Sustainability Statement

Proposed Residential Development at

Garages to the south of 27a West End Lane, London, NW6 4QJ

Authorisation	Name	Date	Signature
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1. Executive Summary

This report has been produced on behalf of Street Plot Ltd to form part of the planning application to The London Borough of Camden for the development at West End Lane.

The development consists of 3no. residential units. Build Energy Ltd have been appointed to produce an Sustainability Statement presenting how the development will comply with the requirements of The London Borough of Camden. As required, a 20% improvement over Part L 2013 of the Building Regulations is to be evidenced as well as a 20% reduction in on-site carbon emissions through renewable technologies. The strategy for reducing emissions is based on the Energy Hierarchy, as follows:

- Reduce the demand for energy
- Supply energy efficiently
- Use renewable energy

In order to minimise the use of energy by this development, a low carbon approach for the design of the building's fabric and associated systems has been used.

The fabric has been designed to be highly air tight, with a Design Air Permeability rate of 5 m^3/hm^2 and the use of Accredited Construction Details throughout.

The use of gas fired Combined Heat and Power (CHP) and boiler units has been considered but for a development of this scale and heat demand, it has been deemed inappropriate. The potential to connect to an existing heat network has been investigated and no opportunities exist at present.

The use of photovoltaic solar panels has been identified as the optimum strategy for lowering CO_2 emissions over and above the improvements achieved through fabric and building services efficiency. A system of at least 0.98kWp (horizontal on the roof) per house results in a 20.3% reduction in carbon emission through renewable energy, meeting the 20% target.

It has been identified that these energy measures have resulted in a reduction in CO_2 emissions of 24.7% when measured against Part L 2013 Building Regulations, meeting the 20% target (Code Level 4 equivalent).

The following chart details the reductions in carbon emissions as a result of following the energy hierarchy.

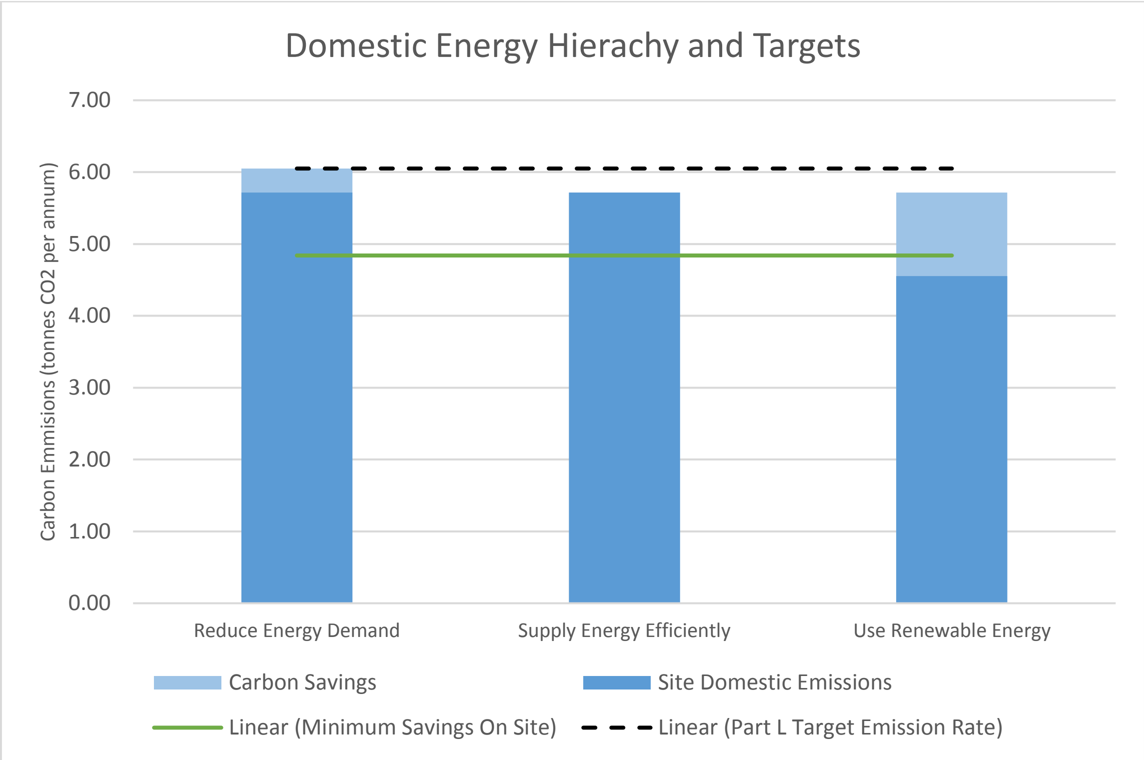

Figure 1 – Carbon Emissions at West End Lane before and after measures from the Energy Hierarchy.

2. Introduction

Street Plot Ltd are proposing to submit a planning application to The London Borough of Camden for the development at West End Lane.

The proposed development at West End Lane comprises 3no. three storey houses.

Build Energy Ltd have been appointed to produce a site-wide Sustainability Statement report identifying how the development will address the policies set out by The London Borough of Camden. These include reducing carbon emissions, efficient water use and Sustainable Drainage Systems (SuDS).

The strategy for reducing carbon emissions is based on the Energy Hierarchy, as follows:

- Reduce the demand for energy
- Supply energy efficiently
- Use renewable energy

The use of passive design and energy efficient features are key to reducing energy demand. The proposed energy efficiency measures include a well-insulated building fabric, high air tightness and efficient combi boilers. These measures will go some way towards achieving compliance, however, renewable energy technologies will be required in order to demonstrate compliance with requirements set out under relevant planning policy. The strategy is based on information provided by the project design team.

The embodied energy of the development is out of the scope of this report. The focus will be on delivered energy demand.

3. Planning Policy Guidance & Legislation Affecting West End Lane

The following guidance documents will apply to the development;

- Camden Core Strategy 2010-2015 Local Development Framework
- Camden Planning Guidance: Sustainability (CPG3)

StreetPlot Ltd have also received pre-application advice from Camden Council detailing the sustainability requirements of the development. These requirements are as follows

- Code Level 4 Equivalent for carbon emissions - a 20% reduction below Part L Building Regulations 2013.
- A 20% reduction in on-site carbon emissions through renewable technologies, unless demonstrated that this is not feasible.
- A maximum internal water use of 105 litres per person per day, with an additional 5 litres per person per day for external water use.
- The incorporation of green or brown roofs wherever suitable.
- The use of Sustainable Drainage Systems and a reduction of surface run-off rates by 50% across the development.
- The incorporation of bird and bat boxes where there are opportunities for these.

4. Carbon Emissions

Energy Strategy Objective

The purpose of this energy strategy is to demonstrate that climate change mitigation measures have been fully considered and appropriately selected and specified as part of the scheme's design.

In accordance with the guidance notes, after establishing the baseline carbon emissions of the site, the strategy for the development at West End Lane follows the Energy Hierarchy given in Camden Planning Guidance (Reduce the demand for energy, Supply Energy Efficiently, Use Renewable Energy) in appraising appropriate measures to reduce carbon emissions.

The following sections provide more details on each of the steps of the Energy Hierarchy.

Methodology

Government approved software (Stroma FSAP 2012) has been used to calculate energy consumption based on current SAP methodology (2013).

All proposed plots within this development have been modelled.

Energy Strategy

The total carbon emissions at the various stages of the energy hierarchy can be seen in Appendix A. The SAP worksheets showing the carbon emissions of each house at the various stages can be seen in Appendix B.

Baseline Energy Assessment

Before energy efficiency measures are investigated, it is important to establish the baseline carbon emissions (the maximum allowed value that meets Part L Building Regulations 2013) of the development, for comparison and evaluation of energy and efficiency proposals for the development. The total base line emissions are found to be 6.05 tonnes CO_2 per annum.

Reduce the demand for energy

The primary focus for providing an energy efficient development is driven through the generation of a design that takes advantage of energy use reduction through improved building fabric and engineering services.

The energy demand of the development will be reduced through incorporation of measures including high levels of thermal insulation, detailing to reduce air permeability, construction details at junctions that reduce thermal bridging, and the use of low-energy lighting.

The use of building fabric specifications that better the minimum requirements of Part L as well as maximising daylight will allow for the reduction in the need for heating and lighting through better building design.

Highly efficient combi boilers have been specified to provide efficient heating. Weather compensators and time and temperature zone controls have also been incorporated to ensure the time and areas of heating result in minimal wasted heating.

After reducing the demand for energy, the emissions are found to be 5.72 tonnes CO_2 per annum.

Supply energy efficiently

The next step in the energy hierarchy is investigating the use of decentralised energy such as combined heat and power systems and heat networks.

All of the London Boroughs have over the course of several years been producing or commissioning heat map studies to explore the viability of decentralised heat networks. The London Borough of Camden completed the 'District Heat Network Local Development Order' in March 2011. The London Heat Map has also been consulted.

A snapshot from The London Heat Map is shown below. There are no existing networks close enough to be shown. The development is around 450m from the nearest potential network (shown in red), and therefore the costs involved in extending the network would outweigh the advantages from a connection due to the small size of the development. Because the site lies outside the potential areas for decentralised energy (shown in purple), this also shows the site would be unfeasible to connect to the network.

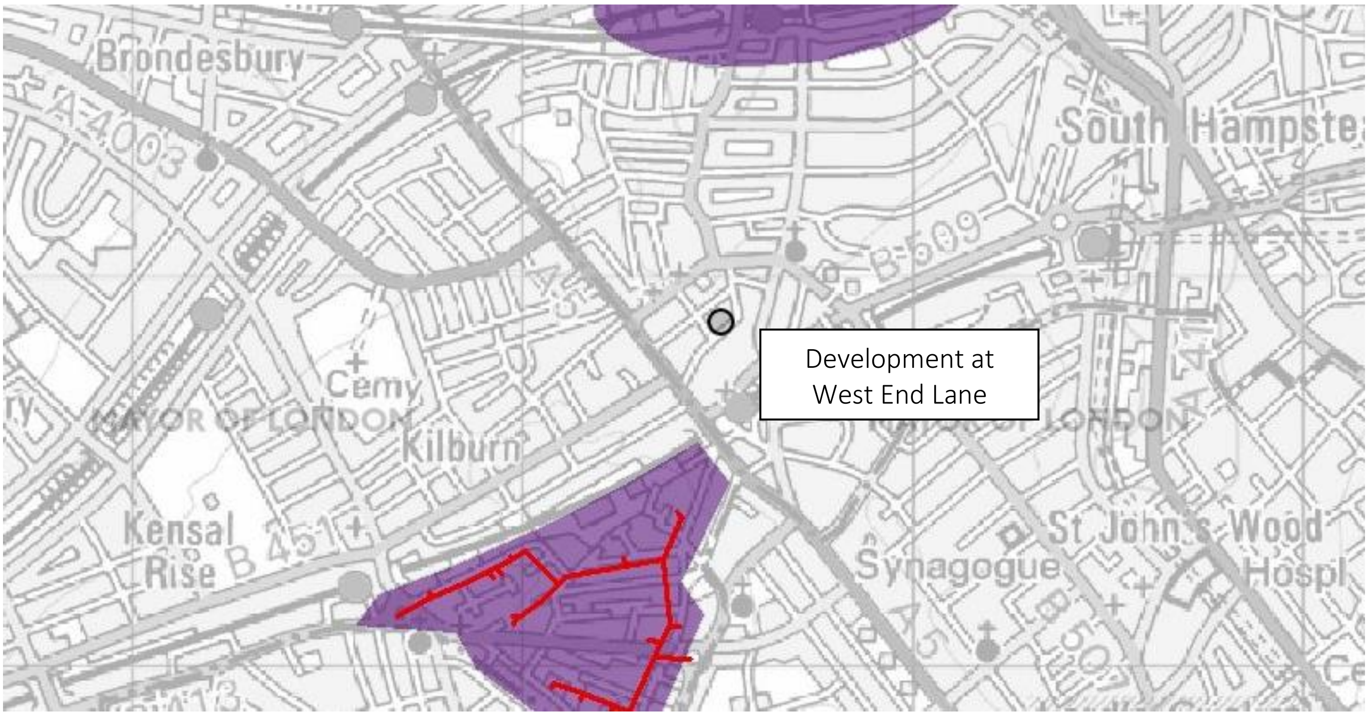

Figure 2 – London Heat Map view of West End Lane.

The possibility of connecting to future networks has also been considered, and after consultation with M&E advice it is apparent that the cost of the central plant and distribution and heat interface units is likely to be far in excess of a boiler and gas installation to each house. The running costs are also likely to be higher due to the standing losses, management and maintenance of the central plant.

Combined Heat and Power units (CHP) require significant infrastructure and a substantial heat demand. In order to obtain maximum efficiency, it is necessary to have an energy demand profile which is evenly spread throughout the day and night. A CHP unit will operate efficiently when running continuously and so requires its energy to be used continuously to avoid wastage. This usage profile does not match that of the proposed development and hence a CHP system is not recommended for this site of three houses.

Therefore this stage of the hierarchy makes no change to the carbon emissions.

Use Renewable Energy

The third and final stage of the energy hierarchy is the use of renewable energy. The potential of a range of renewable energy systems has been assessed to ascertain if their characteristics will be suited to serve the energy requirements of this development and thereby be used to offset CO_2 emissions.

A number of high efficiency or renewable technologies have been reviewed for use in this development. The review of green technologies identifies that the development will be suitable for the inclusion of photovoltaic solar panels.

Providing 0.98 kWp to each house will reduce total emissions to 4.55 tonnes CO_2 per annum. This is a reduction of 20.3% from 5.72 tonnes CO_2 per annum, meeting the target for reducing on-site emissions by 20% through renewable energy.

Emission Reduction Results

By recording the baseline and final emissions we are able to assess the effects of improvements detailed above on the West End Lane development. These are shown in Appendix A in the conclusions of this report, and amount to a total reduction in carbon emissions of 24.7%, meeting the target a 20% carbon emissions reduction below Part L Building Regulations 2013.

The addition of renewable energy results in an emission reduction of 20.3%, meeting the 20% target.

Proposed Specification for West End Lane

Based on this review, the specification of the project at West End Lane has been selected to achieve or better the standards identified in Approved Document Part L wherever possible:

- U-value of exposed floors 0.13 W/m^2K.
- U-value of exposed walls 0.18 W/m^2K.
- U-value of party walls 0 W/m^2K (fully-filled cavity with sealed edges or solid).
- U-value of roofs 0.13 W/m^2K.
- U-value of windows 1.4 W/m^2K, whole-window U-value.
- U-value of doors 1.0 W/m^2K, whole-door U-value.
- Thermal bridging to be addressed with Accredited Construction Details applied throughout.
- Air permeability of 5 $m^3/m^2.h$ @50Pa has been specified to be achieved on testing.
- Worcester Greenstar 28CDi Compact ErP gas boilers with time and temperature zone controls and weather compensators.
- 100% low energy light fittings.
- Photovoltaic panels equating to a system peak power of 0.98kWp per plot. This is proposed as 4no. 245W panels per house, positioned horizontally on the roof.

5. Renewable Technology Consideration

As part of this process, a number of technologies have been considered, with feasibility / viability and practicality considered given the various design considerations.

A feasibility study has been undertaken, identifying the following:

- Appropriate technologies.
- Energy generated from Low and Zero Carbon Technologies per annum.
- Available funding grants.
- Life cycle cost of specification (including allowances for payback).
- Local planning criteria (Inc. preferred solutions).
- Feasibility of exporting heat / electricity from chosen system.

In order to fully identify appropriate technologies, an initial evaluation has been undertaken based on the expected baseline carbon emissions. Baseline emissions are calculated on a development with identical geometry built to meet Building Regulations, thus using standard building fabric parameters and notional heating systems.

Photovoltaics

The PV panels should be orientated between southeast and southwest (optimally south). The optimal tilt angle (inclination of panel from horizontal) should be calculated to ensure the best possible output of the system during the year. In the UK, the angles of most pitched roofs are suitable for mounting PV panels.

Panels can also be mounted on A-frames on flat-roofed buildings. PV technology comes in a range of forms: PV panels that can be retrofitted to the roof of an existing building or equally, sunk to fit flush with the roof line; PV cells that are 'laminated' between sheets of glass to provide shading in a glazed area, and PV cladding.

PV systems are low maintenance as they have no moving parts and panels generally have 25 year warranties, although the lifetime of the panel can be expected to be beyond this time.

