7	217.17	x	0.18	=	39.09			(29)
Walls Type2	148.43	0	148.43	x	0.18	=	26.72			(29)
Roof Type1	123.86	0	123.86	x	0.13	=	16.1			(30)
Roof Type2	6.46	0	6.46	x	0.13	=	0.84			(30)
Total area of elements, m²			687.53							(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) = 179.58 (33)

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		34.35	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	213.93	(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=	199.49	198.81	198.14	195.01	194.43	191.7	191.7	191.19	192.75	194.43	195.61	196.85	(38)

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

(39)m=	413.42	412.74	412.07	408.94	408.35	405.62	405.62	405.12	406.68	408.35	409.54	410.78	

Average = Sum(39)$_{1\ldots12}$ /12= 408.94 (39)

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

(40)m=	1.09	1.09	1.08	1.08	1.07	1.07	1.07	1.07	1.07	1.07	1.08	1.08

Average = Sum(40)$_{1\ldots12}$ /12= 1.08 (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 3.24 (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) + 36 111.05 (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)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	122.16	117.72	113.27	108.83	104.39	99.95	99.95	104.39	108.83	113.27	117.72	122.16

Total = Sum(44)$_{1\ldots12}$ = 1332.64 (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=	181.16	158.44	163.5	142.54	136.77	118.02	109.37	125.5	127	148	161.56	175.44

Total = Sum(45)$_{1\ldots12}$ = 1747.31 (45)

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

(46)m=	27.17	23.77	24.52	21.38	20.52	17.7	16.4	18.82	19.05	22.2	24.23	26.32	(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:			
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=	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04	(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=	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04	

Output from water heater (annual)$_{1...12}$ | 2295.92 | (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=	97.51	86.35	91.64	83.47	82.75	75.32	73.64	79	78.3	86.49	89.79	95.61	(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=	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	(66)

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

(67)m=	49.21	43.71	35.55	26.91	20.12	16.98	18.35	23.85	32.02	40.65	47.45	50.58	(67)

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

(68)m=	520.24	525.64	512.04	483.07	446.52	412.16	389.2	383.8	397.41	426.37	462.93	497.29	(68)

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

(69)m=	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	(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=	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	(71)

Water heating gains (Table 5)

(72)m=	131.06	128.5	123.17	115.93	111.23	104.61	98.98	106.19	108.75	116.25	124.71	128.51	(72)

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

(73)m=	775.06	772.39	745.29	700.45	652.4	608.29	581.07	588.39	612.71	657.81	709.62	750.92	(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)	
North	0.9x	0.77	x	3.44	x	10.63	x	0.63	x	0.7	=	11.19	(74)
North	0.9x	0.77	x	3.44	x	20.32	x	0.63	x	0.7	=	21.39	(74)
North	0.9x	0.77	x	3.44	x	34.53	x	0.63	x	0.7	=	36.35	(74)
North	0.9x	0.77	x	3.44	x	55.46	x	0.63	x	0.7	=	58.39	(74)
North	0.9x	0.77	x	3.44	x	74.72	x	0.63	x	0.7	=	78.66	(74)
North	0.9x	0.77	x	3.44	x	79.99	x	0.63	x	0.7	=	84.21	(74)
North	0.9x	0.77	x	3.44	x	74.68	x	0.63	x	0.7	=	78.62	(74)
North	0.9x	0.77	x	3.44	x	59.25	x	0.63	x	0.7	=	62.37	(74)
North	0.9x	0.77	x	3.44	x	41.52	x	0.63	x	0.7	=	43.71	(74)
North	0.9x	0.77	x	3.44	x	24.19	x	0.63	x	0.7	=	25.47	(74)
North	0.9x	0.77	x	3.44	x	13.12	x	0.63	x	0.7	=	13.81	(74)
North	0.9x	0.77	x	3.44	x	8.86	x	0.63	x	0.7	=	9.33	(74)
East	0.9x	0.77	x	19.87	x	19.64	x	0.63	x	0.7	=	119.28	(76)
East	0.9x	0.77	x	19.87	x	38.42	x	0.63	x	0.7	=	233.34	(76)
East	0.9x	0.77	x	19.87	x	63.27	x	0.63	x	0.7	=	384.27	(76)
East	0.9x	0.77	x	19.87	x	92.28	x	0.63	x	0.7	=	560.44	(76)
East	0.9x	0.77	x	19.87	x	113.09	x	0.63	x	0.7	=	686.84	(76)
East	0.9x	0.77	x	19.87	x	115.77	x	0.63	x	0.7	=	703.1	(76)
East	0.9x	0.77	x	19.87	x	110.22	x	0.63	x	0.7	=	669.38	(76)
East	0.9x	0.77	x	19.87	x	94.68	x	0.63	x	0.7	=	574.99	(76)
East	0.9x	0.77	x	19.87	x	73.59	x	0.63	x	0.7	=	446.92	(76)
East	0.9x	0.77	x	19.87	x	45.59	x	0.63	x	0.7	=	276.87	(76)
East	0.9x	0.77	x	19.87	x	24.49	x	0.63	x	0.7	=	148.73	(76)
East	0.9x	0.77	x	19.87	x	16.15	x	0.63	x	0.7	=	98.09	(76)
South	0.9x	0.77	x	0.87	x	46.75	x	0.63	x	0.7	=	12.46	(78)
South	0.9x	0.77	x	0.87	x	76.57	x	0.63	x	0.7	=	20.4	(78)
South	0.9x	0.77	x	0.87	x	97.53	x	0.63	x	0.7	=	25.98	(78)
South	0.9x	0.77	x	0.87	x	110.23	x	0.63	x	0.7	=	29.37	(78)
South	0.9x	0.77	x	0.87	x	114.87	x	0.63	x	0.7	=	30.6	(78)
South	0.9x	0.77	x	0.87	x	110.55	x	0.63	x	0.7	=	29.45	(78)
South	0.9x	0.77	x	0.87	x	108.01	x	0.63	x	0.7	=	28.78	(78)
South	0.9x	0.77	x	0.87	x	104.89	x	0.63	x	0.7	=	27.95	(78)
South	0.9x	0.77	x	0.87	x	101.89	x	0.63	x	0.7	=	27.14	(78)
South	0.9x	0.77	x	0.87	x	82.59	x	0.63	x	0.7	=	22	(78)
South	0.9x	0.77	x	0.87	x	55.42	x	0.63	x	0.7	=	14.76	(78)
South	0.9x	0.77	x	0.87	x	40.4	x	0.63	x	0.7	=	10.76	(78)
West	0.9x	0.77	x	31.81	x	19.64	x	0.63	x	0.7	=	190.91	(80)
West	0.9x	0.77	x	31.81	x	38.42	x	0.63	x	0.7	=	373.47	(80)
West	0.9x	0.77	x	31.81	x	63.27	x	0.63	x	0.7	=	615.05	(80)

TER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	31.81	x	92.28	x	0.63	x	0.7	=	897.01	(80)
West	0.9x	0.77	x	31.81	x	113.09	x	0.63	x	0.7	=	1099.32	(80)
West	0.9x	0.77	x	31.81	x	115.77	x	0.63	x	0.7	=	1125.35	(80)
West	0.9x	0.77	x	31.81	x	110.22	x	0.63	x	0.7	=	1071.38	(80)
West	0.9x	0.77	x	31.81	x	94.68	x	0.63	x	0.7	=	920.3	(80)
West	0.9x	0.77	x	31.81	x	73.59	x	0.63	x	0.7	=	715.33	(80)
West	0.9x	0.77	x	31.81	x	45.59	x	0.63	x	0.7	=	443.15	(80)
West	0.9x	0.77	x	31.81	x	24.49	x	0.63	x	0.7	=	238.05	(80)
West	0.9x	0.77	x	31.81	x	16.15	x	0.63	x	0.7	=	157	(80)

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

(83)m=	333.84	648.6	1061.66	1545.21	1895.42	1942.11	1848.15	1585.61	1233.1	767.49	415.35	275.18	(83)