Technical Considerations
The PV systems should not be shaded. Shading caused by other buildings, greenery and roof 'furniture' such as chimneys or satellite dishes, even over a small area of the panel, can significantly reduce performance. Excess energy can be exported to the grid. Although the Feed-in Tariffs are generally not high, exporters can negotiate with their utility company. Future consideration may be given to the benefits of battery storage.

Economic Considerations
Payback times for this technology are usually approximately twenty years; but this is reducing year on year as the technology matures and are set to reduce further as fuel prices increase. Integrating PV into a building and replacing other building materials can further offset the cost.

Suitability at the West End Lane Development
PV has been identified as a suitable technology for incorporation at West End Lane allowing the required 20% reduction in carbon emissions through renewable energy to be met. A minimum of 0.98kWp per plot is required to meet this target.

Solar Water Heating

A solar collector comprises the housing that contains piping, through which the carrier fluid circulates, and a glass panel to retain the radiation from the Sun. The temperature inside the collector increases and this heat is then transferred to a carrier fluid. In an open loop system, the hot water is heated directly.

Solar thermal panels are generally black in appearance for maximising energy absorption and the glass panels have a special coating in order to retain as much heat as possible.

Two types of collector exist: flat plate and evacuated tube. Flat plate collectors can be mounted on or flush with the roof. The air in the collection tubes can be evacuated to reduce heat losses within the frame by convection. Evacuated tube collectors need to be re-evacuated every few years. They are more difficult to install but are more efficient and allow higher temperature heating

Benefits
Solar thermal collectors offer a good price-performance ratio. Solar hot water systems are best suited to developments with high hot water requirements, such as hotels, care homes and leisure centres. Many systems have been installed in the UK and they work well, even without direct sunlight.

Technical Considerations
Solar thermal systems should be sized to the hot water requirements of the user since any excess heat that is generated cannot be exported elsewhere. The optimal angle for mounting depends on when the water demand is greatest. Ideally, the collectors should be mounted onto a non-shaded, south-facing roof.

Economic Considerations
Solar thermal technology is a cost effective way to reduce carbon emissions, especially if it is replacing electric water heating.

Suitability at the West End Lane Development
Due to limited roof space at West End Lane, solar hot water cannot be used effectively alongside photovoltaic arrays. Accordingly it is considered preferable to install photovoltaic arrays over solar hot water where only one technology can be favoured.

Air Source Heat Pumps

Air source heat pumps work by converting the energy of the outside air into heat, creating a comfortable temperature inside the building as well as supplying energy for the hot water system. As with all heat pumps, air source models are most efficient when supplying low temperature systems such as underfloor heating.

An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside. It can extract heat from the air even when the outside temperature is as low as minus 15°C. Cold water or another fluid is circulated through pipes, picking up the ambient temperature and then passing through the heat exchanger (the evaporator) in the heat pump unit.

The heat exchanger extracts heat from the fluid, using a refrigerant compression cycle to upgrade the heat to a usable temperature (+55°C). This heat is then transferred to the heating system via another heat exchanger, the condenser of the heat pump.

Accordingly ASHP heating systems generally run at a lower temperature than conventional heating systems. There are two main types of air source heat pumps. An air-to-water system uses the heat to warm water. Heat pumps heat water to a lower temperature than a standard boiler system would, so they are better suited to underfloor heating systems than radiator systems.

An air-to-air system produces warm air, which is circulated by fans to heat the building. Whilst heat pumps are not a wholly renewable energy source due to use of electricity, the renewable component is considered as the heat is extracted from the air. It is measured as the difference between heat outputs, less the primary electrical energy input. Using this heat, for every Watt of electrical energy supplied to the system, 4 Watts or more of heating energy can be supplied to a heating system. This 'Coefficient of Performance' (CoP) of 4 is effectively an 'efficiency' of 400% for the system and compares very favourably with even the best gas condensing boiler's efficiency of around 85%. The smaller the temperature difference between the source and the output temperature of the heat pump (i.e. the temperature of the distribution system) the higher the heat pump's CoP.

Benefits

Unlike boilers, there is no pollution on-site and as the mix of power stations used to supply the electricity grid gets 'cleaner', with more renewable electricity generation being brought on line, so the carbon emissions from the heat pumps system will decrease even further.

The key operational benefit of air source heat pumps for the user is the reduction in fuel bills. In addition, space savings can be made over other plant types as an air source heat pump unit is compact, and requires no storage space for fuel.

Technical Considerations

Since air source heat pumps produce less heat than traditional boilers, it is essential that the building where the air source heat pump is proposed is well insulated and draught proofed for the heating system to be effective. Fans and compressors integral to the air source heat pump unit generate some noise, but this is generally acceptable especially where outdoor units can be located away from windows and adjacent buildings. By selecting a heat pump with an outdoor sound rating of 7.6 dB or lower and mounting the unit on a noise-absorbing base these issues can be resolved for the site.

Economic Considerations

Costs for installing a typical system vary but they are considerably more economical to install than an equivalent capacity ground source heat system and can produce similar levels of energy and carbon savings. Actual running costs and savings for space heating will vary depending on a number of factors - including the size and use pattern of the building and how well insulated it is.

Suitability at the West End Lane Development

Due to outdoor space constraints and noise considerations, it is preferred to opt for photovoltaic panels.

Biomass Heating

Biomass can be burnt directly to provide heat in buildings using wood from forests, urban tree pruning, and farmed coppices or as liquid biofuel, such as bio diesel. In non-domestic applications, biomass boilers replace conventional fossil fuel boilers and come with automated features to enable reduced user intervention.

With the long term availability of fossil fuels such as oil and gas, and the persistent number of price rises of oil and natural gas a growing concern in the UK, alternative heating methods such as wood burning boilers are becoming more popular.

Due to technical advances in wood burning technology, and improvements in the preparation of wood fuels, efficiencies of new wood pellet burning boilers have increased to around 90%, with carbon monoxide emissions dropping dramatically.

There are three types of wood burning boiler - logs, woodchips and wood pellets. Wood logs are the most readily available, generally produced as a by-product from forestry and woodland from sawmills, tree surgery and wind damage.

Wood chips have a high moisture content which tends to restrict their efficiency to only 50% and they tend to suffer from blockages hence we would be cautious about their use on this site. Storage space requirements are also high due to the irregularity of the chips. Wood pellets are made from dry waste wood, such as used pallets and off-cuts/sawdust from furniture manufacturers. The waste wood is compressed into uniform, high density pellets that are easier to transport, handle and store than other forms of wood fuel.

Technical and Economic Considerations

Biomass combustion systems (BCS) are generally more mechanically complex than conventional boiler heating systems, especially when it comes to fuel delivery, storage, handling and combustion. The complexity is necessary because of the different combustion characteristics of biomass as compared to conventional fossil fuels. The increased complexity means higher capital costs than for conventional systems. BCSs typically require more frequent maintenance and greater operator attention than conventional systems. As a result, the degree of operator dedication to the system is critical to its success. They often require special attention to fire insurance premiums, air quality standards, ash disposal options and general safety issues.

Suitability at the West End Lane Development

Due to the size of the proposed project, biomass energy has not been considered as an economically suitable technology for this development.

7. Other Sustainability Considerations

Water Efficiency

Water use calculation software has been used to determine a fitting specification that achieves a water consumption total of 110 litres per person per day, as per Camden Council's requirements. This is 105 litres for internal use and 5 litres for external use. The specification of fittings is shown in Appendix C.

Overheating Considerations

An overheating assessment has been carried out as a part of the process to produce SAP calculations. This assessment is related to the factors that contribute to internal temperature: solar gain (taking account of orientation, shading and glazing transmission), ventilation (taking account of window opening in hot weather), thermal capacity and mean summer temperature for the location of the dwelling. Full details of this methodology and relevant calculations can be found in the latest approved SAP document.

Using these criteria, the proposed development at West End Lane has been found to be compliant with overheating rules within SAP, which is for the overheating risk to be 'medium' or lower.

The results for overheating risk are as follows

- House 1 - Slight
- House 2 - Not significant
- House 3 - Not significant

These calculations can be seen in Appendix D.

SuDS (Sustainable Drainage Systems)

A SuDS assessment has been carried out by Create Engineers.

Green Roofs

Green roofing is proposed on both the 1st floor roof and the 2nd floor roof. These will enhance biodiversity, reduce rainfall run-off and increase cooling during hot periods. The proposed green roof is a Optigreen System Type "Nature Roof" and can be seen in Appendix E.

Bird and Bat Boxes

Three bat houses and three sparrow terrace boxes will be incorporated into the brickwork of the development. Details of these can be seen in the Design and Access Statement.

8. Conclusion

This strategy is based on the Energy Hierarchy, as follows:

- Use less energy.
- Supply energy efficiently.
- Use renewable energy.

CO_2 emission savings can be achieved through the use of the following proposal:

- Improved fabric energy efficiency.
- Efficient boilers with weather compensators and time and temperature zone controls.
- Photovoltaic solar panels (total system size of 0.98kWp per property).

These measures result in a reduction in CO_2 emissions of 24.7% when measured against Part L 2013 Building Regulations. The addition of solar PV has resulted in a reduction of on-site emissions of 20.3%. Therefore the targets of a 20% improvement on Part L Boiling Regulations 2013 and a 20% reduction in emissions through renewable energy have both been met.

The following chart details the reductions in CO_2 emissions as a result of following the energy hierarchy.

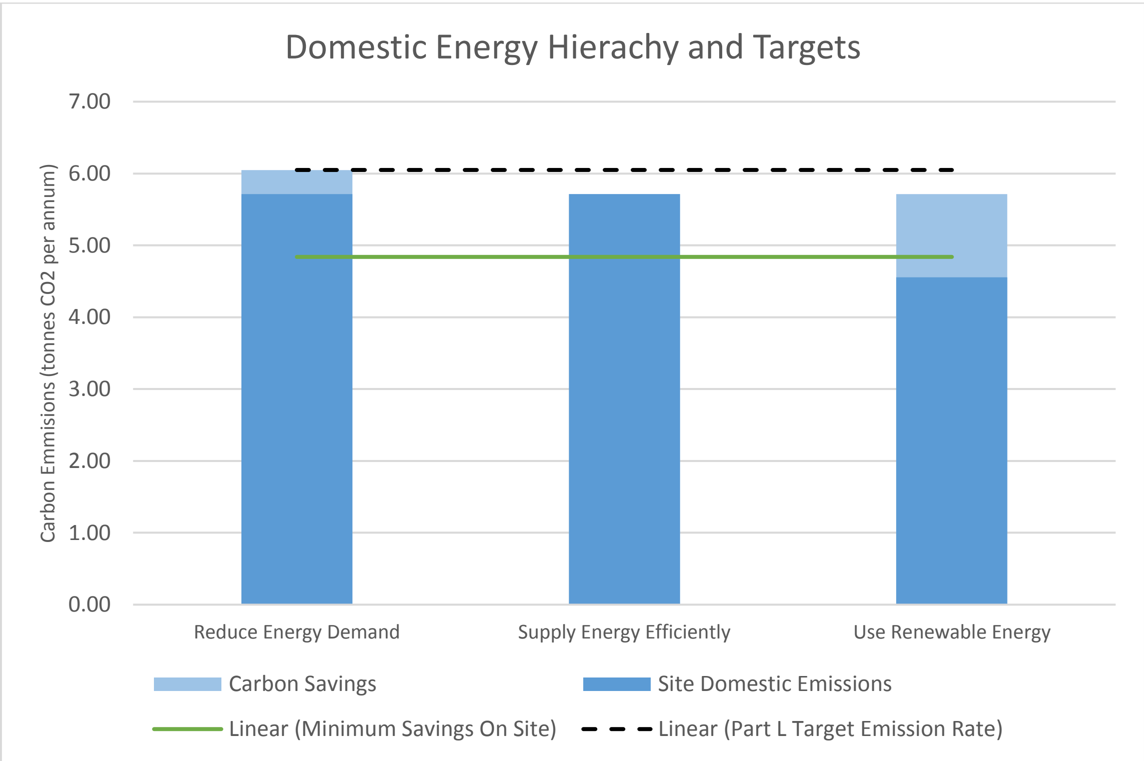

Figure 3 – Carbon Emissions at West End Lane before and after measures from the Energy Hierarchy.

Further sustainability measures of water use, biodiversity, overheating and sustainable drainage have also been demonstrated.

9. Appendices

Appendix A – Domestic Results Tables

Appendix B – SAP Worksheets

- House 1 TER (Target Emission Rate) Worksheet
- House 2 TER Worksheet
- House 3 TER Worksheet
- House 1 After Reducing Energy Demand DER (Dwelling Emission Rate) Worksheet
- House 2 After Reducing Energy Demand DER Worksheet
- House 3 After Reducing Energy Demand DER Worksheet
- House 1 After Renewable Energy DER Worksheet
- House 2 After Renewable Energy DER Worksheet
- House 3 After Renewable Energy DER Worksheet

Appendix C – Part G Compliance Report

Appendix D – Overheating Calculations

Appendix E – Green Roof

Cumulative Emissions & Savings

	Carbon dioxide emissions for domestic buildings (Tonnes CO_2 per annum)
Baseline: Part L 2013 of the Building Regulations Compliant Development	6.05
After Reducing Energy Demand	5.72
After Supplying Energy Efficiently	5.72
After Using Renewable Energy	4.55

Table 1: Carbon dioxide emissions after each stage of the Energy Hierarchy

	Regulated carbon dioxide savings		
	(Tonnes CO_2 / annum)	**% saving compared to baseline**	**% saving compared to previous stage**
Savings from Reducing Energy Demand	0.33	5.53	5.53
Savings from Supplying Energy Efficiently	0.00	0.00	0.00
Savings from Using Renewable Energy	1.16	19.18	**20.30**
Cumulative on site Savings	**1.49**	**24.71**	
Total Target Savings	1.21	20.00	

Table 2: Regulated carbon dioxide savings from each stage of the Energy Hierarchy

Results by Plot

Baseline

Baseline: Part L 2013 of the Building Regulations Compliant Development	House 1	House 2	House 3
	CO_2 Emissions (tonnes CO_2 per annum)	CO_2 Emissions (tonnes CO_2 per annum)	CO_2 Emissions (tonnes CO_2 per annum)
Baseline	2.171	1.797	2.082

Reduce Energy Demand

After Reducing Energy Demand	House 1	House 2	House 3
	CO_2 Emissions (tonnes CO_2 per annum)	CO_2 Emissions (tonnes CO_2 per annum)	CO_2 Emissions (tonnes CO_2 per annum)
Baseline	2.171	1.797	2.082
Reduce Energy Demand	2.020	1.706	1.989
% Improvement	6.96	5.04	4.45

Supply Energy Efficiently

After Supplying Energy Efficiently	House 1	House 2	House 3
	CO_2 Emissions (tonnes CO_2 per annum)	CO_2 Emissions (tonnes CO_2 per annum)	CO_2 Emissions (tonnes CO_2 per annum)
Baseline	2.171	1.797	2.082
Supply Energy Efficiently	2.020	1.706	1.989
% Improvement	6.96	5.04	4.45

Be Lean, Clean & Green

After Using Renewable Energy	House 1	House 2	House 3
	CO_2 Emissions (tonnes CO_2 per annum)	CO_2 Emissions (tonnes CO_2 per annum)	CO_2 Emissions (tonnes CO_2 per annum)
Baseline	2.171	1.797	2.082
Use Renewable Energy	1.633	1.320	1.602
% Improvement	24.78	26.57	23.03

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Mitchell Finn	**Stroma Number:**	STRO029125
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.11

Property Address: House 1

Address : House 1, South of 27a West End Lane, London, NW6 4QJ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	47.13	(1a)	x	2.45	(2a)	=	115.47	(3a)
First floor	47.13	(1b)	x	2.75	(2b)	=	129.61	(3b)
Second floor	24.95	(1c)	x	2.9	(2c)	=	72.36	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	119.21	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	317.43	(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) =	0.13	(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)	0.38	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(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

0.48	0.47	0.46	0.41	0.4	0.36	0.36	0.35	0.38	0.4	0.42	0.44

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=	0.61	0.61	0.61	0.59	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6	(24d)