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

(84)m=	1108.9	1420.98	1806.95	2245.66	2547.82	2550.39	2429.22	2173.99	1845.82	1425.3	1124.97	1026.1	(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	0.96	0.85	0.69	0.77	0.96	1	1	1	(86)

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

(87)m=	19.55	19.69	19.96	20.32	20.66	20.89	20.97	20.95	20.74	20.29	19.86	19.53	(87)

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

(88)m=	20.01	20.01	20.01	20.02	20.02	20.03	20.03	20.03	20.03	20.02	20.02	20.02	(88)

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

(89)m=	1	1	1	0.99	0.94	0.77	0.56	0.65	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=	18.04	18.25	18.63	19.17	19.65	19.94	20.02	20.01	19.77	19.13	18.49	18.01	(90)

fLA = Living area ÷ (4) = 0.07 (91)

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

(92)m=	18.15	18.35	18.73	19.25	19.72	20.01	20.09	20.07	19.84	19.22	18.59	18.12	(92)

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

(93)m=	18.15	18.35	18.73	19.25	19.72	20.01	20.09	20.07	19.84	19.22	18.59	18.12	(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	0.93	0.77	0.57	0.65	0.92	1	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1108.74	1420.17	1801.74	2208.38	2360.36	1971.83	1380.15	1420.44	1703.03	1418.28	1124.54	1026	(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=	5725.75	5553.07	5040.23	4232.69	3276.29	2196.02	1414.17	1488.68	2335.26	3518.49	4706.08	5718.99	(97)

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

(98)m=	3435.06	2777.3	2409.44	1457.5	681.45	0	0	0	0	1562.56	2578.71	3491.59

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 18393.61 (98)

Space heating requirement in kWh/m²/year 48.4 (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)	3435.06	2777.3	2409.44	1457.5	681.45	0	0	0	0	1562.56	2578.71	3491.59		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	3673.86	2970.38	2576.94	1558.82	728.83	0	0	0	0	1671.19	2757.98	3734.32		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													19672.31	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04		
Efficiency of water heater													79.8	(216)
(217)m=	89.75	89.69	89.54	89.14	88	79.8	79.8	79.8	79.8	89.18	89.61	89.78		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	253.76	223.58	234.64	210.5	208.38	204.41	195.44	215.66	215.65	218.22	230.61	247.31		
Total = Sum(219a)$_{1...12}$ =													2658.16	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			19672.31	
Water heating fuel used			2658.16	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			869.11	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DRAFT

TER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	4249.22	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	574.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4823.38	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	451.07	(268)
Total CO2, kg/year		sum of (265)…(271) =		5313.37	(272)

TER = 13.98 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.26

Property Address: 9D The Grove_Proposed_Be Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	126.23	(1a) x	3	(2a) =	378.69	(3a)
Ground floor	129.92	(1b) x	3	(2b) =	389.76	(3b)
First floor	123.86	(1c) x	2.7	(2c) =	334.42	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	380.01	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		1102.87	(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
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

DER WorkSheet: New dwelling design stage

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)

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 Type 1			2.89	x	1	=	2.887727			(26)
Doors Type 2			2.82	x	1	=	2.815407			(26)
Windows Type 1			3.444768	x1/[1/(0.8)+ 0.04]		=	2.67			(27)
Windows Type 2			19.87223	x1/[1/(0.8)+ 0.04]		=	15.4			(27)
Windows Type 3			0.871749	x1/[1/(0.8)+ 0.04]		=	0.68			(27)
Windows Type 4			31.8067	x1/[1/(0.8)+ 0.04]		=	24.66			(27)
Floor Type 1			126.23	x	0.1	=	12.623			(28)
Floor Type 2			3.6905	x	0.1	=	0.36905			(28)
Walls Type1	278.86	61.7	217.17	x	0.15	=	32.57			(29)
Walls Type2	148.43	0	148.43	x	0.15	=	22.26			(29)
Roof Type1	123.86	0	123.86	x	0.12	=	14.86			(30)
Roof Type2	6.46	0	6.46	x	0.12	=	0.77			(30)
Total area of elements, m²			687.53							(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) = 132.58 (33)

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 | 34.35 | (36)

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

Total fabric heat loss (33) + (36) = | 166.93 | (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=	108.12	106.96	105.8	99.99	98.83	93.03	93.03	91.87	95.35	98.83	101.15	103.47	(38)

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

(39)m=	275.04	273.88	272.72	266.92	265.76	259.96	259.96	258.8	262.28	265.76	268.08	270.4	

Average = $Sum(39)_{1...12}$ /12= | 266.63 | (39)

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

(40)m=	0.72	0.72	0.72	0.7	0.7	0.68	0.68	0.68	0.69	0.7	0.71	0.71	

Average = $Sum(40)_{1...12}$ /12= | 0.7 | (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 | 3.24 | (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 | 111.05 | (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)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	122.16	117.72	113.27	108.83	104.39	99.95	99.95	104.39	108.83	113.27	117.72	122.16	

Total = $Sum(44)_{1...12}$ = | 1332.64 | (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=	181.16	158.44	163.5	142.54	136.77	118.02	109.37	125.5	127	148	161.56	175.44	

Total = $Sum(45)_{1...12}$ = | 1747.31 | (45)

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

(46)m=	27.17	23.77	24.52	21.38	20.52	17.7	16.4	18.82	19.05	22.2	24.23	26.32	(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:

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)

DER WorkSheet: New dwelling design stage

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=	237.06	208.94	219.4	196.64	192.68	172.13	165.27	181.41	181.1	203.91	215.66	231.35	(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=	237.06	208.94	219.4	196.64	192.68	172.13	165.27	181.41	181.1	203.91	215.66	231.35	

Output from water heater (annual)$_{1...12}$ — 2405.55 (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=	104.96	93.08	99.09	90.68	90.2	82.52	81.09	86.45	85.51	93.94	97	103.06	(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=	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	(66)

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

(67)m=	50.67	45	36.6	27.71	20.71	17.49	18.89	24.56	32.96	41.85	48.85	52.08	(67)

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

(68)m=	520.24	525.64	512.04	483.07	446.52	412.16	389.2	383.8	397.41	426.37	462.93	497.29	(68)

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

(69)m=	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	(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=	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	(71)

Water heating gains (Table 5)

(72)m=	141.07	138.51	133.18	125.94	121.24	114.62	108.99	116.2	118.76	126.26	134.72	138.52	(72)

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

(73)m=	786.52	783.69	756.36	711.26	663	618.8	591.63	599.1	623.67	669.02	721.04	762.42	(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.44	x	10.63	x	0.6	x	0.7	=	10.66	(74)
North	0.9x	0.77	x	3.44	x	20.32	x	0.6	x	0.7	=	20.37	(74)
North	0.9x	0.77	x	3.44	x	34.53	x	0.6	x	0.7	=	34.62	(74)
North	0.9x	0.77	x	3.44	x	55.46	x	0.6	x	0.7	=	55.61	(74)
North	0.9x	0.77	x	3.44	x	74.72	x	0.6	x	0.7	=	74.91	(74)
North	0.9x	0.77	x	3.44	x	79.99	x	0.6	x	0.7	=	80.2	(74)
North	0.9x	0.77	x	3.44	x	74.68	x	0.6	x	0.7	=	74.87	(74)
North	0.9x	0.77	x	3.44	x	59.25	x	0.6	x	0.7	=	59.4	(74)
North	0.9x	0.77	x	3.44	x	41.52	x	0.6	x	0.7	=	41.63	(74)
North	0.9x	0.77	x	3.44	x	24.19	x	0.6	x	0.7	=	24.25	(74)
North	0.9x	0.77	x	3.44	x	13.12	x	0.6	x	0.7	=	13.15	(74)
North	0.9x	0.77	x	3.44	x	8.86	x	0.6	x	0.7	=	8.89	(74)
East	0.9x	0.77	x	19.87	x	19.64	x	0.6	x	0.7	=	113.6	(76)
East	0.9x	0.77	x	19.87	x	38.42	x	0.6	x	0.7	=	222.22	(76)
East	0.9x	0.77	x	19.87	x	63.27	x	0.6	x	0.7	=	365.97	(76)
East	0.9x	0.77	x	19.87	x	92.28	x	0.6	x	0.7	=	533.75	(76)
East	0.9x	0.77	x	19.87	x	113.09	x	0.6	x	0.7	=	654.13	(76)
East	0.9x	0.77	x	19.87	x	115.77	x	0.6	x	0.7	=	669.62	(76)
East	0.9x	0.77	x	19.87	x	110.22	x	0.6	x	0.7	=	637.5	(76)
East	0.9x	0.77	x	19.87	x	94.68	x	0.6	x	0.7	=	547.61	(76)
East	0.9x	0.77	x	19.87	x	73.59	x	0.6	x	0.7	=	425.64	(76)
East	0.9x	0.77	x	19.87	x	45.59	x	0.6	x	0.7	=	263.69	(76)
East	0.9x	0.77	x	19.87	x	24.49	x	0.6	x	0.7	=	141.65	(76)
East	0.9x	0.77	x	19.87	x	16.15	x	0.6	x	0.7	=	93.42	(76)
South	0.9x	0.77	x	0.87	x	46.75	x	0.6	x	0.7	=	11.86	(78)
South	0.9x	0.77	x	0.87	x	76.57	x	0.6	x	0.7	=	19.43	(78)
South	0.9x	0.77	x	0.87	x	97.53	x	0.6	x	0.7	=	24.75	(78)
South	0.9x	0.77	x	0.87	x	110.23	x	0.6	x	0.7	=	27.97	(78)
South	0.9x	0.77	x	0.87	x	114.87	x	0.6	x	0.7	=	29.15	(78)
South	0.9x	0.77	x	0.87	x	110.55	x	0.6	x	0.7	=	28.05	(78)
South	0.9x	0.77	x	0.87	x	108.01	x	0.6	x	0.7	=	27.41	(78)
South	0.9x	0.77	x	0.87	x	104.89	x	0.6	x	0.7	=	26.62	(78)
South	0.9x	0.77	x	0.87	x	101.89	x	0.6	x	0.7	=	25.85	(78)
South	0.9x	0.77	x	0.87	x	82.59	x	0.6	x	0.7	=	20.95	(78)
South	0.9x	0.77	x	0.87	x	55.42	x	0.6	x	0.7	=	14.06	(78)
South	0.9x	0.77	x	0.87	x	40.4	x	0.6	x	0.7	=	10.25	(78)
West	0.9x	0.77	x	31.81	x	19.64	x	0.6	x	0.7	=	181.82	(80)
West	0.9x	0.77	x	31.81	x	38.42	x	0.6	x	0.7	=	355.68	(80)
West	0.9x	0.77	x	31.81	x	63.27	x	0.6	x	0.7	=	585.76	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	31.81	x	92.28	x	0.6	x	0.7	=	854.3	(80)
West	0.9x	0.77	x	31.81	x	113.09	x	0.6	x	0.7	=	1046.97	(80)
West	0.9x	0.77	x	31.81	x	115.77	x	0.6	x	0.7	=	1071.76	(80)
West	0.9x	0.77	x	31.81	x	110.22	x	0.6	x	0.7	=	1020.36	(80)
West	0.9x	0.77	x	31.81	x	94.68	x	0.6	x	0.7	=	876.48	(80)
West	0.9x	0.77	x	31.81	x	73.59	x	0.6	x	0.7	=	681.26	(80)
West	0.9x	0.77	x	31.81	x	45.59	x	0.6	x	0.7	=	422.05	(80)
West	0.9x	0.77	x	31.81	x	24.49	x	0.6	x	0.7	=	226.71	(80)
West	0.9x	0.77	x	31.81	x	16.15	x	0.6	x	0.7	=	149.52	(80)

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

(83)m=	317.95	617.71	1011.1	1471.63	1805.16	1849.63	1760.15	1510.1	1174.38	730.95	395.57	262.08	(83)

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

(84)m=	1104.47	1401.4	1767.46	2182.89	2468.17	2468.43	2351.77	2109.2	1798.05	1399.96	1116.61	1024.5	(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	0.98	0.88	0.66	0.49	0.56	0.89	1	1	1	(86)

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

(87)m=	20.66	20.69	20.74	20.82	20.87	20.89	20.89	20.89	20.88	20.8	20.72	20.65	(87)

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

(88)m=	20.32	20.32	20.33	20.34	20.34	20.35	20.35	20.36	20.35	20.34	20.34	20.33	(88)

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

(89)m=	1	1	1	0.98	0.85	0.6	0.41	0.48	0.84	1	1	1	(89)

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

(90)m=	19.83	19.88	19.97	20.09	20.16	20.2	20.2	20.2	20.18	20.07	19.94	19.84	(90)

fLA = Living area ÷ (4) = 0.07 (91)

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

(92)m=	19.89	19.94	20.02	20.14	20.22	20.25	20.25	20.25	20.23	20.12	20	19.9	(92)

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

(93)m=	19.74	19.79	19.87	19.99	20.07	20.1	20.1	20.1	20.08	19.97	19.85	19.75	(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	0.97	0.83	0.58	0.39	0.45	0.82	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1104.43	1401.07	1763.33	2121.76	2055.86	1421.17	909.93	957.63	1468.45	1392.3	1116.45	1024.48	(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=	4247.9	4079.01	3647.53	2961.16	2223.54	1429.9	910.28	958.74	1569.16	2490.29	3416.82	4205.46	(97)

DER WorkSheet: New dwelling design stage

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

(98)m=	2338.74	1799.58	1401.85	604.37	124.76	0	0	0	0	816.91	1656.27	2366.65

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 11109.11 (98)

Space heating requirement in kWh/m²/year 29.23 (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	2443.66	1923.73	1966.91	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.96	0.99	0.97	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	2343.62	1897.21	1912.03	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	3057.76	2916.81	2637.86	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	514.18	758.58	540.02	0	0	0	0

Total = $Sum(104)_{6...8}$ = 1812.78 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1.57 (105)

Intermittency factor (Table 10b)

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

Total = $Sum(104)_{6...8}$ = 0 (106)

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

(107)m=	0	0	0	0	0	201.71	297.59	211.85	0	0	0	0

Total = $Sum(107)_{6...8}$ = 711.14 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.87 (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		89.9	(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)													
	2338.74	1799.58	1401.85	604.37	124.76	0	0	0	0	816.91	1656.27	2366.65	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	2601.49	2001.75	1559.34	672.27	138.77	0	0	0	0	908.68	1842.34	2632.53	

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 12357.19 (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)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

	237.06	208.94	219.4	196.64	192.68	172.13	165.27	181.41	181.1	203.91	215.66	231.35	
Efficiency of water heater													79.8 (216)
(217)m=	88.86	88.73	88.39	87.19	83.49	79.8	79.8	79.8	79.8	87.68	88.61	88.9	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	266.77	235.47	248.23	225.53	230.79	215.7	207.11	227.32	226.94	232.55	243.39	260.24	

Total = Sum(219a)$_{1...12}$ = 2820.05 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	49.8	73.48	52.31	0	0	0	0

Total = Sum(221)$_{6...8}$ = 175.59 (221)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		12357.19	
Water heating fuel used		2820.05	
Space cooling fuel used		175.59	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	1480.05		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	1510.05	(231)
Electricity for lighting		894.79	(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	=	2669.15	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	609.13	(264)
Space and water heating	(261) + (262) + (263) + (264) =				3278.28	(265)
Space cooling	(221)	x	0.519	=	91.13	(266)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	783.72	(267)
Electricity for lighting	(232)	x	0.519	=	464.4	(268)
Total CO2, kg/year			sum of (265)…(271) =		4617.53	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		12.15	(273)
EI rating (section 14)					85	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: 9D The Grove_Proposed_Be Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	126.23	(1a)	x	3	(2a)	=	378.69	(3a)
Ground floor	129.92	(1b)	x	3	(2b)	=	389.76	(3b)
First floor	123.86	(1c)	x	2.7	(2c)	=	334.42	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	380.01	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	1102.87	(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)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.04	(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)	0.29	(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) =	0.24	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.31	0.3	0.3	0.27	0.26	0.23	0.23	0.23	0.24	0.26	0.27	0.29