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

(25)m=	0.61	0.61	0.61	0.59	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.6	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			11.8	x1/[1/(1.4)+ 0.04]		=	15.64			(27)
Windows Type 2			5.91	x1/[1/(1.4)+ 0.04]		=	7.84			(27)
Windows Type 3			8.32	x1/[1/(1.4)+ 0.04]		=	11.03			(27)
Rooflights			1.614788	x1/[1/(1.7) + 0.04]		=	2.745139			(27b)
Floor			47.13	x	0.13	=	6.1269			(28)
Walls	145.49	28.18	117.31	x	0.18	=	21.12			(29)
Roof	47.13	1.61	45.52	x	0.13	=	5.92			(30)
Total area of elements, m²			239.75							(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) = 72.39 (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 30.39 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 102.78 (37)

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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=	64.41	63.95	63.49	61.34	60.93	59.06	59.06	58.71	59.78	60.93	61.75	62.6	(38)

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

(39)m=	167.19	166.73	166.27	164.12	163.71	161.84	161.84	161.49	162.56	163.71	164.53	165.38	

Average = Sum(39)$_{1…12}$ /12= 164.12 (39)

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

(40)m=	1.4	1.4	1.39	1.38	1.37	1.36	1.36	1.35	1.36	1.37	1.38	1.39	

Average = Sum(40)$_{1…12}$ /12= 1.38 (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 2.86 (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) + 36 102.13 (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=	112.34	108.26	104.17	100.09	96	91.92	91.92	96	100.09	104.17	108.26	112.34	

Total = Sum(44)$_{1…12}$ = 1225.56 (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=	166.6	145.71	150.36	131.09	125.78	108.54	100.58	115.42	116.79	136.11	148.58	161.34	

Total = Sum(45)$_{1…12}$ = 1606.9 (45)

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

(46)m=	24.99	21.86	22.55	19.66	18.87	16.28	15.09	17.31	17.52	20.42	22.29	24.2	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If 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 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

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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=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	50.96	46.03	50.96	49.32	48.92	45.33	46.84	48.92	49.32	50.96	49.32	50.96	(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=	217.56	191.74	201.32	180.4	174.7	153.87	147.42	164.34	166.11	187.07	197.89	212.3	(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=	217.56	191.74	201.32	180.4	174.7	153.87	147.42	164.34	166.11	187.07	197.89	212.3

Output from water heater (annual)$_{1...12}$ — 2194.72 (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=	68.13	59.96	62.73	55.92	54.05	47.42	45.15	50.61	51.16	58	61.73	66.39	(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=	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	(66)

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

(67)m=	25.33	22.5	18.3	13.85	10.36	8.74	9.45	12.28	16.48	20.93	24.43	26.04	(67)

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

(68)m=	284.18	287.13	279.7	263.88	243.91	225.14	212.6	209.65	217.08	232.9	252.87	271.64	(68)

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

(69)m=	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	(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=	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	(71)

Water heating gains (Table 5)

(72)m=	91.58	89.22	84.32	77.66	72.65	65.86	60.69	68.02	71.06	77.95	85.74	89.23	(72)

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

(73)m=	470	467.76	451.22	424.3	395.82	368.65	351.64	358.85	373.53	400.69	431.94	455.81	(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)

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Northeast	0.9x	0.77	x	8.32	x	11.28	x	0.63	x	0.7	=	28.69	(75)
Northeast	0.9x	0.77	x	8.32	x	22.97	x	0.63	x	0.7	=	58.4	(75)
Northeast	0.9x	0.77	x	8.32	x	41.38	x	0.63	x	0.7	=	105.21	(75)
Northeast	0.9x	0.77	x	8.32	x	67.96	x	0.63	x	0.7	=	172.79	(75)
Northeast	0.9x	0.77	x	8.32	x	91.35	x	0.63	x	0.7	=	232.27	(75)
Northeast	0.9x	0.77	x	8.32	x	97.38	x	0.63	x	0.7	=	247.62	(75)
Northeast	0.9x	0.77	x	8.32	x	91.1	x	0.63	x	0.7	=	231.64	(75)
Northeast	0.9x	0.77	x	8.32	x	72.63	x	0.63	x	0.7	=	184.67	(75)
Northeast	0.9x	0.77	x	8.32	x	50.42	x	0.63	x	0.7	=	128.2	(75)
Northeast	0.9x	0.77	x	8.32	x	28.07	x	0.63	x	0.7	=	71.37	(75)
Northeast	0.9x	0.77	x	8.32	x	14.2	x	0.63	x	0.7	=	36.1	(75)
Northeast	0.9x	0.77	x	8.32	x	9.21	x	0.63	x	0.7	=	23.43	(75)
Southeast	0.9x	0.77	x	11.8	x	36.79	x	0.63	x	0.7	=	132.69	(77)
Southeast	0.9x	0.77	x	11.8	x	62.67	x	0.63	x	0.7	=	226.02	(77)
Southeast	0.9x	0.77	x	11.8	x	85.75	x	0.63	x	0.7	=	309.24	(77)
Southeast	0.9x	0.77	x	11.8	x	106.25	x	0.63	x	0.7	=	383.17	(77)
Southeast	0.9x	0.77	x	11.8	x	119.01	x	0.63	x	0.7	=	429.18	(77)
Southeast	0.9x	0.77	x	11.8	x	118.15	x	0.63	x	0.7	=	426.08	(77)
Southeast	0.9x	0.77	x	11.8	x	113.91	x	0.63	x	0.7	=	410.78	(77)
Southeast	0.9x	0.77	x	11.8	x	104.39	x	0.63	x	0.7	=	376.46	(77)
Southeast	0.9x	0.77	x	11.8	x	92.85	x	0.63	x	0.7	=	334.85	(77)
Southeast	0.9x	0.77	x	11.8	x	69.27	x	0.63	x	0.7	=	249.8	(77)
Southeast	0.9x	0.77	x	11.8	x	44.07	x	0.63	x	0.7	=	158.93	(77)
Southeast	0.9x	0.77	x	11.8	x	31.49	x	0.63	x	0.7	=	113.55	(77)
Southwest	0.9x	0.77	x	5.91	x	36.79		0.63	x	0.7	=	66.46	(79)
Southwest	0.9x	0.77	x	5.91	x	62.67		0.63	x	0.7	=	113.2	(79)
Southwest	0.9x	0.77	x	5.91	x	85.75		0.63	x	0.7	=	154.88	(79)
Southwest	0.9x	0.77	x	5.91	x	106.25		0.63	x	0.7	=	191.91	(79)
Southwest	0.9x	0.77	x	5.91	x	119.01		0.63	x	0.7	=	214.95	(79)
Southwest	0.9x	0.77	x	5.91	x	118.15		0.63	x	0.7	=	213.4	(79)
Southwest	0.9x	0.77	x	5.91	x	113.91		0.63	x	0.7	=	205.74	(79)
Southwest	0.9x	0.77	x	5.91	x	104.39		0.63	x	0.7	=	188.55	(79)
Southwest	0.9x	0.77	x	5.91	x	92.85		0.63	x	0.7	=	167.71	(79)
Southwest	0.9x	0.77	x	5.91	x	69.27		0.63	x	0.7	=	125.11	(79)
Southwest	0.9x	0.77	x	5.91	x	44.07		0.63	x	0.7	=	79.6	(79)
Southwest	0.9x	0.77	x	5.91	x	31.49		0.63	x	0.7	=	56.87	(79)
Rooflights	0.9x	1	x	1.61	x	26	x	0.63	x	0.7	=	16.66	(82)
Rooflights	0.9x	1	x	1.61	x	54	x	0.63	x	0.7	=	34.61	(82)
Rooflights	0.9x	1	x	1.61	x	96	x	0.63	x	0.7	=	61.53	(82)
Rooflights	0.9x	1	x	1.61	x	150	x	0.63	x	0.7	=	96.14	(82)
Rooflights	0.9x	1	x	1.61	x	192	x	0.63	x	0.7	=	123.05	(82)

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Rooflights 0.9x	1	x	1.61	x	200	x	0.63	x	0.7	=	128.18	(82)
Rooflights 0.9x	1	x	1.61	x	189	x	0.63	x	0.7	=	121.13	(82)
Rooflights 0.9x	1	x	1.61	x	157	x	0.63	x	0.7	=	100.62	(82)
Rooflights 0.9x	1	x	1.61	x	115	x	0.63	x	0.7	=	73.7	(82)
Rooflights 0.9x	1	x	1.61	x	66	x	0.63	x	0.7	=	42.3	(82)
Rooflights 0.9x	1	x	1.61	x	33	x	0.63	x	0.7	=	21.15	(82)
Rooflights 0.9x	1	x	1.61	x	21	x	0.63	x	0.7	=	13.46	(82)

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

(83)m=	244.5	432.22	630.87	844	999.45	1015.28	969.3	850.29	704.46	488.57	295.78	207.31	(83)

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

(84)m=	714.49	899.98	1082.09	1268.3	1395.27	1383.93	1320.94	1209.15	1077.99	889.26	727.72	663.13	(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	0.99	0.98	0.94	0.85	0.68	0.52	0.58	0.83	0.97	1	1	(86)

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

(87)m=	19.43	19.65	19.98	20.4	20.74	20.93	20.98	20.97	20.83	20.36	19.82	19.4	(87)

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

(88)m=	19.76	19.76	19.77	19.78	19.78	19.8	19.8	19.8	19.79	19.78	19.78	19.77	(88)

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

(89)m=	1	0.99	0.98	0.92	0.79	0.58	0.39	0.45	0.75	0.96	0.99	1	(89)

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

(90)m=	17.7	18.01	18.5	19.1	19.54	19.75	19.79	19.79	19.66	19.06	18.27	17.66	(90)

fLA = Living area ÷ (4) = 0.15 (91)

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

(92)m=	17.96	18.26	18.72	19.3	19.72	19.93	19.97	19.97	19.84	19.26	18.51	17.92	(92)

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

(93)m=	17.96	18.26	18.72	19.3	19.72	19.93	19.97	19.97	19.84	19.26	18.51	17.92	(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	0.97	0.91	0.79	0.59	0.41	0.47	0.75	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	711.17	889.11	1047.65	1156.26	1100.22	819.09	539.26	564.72	809.96	842.25	720.47	660.86	(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=	2284.08	2228.16	2032.51	1706.51	1313.77	862.97	545.81	576.35	932.69	1417.6	1876.56	2269.52	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1170.24	899.84	732.74	396.18	158.88	0	0	0	0	428.06	832.39	1196.84	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5815.16 (98)

Space heating requirement in kWh/m²/year 48.78 (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 93.4 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	1170.24	899.84	732.74	396.18	158.88	0	0	0	0	428.06	832.39	1196.84		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1252.94	963.43	784.51	424.17	170.11	0	0	0	0	458.31	891.21	1281.41		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													6226.08	(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)	217.56	191.74	201.32	180.4	174.7	153.87	147.42	164.34	166.11	187.07	197.89	212.3		
Efficiency of water heater													80.3	(216)
(217)m=	88.65	88.45	88.01	86.98	84.81	80.3	80.3	80.3	80.3	87.07	88.27	88.72		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	245.41	216.79	228.74	207.41	205.99	191.62	183.58	204.65	206.86	214.85	224.2	239.3		
Total = Sum(219a)$_{1...12}$ =													2569.39	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			6226.08	
Water heating fuel used			2569.39	
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			447.42	(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	=	1344.83	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	554.99	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1899.82	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	232.21	(268)
Total CO2, kg/year		sum of (265)…(271) =		2170.96	(272)

TER =	18.21	(273)

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User Details:

Assessor Name:	Mitchell Finn	**Stroma Number:**	STRO029125
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.11

Property Address: House 2

Address : House 2, South of 27a West End Lane, London, NW6 4QJ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	41.61	(1a)	x	2.45	(2a)	=	101.94	(3a)
First floor	41.61	(1b)	x	2.75	(2b)	=	114.43	(3b)
Second floor	25.43	(1c)	x	2.9	(2c)	=	73.75	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	108.65	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	290.12	(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) =	0.14	(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)	0.39	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.49	0.48	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.58	0.59	0.6	0.6	(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.58	0.59	0.6	0.6	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			10	x1/[1/(1.4)+ 0.04]		=	13.26			(27)
Windows Type 2			11.67	x1/[1/(1.4)+ 0.04]		=	15.47			(27)
Rooflights			2.73	x1/[1/(1.7) + 0.04]		=	4.641			(27b)
Floor			41.61	x	0.13	=	5.4093			(28)
Walls	55.69	23.87	31.82	x	0.18	=	5.73			(29)
Roof	41.61	2.73	38.88	x	0.13	=	5.05			(30)
Total area of elements, m²			138.91							(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) = 51.47 (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 18.46 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 69.92 (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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	59.58	59.12	58.68	56.58	56.19	54.37	54.37	54.03	55.07	56.19	56.98	57.81	(38)

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

(39)m=	129.5	129.05	128.6	126.51	126.12	124.29	124.29	123.96	125	126.12	126.91	127.74	

Average = Sum(39)$_{1...12}$ /12= 126.51 (39)

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

(40)m=	1.19	1.19	1.18	1.16	1.16	1.14	1.14	1.14	1.15	1.16	1.17	1.18	

Average = Sum(40)$_{1...12}$ /12= 1.16 (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 2.81 (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) + 36 100.85 (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=	110.94	106.91	102.87	98.84	94.8	90.77	90.77	94.8	98.84	102.87	106.91	110.94

Total = Sum(44)$_{1...12}$ = 1210.25 (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=	164.52	143.89	148.48	129.45	124.21	107.18	99.32	113.97	115.33	134.41	146.72	159.33

Total = Sum(45)$_{1...12}$ = 1586.82 (45)

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

(46)m=	24.68	21.58	22.27	19.42	18.63	16.08	14.9	17.1	17.3	20.16	22.01	23.9	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If 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 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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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=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	50.96	46.03	50.96	48.74	48.31	44.76	46.25	48.31	48.74	50.96	49.32	50.96	(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=	215.48	189.92	199.44	178.19	172.52	151.95	145.58	162.28	164.08	185.37	196.04	210.29	(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=	215.48	189.92	199.44	178.19	172.52	151.95	145.58	162.28	164.08	185.37	196.04	210.29

Output from water heater (annual)1…12 | 2171.12 | (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=	67.44	59.35	62.11	55.23	53.38	46.83	44.59	49.97	50.53	57.43	61.11	65.72	(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=	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	(66)

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

(67)m=	24.04	21.35	17.36	13.14	9.82	8.29	8.96	11.65	15.64	19.85	23.17	24.7	(67)

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

(68)m=	269.6	272.4	265.35	250.34	231.4	213.59	201.69	198.9	205.95	220.95	239.9	257.71	(68)

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

(69)m=	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	(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=	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	(71)

Water heating gains (Table 5)

(72)m=	90.65	88.32	83.48	76.7	71.74	65.04	59.93	67.17	70.19	77.19	84.88	88.33	(72)

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

(73)m=	452.38	450.16	434.29	408.29	381.06	355.02	338.68	345.81	359.87	386.1	416.05	438.84	(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)	
Northeast 0.9x	0.77	x	11.67	x	11.28	x	0.63	x	0.7	=	40.24	(75)
Northeast 0.9x	0.77	x	11.67	x	22.97	x	0.63	x	0.7	=	81.91	(75)