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=	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	(24d)

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

(25)m=	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	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 Type 1			2.89	x	1	=	2.887727			(26)
Doors Type 2			2.82	x	1	=	2.815407			(26)
Windows Type 1			3.444768	x1/[1/(1.4)+ 0.04]		=	4.57			(27)
Windows Type 2			19.87223	x1/[1/(1.4)+ 0.04]		=	26.35			(27)
Windows Type 3			0.871749	x1/[1/(1.4)+ 0.04]		=	1.16			(27)
Windows Type 4			31.8067	x1/[1/(1.4)+ 0.04]		=	42.17			(27)
Floor Type 1			126.23	x	0.13	=	16.4099			(28)
Floor Type 2			3.6905	x	0.13	=	0.479765			(28)
Walls Type1	278.86	61.7	217.17	x	0.18	=	39.09			(29)
Walls Type2	148.43	0	148.43	x	0.18	=	26.72			(29)
Roof Type1	123.86	0	123.86	x	0.13	=	16.1			(30)
Roof Type2	6.46	0	6.46	x	0.13	=	0.84			(30)
Total area of elements, m²			687.53							(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) = 179.58 (33)

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 — 34.35 (36)

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

Total fabric heat loss — (33) + (36) = — 213.93 (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=	199.49	198.81	198.14	195.01	194.43	191.7	191.7	191.19	192.75	194.43	195.61	196.85	(38)

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

(39)m=	413.42	412.74	412.07	408.94	408.35	405.62	405.62	405.12	406.68	408.35	409.54	410.78	

Average = $Sum(39)_{1...12}$ /12= 408.94 (39)

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

(40)m=	1.09	1.09	1.08	1.08	1.07	1.07	1.07	1.07	1.07	1.07	1.08	1.08	

Average = $Sum(40)_{1...12}$ /12= 1.08 (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 — 3.24 (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 — 111.05 (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)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	122.16	117.72	113.27	108.83	104.39	99.95	99.95	104.39	108.83	113.27	117.72	122.16

Total = $Sum(44)_{1...12}$ = 1332.64 (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=	181.16	158.44	163.5	142.54	136.77	118.02	109.37	125.5	127	148	161.56	175.44

Total = $Sum(45)_{1...12}$ = 1747.31 (45)

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

(46)m=	27.17	23.77	24.52	21.38	20.52	17.7	16.4	18.82	19.05	22.2	24.23	26.32	(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:

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)

TER WorkSheet: New dwelling design stage

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=	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04	(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=	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04	

Output from water heater (annual)$_{1...12}$ 2295.92 (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=	97.51	86.35	91.64	83.47	82.75	75.32	73.64	79	78.3	86.49	89.79	95.61	(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=	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	(66)

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

(67)m=	49.21	43.71	35.55	26.91	20.12	16.98	18.35	23.85	32.02	40.65	47.45	50.58	(67)

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

(68)m=	520.24	525.64	512.04	483.07	446.52	412.16	389.2	383.8	397.41	426.37	462.93	497.29	(68)

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

(69)m=	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	(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=	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	(71)

Water heating gains (Table 5)

(72)m=	131.06	128.5	123.17	115.93	111.23	104.61	98.98	106.19	108.75	116.25	124.71	128.51	(72)

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

(73)m=	775.06	772.39	745.29	700.45	652.4	608.29	581.07	588.39	612.71	657.81	709.62	750.92	(73)

6. Solar gains:

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

TER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.44	x	10.63	x	0.63	x	0.7	=	11.19	(74)
North	0.9x	0.77	x	3.44	x	20.32	x	0.63	x	0.7	=	21.39	(74)
North	0.9x	0.77	x	3.44	x	34.53	x	0.63	x	0.7	=	36.35	(74)
North	0.9x	0.77	x	3.44	x	55.46	x	0.63	x	0.7	=	58.39	(74)
North	0.9x	0.77	x	3.44	x	74.72	x	0.63	x	0.7	=	78.66	(74)
North	0.9x	0.77	x	3.44	x	79.99	x	0.63	x	0.7	=	84.21	(74)
North	0.9x	0.77	x	3.44	x	74.68	x	0.63	x	0.7	=	78.62	(74)
North	0.9x	0.77	x	3.44	x	59.25	x	0.63	x	0.7	=	62.37	(74)
North	0.9x	0.77	x	3.44	x	41.52	x	0.63	x	0.7	=	43.71	(74)
North	0.9x	0.77	x	3.44	x	24.19	x	0.63	x	0.7	=	25.47	(74)
North	0.9x	0.77	x	3.44	x	13.12	x	0.63	x	0.7	=	13.81	(74)
North	0.9x	0.77	x	3.44	x	8.86	x	0.63	x	0.7	=	9.33	(74)
East	0.9x	0.77	x	19.87	x	19.64	x	0.63	x	0.7	=	119.28	(76)
East	0.9x	0.77	x	19.87	x	38.42	x	0.63	x	0.7	=	233.34	(76)
East	0.9x	0.77	x	19.87	x	63.27	x	0.63	x	0.7	=	384.27	(76)
East	0.9x	0.77	x	19.87	x	92.28	x	0.63	x	0.7	=	560.44	(76)
East	0.9x	0.77	x	19.87	x	113.09	x	0.63	x	0.7	=	686.84	(76)
East	0.9x	0.77	x	19.87	x	115.77	x	0.63	x	0.7	=	703.1	(76)
East	0.9x	0.77	x	19.87	x	110.22	x	0.63	x	0.7	=	669.38	(76)
East	0.9x	0.77	x	19.87	x	94.68	x	0.63	x	0.7	=	574.99	(76)
East	0.9x	0.77	x	19.87	x	73.59	x	0.63	x	0.7	=	446.92	(76)
East	0.9x	0.77	x	19.87	x	45.59	x	0.63	x	0.7	=	276.87	(76)
East	0.9x	0.77	x	19.87	x	24.49	x	0.63	x	0.7	=	148.73	(76)
East	0.9x	0.77	x	19.87	x	16.15	x	0.63	x	0.7	=	98.09	(76)
South	0.9x	0.77	x	0.87	x	46.75	x	0.63	x	0.7	=	12.46	(78)
South	0.9x	0.77	x	0.87	x	76.57	x	0.63	x	0.7	=	20.4	(78)
South	0.9x	0.77	x	0.87	x	97.53	x	0.63	x	0.7	=	25.98	(78)
South	0.9x	0.77	x	0.87	x	110.23	x	0.63	x	0.7	=	29.37	(78)
South	0.9x	0.77	x	0.87	x	114.87	x	0.63	x	0.7	=	30.6	(78)
South	0.9x	0.77	x	0.87	x	110.55	x	0.63	x	0.7	=	29.45	(78)
South	0.9x	0.77	x	0.87	x	108.01	x	0.63	x	0.7	=	28.78	(78)
South	0.9x	0.77	x	0.87	x	104.89	x	0.63	x	0.7	=	27.95	(78)
South	0.9x	0.77	x	0.87	x	101.89	x	0.63	x	0.7	=	27.14	(78)
South	0.9x	0.77	x	0.87	x	82.59	x	0.63	x	0.7	=	22	(78)
South	0.9x	0.77	x	0.87	x	55.42	x	0.63	x	0.7	=	14.76	(78)
South	0.9x	0.77	x	0.87	x	40.4	x	0.63	x	0.7	=	10.76	(78)
West	0.9x	0.77	x	31.81	x	19.64	x	0.63	x	0.7	=	190.91	(80)
West	0.9x	0.77	x	31.81	x	38.42	x	0.63	x	0.7	=	373.47	(80)
West	0.9x	0.77	x	31.81	x	63.27	x	0.63	x	0.7	=	615.05	(80)

TER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	31.81	x	92.28	x	0.63	x	0.7	=	897.01	(80)
West	0.9x	0.77	x	31.81	x	113.09	x	0.63	x	0.7	=	1099.32	(80)
West	0.9x	0.77	x	31.81	x	115.77	x	0.63	x	0.7	=	1125.35	(80)
West	0.9x	0.77	x	31.81	x	110.22	x	0.63	x	0.7	=	1071.38	(80)
West	0.9x	0.77	x	31.81	x	94.68	x	0.63	x	0.7	=	920.3	(80)
West	0.9x	0.77	x	31.81	x	73.59	x	0.63	x	0.7	=	715.33	(80)
West	0.9x	0.77	x	31.81	x	45.59	x	0.63	x	0.7	=	443.15	(80)
West	0.9x	0.77	x	31.81	x	24.49	x	0.63	x	0.7	=	238.05	(80)
West	0.9x	0.77	x	31.81	x	16.15	x	0.63	x	0.7	=	157	(80)

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

(83)m=	333.84	648.6	1061.66	1545.21	1895.42	1942.11	1848.15	1585.61	1233.1	767.49	415.35	275.18	(83)

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

(84)m=	1108.9	1420.98	1806.95	2245.66	2547.82	2550.39	2429.22	2173.99	1845.82	1425.3	1124.97	1026.1	(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	0.96	0.85	0.69	0.77	0.96	1	1	1	(86)

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

(87)m=	19.55	19.69	19.96	20.32	20.66	20.89	20.97	20.95	20.74	20.29	19.86	19.53	(87)

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

(88)m=	20.01	20.01	20.01	20.02	20.02	20.03	20.03	20.03	20.03	20.02	20.02	20.02	(88)

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

(89)m=	1	1	1	0.99	0.94	0.77	0.56	0.65	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=	18.04	18.25	18.63	19.17	19.65	19.94	20.02	20.01	19.77	19.13	18.49	18.01	(90)

fLA = Living area ÷ (4) = | 0.07 | (91)

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

(92)m=	18.15	18.35	18.73	19.25	19.72	20.01	20.09	20.07	19.84	19.22	18.59	18.12	(92)

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

(93)m=	18.15	18.35	18.73	19.25	19.72	20.01	20.09	20.07	19.84	19.22	18.59	18.12	(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	0.93	0.77	0.57	0.65	0.92	1	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1108.74	1420.17	1801.74	2208.38	2360.36	1971.83	1380.15	1420.44	1703.03	1418.28	1124.54	1026	(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=	5725.75	5553.07	5040.23	4232.69	3276.29	2196.02	1414.17	1488.68	2335.26	3518.49	4706.08	5718.99	(97)

TER WorkSheet: New dwelling design stage

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

(98)m=	3435.06	2777.3	2409.44	1457.5	681.45	0	0	0	0	1562.56	2578.71	3491.59

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 18393.61 (98)

Space heating requirement in kWh/m²/year 48.4 (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)	3435.06	2777.3	2409.44	1457.5	681.45	0	0	0	0	1562.56	2578.71	3491.59		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	3673.86	2970.38	2576.94	1558.82	728.83	0	0	0	0	1671.19	2757.98	3734.32		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													19672.31	(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)	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04		
Efficiency of water heater													79.8	(216)
(217)m=	89.75	89.69	89.54	89.14	88	79.8	79.8	79.8	79.8	89.18	89.61	89.78		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	253.76	223.58	234.64	210.5	208.38	204.41	195.44	215.66	215.65	218.22	230.61	247.31		
Total = Sum(219a)$_{1...12}$ =													2658.16	(219)

Annual totals

		kWh/year	kWh/year	
Space heating fuel used, main system 1			19672.31	
Water heating fuel used			2658.16	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			869.11	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year

TER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	4249.22	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	574.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4823.38	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	451.07	(268)
Total CO2, kg/year		sum of (265)…(271) =		5313.37	(272)

TER = 13.98 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: 9D The Grove_Proposed_Be Green

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	126.23	(1a)	x	3	(2a)	=	378.69	(3a)
Ground floor	129.92	(1b)	x	3	(2b)	=	389.76	(3b)
First floor	123.86	(1c)	x	2.7	(2c)	=	334.42	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	380.01	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	1102.87	(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
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)

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 Type 1			2.89	x	1	=	2.887727			(26)
Doors Type 2			2.82	x	1	=	2.815407			(26)
Windows Type 1			3.444768	x1/[1/(0.8)+ 0.04]		=	2.67			(27)
Windows Type 2			19.87223	x1/[1/(0.8)+ 0.04]		=	15.4			(27)
Windows Type 3			0.871749	x1/[1/(0.8)+ 0.04]		=	0.68			(27)
Windows Type 4			31.8067	x1/[1/(0.8)+ 0.04]		=	24.66			(27)
Floor Type 1			126.23	x	0.1	=	12.623			(28)
Floor Type 2			3.6905	x	0.1	=	0.36905			(28)
Walls Type1	278.86	61.7	217.17	x	0.15	=	32.57			(29)
Walls Type2	148.43	0	148.43	x	0.15	=	22.26			(29)
Roof Type1	123.86	0	123.86	x	0.12	=	14.86			(30)
Roof Type2	6.46	0	6.46	x	0.12	=	0.77			(30)
Total area of elements, m²			687.53							(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) =	132.58	(33)
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 | 34.35 | (36)

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

Total fabric heat loss (33) + (36) = | 166.93 | (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=	108.12	106.96	105.8	99.99	98.83	93.03	93.03	91.87	95.35	98.83	101.15	103.47	(38)

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

(39)m=	275.04	273.88	272.72	266.92	265.76	259.96	259.96	258.8	262.28	265.76	268.08	270.4	

Average = Sum(39)$_{1…12}$ /12= | 266.63 | (39)

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

(40)m=	0.72	0.72	0.72	0.7	0.7	0.68	0.68	0.68	0.69	0.7	0.71	0.71

Average = Sum(40)$_{1…12}$ /12= | 0.7 | (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 | 3.24 | (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 | 111.05 | (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=	122.16	117.72	113.27	108.83	104.39	99.95	99.95	104.39	108.83	113.27	117.72	122.16

Total = Sum(44)$_{1…12}$ = | 1332.64 | (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=	181.16	158.44	163.5	142.54	136.77	118.02	109.37	125.5	127	148	161.56	175.44

Total = Sum(45)$_{1…12}$ = | 1747.31 | (45)

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

(46)m=	27.17	23.77	24.52	21.38	20.52	17.7	16.4	18.82	19.05	22.2	24.23	26.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 151.6 | (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:

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=	32.29	29.17	32.29	31.25	32.29	31.25	32.29	32.29	31.25	32.29	31.25	32.29	(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	21.87	15.76	10.47	9.91	10.24	11.17	17.11	21.87	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=	236.72	208.62	217.66	189.55	179.53	159.18	151.9	168.96	175.36	202.17	215.32	231	(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=	-17.34	-28.94	-49.29	-66.06	-81.62	-80.24	-79.18	-69.18	-54.18	-37	-20.57	-14.51	(63)

Output from water heater

(64)m=	219.37	179.68	168.37	123.49	97.92	78.94	72.72	99.78	121.18	165.17	194.75	216.48	

Output from water heater (annual)$_{1...12}$ | 1737.84 | (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=	104.68	92.83	97.69	85	79.69	72.17	70.39	76.5	80.92	92.54	96.73	102.78	(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=	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	(66)

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

(67)m=	50.67	45	36.6	27.71	20.71	17.49	18.89	24.56	32.96	41.85	48.85	52.08	(67)

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

(68)m=	520.24	525.64	512.04	483.07	446.52	412.16	389.2	383.8	397.41	426.37	462.93	497.29	(68)

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

(69)m=	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	(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=	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	(71)

Water heating gains (Table 5)

(72)m=	140.7	138.13	131.31	118.06	107.11	100.24	94.61	102.82	112.38	124.38	134.35	138.15	(72)