Northeast 0.9x	0.77	x	11.67	x	41.38	x	0.63	x	0.7	=	147.58	(75)
Northeast 0.9x	0.77	x	11.67	x	67.96	x	0.63	x	0.7	=	242.36	(75)
Northeast 0.9x	0.77	x	11.67	x	91.35	x	0.63	x	0.7	=	325.79	(75)
Northeast 0.9x	0.77	x	11.67	x	97.38	x	0.63	x	0.7	=	347.32	(75)
Northeast 0.9x	0.77	x	11.67	x	91.1	x	0.63	x	0.7	=	324.91	(75)
Northeast 0.9x	0.77	x	11.67	x	72.63	x	0.63	x	0.7	=	259.02	(75)
Northeast 0.9x	0.77	x	11.67	x	50.42	x	0.63	x	0.7	=	179.83	(75)
Northeast 0.9x	0.77	x	11.67	x	28.07	x	0.63	x	0.7	=	100.1	(75)
Northeast 0.9x	0.77	x	11.67	x	14.2	x	0.63	x	0.7	=	50.63	(75)
Northeast 0.9x	0.77	x	11.67	x	9.21	x	0.63	x	0.7	=	32.86	(75)
Southwest 0.9x	0.77	x	10	x	36.79		0.63	x	0.7	=	112.45	(79)
Southwest 0.9x	0.77	x	10	x	62.67		0.63	x	0.7	=	191.54	(79)
Southwest 0.9x	0.77	x	10	x	85.75		0.63	x	0.7	=	262.07	(79)
Southwest 0.9x	0.77	x	10	x	106.25		0.63	x	0.7	=	324.72	(79)
Southwest 0.9x	0.77	x	10	x	119.01		0.63	x	0.7	=	363.71	(79)
Southwest 0.9x	0.77	x	10	x	118.15		0.63	x	0.7	=	361.08	(79)
Southwest 0.9x	0.77	x	10	x	113.91		0.63	x	0.7	=	348.12	(79)
Southwest 0.9x	0.77	x	10	x	104.39		0.63	x	0.7	=	319.03	(79)
Southwest 0.9x	0.77	x	10	x	92.85		0.63	x	0.7	=	283.77	(79)
Southwest 0.9x	0.77	x	10	x	69.27		0.63	x	0.7	=	211.69	(79)
Southwest 0.9x	0.77	x	10	x	44.07		0.63	x	0.7	=	134.69	(79)
Southwest 0.9x	0.77	x	10	x	31.49		0.63	x	0.7	=	96.23	(79)
Rooflights 0.9x	1	x	2.73	x	26	x	0.63	x	0.7	=	28.17	(82)
Rooflights 0.9x	1	x	2.73	x	54	x	0.63	x	0.7	=	58.51	(82)
Rooflights 0.9x	1	x	2.73	x	96	x	0.63	x	0.7	=	104.02	(82)
Rooflights 0.9x	1	x	2.73	x	150	x	0.63	x	0.7	=	162.53	(82)
Rooflights 0.9x	1	x	2.73	x	192	x	0.63	x	0.7	=	208.04	(82)
Rooflights 0.9x	1	x	2.73	x	200	x	0.63	x	0.7	=	216.71	(82)
Rooflights 0.9x	1	x	2.73	x	189	x	0.63	x	0.7	=	204.79	(82)
Rooflights 0.9x	1	x	2.73	x	157	x	0.63	x	0.7	=	170.12	(82)
Rooflights 0.9x	1	x	2.73	x	115	x	0.63	x	0.7	=	124.61	(82)
Rooflights 0.9x	1	x	2.73	x	66	x	0.63	x	0.7	=	71.51	(82)
Rooflights 0.9x	1	x	2.73	x	33	x	0.63	x	0.7	=	35.76	(82)
Rooflights 0.9x	1	x	2.73	x	21	x	0.63	x	0.7	=	22.75	(82)

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

(83)m=	180.86	331.96	513.67	729.61	897.54	925.11	877.82	748.17	588.2	383.31	221.08	151.85	(83)

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

(84)m=	633.24	782.12	947.96	1137.9	1278.6	1280.13	1216.51	1093.98	948.07	769.4	637.12	590.68	(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

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(86)m=	1	0.99	0.98	0.93	0.8	0.6	0.45	0.51	0.79	0.97	1	1	(86)

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

(87)m=	19.69	19.88	20.2	20.59	20.87	20.97	21	20.99	20.9	20.51	20.03	19.66	(87)

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

(88)m=	19.93	19.93	19.93	19.95	19.95	19.97	19.97	19.97	19.96	19.95	19.95	19.94	(88)

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

(89)m=	1	0.99	0.98	0.91	0.74	0.51	0.34	0.4	0.71	0.96	0.99	1	(89)

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

(90)m=	18.18	18.47	18.92	19.48	19.83	19.95	19.96	19.96	19.89	19.39	18.69	18.15	(90)

fLA = Living area ÷ (4) = 0.18 (91)

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

(92)m=	18.46	18.73	19.16	19.69	20.02	20.14	20.15	20.15	20.07	19.6	18.93	18.43	(92)

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

(93)m=	18.46	18.73	19.16	19.69	20.02	20.14	20.15	20.15	20.07	19.6	18.93	18.43	(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	0.97	0.9	0.74	0.53	0.36	0.42	0.72	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	630.93	774.33	918.95	1022.4	948.02	674.17	439.98	461.68	684.06	729.87	631.89	589.13	(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=	1833.17	1784.52	1627.81	1364.86	1049.15	688.4	441.68	465.24	746.73	1134.63	1501.89	1817.39	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	894.47	678.85	527.39	246.57	75.24	0	0	0	0	301.14	626.4	913.82	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4263.88 (98)

Space heating requirement in kWh/m²/year 39.24 (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		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	894.47	678.85	527.39	246.57	75.24	0	0	0	0	301.14	626.4	913.82	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	957.67	726.82	564.66	264	80.56	0	0	0	0	322.42	670.66	978.4	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4565.18 (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)

215.48	189.92	199.44	178.19	172.52	151.95	145.58	162.28	164.08	185.37	196.04	210.29

Efficiency of water heater 80.3 (216)

(217)m=	88.25	87.98	87.38	85.87	83.12	80.3	80.3	80.3	80.3	86.27	87.77	88.32	(217)

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

(219)m=	244.18	215.86	228.23	207.51	207.56	189.22	181.29	202.1	204.33	214.88	223.35	238.09

Total = Sum(219a)$_{1...12}$ = 2556.61 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4565.18	
Water heating fuel used			2556.61	
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			424.47	(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	=	986.08	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	552.23	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1538.31	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	220.3	(268)
Total CO2, kg/year		sum of (265)…(271) =		1797.53	(272)

TER = 16.54 (273)

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User Details:

Assessor Name:	Mitchell Finn	**Stroma Number:**	STRO029125
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.11

Property Address: House 3

Address : House 3, South of 27a West End Lane, London, NW6 4QJ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	41.51	(1a)	x	2.45	(2a)	=	101.7	(3a)
First floor	41.51	(1b)	x	2.75	(2b)	=	114.15	(3b)
Second floor	24.07	(1c)	x	2.9	(2c)	=	69.8	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.09	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	285.65	(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) =	0.14	(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)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.2	x	1	=	2.2			(26)
Windows Type 1			3.73	x1/[1/(1.4)+ 0.04]		=	4.95			(27)
Windows Type 2			8.54	x1/[1/(1.4)+ 0.04]		=	11.32			(27)
Windows Type 3			9.97	x1/[1/(1.4)+ 0.04]		=	13.22			(27)
Rooflights			2.331697	x1/[1/(1.7) + 0.04]		=	3.963885			(27b)
Floor			41.51	x	0.13	=	5.396299			(28)
Walls	134.4	24.44	109.96	x	0.18	=	19.79			(29)
Roof	41.51	2.33	39.18	x	0.13	=	5.09			(30)
Total area of elements, m²			217.42							(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) = 65.68 (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 28.06 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 93.73 (37)

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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=	58.79	58.34	57.89	55.81	55.42	53.6	53.6	53.27	54.3	55.42	56.21	57.03	(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=	152.52	152.07	151.63	149.54	149.15	147.34	147.34	147	148.04	149.15	149.94	150.77	

Average = Sum(39)$_{1…12}$ /12= 149.54 (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=	1.42	1.42	1.42	1.4	1.39	1.38	1.38	1.37	1.38	1.39	1.4	1.41	

Average = Sum(40)$_{1…12}$ /12= 1.4 (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 — 2.8 (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 — 100.61 (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=	110.67	106.65	102.62	98.6	94.57	90.55	90.55	94.57	98.6	102.62	106.65	110.67

Total = Sum(44)$_{1…12}$ = 1207.31 (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=	164.12	143.54	148.12	129.14	123.91	106.92	99.08	113.7	115.05	134.09	146.36	158.94

Total = Sum(45)$_{1…12}$ = 1582.98 (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=	24.62	21.53	22.22	19.37	18.59	16.04	14.86	17.05	17.26	20.11	21.95	23.84	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (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): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If 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 (55)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	50.96	46.03	50.96	48.62	48.19	44.65	46.14	48.19	48.62	50.96	49.32	50.96	(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=	215.08	189.57	199.08	177.76	172.1	151.58	145.22	161.89	163.68	185.04	195.68	209.9	(62)

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

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

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

Output from water heater

(64)m=	215.08	189.57	199.08	177.76	172.1	151.58	145.22	161.89	163.68	185.04	195.68	209.9

Output from water heater (annual)$_{1\ldots12}$ — 2166.58 — (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=	67.31	59.23	61.99	55.09	53.25	46.72	44.48	49.85	50.41	57.32	60.99	65.59	(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=	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	(66)

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

(67)m=	23.83	21.17	17.21	13.03	9.74	8.22	8.89	11.55	15.5	19.69	22.98	24.49	(67)

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

(68)m=	267.31	270.08	263.09	248.21	229.43	211.77	199.98	197.2	204.19	219.07	237.86	255.51	(68)

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

(69)m=	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	(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=	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	(71)

Water heating gains (Table 5)

(72)m=	90.47	88.15	83.32	76.52	71.57	64.88	59.78	67.01	70.02	77.05	84.72	88.16	(72)

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

(73)m=	449.55	447.34	431.57	405.7	378.68	352.82	336.59	343.7	357.66	383.75	413.49	436.1	(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)

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Northeast	0.9x	0.77	x	9.97	x	11.28	x	0.63	x	0.7	=	34.38	(75)
Northeast	0.9x	0.77	x	9.97	x	22.97	x	0.63	x	0.7	=	69.98	(75)
Northeast	0.9x	0.77	x	9.97	x	41.38	x	0.63	x	0.7	=	126.08	(75)
Northeast	0.9x	0.77	x	9.97	x	67.96	x	0.63	x	0.7	=	207.06	(75)
Northeast	0.9x	0.77	x	9.97	x	91.35	x	0.63	x	0.7	=	278.33	(75)
Northeast	0.9x	0.77	x	9.97	x	97.38	x	0.63	x	0.7	=	296.73	(75)
Northeast	0.9x	0.77	x	9.97	x	91.1	x	0.63	x	0.7	=	277.58	(75)
Northeast	0.9x	0.77	x	9.97	x	72.63	x	0.63	x	0.7	=	221.29	(75)
Northeast	0.9x	0.77	x	9.97	x	50.42	x	0.63	x	0.7	=	153.63	(75)
Northeast	0.9x	0.77	x	9.97	x	28.07	x	0.63	x	0.7	=	85.52	(75)
Northeast	0.9x	0.77	x	9.97	x	14.2	x	0.63	x	0.7	=	43.26	(75)
Northeast	0.9x	0.77	x	9.97	x	9.21	x	0.63	x	0.7	=	28.08	(75)
Southwest	0.9x	0.77	x	8.54	x	36.79		0.63	x	0.7	=	96.03	(79)
Southwest	0.9x	0.77	x	8.54	x	62.67		0.63	x	0.7	=	163.57	(79)
Southwest	0.9x	0.77	x	8.54	x	85.75		0.63	x	0.7	=	223.81	(79)
Southwest	0.9x	0.77	x	8.54	x	106.25		0.63	x	0.7	=	277.31	(79)
Southwest	0.9x	0.77	x	8.54	x	119.01		0.63	x	0.7	=	310.61	(79)
Southwest	0.9x	0.77	x	8.54	x	118.15		0.63	x	0.7	=	308.36	(79)
Southwest	0.9x	0.77	x	8.54	x	113.91		0.63	x	0.7	=	297.3	(79)
Southwest	0.9x	0.77	x	8.54	x	104.39		0.63	x	0.7	=	272.45	(79)
Southwest	0.9x	0.77	x	8.54	x	92.85		0.63	x	0.7	=	242.34	(79)
Southwest	0.9x	0.77	x	8.54	x	69.27		0.63	x	0.7	=	180.78	(79)
Southwest	0.9x	0.77	x	8.54	x	44.07		0.63	x	0.7	=	115.02	(79)
Southwest	0.9x	0.77	x	8.54	x	31.49		0.63	x	0.7	=	82.18	(79)
Northwest	0.9x	0.77	x	3.73	x	11.28	x	0.63	x	0.7	=	12.86	(81)
Northwest	0.9x	0.77	x	3.73	x	22.97	x	0.63	x	0.7	=	26.18	(81)
Northwest	0.9x	0.77	x	3.73	x	41.38	x	0.63	x	0.7	=	47.17	(81)
Northwest	0.9x	0.77	x	3.73	x	67.96	x	0.63	x	0.7	=	77.47	(81)
Northwest	0.9x	0.77	x	3.73	x	91.35	x	0.63	x	0.7	=	104.13	(81)
Northwest	0.9x	0.77	x	3.73	x	97.38	x	0.63	x	0.7	=	111.01	(81)
Northwest	0.9x	0.77	x	3.73	x	91.1	x	0.63	x	0.7	=	103.85	(81)
Northwest	0.9x	0.77	x	3.73	x	72.63	x	0.63	x	0.7	=	82.79	(81)
Northwest	0.9x	0.77	x	3.73	x	50.42	x	0.63	x	0.7	=	57.48	(81)
Northwest	0.9x	0.77	x	3.73	x	28.07	x	0.63	x	0.7	=	31.99	(81)
Northwest	0.9x	0.77	x	3.73	x	14.2	x	0.63	x	0.7	=	16.18	(81)
Northwest	0.9x	0.77	x	3.73	x	9.21	x	0.63	x	0.7	=	10.5	(81)
Rooflights	0.9x	1	x	2.33	x	26	x	0.63	x	0.7	=	24.06	(82)
Rooflights	0.9x	1	x	2.33	x	54	x	0.63	x	0.7	=	49.97	(82)
Rooflights	0.9x	1	x	2.33	x	96	x	0.63	x	0.7	=	88.84	(82)
Rooflights	0.9x	1	x	2.33	x	150	x	0.63	x	0.7	=	138.82	(82)
Rooflights	0.9x	1	x	2.33	x	192	x	0.63	x	0.7	=	177.69	(82)

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Rooflights 0.9x	1	x	2.33	x	200	x	0.63	x	0.7	=	185.09	(82)
Rooflights 0.9x	1	x	2.33	x	189	x	0.63	x	0.7	=	174.91	(82)
Rooflights 0.9x	1	x	2.33	x	157	x	0.63	x	0.7	=	145.3	(82)
Rooflights 0.9x	1	x	2.33	x	115	x	0.63	x	0.7	=	106.43	(82)
Rooflights 0.9x	1	x	2.33	x	66	x	0.63	x	0.7	=	61.08	(82)
Rooflights 0.9x	1	x	2.33	x	33	x	0.63	x	0.7	=	30.54	(82)
Rooflights 0.9x	1	x	2.33	x	21	x	0.63	x	0.7	=	19.43	(82)

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

(83)m=	167.33	309.71	485.9	700.65	870.75	901.19	853.64	721.83	559.87	359.38	205	140.19	(83)

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

(84)m=	616.88	757.04	917.47	1106.35	1249.43	1254.01	1190.23	1065.53	917.53	743.13	618.49	576.3	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.95	0.85	0.68	0.53	0.6	0.85	0.98	1	1	(86)

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

(87)m=	19.39	19.58	19.92	20.36	20.73	20.93	20.98	20.97	20.8	20.31	19.77	19.36	(87)

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

(88)m=	19.74	19.75	19.75	19.77	19.77	19.78	19.78	19.78	19.78	19.77	19.76	19.76	(88)

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

(89)m=	1	0.99	0.98	0.93	0.8	0.58	0.39	0.46	0.78	0.97	0.99	1	(89)

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

(90)m=	17.62	17.9	18.39	19.03	19.51	19.74	19.78	19.77	19.62	18.97	18.19	17.59	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	17.95	18.22	18.68	19.28	19.74	19.96	20	20	19.84	19.22	18.48	17.92	(92)

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

(93)m=	17.95	18.22	18.68	19.28	19.74	19.96	20	20	19.84	19.22	18.48	17.92	(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	0.97	0.92	0.8	0.6	0.42	0.48	0.78	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	614.41	749.84	893.57	1018.1	993.48	747.23	494.41	515.89	716.14	712.15	613.49	574.56	(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=	2081.44	2025.33	1846.35	1552.57	1199.21	789.59	501.13	528.61	849.6	1285.66	1706.64	2068.09	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1091.47	857.13	708.87	384.82	153.07	0	0	0	0	426.69	787.07	1111.18	

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Total per year (kWh/year) = Sum(98)1...5,9...12 =	5520.3	(98)
Space heating requirement in kWh/m²/year	51.55	(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		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	1091.47	857.13	708.87	384.82	153.07	0	0	0	0	426.69	787.07	1111.18		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1168.6	917.7	758.96	412.01	163.88	0	0	0	0	456.84	842.69	1189.7		(211)
Total (kWh/year) =Sum(211)1...5,10...12=													5910.38	(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)	215.08	189.57	199.08	177.76	172.1	151.58	145.22	161.89	163.68	185.04	195.68	209.9		
Efficiency of water heater													80.3	(216)
(217)m=	88.57	88.39	87.97	86.94	84.76	80.3	80.3	80.3	80.3	87.09	88.19	88.63		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	242.85	214.48	226.3	204.45	203.05	188.76	180.85	201.61	203.83	212.48	221.88	236.83		
Total = Sum(219a)1...12 =													2537.37	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5910.38	
Water heating fuel used			2537.37	
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			420.86	(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	=	1276.64	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	548.07	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1824.71	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	218.42	(268)
Total CO2, kg/year		sum of (265)…(271) =		2082.06	(272)