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

(73)m=	783.15	780.32	751.48	700.38	645.87	601.42	574.24	582.72	614.29	664.14	717.66	759.05	(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.44	x	10.63	x	0.6	x	0.7	=	10.66	(74)
North	0.9x	0.77	x	3.44	x	20.32	x	0.6	x	0.7	=	20.37	(74)
North	0.9x	0.77	x	3.44	x	34.53	x	0.6	x	0.7	=	34.62	(74)
North	0.9x	0.77	x	3.44	x	55.46	x	0.6	x	0.7	=	55.61	(74)
North	0.9x	0.77	x	3.44	x	74.72	x	0.6	x	0.7	=	74.91	(74)
North	0.9x	0.77	x	3.44	x	79.99	x	0.6	x	0.7	=	80.2	(74)
North	0.9x	0.77	x	3.44	x	74.68	x	0.6	x	0.7	=	74.87	(74)
North	0.9x	0.77	x	3.44	x	59.25	x	0.6	x	0.7	=	59.4	(74)
North	0.9x	0.77	x	3.44	x	41.52	x	0.6	x	0.7	=	41.63	(74)
North	0.9x	0.77	x	3.44	x	24.19	x	0.6	x	0.7	=	24.25	(74)
North	0.9x	0.77	x	3.44	x	13.12	x	0.6	x	0.7	=	13.15	(74)
North	0.9x	0.77	x	3.44	x	8.86	x	0.6	x	0.7	=	8.89	(74)
East	0.9x	0.77	x	19.87	x	19.64	x	0.6	x	0.7	=	113.6	(76)
East	0.9x	0.77	x	19.87	x	38.42	x	0.6	x	0.7	=	222.22	(76)
East	0.9x	0.77	x	19.87	x	63.27	x	0.6	x	0.7	=	365.97	(76)
East	0.9x	0.77	x	19.87	x	92.28	x	0.6	x	0.7	=	533.75	(76)
East	0.9x	0.77	x	19.87	x	113.09	x	0.6	x	0.7	=	654.13	(76)
East	0.9x	0.77	x	19.87	x	115.77	x	0.6	x	0.7	=	669.62	(76)
East	0.9x	0.77	x	19.87	x	110.22	x	0.6	x	0.7	=	637.5	(76)
East	0.9x	0.77	x	19.87	x	94.68	x	0.6	x	0.7	=	547.61	(76)
East	0.9x	0.77	x	19.87	x	73.59	x	0.6	x	0.7	=	425.64	(76)
East	0.9x	0.77	x	19.87	x	45.59	x	0.6	x	0.7	=	263.69	(76)
East	0.9x	0.77	x	19.87	x	24.49	x	0.6	x	0.7	=	141.65	(76)
East	0.9x	0.77	x	19.87	x	16.15	x	0.6	x	0.7	=	93.42	(76)
South	0.9x	0.77	x	0.87	x	46.75	x	0.6	x	0.7	=	11.86	(78)
South	0.9x	0.77	x	0.87	x	76.57	x	0.6	x	0.7	=	19.43	(78)
South	0.9x	0.77	x	0.87	x	97.53	x	0.6	x	0.7	=	24.75	(78)
South	0.9x	0.77	x	0.87	x	110.23	x	0.6	x	0.7	=	27.97	(78)
South	0.9x	0.77	x	0.87	x	114.87	x	0.6	x	0.7	=	29.15	(78)
South	0.9x	0.77	x	0.87	x	110.55	x	0.6	x	0.7	=	28.05	(78)
South	0.9x	0.77	x	0.87	x	108.01	x	0.6	x	0.7	=	27.41	(78)
South	0.9x	0.77	x	0.87	x	104.89	x	0.6	x	0.7	=	26.62	(78)
South	0.9x	0.77	x	0.87	x	101.89	x	0.6	x	0.7	=	25.85	(78)
South	0.9x	0.77	x	0.87	x	82.59	x	0.6	x	0.7	=	20.95	(78)
South	0.9x	0.77	x	0.87	x	55.42	x	0.6	x	0.7	=	14.06	(78)
South	0.9x	0.77	x	0.87	x	40.4	x	0.6	x	0.7	=	10.25	(78)
West	0.9x	0.77	x	31.81	x	19.64	x	0.6	x	0.7	=	181.82	(80)
West	0.9x	0.77	x	31.81	x	38.42	x	0.6	x	0.7	=	355.68	(80)
West	0.9x	0.77	x	31.81	x	63.27	x	0.6	x	0.7	=	585.76	(80)

West	0.9x	0.77	x	31.81	x	92.28	x	0.6	x	0.7	=	854.3	(80)
West	0.9x	0.77	x	31.81	x	113.09	x	0.6	x	0.7	=	1046.97	(80)
West	0.9x	0.77	x	31.81	x	115.77	x	0.6	x	0.7	=	1071.76	(80)
West	0.9x	0.77	x	31.81	x	110.22	x	0.6	x	0.7	=	1020.36	(80)
West	0.9x	0.77	x	31.81	x	94.68	x	0.6	x	0.7	=	876.48	(80)
West	0.9x	0.77	x	31.81	x	73.59	x	0.6	x	0.7	=	681.26	(80)
West	0.9x	0.77	x	31.81	x	45.59	x	0.6	x	0.7	=	422.05	(80)
West	0.9x	0.77	x	31.81	x	24.49	x	0.6	x	0.7	=	226.71	(80)
West	0.9x	0.77	x	31.81	x	16.15	x	0.6	x	0.7	=	149.52	(80)

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

(83)m=	317.95	617.71	1011.1	1471.63	1805.16	1849.63	1760.15	1510.1	1174.38	730.95	395.57	262.08	(83)

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

(84)m=	1101.09	1398.03	1762.58	2172.01	2451.04	2451.04	2334.39	2092.82	1788.68	1395.09	1113.23	1021.13	(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	0.98	0.89	0.67	0.49	0.57	0.89	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=	20.32	20.32	20.33	20.34	20.34	20.35	20.35	20.36	20.35	20.34	20.34	20.33	(88)

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

(89)m=	1	1	1	0.98	0.85	0.61	0.42	0.49	0.84	1	1	1	(89)

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

(90)m=	20.32	20.32	20.33	20.34	20.34	20.35	20.35	20.36	20.35	20.34	20.34	20.33	(90)

fLA = Living area ÷ (4) = 0.07 (91)

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

(92)m=	20.37	20.37	20.37	20.39	20.39	20.4	20.4	20.4	20.4	20.39	20.38	20.38	(92)

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

(93)m=	20.37	20.37	20.37	20.39	20.39	20.4	20.4	20.4	20.4	20.39	20.38	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	0.86	0.61	0.42	0.49	0.85	1	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1101.07	1397.78	1759.4	2123.25	2098.15	1494.83	987.74	1034.27	1514.87	1389.46	1113.12	1021.11	(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=	4419.92	4237.63	3784	3066.23	2309.43	1508.38	988.46	1036.45	1651.67	2601.77	3561.44	4375.08	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(98)m=	2469.23	1908.38	1506.3	678.94	157.19	0	0	0	0	901.96	1762.79	2495.35

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 11880.14 (98)

Space heating requirement in kWh/m²/year 31.26 (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	2443.66	1923.73	1966.91	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.96	0.99	0.97	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	2341.14	1896.4	1910.45	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	3043.38	2902.43	2624.48	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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(104)m=	0	0	0	0	0	505.62	748.48	531.24	0	0	0	0

Total = Sum(104)$_{6...8}$ = 1785.33 (104)

Cooled fraction f C = cooled area ÷ (4) = 1.57 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	198.35	293.62	208.4	0	0	0	0

Total = Sum(107)$_{6...8}$ = 700.37 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.84 (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		396.16	(206)
Efficiency of secondary/supplementary heating system, %		65	(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)	2469.23	1908.38	1506.3	678.94	157.19	0	0	0	0	901.96	1762.79	2495.35	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	623.29	481.72	380.22	171.38	39.68	0	0	0	0	227.68	444.97	629.89	(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2998.82 (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)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

219.37	179.68	168.37	123.49	97.92	78.94	72.72	99.78	121.18	165.17	194.75	216.48

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=	183.82	150.56	141.08	103.48	82.05	66.15	60.93	83.61	101.54	138.4	163.19	181.4

Total = Sum(219a)$_{1...12}$ = 1456.21 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	48.98	72.5	51.46	0	0	0	0

Total = Sum(221)$_{6...8}$ = 172.93 (221)

Annual totals

	kWh/year	kWh/year	
Space heating fuel used, main system 1		2998.82	
Water heating fuel used		1456.21	
Space cooling fuel used		172.93	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	1480.05		(230a)
pump for solar water heating	50		(230g)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		1530.05	(231)
Electricity for lighting		894.79	(232)
Electricity generated by PVs		-3109.03	(233)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	1556.39	(261)
Space heating (secondary)	(215) x	0.019	=	0	(263)
Water heating	(219) x	0.519	=	755.77	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2312.16	(265)
Space cooling	(221) x	0.519	=	89.75	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	794.1	(267)
Electricity for lighting	(232) x	0.519	=	464.4	(268)
Energy saving/generation technologies Item 1		0.519	=	-1613.59	(269)
Total CO2, kg/year		sum of (265)…(271) =		2046.82	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		5.39	(273)
EI rating (section 14)				94	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: 9D The Grove_Proposed_Be Green

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	126.23	(1a)	x	3	(2a)	=	378.69	(3a)
Ground floor	129.92	(1b)	x	3	(2b)	=	389.76	(3b)
First floor	123.86	(1c)	x	2.7	(2c)	=	334.42	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	380.01	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	1102.87	(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) =	0.04	(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)	0.29	(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) =	0.24	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

TER WorkSheet: New dwelling design stage

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

0.31	0.3	0.3	0.27	0.26	0.23	0.23	0.23	0.24	0.26	0.27	0.29

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=	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	(24d)

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

(25)m=	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	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 Type 1			2.89	x	1	=	2.887727			(26)
Doors Type 2			2.82	x	1	=	2.815407			(26)
Windows Type 1			3.444768	x1/[1/(1.4)+ 0.04]		=	4.57			(27)
Windows Type 2			19.87223	x1/[1/(1.4)+ 0.04]		=	26.35			(27)
Windows Type 3			0.871749	x1/[1/(1.4)+ 0.04]		=	1.16			(27)
Windows Type 4			31.8067	x1/[1/(1.4)+ 0.04]		=	42.17			(27)
Floor Type 1			126.23	x	0.13	=	16.4099			(28)
Floor Type 2			3.6905	x	0.13	=	0.479765			(28)
Walls Type1	278.86	61.7	217.17	x	0.18	=	39.09			(29)
Walls Type2	148.43	0	148.43	x	0.18	=	26.72			(29)
Roof Type1	123.86	0	123.86	x	0.13	=	16.1			(30)
Roof Type2	6.46	0	6.46	x	0.13	=	0.84			(30)
Total area of elements, m²			687.53							(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) =	179.58	(33)
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 | 34.35 | (36)

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

Total fabric heat loss (33) + (36) = | 213.93 | (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=	199.49	198.81	198.14	195.01	194.43	191.7	191.7	191.19	192.75	194.43	195.61	196.85	(38)

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

(39)m=	413.42	412.74	412.07	408.94	408.35	405.62	405.62	405.12	406.68	408.35	409.54	410.78	

Average = Sum(39)$_{1…12}$ /12= | 408.94 | (39)

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

(40)m=	1.09	1.09	1.08	1.08	1.07	1.07	1.07	1.07	1.07	1.07	1.08	1.08	

Average = Sum(40)$_{1…12}$ /12= | 1.08 | (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 | 3.24 | (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 | 111.05 | (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)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	122.16	117.72	113.27	108.83	104.39	99.95	99.95	104.39	108.83	113.27	117.72	122.16

Total = Sum(44)$_{1…12}$ = | 1332.64 | (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=	181.16	158.44	163.5	142.54	136.77	118.02	109.37	125.5	127	148	161.56	175.44

Total = Sum(45)$_{1…12}$ = | 1747.31 | (45)

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

(46)m=	27.17	23.77	24.52	21.38	20.52	17.7	16.4	18.82	19.05	22.2	24.23	26.32	(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:

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)

TER WorkSheet: New dwelling design stage

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=	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04	(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=	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04	

Output from water heater (annual)1…12 | 2295.92 | (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=	97.51	86.35	91.64	83.47	82.75	75.32	73.64	79	78.3	86.49	89.79	95.61	(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=	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	(66)

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

(67)m=	49.21	43.71	35.55	26.91	20.12	16.98	18.35	23.85	32.02	40.65	47.45	50.58	(67)

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

(68)m=	520.24	525.64	512.04	483.07	446.52	412.16	389.2	383.8	397.41	426.37	462.93	497.29	(68)

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

(69)m=	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	39.18	(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=	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	-129.44	(71)

Water heating gains (Table 5)

(72)m=	131.06	128.5	123.17	115.93	111.23	104.61	98.98	106.19	108.75	116.25	124.71	128.51	(72)

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

(73)m=	775.06	772.39	745.29	700.45	652.4	608.29	581.07	588.39	612.71	657.81	709.62	750.92	(73)

6. Solar gains:

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

TER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.44	x	10.63	x	0.63	x	0.7	=	11.19	(74)
North	0.9x	0.77	x	3.44	x	20.32	x	0.63	x	0.7	=	21.39	(74)
North	0.9x	0.77	x	3.44	x	34.53	x	0.63	x	0.7	=	36.35	(74)
North	0.9x	0.77	x	3.44	x	55.46	x	0.63	x	0.7	=	58.39	(74)
North	0.9x	0.77	x	3.44	x	74.72	x	0.63	x	0.7	=	78.66	(74)
North	0.9x	0.77	x	3.44	x	79.99	x	0.63	x	0.7	=	84.21	(74)
North	0.9x	0.77	x	3.44	x	74.68	x	0.63	x	0.7	=	78.62	(74)
North	0.9x	0.77	x	3.44	x	59.25	x	0.63	x	0.7	=	62.37	(74)
North	0.9x	0.77	x	3.44	x	41.52	x	0.63	x	0.7	=	43.71	(74)
North	0.9x	0.77	x	3.44	x	24.19	x	0.63	x	0.7	=	25.47	(74)
North	0.9x	0.77	x	3.44	x	13.12	x	0.63	x	0.7	=	13.81	(74)
North	0.9x	0.77	x	3.44	x	8.86	x	0.63	x	0.7	=	9.33	(74)
East	0.9x	0.77	x	19.87	x	19.64	x	0.63	x	0.7	=	119.28	(76)
East	0.9x	0.77	x	19.87	x	38.42	x	0.63	x	0.7	=	233.34	(76)
East	0.9x	0.77	x	19.87	x	63.27	x	0.63	x	0.7	=	384.27	(76)
East	0.9x	0.77	x	19.87	x	92.28	x	0.63	x	0.7	=	560.44	(76)
East	0.9x	0.77	x	19.87	x	113.09	x	0.63	x	0.7	=	686.84	(76)
East	0.9x	0.77	x	19.87	x	115.77	x	0.63	x	0.7	=	703.1	(76)
East	0.9x	0.77	x	19.87	x	110.22	x	0.63	x	0.7	=	669.38	(76)
East	0.9x	0.77	x	19.87	x	94.68	x	0.63	x	0.7	=	574.99	(76)
East	0.9x	0.77	x	19.87	x	73.59	x	0.63	x	0.7	=	446.92	(76)
East	0.9x	0.77	x	19.87	x	45.59	x	0.63	x	0.7	=	276.87	(76)
East	0.9x	0.77	x	19.87	x	24.49	x	0.63	x	0.7	=	148.73	(76)
East	0.9x	0.77	x	19.87	x	16.15	x	0.63	x	0.7	=	98.09	(76)
South	0.9x	0.77	x	0.87	x	46.75	x	0.63	x	0.7	=	12.46	(78)
South	0.9x	0.77	x	0.87	x	76.57	x	0.63	x	0.7	=	20.4	(78)
South	0.9x	0.77	x	0.87	x	97.53	x	0.63	x	0.7	=	25.98	(78)
South	0.9x	0.77	x	0.87	x	110.23	x	0.63	x	0.7	=	29.37	(78)
South	0.9x	0.77	x	0.87	x	114.87	x	0.63	x	0.7	=	30.6	(78)
South	0.9x	0.77	x	0.87	x	110.55	x	0.63	x	0.7	=	29.45	(78)
South	0.9x	0.77	x	0.87	x	108.01	x	0.63	x	0.7	=	28.78	(78)
South	0.9x	0.77	x	0.87	x	104.89	x	0.63	x	0.7	=	27.95	(78)
South	0.9x	0.77	x	0.87	x	101.89	x	0.63	x	0.7	=	27.14	(78)
South	0.9x	0.77	x	0.87	x	82.59	x	0.63	x	0.7	=	22	(78)
South	0.9x	0.77	x	0.87	x	55.42	x	0.63	x	0.7	=	14.76	(78)
South	0.9x	0.77	x	0.87	x	40.4	x	0.63	x	0.7	=	10.76	(78)
West	0.9x	0.77	x	31.81	x	19.64	x	0.63	x	0.7	=	190.91	(80)
West	0.9x	0.77	x	31.81	x	38.42	x	0.63	x	0.7	=	373.47	(80)
West	0.9x	0.77	x	31.81	x	63.27	x	0.63	x	0.7	=	615.05	(80)