TER = 19.44 (273)

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User Details:

Assessor Name:	Mitchell Finn	**Stroma Number:**	STRO029125
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.11

Property Address: House 1 After Reducing Energy Demand

Address : House 1, South of 27a West End Lane, London, NW6 4QJ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	47.13	(1a)	x	2.45	(2a)	=	115.47	(3a)
First floor	47.13	(1b)	x	2.75	(2b)	=	129.61	(3b)
Second floor	24.95	(1c)	x	2.9	(2c)	=	72.36	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	119.21	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	317.43	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.06	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.31	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.4	0.39	0.38	0.34	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37

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			2.15	x	1	=	2.15			(26)
Windows Type 1			19.95	x1/[1/(1.4)+ 0.04]		=	26.45			(27)
Windows Type 2			10	x1/[1/(1.4)+ 0.04]		=	13.26			(27)
Windows Type 3			14.07	x1/[1/(1.4)+ 0.04]		=	18.65			(27)
Rooflights			2.73	x1/[1/(1.4) + 0.04]		=	3.822			(27b)
Floor			47.13	x	0.13	=	6.1269			(28)
Walls	145.49	46.17	99.32	x	0.18	=	17.88			(29)
Roof	47.13	2.73	44.4	x	0.13	=	5.77			(30)
Total area of elements, m²			239.75							(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) = 93.91 (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 39.17 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 133.08 (37)

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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=	60.72	60.39	60.08	58.59	58.31	57.01	57.01	56.77	57.51	58.31	58.87	59.46	(38)

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

(39)m=	193.8	193.47	193.15	191.66	191.38	190.08	190.08	189.84	190.59	191.38	191.95	192.54	

Average = Sum(39)$_{1…12}$ /12= 191.66 (39)

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

(40)m=	1.63	1.62	1.62	1.61	1.61	1.59	1.59	1.59	1.6	1.61	1.61	1.62	

Average = Sum(40)$_{1…12}$ /12= 1.61 (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 — 2.86 (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 — 102.13 (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=	112.34	108.26	104.17	100.09	96	91.92	91.92	96	100.09	104.17	108.26	112.34	

Total = Sum(44)$_{1…12}$ = 1225.56 (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=	166.6	145.71	150.36	131.09	125.78	108.54	100.58	115.42	116.79	136.11	148.58	161.34	

Total = Sum(45)$_{1…12}$ = 1606.9 (45)

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

(46)m=	24.99	21.86	22.55	19.66	18.87	16.28	15.09	17.31	17.52	20.42	22.29	24.2	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (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): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If 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 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	29.17	26.34	29.15	28.19	29.1	28.14	29.06	29.09	28.16	29.13	28.21	29.16	(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=	195.77	172.05	179.51	159.27	154.89	136.68	129.64	144.5	144.96	165.24	176.79	190.51	(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=	195.77	172.05	179.51	159.27	154.89	136.68	129.64	144.5	144.96	165.24	176.79	190.51

Output from water heater (annual)$_{1...12}$ — 1949.81 (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=	62.69	55.03	57.28	50.63	49.1	43.12	40.71	45.65	45.88	52.54	56.45	60.94	(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=	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	25.33	22.5	18.3	13.85	10.36	8.74	9.45	12.28	16.48	20.93	24.43	26.04	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	284.18	287.13	279.7	263.88	243.91	225.14	212.6	209.65	217.08	232.9	252.87	271.64	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	(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=	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	(71)
Water heating gains (Table 5)													
(72)m=	84.26	81.9	76.99	70.32	65.99	59.9	54.71	61.35	63.72	70.62	78.41	81.91	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	462.68	460.43	443.89	416.96	389.16	362.68	345.67	352.19	366.18	393.35	424.61	448.49	(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)

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Northeast	0.9x	0.77	x	14.07	x	11.28	x	0.76	x	0.7	=	58.53	(75)
Northeast	0.9x	0.77	x	14.07	x	22.97	x	0.76	x	0.7	=	119.13	(75)
Northeast	0.9x	0.77	x	14.07	x	41.38	x	0.76	x	0.7	=	214.64	(75)
Northeast	0.9x	0.77	x	14.07	x	67.96	x	0.76	x	0.7	=	352.51	(75)
Northeast	0.9x	0.77	x	14.07	x	91.35	x	0.76	x	0.7	=	473.84	(75)
Northeast	0.9x	0.77	x	14.07	x	97.38	x	0.76	x	0.7	=	505.16	(75)
Northeast	0.9x	0.77	x	14.07	x	91.1	x	0.76	x	0.7	=	472.57	(75)
Northeast	0.9x	0.77	x	14.07	x	72.63	x	0.76	x	0.7	=	376.74	(75)
Northeast	0.9x	0.77	x	14.07	x	50.42	x	0.76	x	0.7	=	261.55	(75)
Northeast	0.9x	0.77	x	14.07	x	28.07	x	0.76	x	0.7	=	145.59	(75)
Northeast	0.9x	0.77	x	14.07	x	14.2	x	0.76	x	0.7	=	73.64	(75)
Northeast	0.9x	0.77	x	14.07	x	9.21	x	0.76	x	0.7	=	47.8	(75)
Southeast	0.9x	0.77	x	19.95	x	36.79	x	0.76	x	0.7	=	270.62	(77)
Southeast	0.9x	0.77	x	19.95	x	62.67	x	0.76	x	0.7	=	460.97	(77)
Southeast	0.9x	0.77	x	19.95	x	85.75	x	0.76	x	0.7	=	630.72	(77)
Southeast	0.9x	0.77	x	19.95	x	106.25	x	0.76	x	0.7	=	781.49	(77)
Southeast	0.9x	0.77	x	19.95	x	119.01	x	0.76	x	0.7	=	875.33	(77)
Southeast	0.9x	0.77	x	19.95	x	118.15	x	0.76	x	0.7	=	869	(77)
Southeast	0.9x	0.77	x	19.95	x	113.91	x	0.76	x	0.7	=	837.81	(77)
Southeast	0.9x	0.77	x	19.95	x	104.39	x	0.76	x	0.7	=	767.8	(77)
Southeast	0.9x	0.77	x	19.95	x	92.85	x	0.76	x	0.7	=	682.93	(77)
Southeast	0.9x	0.77	x	19.95	x	69.27	x	0.76	x	0.7	=	509.47	(77)
Southeast	0.9x	0.77	x	19.95	x	44.07	x	0.76	x	0.7	=	324.14	(77)
Southeast	0.9x	0.77	x	19.95	x	31.49	x	0.76	x	0.7	=	231.6	(77)
Southwest	0.9x	0.77	x	10	x	36.79		0.76	x	0.7	=	135.65	(79)
Southwest	0.9x	0.77	x	10	x	62.67		0.76	x	0.7	=	231.06	(79)
Southwest	0.9x	0.77	x	10	x	85.75		0.76	x	0.7	=	316.15	(79)
Southwest	0.9x	0.77	x	10	x	106.25		0.76	x	0.7	=	391.72	(79)
Southwest	0.9x	0.77	x	10	x	119.01		0.76	x	0.7	=	438.76	(79)
Southwest	0.9x	0.77	x	10	x	118.15		0.76	x	0.7	=	435.59	(79)
Southwest	0.9x	0.77	x	10	x	113.91		0.76	x	0.7	=	419.96	(79)
Southwest	0.9x	0.77	x	10	x	104.39		0.76	x	0.7	=	384.86	(79)
Southwest	0.9x	0.77	x	10	x	92.85		0.76	x	0.7	=	342.32	(79)
Southwest	0.9x	0.77	x	10	x	69.27		0.76	x	0.7	=	255.37	(79)
Southwest	0.9x	0.77	x	10	x	44.07		0.76	x	0.7	=	162.48	(79)
Southwest	0.9x	0.77	x	10	x	31.49		0.76	x	0.7	=	116.09	(79)
Rooflights	0.9x	1	x	2.73	x	26	x	0.76	x	0.7	=	33.99	(82)
Rooflights	0.9x	1	x	2.73	x	54	x	0.76	x	0.7	=	70.58	(82)
Rooflights	0.9x	1	x	2.73	x	96	x	0.76	x	0.7	=	125.48	(82)
Rooflights	0.9x	1	x	2.73	x	150	x	0.76	x	0.7	=	196.07	(82)
Rooflights	0.9x	1	x	2.73	x	192	x	0.76	x	0.7	=	250.97	(82)

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Rooflights 0.9x	1	x	2.73	x	200	x	0.76	x	0.7	=	261.42	(82)
Rooflights 0.9x	1	x	2.73	x	189	x	0.76	x	0.7	=	247.05	(82)
Rooflights 0.9x	1	x	2.73	x	157	x	0.76	x	0.7	=	205.22	(82)
Rooflights 0.9x	1	x	2.73	x	115	x	0.76	x	0.7	=	150.32	(82)
Rooflights 0.9x	1	x	2.73	x	66	x	0.76	x	0.7	=	86.27	(82)
Rooflights 0.9x	1	x	2.73	x	33	x	0.76	x	0.7	=	43.14	(82)
Rooflights 0.9x	1	x	2.73	x	21	x	0.76	x	0.7	=	27.45	(82)

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

(83)m=	498.78	881.75	1286.99	1721.79	2038.9	2071.18	1977.38	1734.62	1437.12	996.7	603.4	422.93	(83)

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

(84)m=	961.46	1342.18	1730.89	2138.75	2428.06	2433.86	2323.05	2086.81	1803.31	1390.06	1028.01	871.42	(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=	0.99	0.98	0.93	0.83	0.66	0.48	0.36	0.41	0.66	0.91	0.98	1	(86)

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

(87)m=	19.35	19.69	20.14	20.6	20.87	20.97	20.99	20.99	20.9	20.47	19.8	19.28	(87)

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

(88)m=	19.59	19.6	19.6	19.61	19.61	19.62	19.62	19.62	19.61	19.61	19.61	19.6	(88)

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

(89)m=	0.99	0.97	0.91	0.78	0.58	0.39	0.25	0.29	0.55	0.87	0.98	0.99	(89)

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

(90)m=	17.46	17.96	18.59	19.19	19.5	19.6	19.62	19.62	19.55	19.06	18.12	17.37	(90)

fLA = Living area ÷ (4) = 0.15 (91)

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

(92)m=	17.75	18.22	18.83	19.41	19.71	19.81	19.83	19.82	19.76	19.28	18.38	17.66	(92)

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

(93)m=	17.75	18.22	18.83	19.41	19.71	19.81	19.83	19.82	19.76	19.28	18.38	17.66	(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	0.96	0.9	0.77	0.59	0.4	0.26	0.31	0.56	0.86	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	948.27	1287.83	1555.47	1648.03	1427.09	972.6	610.68	645.44	1014.89	1194.52	997.05	862.83	(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=	2606.02	2577.75	2380.9	2014.22	1533.05	990.38	613.17	650.15	1078.55	1660.74	2164.57	2591.74	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1233.36	866.82	614.12	263.66	78.83	0	0	0	0	346.87	840.61	1286.31	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5530.59 (98)

Space heating requirement in kWh/m²/year 46.39 (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 93.7 (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)	1233.36	866.82	614.12	263.66	78.83	0	0	0	0	346.87	840.61	1286.31		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1316.29	925.1	655.42	281.38	84.13	0	0	0	0	370.19	897.13	1372.8		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													5902.44	(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)	195.77	172.05	179.51	159.27	154.89	136.68	129.64	144.5	144.96	165.24	176.79	190.51		
Efficiency of water heater													87	(216)
(217)m=	90.17	90.07	89.84	89.27	88.21	87	87	87	87	89.47	90.03	90.21		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	217.11	191.03	199.82	178.42	175.58	157.1	149.01	166.1	166.62	184.68	196.36	211.2		
Total = Sum(219a)$_{1...12}$ =													2193.02	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5902.44	
Water heating fuel used			2193.02	
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			447.42	(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	=	1274.93	(261)

DER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	473.69	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1748.62	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	232.21	(268)
Total CO2, kg/year		sum of (265)…(271) =		2019.76	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.94	(273)
EI rating (section 14)				84	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Mitchell Finn	**Stroma Number:**	STRO029125
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.11

Property Address: House 2 After Reducing Energy Demand

Address : House 2, South of 27a West End Lane, London, NW6 4QJ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	41.61	(1a)	x	2.45	(2a)	=	101.94	(3a)
First floor	41.61	(1b)	x	2.75	(2b)	=	114.43	(3b)
Second floor	25.43	(1c)	x	2.9	(2c)	=	73.75	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	108.65	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	290.12	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.07	(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)	0.32	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.32	(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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.41	0.4	0.39	0.35	0.34	0.3	0.3	0.3	0.32	0.34	0.36	0.37

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	0.58	0.56	0.56	0.55	0.55	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	0.58	0.56	0.56	0.55	0.55	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			2.2	x	1	=	2.2			(26)
Windows Type 1			10	x1/[1/(1.4)+ 0.04]		=	13.26			(27)
Windows Type 2			11.67	x1/[1/(1.4)+ 0.04]		=	15.47			(27)
Rooflights			2.73	x1/[1/(1.4) + 0.04]		=	3.822			(27b)
Floor			41.61	x	0.13	=	5.4093			(28)
Walls	55.69	23.87	31.82	x	0.18	=	5.73			(29)
Roof	41.61	2.73	38.88	x	0.13	=	5.05			(30)
Total area of elements, m²			138.91							(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) = 50.74 (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 26.91 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 77.65 (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

DER WorkSheet: New dwelling design stage

(38)m=	55.79	55.48	55.18	53.76	53.5	52.26	52.26	52.04	52.74	53.5	54.03	54.59	(38)

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

(39)m=	133.43	133.13	132.83	131.41	131.15	129.91	129.91	129.69	130.39	131.15	131.68	132.24	

Average = Sum(39)$_{1...12}$ /12= 131.41 (39)

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

(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.19	1.2	1.21	1.21	1.22

Average = Sum(40)$_{1...12}$ /12= 1.21 (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 2.81 (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) + 36 100.85 (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=	110.94	106.91	102.87	98.84	94.8	90.77	90.77	94.8	98.84	102.87	106.91	110.94

Total = Sum(44)$_{1...12}$ = 1210.25 (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=	164.52	143.89	148.48	129.45	124.21	107.18	99.32	113.97	115.33	134.41	146.72	159.33

Total = Sum(45)$_{1...12}$ = 1586.82 (45)

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

(46)m=	24.68	21.58	22.27	19.42	18.63	16.08	14.9	17.1	17.3	20.16	22.01	23.9	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If 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 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	29.17	26.34	29.15	28.18	29.1	28.14	29.06	29.08	28.16	29.12	28.21	29.16	(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=	193.69	170.23	177.63	157.63	153.31	135.32	128.38	143.06	143.49	163.54	174.93	188.49	(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=	193.69	170.23	177.63	157.63	153.31	135.32	128.38	143.06	143.49	163.54	174.93	188.49

Output from water heater (annual)$_{1...12}$ | 1929.69 | (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=	62	54.43	56.66	50.09	48.57	42.67	40.29	45.17	45.39	51.97	55.84	60.27	(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=	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	24.04	21.35	17.36	13.14	9.82	8.29	8.96	11.65	15.64	19.85	23.17	24.7	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	269.6	272.4	265.35	250.34	231.4	213.59	201.69	198.9	205.95	220.95	239.9	257.71	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	(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=	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	(71)
Water heating gains (Table 5)													
(72)m=	83.33	80.99	76.15	69.57	65.29	59.27	54.15	60.71	63.04	69.86	77.55	81	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	445.06	442.84	426.96	401.15	374.61	349.25	332.91	339.35	352.72	378.76	408.72	431.51	(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)	
Northeast	0.9x	0.77	x	11.67	x	11.28	x	0.76	x	0.7	=	48.54	(75)
Northeast	0.9x	0.77	x	11.67	x	22.97	x	0.76	x	0.7	=	98.81	(75)