TER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	31.81	x	92.28	x	0.63	x	0.7	=	897.01	(80)
West	0.9x	0.77	x	31.81	x	113.09	x	0.63	x	0.7	=	1099.32	(80)
West	0.9x	0.77	x	31.81	x	115.77	x	0.63	x	0.7	=	1125.35	(80)
West	0.9x	0.77	x	31.81	x	110.22	x	0.63	x	0.7	=	1071.38	(80)
West	0.9x	0.77	x	31.81	x	94.68	x	0.63	x	0.7	=	920.3	(80)
West	0.9x	0.77	x	31.81	x	73.59	x	0.63	x	0.7	=	715.33	(80)
West	0.9x	0.77	x	31.81	x	45.59	x	0.63	x	0.7	=	443.15	(80)
West	0.9x	0.77	x	31.81	x	24.49	x	0.63	x	0.7	=	238.05	(80)
West	0.9x	0.77	x	31.81	x	16.15	x	0.63	x	0.7	=	157	(80)

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

(83)m=	333.84	648.6	1061.66	1545.21	1895.42	1942.11	1848.15	1585.61	1233.1	767.49	415.35	275.18	(83)

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

(84)m=	1108.9	1420.98	1806.95	2245.66	2547.82	2550.39	2429.22	2173.99	1845.82	1425.3	1124.97	1026.1	(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	0.96	0.85	0.69	0.77	0.96	1	1	1	(86)

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

(87)m=	19.55	19.69	19.96	20.32	20.66	20.89	20.97	20.95	20.74	20.29	19.86	19.53	(87)

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

(88)m=	20.01	20.01	20.01	20.02	20.02	20.03	20.03	20.03	20.03	20.02	20.02	20.02	(88)

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

(89)m=	1	1	1	0.99	0.94	0.77	0.56	0.65	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=	18.04	18.25	18.63	19.17	19.65	19.94	20.02	20.01	19.77	19.13	18.49	18.01	(90)

fLA = Living area ÷ (4) = 0.07 (91)

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

(92)m=	18.15	18.35	18.73	19.25	19.72	20.01	20.09	20.07	19.84	19.22	18.59	18.12	(92)

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

(93)m=	18.15	18.35	18.73	19.25	19.72	20.01	20.09	20.07	19.84	19.22	18.59	18.12	(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	0.93	0.77	0.57	0.65	0.92	1	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1108.74	1420.17	1801.74	2208.38	2360.36	1971.83	1380.15	1420.44	1703.03	1418.28	1124.54	1026	(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=	5725.75	5553.07	5040.23	4232.69	3276.29	2196.02	1414.17	1488.68	2335.26	3518.49	4706.08	5718.99	(97)

TER WorkSheet: New dwelling design stage

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

(98)m=	3435.06	2777.3	2409.44	1457.5	681.45	0	0	0	0	1562.56	2578.71	3491.59

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 18393.61 (98)

Space heating requirement in kWh/m²/year 48.4 (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)	3435.06	2777.3	2409.44	1457.5	681.45	0	0	0	0	1562.56	2578.71	3491.59		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	3673.86	2970.38	2576.94	1558.82	728.83	0	0	0	0	1671.19	2757.98	3734.32		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													19672.31	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	227.75	200.53	210.09	187.63	183.37	163.12	155.96	172.09	172.09	194.6	206.65	222.04		
Efficiency of water heater													79.8	(216)
(217)m=	89.75	89.69	89.54	89.14	88	79.8	79.8	79.8	79.8	89.18	89.61	89.78		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	253.76	223.58	234.64	210.5	208.38	204.41	195.44	215.66	215.65	218.22	230.61	247.31		
Total = Sum(219a)$_{1...12}$ =													2658.16	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			19672.31	
Water heating fuel used			2658.16	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			869.11	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

DRAFT

TER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	4249.22	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	574.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4823.38	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	451.07	(268)
Total CO2, kg/year		sum of (265)…(271) =		5313.37	(272)

TER = 20.96 (273)

Appendix

Appendix 3 : Water Calculations

Installation Type	Unit of Measure	Capacity/Flow rate (1)	Use Factor (2)	Fixed use (litres/person/day) (3)	Litres/person/day = [(1)x(2)] + (3) (4)
WC (single flush)	Flush Volume (litres)		4.42	0.00	0
WC (dual flush)	Full flush Volume (litres)		1.46	0.00	0
	Part flush Volume (litres)		2.96	0.00	0
WC (multiple fittings)	Average effective flushing Volume (litres)	3.99	4.42	0.00	17.64
Taps (excluding kitchen/utility room taps)	Flow rate (litres/min)	5.00	1.58	1.58	9.48
Bath (where shower also present)	Capacity to overflow(litres)	170.00	0.11	0.00	18.70
Shower (where bath also present)	Flow Rate(litres / minute)	12.00	4.37	0.00	52.44
Bath Only	Capacity to overflow(litres)		0.50	0.00	0
Shower Only	Flow Rate (litres/minute)		5.60	0.00	0
Kitchen/Utility room sink taps	Flow rate (litres/minute)	7.50	0.44	10.36	13.66
Washing Machine	(Litres/kg dry load)	5.00	2.1	0.00	10.50
Dishwasher	(Litres/place setting)	1.00	3.6	0.00	3.60
Waste disposal unit	(Litres/use)	☐ Present	3.08	0.00	0
Water Softener	(Litres/person/day)		1.00	0.00	0
	(5)	Total Calculated use (litres/person/day) =SUM(column 4)			126.02
	(6)	Contribution from greywater (litres/person/day)			0
	(7)	Contribution from rainwater (litres/person/day)			15.96
	(8)	Normalisation factor			0.91
	(9)	Total internal water consumption = [(5)-(6)-(7)]x(8) (litres/person/day)			100.15
	(10)	External water use			5.0
	(11)	Total water consumption (Building Regulation 17.K) =(9)+(10)(litres/person/day)			105.2

Installation Type	Make/Model (mandatory)	Litres/Person/Day
WC (multiple fittings)	All WCs	17.64
Taps	All basin taps	9.48
Baths (shower(s) present)	Master Bathroom, Family Bathroom	18.70
Showers (bath(s) present)	All showers	52.44
Kitchen Taps	Kitchen Tap	13.66
Washing Machines		10.50
Dishwasher		3.60
Contribution from rainwater (litres/person/day)	Flat Roof	17.64

Terms and Conditions
System Requirements