Northeast 0.9x	0.77	x	11.67	x	41.38	x	0.76	x	0.7	=	178.03	(75)
Northeast 0.9x	0.77	x	11.67	x	67.96	x	0.76	x	0.7	=	292.38	(75)
Northeast 0.9x	0.77	x	11.67	x	91.35	x	0.76	x	0.7	=	393.01	(75)
Northeast 0.9x	0.77	x	11.67	x	97.38	x	0.76	x	0.7	=	418.99	(75)
Northeast 0.9x	0.77	x	11.67	x	91.1	x	0.76	x	0.7	=	391.96	(75)
Northeast 0.9x	0.77	x	11.67	x	72.63	x	0.76	x	0.7	=	312.47	(75)
Northeast 0.9x	0.77	x	11.67	x	50.42	x	0.76	x	0.7	=	216.93	(75)
Northeast 0.9x	0.77	x	11.67	x	28.07	x	0.76	x	0.7	=	120.76	(75)
Northeast 0.9x	0.77	x	11.67	x	14.2	x	0.76	x	0.7	=	61.08	(75)
Northeast 0.9x	0.77	x	11.67	x	9.21	x	0.76	x	0.7	=	39.64	(75)
Southwest 0.9x	0.77	x	10	x	36.79		0.76	x	0.7	=	135.65	(79)
Southwest 0.9x	0.77	x	10	x	62.67		0.76	x	0.7	=	231.06	(79)
Southwest 0.9x	0.77	x	10	x	85.75		0.76	x	0.7	=	316.15	(79)
Southwest 0.9x	0.77	x	10	x	106.25		0.76	x	0.7	=	391.72	(79)
Southwest 0.9x	0.77	x	10	x	119.01		0.76	x	0.7	=	438.76	(79)
Southwest 0.9x	0.77	x	10	x	118.15		0.76	x	0.7	=	435.59	(79)
Southwest 0.9x	0.77	x	10	x	113.91		0.76	x	0.7	=	419.96	(79)
Southwest 0.9x	0.77	x	10	x	104.39		0.76	x	0.7	=	384.86	(79)
Southwest 0.9x	0.77	x	10	x	92.85		0.76	x	0.7	=	342.32	(79)
Southwest 0.9x	0.77	x	10	x	69.27		0.76	x	0.7	=	255.37	(79)
Southwest 0.9x	0.77	x	10	x	44.07		0.76	x	0.7	=	162.48	(79)
Southwest 0.9x	0.77	x	10	x	31.49		0.76	x	0.7	=	116.09	(79)
Rooflights 0.9x	1	x	2.73	x	26	x	0.76	x	0.7	=	33.99	(82)
Rooflights 0.9x	1	x	2.73	x	54	x	0.76	x	0.7	=	70.58	(82)
Rooflights 0.9x	1	x	2.73	x	96	x	0.76	x	0.7	=	125.48	(82)
Rooflights 0.9x	1	x	2.73	x	150	x	0.76	x	0.7	=	196.07	(82)
Rooflights 0.9x	1	x	2.73	x	192	x	0.76	x	0.7	=	250.97	(82)
Rooflights 0.9x	1	x	2.73	x	200	x	0.76	x	0.7	=	261.42	(82)
Rooflights 0.9x	1	x	2.73	x	189	x	0.76	x	0.7	=	247.05	(82)
Rooflights 0.9x	1	x	2.73	x	157	x	0.76	x	0.7	=	205.22	(82)
Rooflights 0.9x	1	x	2.73	x	115	x	0.76	x	0.7	=	150.32	(82)
Rooflights 0.9x	1	x	2.73	x	66	x	0.76	x	0.7	=	86.27	(82)
Rooflights 0.9x	1	x	2.73	x	33	x	0.76	x	0.7	=	43.14	(82)
Rooflights 0.9x	1	x	2.73	x	21	x	0.76	x	0.7	=	27.45	(82)

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

(83)m=	218.18	400.46	619.66	880.17	1082.74	1116.01	1058.96	902.55	709.57	462.4	266.69	183.18	(83)

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

(84)m=	663.24	843.3	1046.62	1281.32	1457.35	1465.26	1391.87	1241.91	1062.29	841.16	675.42	614.69	(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	0.99	0.97	0.9	0.75	0.55	0.41	0.47	0.75	0.96	0.99	1	(86)

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

(87)m=	19.66	19.89	20.23	20.63	20.89	20.98	21	20.99	20.92	20.52	20.01	19.63	(87)

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

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.93	19.92	19.91	19.91	19.91	(88)

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

(89)m=	1	0.99	0.97	0.87	0.69	0.47	0.31	0.37	0.67	0.94	0.99	1	(89)

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

(90)m=	18.13	18.45	18.94	19.5	19.82	19.91	19.92	19.92	19.86	19.38	18.64	18.08	(90)

fLA = Living area ÷ (4) = 0.18 (91)

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

(92)m=	18.41	18.71	19.18	19.71	20.01	20.11	20.12	20.12	20.05	19.59	18.89	18.36	(92)

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

(93)m=	18.41	18.71	19.18	19.71	20.01	20.11	20.12	20.12	20.05	19.59	18.89	18.36	(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	0.96	0.87	0.69	0.48	0.33	0.39	0.68	0.93	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	660.27	832.17	1003.2	1112.45	1007.56	704.27	455.94	479.42	722.06	786.4	668.45	612.73	(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=	1882.59	1839	1683.96	1420.71	1090.27	715.59	457.29	482.36	776.2	1178.76	1552.61	1872.73	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	909.41	676.59	506.48	221.95	61.54	0	0	0	0	291.92	636.59	937.44	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4241.92 (98)

Space heating requirement in kWh/m²/year 39.04 (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		93.7	(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)													
	909.41	676.59	506.48	221.95	61.54	0	0	0	0	291.92	636.59	937.44	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	970.55	722.08	540.54	236.87	65.67	0	0	0	0	311.55	679.39	1000.47	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4527.13 (211)

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

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

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

Water heating

Output from water heater (calculated above)

193.69	170.23	177.63	157.63	153.31	135.32	128.38	143.06	143.49	163.54	174.93	188.49

Efficiency of water heater 87 (216)

(217)m=	90.03	89.93	89.71	89.13	88.03	87	87	87	87	89.34	89.88	90.06	(217)

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

(219)m=	215.14	189.29	198	176.86	174.16	155.54	147.56	164.43	164.94	183.06	194.63	209.3

Total = Sum(219a)$_{1...12}$ = 2172.92 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		4527.13	
Water heating fuel used		2172.92	
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		424.47	(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	=	977.86	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	469.35	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1447.21	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	220.3	(268)
Total CO2, kg/year			sum of (265)…(271) =		1706.44	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		15.71	(273)
EI rating (section 14)					85	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Mitchell Finn	**Stroma Number:**	STRO029125
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.11

Property Address: House 3 After Reducing Energy Demand

Address : House 3, South of 27a West End Lane, London, NW6 4QJ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	41.51	(1a)	x	2.45	(2a)	=	101.7	(3a)
First floor	41.51	(1b)	x	2.75	(2b)	=	114.15	(3b)
Second floor	24.07	(1c)	x	2.9	(2c)	=	69.8	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.09	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	285.65	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.07	(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)			0.32	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.32	(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

0.41	0.4	0.39	0.35	0.34	0.3	0.3	0.3	0.32	0.34	0.36	0.38

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	0.58	0.56	0.56	0.55	0.55	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	0.58	0.56	0.56	0.55	0.55	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			2.2	x	1	=	2.2			(26)
Windows Type 1			4.37	x1/[1/(1.4)+ 0.04]		=	5.79			(27)
Windows Type 2			10	x1/[1/(1.4)+ 0.04]		=	13.26			(27)
Windows Type 3			11.67	x1/[1/(1.4)+ 0.04]		=	15.47			(27)
Rooflights			2.73	x1/[1/(1.4) + 0.04]		=	3.822			(27b)
Floor			41.51	x	0.13	=	5.396299			(28)
Walls	134.4	28.24	106.16	x	0.18	=	19.11			(29)
Roof	41.51	2.73	38.78	x	0.13	=	5.04			(30)
Total area of elements, m²			217.42							(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) = 69.89 (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 37.03 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 106.91 (37)

DER WorkSheet: New dwelling design stage

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=	54.98	54.68	54.38	52.97	52.71	51.49	51.49	51.26	51.96	52.71	53.24	53.8	(38)

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

(39)m=	161.89	161.59	161.29	159.89	159.63	158.4	158.4	158.18	158.87	159.63	160.16	160.71	

Average = $Sum(39)_{1...12}$ /12= 159.89 (39)

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

(40)m=	1.51	1.51	1.51	1.49	1.49	1.48	1.48	1.48	1.48	1.49	1.5	1.5

Average = $Sum(40)_{1...12}$ /12= 1.49 (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 2.8 (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) + 36 100.61 (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=	110.67	106.65	102.62	98.6	94.57	90.55	90.55	94.57	98.6	102.62	106.65	110.67

Total = $Sum(44)_{1...12}$ = 1207.31 (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=	164.12	143.54	148.12	129.14	123.91	106.92	99.08	113.7	115.05	134.09	146.36	158.94

Total = $Sum(45)_{1...12}$ = 1582.98 (45)

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

(46)m=	24.62	21.53	22.22	19.37	18.59	16.04	14.86	17.05	17.26	20.11	21.95	23.84	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If 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 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

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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=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	29.17	26.34	29.14	28.18	29.1	28.13	29.06	29.08	28.16	29.12	28.21	29.16	(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=	193.29	169.88	177.27	157.32	153.01	135.06	128.14	142.78	143.21	163.21	174.57	188.1	(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=	193.29	169.88	177.27	157.32	153.01	135.06	128.14	142.78	143.21	163.21	174.57	188.1

Output from water heater (annual)$_{1...12}$ — 1925.84 — (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=	61.86	54.31	56.54	49.98	48.47	42.59	40.21	45.08	45.3	51.86	55.72	60.14	(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=	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	(66)

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

(67)m=	23.83	21.17	17.21	13.03	9.74	8.22	8.89	11.55	15.5	19.69	22.98	24.49	(67)

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

(68)m=	267.31	270.08	263.09	248.21	229.43	211.77	199.98	197.2	204.19	219.07	237.86	255.51	(68)

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

(69)m=	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	(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=	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	(71)

Water heating gains (Table 5)

(72)m=	83.15	80.82	75.99	69.42	65.15	59.15	54.04	60.58	62.91	69.71	77.39	80.83	(72)

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

(73)m=	442.23	440.01	424.24	398.61	372.26	347.09	330.85	337.28	350.55	376.41	406.16	428.78	(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)

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Northeast	0.9x	0.77	x	11.67	x	11.28	x	0.76	x	0.7	=	48.54	(75)
Northeast	0.9x	0.77	x	11.67	x	22.97	x	0.76	x	0.7	=	98.81	(75)
Northeast	0.9x	0.77	x	11.67	x	41.38	x	0.76	x	0.7	=	178.03	(75)
Northeast	0.9x	0.77	x	11.67	x	67.96	x	0.76	x	0.7	=	292.38	(75)
Northeast	0.9x	0.77	x	11.67	x	91.35	x	0.76	x	0.7	=	393.01	(75)
Northeast	0.9x	0.77	x	11.67	x	97.38	x	0.76	x	0.7	=	418.99	(75)
Northeast	0.9x	0.77	x	11.67	x	91.1	x	0.76	x	0.7	=	391.96	(75)
Northeast	0.9x	0.77	x	11.67	x	72.63	x	0.76	x	0.7	=	312.47	(75)
Northeast	0.9x	0.77	x	11.67	x	50.42	x	0.76	x	0.7	=	216.93	(75)
Northeast	0.9x	0.77	x	11.67	x	28.07	x	0.76	x	0.7	=	120.76	(75)
Northeast	0.9x	0.77	x	11.67	x	14.2	x	0.76	x	0.7	=	61.08	(75)
Northeast	0.9x	0.77	x	11.67	x	9.21	x	0.76	x	0.7	=	39.64	(75)
Southwest	0.9x	0.77	x	10	x	36.79		0.76	x	0.7	=	135.65	(79)
Southwest	0.9x	0.77	x	10	x	62.67		0.76	x	0.7	=	231.06	(79)
Southwest	0.9x	0.77	x	10	x	85.75		0.76	x	0.7	=	316.15	(79)
Southwest	0.9x	0.77	x	10	x	106.25		0.76	x	0.7	=	391.72	(79)
Southwest	0.9x	0.77	x	10	x	119.01		0.76	x	0.7	=	438.76	(79)
Southwest	0.9x	0.77	x	10	x	118.15		0.76	x	0.7	=	435.59	(79)
Southwest	0.9x	0.77	x	10	x	113.91		0.76	x	0.7	=	419.96	(79)
Southwest	0.9x	0.77	x	10	x	104.39		0.76	x	0.7	=	384.86	(79)
Southwest	0.9x	0.77	x	10	x	92.85		0.76	x	0.7	=	342.32	(79)
Southwest	0.9x	0.77	x	10	x	69.27		0.76	x	0.7	=	255.37	(79)
Southwest	0.9x	0.77	x	10	x	44.07		0.76	x	0.7	=	162.48	(79)
Southwest	0.9x	0.77	x	10	x	31.49		0.76	x	0.7	=	116.09	(79)
Northwest	0.9x	0.77	x	4.37	x	11.28	x	0.76	x	0.7	=	18.18	(81)
Northwest	0.9x	0.77	x	4.37	x	22.97	x	0.76	x	0.7	=	37	(81)
Northwest	0.9x	0.77	x	4.37	x	41.38	x	0.76	x	0.7	=	66.67	(81)
Northwest	0.9x	0.77	x	4.37	x	67.96	x	0.76	x	0.7	=	109.48	(81)
Northwest	0.9x	0.77	x	4.37	x	91.35	x	0.76	x	0.7	=	147.17	(81)
Northwest	0.9x	0.77	x	4.37	x	97.38	x	0.76	x	0.7	=	156.9	(81)
Northwest	0.9x	0.77	x	4.37	x	91.1	x	0.76	x	0.7	=	146.77	(81)
Northwest	0.9x	0.77	x	4.37	x	72.63	x	0.76	x	0.7	=	117.01	(81)
Northwest	0.9x	0.77	x	4.37	x	50.42	x	0.76	x	0.7	=	81.23	(81)
Northwest	0.9x	0.77	x	4.37	x	28.07	x	0.76	x	0.7	=	45.22	(81)
Northwest	0.9x	0.77	x	4.37	x	14.2	x	0.76	x	0.7	=	22.87	(81)
Northwest	0.9x	0.77	x	4.37	x	9.21	x	0.76	x	0.7	=	14.85	(81)
Rooflights	0.9x	1	x	2.73	x	26	x	0.76	x	0.7	=	33.99	(82)
Rooflights	0.9x	1	x	2.73	x	54	x	0.76	x	0.7	=	70.58	(82)
Rooflights	0.9x	1	x	2.73	x	96	x	0.76	x	0.7	=	125.48	(82)
Rooflights	0.9x	1	x	2.73	x	150	x	0.76	x	0.7	=	196.07	(82)
Rooflights	0.9x	1	x	2.73	x	192	x	0.76	x	0.7	=	250.97	(82)

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Rooflights 0.9x	1	x	2.73	x	200	x	0.76	x	0.7	=	261.42	(82)
Rooflights 0.9x	1	x	2.73	x	189	x	0.76	x	0.7	=	247.05	(82)
Rooflights 0.9x	1	x	2.73	x	157	x	0.76	x	0.7	=	205.22	(82)
Rooflights 0.9x	1	x	2.73	x	115	x	0.76	x	0.7	=	150.32	(82)
Rooflights 0.9x	1	x	2.73	x	66	x	0.76	x	0.7	=	86.27	(82)
Rooflights 0.9x	1	x	2.73	x	33	x	0.76	x	0.7	=	43.14	(82)
Rooflights 0.9x	1	x	2.73	x	21	x	0.76	x	0.7	=	27.45	(82)

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

(83)m=	236.36	437.46	686.33	989.65	1229.91	1272.9	1205.73	1019.56	790.81	507.62	289.57	198.03	(83)

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

(84)m=	678.59	877.47	1110.57	1388.26	1602.18	1619.99	1536.59	1356.85	1141.36	884.03	695.73	626.81	(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	0.99	0.97	0.91	0.77	0.59	0.44	0.52	0.79	0.96	0.99	1	(86)

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

(87)m=	19.33	19.57	19.96	20.45	20.8	20.95	20.99	20.98	20.84	20.33	19.73	19.29	(87)

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

(88)m=	19.68	19.68	19.68	19.69	19.69	19.7	19.7	19.7	19.7	19.69	19.69	19.69	(88)

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

(89)m=	1	0.99	0.96	0.88	0.7	0.48	0.32	0.38	0.69	0.94	0.99	1	(89)

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

(90)m=	17.49	17.85	18.41	19.08	19.51	19.67	19.7	19.7	19.58	18.95	18.09	17.44	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	17.84	18.17	18.7	19.34	19.75	19.91	19.94	19.94	19.82	19.21	18.4	17.78	(92)

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

(93)m=	17.84	18.17	18.7	19.34	19.75	19.91	19.94	19.94	19.82	19.21	18.4	17.78	(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	0.87	0.71	0.5	0.34	0.41	0.7	0.93	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	674.57	863.65	1060.79	1208.15	1133.23	813.56	524.84	550.86	803.28	826.4	687.11	624.07	(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=	2191.52	2144.36	1967.91	1669.06	1285.67	841.58	529.1	559.39	908.19	1373.94	1809.01	2182.94	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1128.61	860.64	674.89	331.86	113.41	0	0	0	0	407.36	807.77	1159.8	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	5484.34	(98)
Space heating requirement in kWh/m²/year	51.21	(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		93.7	(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)	1128.61	860.64	674.89	331.86	113.41	0	0	0	0	407.36	807.77	1159.8		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1204.49	918.5	720.27	354.17	121.04	0	0	0	0	434.75	862.08	1237.78		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													5853.09	(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)	193.29	169.88	177.27	157.32	153.01	135.06	128.14	142.78	143.21	163.21	174.57	188.1		
Efficiency of water heater													87	(216)
(217)m=	90.14	90.07	89.9	89.48	88.54	87	87	87	87	89.61	90.02	90.16		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	214.43	188.61	197.17	175.82	172.82	155.24	147.29	164.12	164.61	182.13	193.93	208.62		
Total = Sum(219a)$_{1...12}$ =													2164.79	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5853.09	
Water heating fuel used			2164.79	
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			420.86	(232)

12a. CO_2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO_2/kWh		**Emissions** kg CO_2/year	
Space heating (main system 1)	(211)	x	0.216	=	1264.27	(261)

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Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	467.6	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1731.86	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	218.42	(268)
Total CO2, kg/year		sum of (265)…(271) =		1989.21	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.58	(273)
EI rating (section 14)				82	(274)

DER WorkSheet: New dwelling design stage

User Details:			
Assessor Name:	Mitchell Finn	**Stroma Number:**	STRO029125
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.11

Property Address: House 1 After Renewable Energy

Address : House 1, South of 27a West End Lane, London, NW6 4QJ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	47.13	(1a)	x	2.45	(2a)	=	115.47	(3a)
First floor	47.13	(1b)	x	2.75	(2b)	=	129.61	(3b)
Second floor	24.95	(1c)	x	2.9	(2c)	=	72.36	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	119.21	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	317.43	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.06	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.31	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1	(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

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

0.4	0.39	0.38	0.34	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37

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			2.15	x	1	=	2.15			(26)
Windows Type 1			19.95	x1/[1/(1.4)+ 0.04]		=	26.45			(27)
Windows Type 2			10	x1/[1/(1.4)+ 0.04]		=	13.26			(27)
Windows Type 3			14.07	x1/[1/(1.4)+ 0.04]		=	18.65			(27)
Rooflights			2.73	x1/[1/(1.4) + 0.04]		=	3.822			(27b)
Floor			47.13	x	0.13	=	6.1269			(28)
Walls	145.49	46.17	99.32	x	0.18	=	17.88			(29)
Roof	47.13	2.73	44.4	x	0.13	=	5.77			(30)
Total area of elements, m²			239.75							(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) = 93.91 (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 39.17 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 133.08 (37)

DER WorkSheet: New dwelling design stage

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=	60.72	60.39	60.08	58.59	58.31	57.01	57.01	56.77	57.51	58.31	58.87	59.46	(38)

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

(39)m=	193.8	193.47	193.15	191.66	191.38	190.08	190.08	189.84	190.59	191.38	191.95	192.54	

Average = $Sum(39)_{1...12}$ /12= 191.66 (39)

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

(40)m=	1.63	1.62	1.62	1.61	1.61	1.59	1.59	1.59	1.6	1.61	1.61	1.62	

Average = $Sum(40)_{1...12}$ /12= 1.61 (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 2.86 (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) + 36 102.13 (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=	112.34	108.26	104.17	100.09	96	91.92	91.92	96	100.09	104.17	108.26	112.34	

Total = $Sum(44)_{1...12}$ = 1225.56 (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=	166.6	145.71	150.36	131.09	125.78	108.54	100.58	115.42	116.79	136.11	148.58	161.34	

Total = $Sum(45)_{1...12}$ = 1606.9 (45)

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

(46)m=	24.99	21.86	22.55	19.66	18.87	16.28	15.09	17.31	17.52	20.42	22.29	24.2	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If 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 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	29.17	26.34	29.15	28.19	29.1	28.14	29.06	29.09	28.16	29.13	28.21	29.16	(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=	195.77	172.05	179.51	159.27	154.89	136.68	129.64	144.5	144.96	165.24	176.79	190.51	(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=	195.77	172.05	179.51	159.27	154.89	136.68	129.64	144.5	144.96	165.24	176.79	190.51

Output from water heater (annual)$_{1...12}$ — 1949.81 (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=	62.69	55.03	57.28	50.63	49.1	43.12	40.71	45.65	45.88	52.54	56.45	60.94	(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=	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	143.01	(66)

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

(67)m=	25.33	22.5	18.3	13.85	10.36	8.74	9.45	12.28	16.48	20.93	24.43	26.04	(67)

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

(68)m=	284.18	287.13	279.7	263.88	243.91	225.14	212.6	209.65	217.08	232.9	252.87	271.64	(68)

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

(69)m=	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	37.3	(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=	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	-114.41	(71)

Water heating gains (Table 5)

(72)m=	84.26	81.9	76.99	70.32	65.99	59.9	54.71	61.35	63.72	70.62	78.41	81.91	(72)

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

(73)m=	462.68	460.43	443.89	416.96	389.16	362.68	345.67	352.19	366.18	393.35	424.61	448.49	(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)

DER WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	14.07	x	11.28	x	0.76	x	0.7	=	58.53	(75)
Northeast	0.9x	0.77	x	14.07	x	22.97	x	0.76	x	0.7	=	119.13	(75)
Northeast	0.9x	0.77	x	14.07	x	41.38	x	0.76	x	0.7	=	214.64	(75)
Northeast	0.9x	0.77	x	14.07	x	67.96	x	0.76	x	0.7	=	352.51	(75)
Northeast	0.9x	0.77	x	14.07	x	91.35	x	0.76	x	0.7	=	473.84	(75)
Northeast	0.9x	0.77	x	14.07	x	97.38	x	0.76	x	0.7	=	505.16	(75)
Northeast	0.9x	0.77	x	14.07	x	91.1	x	0.76	x	0.7	=	472.57	(75)
Northeast	0.9x	0.77	x	14.07	x	72.63	x	0.76	x	0.7	=	376.74	(75)
Northeast	0.9x	0.77	x	14.07	x	50.42	x	0.76	x	0.7	=	261.55	(75)
Northeast	0.9x	0.77	x	14.07	x	28.07	x	0.76	x	0.7	=	145.59	(75)
Northeast	0.9x	0.77	x	14.07	x	14.2	x	0.76	x	0.7	=	73.64	(75)
Northeast	0.9x	0.77	x	14.07	x	9.21	x	0.76	x	0.7	=	47.8	(75)
Southeast	0.9x	0.77	x	19.95	x	36.79	x	0.76	x	0.7	=	270.62	(77)
Southeast	0.9x	0.77	x	19.95	x	62.67	x	0.76	x	0.7	=	460.97	(77)
Southeast	0.9x	0.77	x	19.95	x	85.75	x	0.76	x	0.7	=	630.72	(77)
Southeast	0.9x	0.77	x	19.95	x	106.25	x	0.76	x	0.7	=	781.49	(77)
Southeast	0.9x	0.77	x	19.95	x	119.01	x	0.76	x	0.7	=	875.33	(77)
Southeast	0.9x	0.77	x	19.95	x	118.15	x	0.76	x	0.7	=	869	(77)
Southeast	0.9x	0.77	x	19.95	x	113.91	x	0.76	x	0.7	=	837.81	(77)
Southeast	0.9x	0.77	x	19.95	x	104.39	x	0.76	x	0.7	=	767.8	(77)
Southeast	0.9x	0.77	x	19.95	x	92.85	x	0.76	x	0.7	=	682.93	(77)
Southeast	0.9x	0.77	x	19.95	x	69.27	x	0.76	x	0.7	=	509.47	(77)
Southeast	0.9x	0.77	x	19.95	x	44.07	x	0.76	x	0.7	=	324.14	(77)
Southeast	0.9x	0.77	x	19.95	x	31.49	x	0.76	x	0.7	=	231.6	(77)
Southwest	0.9x	0.77	x	10	x	36.79		0.76	x	0.7	=	135.65	(79)
Southwest	0.9x	0.77	x	10	x	62.67		0.76	x	0.7	=	231.06	(79)
Southwest	0.9x	0.77	x	10	x	85.75		0.76	x	0.7	=	316.15	(79)
Southwest	0.9x	0.77	x	10	x	106.25		0.76	x	0.7	=	391.72	(79)
Southwest	0.9x	0.77	x	10	x	119.01		0.76	x	0.7	=	438.76	(79)
Southwest	0.9x	0.77	x	10	x	118.15		0.76	x	0.7	=	435.59	(79)
Southwest	0.9x	0.77	x	10	x	113.91		0.76	x	0.7	=	419.96	(79)
Southwest	0.9x	0.77	x	10	x	104.39		0.76	x	0.7	=	384.86	(79)
Southwest	0.9x	0.77	x	10	x	92.85		0.76	x	0.7	=	342.32	(79)
Southwest	0.9x	0.77	x	10	x	69.27		0.76	x	0.7	=	255.37	(79)
Southwest	0.9x	0.77	x	10	x	44.07		0.76	x	0.7	=	162.48	(79)
Southwest	0.9x	0.77	x	10	x	31.49		0.76	x	0.7	=	116.09	(79)
Rooflights	0.9x	1	x	2.73	x	26	x	0.76	x	0.7	=	33.99	(82)
Rooflights	0.9x	1	x	2.73	x	54	x	0.76	x	0.7	=	70.58	(82)
Rooflights	0.9x	1	x	2.73	x	96	x	0.76	x	0.7	=	125.48	(82)
Rooflights	0.9x	1	x	2.73	x	150	x	0.76	x	0.7	=	196.07	(82)
Rooflights	0.9x	1	x	2.73	x	192	x	0.76	x	0.7	=	250.97	(82)

DER WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	2.73	x	200	x	0.76	x	0.7	=	261.42	(82)
Rooflights 0.9x	1	x	2.73	x	189	x	0.76	x	0.7	=	247.05	(82)
Rooflights 0.9x	1	x	2.73	x	157	x	0.76	x	0.7	=	205.22	(82)
Rooflights 0.9x	1	x	2.73	x	115	x	0.76	x	0.7	=	150.32	(82)
Rooflights 0.9x	1	x	2.73	x	66	x	0.76	x	0.7	=	86.27	(82)
Rooflights 0.9x	1	x	2.73	x	33	x	0.76	x	0.7	=	43.14	(82)
Rooflights 0.9x	1	x	2.73	x	21	x	0.76	x	0.7	=	27.45	(82)

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

(83)m=	498.78	881.75	1286.99	1721.79	2038.9	2071.18	1977.38	1734.62	1437.12	996.7	603.4	422.93	(83)

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

(84)m=	961.46	1342.18	1730.89	2138.75	2428.06	2433.86	2323.05	2086.81	1803.31	1390.06	1028.01	871.42	(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=	0.99	0.98	0.93	0.83	0.66	0.48	0.36	0.41	0.66	0.91	0.98	1	(86)

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

(87)m=	19.35	19.69	20.14	20.6	20.87	20.97	20.99	20.99	20.9	20.47	19.8	19.28	(87)

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

(88)m=	19.59	19.6	19.6	19.61	19.61	19.62	19.62	19.62	19.61	19.61	19.61	19.6	(88)

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

(89)m=	0.99	0.97	0.91	0.78	0.58	0.39	0.25	0.29	0.55	0.87	0.98	0.99	(89)

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

(90)m=	17.46	17.96	18.59	19.19	19.5	19.6	19.62	19.62	19.55	19.06	18.12	17.37	(90)

fLA = Living area ÷ (4) = | 0.15 | (91)

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

(92)m=	17.75	18.22	18.83	19.41	19.71	19.81	19.83	19.82	19.76	19.28	18.38	17.66	(92)

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

(93)m=	17.75	18.22	18.83	19.41	19.71	19.81	19.83	19.82	19.76	19.28	18.38	17.66	(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	0.96	0.9	0.77	0.59	0.4	0.26	0.31	0.56	0.86	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	948.27	1287.83	1555.47	1648.03	1427.09	972.6	610.68	645.44	1014.89	1194.52	997.05	862.83	(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=	2606.02	2577.75	2380.9	2014.22	1533.05	990.38	613.17	650.15	1078.55	1660.74	2164.57	2591.74	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1233.36	866.82	614.12	263.66	78.83	0	0	0	0	346.87	840.61	1286.31	

DER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5530.59 (98)

Space heating requirement in kWh/m²/year 46.39 (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 93.7 (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)	1233.36	866.82	614.12	263.66	78.83	0	0	0	0	346.87	840.61	1286.31		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1316.29	925.1	655.42	281.38	84.13	0	0	0	0	370.19	897.13	1372.8		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													5902.44	(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	kWh/year	
Output from water heater (calculated above)	195.77	172.05	179.51	159.27	154.89	136.68	129.64	144.5	144.96	165.24	176.79	190.51		
Efficiency of water heater													87	(216)
(217)m=	90.17	90.07	89.84	89.27	88.21	87	87	87	87	89.47	90.03	90.21		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	217.11	191.03	199.82	178.42	175.58	157.1	149.01	166.1	166.62	184.68	196.36	211.2		
Total = Sum(219a)$_{1...12}$ =													2193.02	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		5902.44	
Water heating fuel used		2193.02	
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		447.42	(232)
Electricity generated by PVs		-745.28	(233)

12a. CO_2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO_2/kWh	**Emissions** kg CO_2/year

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Space heating (main system 1)	(211) x	0.216	=	1274.93 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	473.69 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1748.62 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93 (267)
Electricity for lighting	(232) x	0.519	=	232.21 (268)
Energy saving/generation technologies Item 1		0.519	=	-386.8 (269)
Total CO2, kg/year		sum of (265)…(271) =		1632.95 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.7 (273)
EI rating (section 14)				87 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Mitchell Finn	**Stroma Number:**	STRO029125
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.11

Property Address: House 2 After Renewable Energy

Address : House 2, South of 27a West End Lane, London, NW6 4QJ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	41.61	(1a)	x	2.45	(2a)	=	101.94	(3a)
First floor	41.61	(1b)	x	2.75	(2b)	=	114.43	(3b)
Second floor	25.43	(1c)	x	2.9	(2c)	=	73.75	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	108.65	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	290.12	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.07	(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)			0.32	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.32	(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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.41	0.4	0.39	0.35	0.34	0.3	0.3	0.3	0.32	0.34	0.36	0.37

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	0.58	0.56	0.56	0.55	0.55	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	0.58	0.56	0.56	0.55	0.55	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			2.2	x	1	=	2.2			(26)
Windows Type 1			10	x1/[1/(1.4)+ 0.04]		=	13.26			(27)
Windows Type 2			11.67	x1/[1/(1.4)+ 0.04]		=	15.47			(27)
Rooflights			2.73	x1/[1/(1.4) + 0.04]		=	3.822			(27b)
Floor			41.61	x	0.13	=	5.4093			(28)
Walls	55.69	23.87	31.82	x	0.18	=	5.73			(29)
Roof	41.61	2.73	38.88	x	0.13	=	5.05			(30)
Total area of elements, m²			138.91							(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) = 50.74 (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 26.91 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss — (33) + (36) = 77.65 (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

DER WorkSheet: New dwelling design stage

(38)m=	55.79	55.48	55.18	53.76	53.5	52.26	52.26	52.04	52.74	53.5	54.03	54.59	(38)

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

(39)m=	133.43	133.13	132.83	131.41	131.15	129.91	129.91	129.69	130.39	131.15	131.68	132.24	

Average = Sum(39)$_{1...12}$ /12= 131.41 (39)

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

(40)m=	1.23	1.23	1.22	1.21	1.21	1.2	1.2	1.19	1.2	1.21	1.21	1.22	

Average = Sum(40)$_{1...12}$ /12= 1.21 (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 2.81 (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) + 36 100.85 (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=	110.94	106.91	102.87	98.84	94.8	90.77	90.77	94.8	98.84	102.87	106.91	110.94

Total = Sum(44)$_{1...12}$ = 1210.25 (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=	164.52	143.89	148.48	129.45	124.21	107.18	99.32	113.97	115.33	134.41	146.72	159.33

Total = Sum(45)$_{1...12}$ = 1586.82 (45)

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

(46)m=	24.68	21.58	22.27	19.42	18.63	16.08	14.9	17.1	17.3	20.16	22.01	23.9	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If 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 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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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=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	29.17	26.34	29.15	28.18	29.1	28.14	29.06	29.08	28.16	29.12	28.21	29.16	(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=	193.69	170.23	177.63	157.63	153.31	135.32	128.38	143.06	143.49	163.54	174.93	188.49	(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=	193.69	170.23	177.63	157.63	153.31	135.32	128.38	143.06	143.49	163.54	174.93	188.49	

Output from water heater (annual)$_{1...12}$ | 1929.69 | (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=	62	54.43	56.66	50.09	48.57	42.67	40.29	45.17	45.39	51.97	55.84	60.27	(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=	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	140.32	(66)

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

(67)m=	24.04	21.35	17.36	13.14	9.82	8.29	8.96	11.65	15.64	19.85	23.17	24.7	(67)

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

(68)m=	269.6	272.4	265.35	250.34	231.4	213.59	201.69	198.9	205.95	220.95	239.9	257.71	(68)

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

(69)m=	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	37.03	(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=	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	-112.26	(71)

Water heating gains (Table 5)

(72)m=	83.33	80.99	76.15	69.57	65.29	59.27	54.15	60.71	63.04	69.86	77.55	81	(72)

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

(73)m=	445.06	442.84	426.96	401.15	374.61	349.25	332.91	339.35	352.72	378.76	408.72	431.51	(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)	
Northeast 0.9x	0.77	x	11.67	x	11.28	x	0.76	x	0.7	=	48.54	(75)
Northeast 0.9x	0.77	x	11.67	x	22.97	x	0.76	x	0.7	=	98.81	(75)

Northeast 0.9x	0.77	x	11.67	x	41.38	x	0.76	x	0.7	=	178.03	(75)
Northeast 0.9x	0.77	x	11.67	x	67.96	x	0.76	x	0.7	=	292.38	(75)
Northeast 0.9x	0.77	x	11.67	x	91.35	x	0.76	x	0.7	=	393.01	(75)
Northeast 0.9x	0.77	x	11.67	x	97.38	x	0.76	x	0.7	=	418.99	(75)
Northeast 0.9x	0.77	x	11.67	x	91.1	x	0.76	x	0.7	=	391.96	(75)
Northeast 0.9x	0.77	x	11.67	x	72.63	x	0.76	x	0.7	=	312.47	(75)
Northeast 0.9x	0.77	x	11.67	x	50.42	x	0.76	x	0.7	=	216.93	(75)
Northeast 0.9x	0.77	x	11.67	x	28.07	x	0.76	x	0.7	=	120.76	(75)
Northeast 0.9x	0.77	x	11.67	x	14.2	x	0.76	x	0.7	=	61.08	(75)
Northeast 0.9x	0.77	x	11.67	x	9.21	x	0.76	x	0.7	=	39.64	(75)
Southwest 0.9x	0.77	x	10	x	36.79		0.76	x	0.7	=	135.65	(79)
Southwest 0.9x	0.77	x	10	x	62.67		0.76	x	0.7	=	231.06	(79)
Southwest 0.9x	0.77	x	10	x	85.75		0.76	x	0.7	=	316.15	(79)
Southwest 0.9x	0.77	x	10	x	106.25		0.76	x	0.7	=	391.72	(79)
Southwest 0.9x	0.77	x	10	x	119.01		0.76	x	0.7	=	438.76	(79)
Southwest 0.9x	0.77	x	10	x	118.15		0.76	x	0.7	=	435.59	(79)
Southwest 0.9x	0.77	x	10	x	113.91		0.76	x	0.7	=	419.96	(79)
Southwest 0.9x	0.77	x	10	x	104.39		0.76	x	0.7	=	384.86	(79)
Southwest 0.9x	0.77	x	10	x	92.85		0.76	x	0.7	=	342.32	(79)
Southwest 0.9x	0.77	x	10	x	69.27		0.76	x	0.7	=	255.37	(79)
Southwest 0.9x	0.77	x	10	x	44.07		0.76	x	0.7	=	162.48	(79)
Southwest 0.9x	0.77	x	10	x	31.49		0.76	x	0.7	=	116.09	(79)
Rooflights 0.9x	1	x	2.73	x	26	x	0.76	x	0.7	=	33.99	(82)
Rooflights 0.9x	1	x	2.73	x	54	x	0.76	x	0.7	=	70.58	(82)
Rooflights 0.9x	1	x	2.73	x	96	x	0.76	x	0.7	=	125.48	(82)
Rooflights 0.9x	1	x	2.73	x	150	x	0.76	x	0.7	=	196.07	(82)
Rooflights 0.9x	1	x	2.73	x	192	x	0.76	x	0.7	=	250.97	(82)
Rooflights 0.9x	1	x	2.73	x	200	x	0.76	x	0.7	=	261.42	(82)
Rooflights 0.9x	1	x	2.73	x	189	x	0.76	x	0.7	=	247.05	(82)
Rooflights 0.9x	1	x	2.73	x	157	x	0.76	x	0.7	=	205.22	(82)
Rooflights 0.9x	1	x	2.73	x	115	x	0.76	x	0.7	=	150.32	(82)
Rooflights 0.9x	1	x	2.73	x	66	x	0.76	x	0.7	=	86.27	(82)
Rooflights 0.9x	1	x	2.73	x	33	x	0.76	x	0.7	=	43.14	(82)
Rooflights 0.9x	1	x	2.73	x	21	x	0.76	x	0.7	=	27.45	(82)

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

(83)m=	218.18	400.46	619.66	880.17	1082.74	1116.01	1058.96	902.55	709.57	462.4	266.69	183.18	(83)

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

(84)m=	663.24	843.3	1046.62	1281.32	1457.35	1465.26	1391.87	1241.91	1062.29	841.16	675.42	614.69	(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

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(86)m=	1	0.99	0.97	0.9	0.75	0.55	0.41	0.47	0.75	0.96	0.99	1	(86)

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

(87)m=	19.66	19.89	20.23	20.63	20.89	20.98	21	20.99	20.92	20.52	20.01	19.63	(87)

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

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.93	19.92	19.91	19.91	19.91	(88)

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

(89)m=	1	0.99	0.97	0.87	0.69	0.47	0.31	0.37	0.67	0.94	0.99	1	(89)

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

(90)m=	18.13	18.45	18.94	19.5	19.82	19.91	19.92	19.92	19.86	19.38	18.64	18.08	(90)

fLA = Living area ÷ (4) = 0.18 (91)

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

(92)m=	18.41	18.71	19.18	19.71	20.01	20.11	20.12	20.12	20.05	19.59	18.89	18.36	(92)

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

(93)m=	18.41	18.71	19.18	19.71	20.01	20.11	20.12	20.12	20.05	19.59	18.89	18.36	(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	0.96	0.87	0.69	0.48	0.33	0.39	0.68	0.93	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	660.27	832.17	1003.2	1112.45	1007.56	704.27	455.94	479.42	722.06	786.4	668.45	612.73	(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=	1882.59	1839	1683.96	1420.71	1090.27	715.59	457.29	482.36	776.2	1178.76	1552.61	1872.73	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	909.41	676.59	506.48	221.95	61.54	0	0	0	0	291.92	636.59	937.44	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4241.92 (98)

Space heating requirement in kWh/m²/year 39.04 (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		93.7	(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)													
	909.41	676.59	506.48	221.95	61.54	0	0	0	0	291.92	636.59	937.44	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	970.55	722.08	540.54	236.87	65.67	0	0	0	0	311.55	679.39	1000.47	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 4527.13 (211)

DER WorkSheet: New dwelling design stage

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)

193.69	170.23	177.63	157.63	153.31	135.32	128.38	143.06	143.49	163.54	174.93	188.49

Efficiency of water heater 87 (216)

(217)m=	90.03	89.93	89.71	89.13	88.03	87	87	87	87	89.34	89.88	90.06

(217)

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

(219)m=	215.14	189.29	198	176.86	174.16	155.54	147.56	164.43	164.94	183.06	194.63	209.3

Total = Sum(219a)$_{1...12}$ = 2172.92 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4527.13	
Water heating fuel used			2172.92	
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			424.47	(232)
Electricity generated by PVs			-745.28	(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	0.216	=	977.86	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	469.35	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1447.21	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	220.3	(268)
Energy saving/generation technologies Item 1		0.519	=	-386.8	(269)
Total CO2, kg/year		sum of (265)…(271) =		1319.63	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		12.15	(273)
EI rating (section 14)				88	(274)

DER WorkSheet: New dwelling design stage

User Details:			
Assessor Name:	Mitchell Finn	**Stroma Number:**	STRO029125
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.11

Property Address: House 3 After Renewable Energy

Address : House 3, South of 27a West End Lane, London, NW6 4QJ

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	41.51	(1a)	x	2.45	(2a)	=	101.7	(3a)
First floor	41.51	(1b)	x	2.75	(2b)	=	114.15	(3b)
Second floor	24.07	(1c)	x	2.9	(2c)	=	69.8	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.09	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	285.65	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.07	(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)	0.32	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.32	(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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.41	0.4	0.39	0.35	0.34	0.3	0.3	0.3	0.32	0.34	0.36	0.38

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	0.58	0.56	0.56	0.55	0.55	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	0.58	0.56	0.56	0.55	0.55	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			2.2	x	1	=	2.2			(26)
Windows Type 1			4.37	x1/[1/(1.4)+ 0.04]		=	5.79			(27)
Windows Type 2			10	x1/[1/(1.4)+ 0.04]		=	13.26			(27)
Windows Type 3			11.67	x1/[1/(1.4)+ 0.04]		=	15.47			(27)
Rooflights			2.73	x1/[1/(1.4) + 0.04]		=	3.822			(27b)
Floor			41.51	x	0.13	=	5.396299			(28)
Walls	134.4	28.24	106.16	x	0.18	=	19.11			(29)
Roof	41.51	2.73	38.78	x	0.13	=	5.04			(30)
Total area of elements, m²			217.42							(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) = 69.89 (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 37.03 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 106.91 (37)

DER WorkSheet: New dwelling design stage

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=	54.98	54.68	54.38	52.97	52.71	51.49	51.49	51.26	51.96	52.71	53.24	53.8	(38)

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

(39)m=	161.89	161.59	161.29	159.89	159.63	158.4	158.4	158.18	158.87	159.63	160.16	160.71	

Average = Sum(39)$_{1…12}$ /12= 159.89 (39)

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

(40)m=	1.51	1.51	1.51	1.49	1.49	1.48	1.48	1.48	1.48	1.49	1.5	1.5	

Average = Sum(40)$_{1…12}$ /12= 1.49 (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 — 2.8 (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 — 100.61 (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=	110.67	106.65	102.62	98.6	94.57	90.55	90.55	94.57	98.6	102.62	106.65	110.67	

Total = Sum(44)$_{1…12}$ = 1207.31 (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=	164.12	143.54	148.12	129.14	123.91	106.92	99.08	113.7	115.05	134.09	146.36	158.94	

Total = Sum(45)$_{1…12}$ = 1582.98 (45)

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

(46)m=	24.62	21.53	22.22	19.37	18.59	16.04	14.86	17.05	17.26	20.11	21.95	23.84	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (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): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If 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 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

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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=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

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

(61)m=	29.17	26.34	29.14	28.18	29.1	28.13	29.06	29.08	28.16	29.12	28.21	29.16	(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=	193.29	169.88	177.27	157.32	153.01	135.06	128.14	142.78	143.21	163.21	174.57	188.1	(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=	193.29	169.88	177.27	157.32	153.01	135.06	128.14	142.78	143.21	163.21	174.57	188.1

Output from water heater (annual)$_{1…12}$ — 1925.84 (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=	61.86	54.31	56.54	49.98	48.47	42.59	40.21	45.08	45.3	51.86	55.72	60.14	(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=	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	139.81	(66)

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

(67)m=	23.83	21.17	17.21	13.03	9.74	8.22	8.89	11.55	15.5	19.69	22.98	24.49	(67)

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

(68)m=	267.31	270.08	263.09	248.21	229.43	211.77	199.98	197.2	204.19	219.07	237.86	255.51	(68)

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

(69)m=	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	(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=	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	-111.85	(71)

Water heating gains (Table 5)

(72)m=	83.15	80.82	75.99	69.42	65.15	59.15	54.04	60.58	62.91	69.71	77.39	80.83	(72)

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

(73)m=	442.23	440.01	424.24	398.61	372.26	347.09	330.85	337.28	350.55	376.41	406.16	428.78	(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)

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Northeast	0.9x	0.77	x	11.67	x	11.28	x	0.76	x	0.7	=	48.54	(75)
Northeast	0.9x	0.77	x	11.67	x	22.97	x	0.76	x	0.7	=	98.81	(75)
Northeast	0.9x	0.77	x	11.67	x	41.38	x	0.76	x	0.7	=	178.03	(75)
Northeast	0.9x	0.77	x	11.67	x	67.96	x	0.76	x	0.7	=	292.38	(75)
Northeast	0.9x	0.77	x	11.67	x	91.35	x	0.76	x	0.7	=	393.01	(75)
Northeast	0.9x	0.77	x	11.67	x	97.38	x	0.76	x	0.7	=	418.99	(75)
Northeast	0.9x	0.77	x	11.67	x	91.1	x	0.76	x	0.7	=	391.96	(75)
Northeast	0.9x	0.77	x	11.67	x	72.63	x	0.76	x	0.7	=	312.47	(75)
Northeast	0.9x	0.77	x	11.67	x	50.42	x	0.76	x	0.7	=	216.93	(75)
Northeast	0.9x	0.77	x	11.67	x	28.07	x	0.76	x	0.7	=	120.76	(75)
Northeast	0.9x	0.77	x	11.67	x	14.2	x	0.76	x	0.7	=	61.08	(75)
Northeast	0.9x	0.77	x	11.67	x	9.21	x	0.76	x	0.7	=	39.64	(75)
Southwest	0.9x	0.77	x	10	x	36.79		0.76	x	0.7	=	135.65	(79)
Southwest	0.9x	0.77	x	10	x	62.67		0.76	x	0.7	=	231.06	(79)
Southwest	0.9x	0.77	x	10	x	85.75		0.76	x	0.7	=	316.15	(79)
Southwest	0.9x	0.77	x	10	x	106.25		0.76	x	0.7	=	391.72	(79)
Southwest	0.9x	0.77	x	10	x	119.01		0.76	x	0.7	=	438.76	(79)
Southwest	0.9x	0.77	x	10	x	118.15		0.76	x	0.7	=	435.59	(79)
Southwest	0.9x	0.77	x	10	x	113.91		0.76	x	0.7	=	419.96	(79)
Southwest	0.9x	0.77	x	10	x	104.39		0.76	x	0.7	=	384.86	(79)
Southwest	0.9x	0.77	x	10	x	92.85		0.76	x	0.7	=	342.32	(79)
Southwest	0.9x	0.77	x	10	x	69.27		0.76	x	0.7	=	255.37	(79)
Southwest	0.9x	0.77	x	10	x	44.07		0.76	x	0.7	=	162.48	(79)
Southwest	0.9x	0.77	x	10	x	31.49		0.76	x	0.7	=	116.09	(79)
Northwest	0.9x	0.77	x	4.37	x	11.28	x	0.76	x	0.7	=	18.18	(81)
Northwest	0.9x	0.77	x	4.37	x	22.97	x	0.76	x	0.7	=	37	(81)
Northwest	0.9x	0.77	x	4.37	x	41.38	x	0.76	x	0.7	=	66.67	(81)
Northwest	0.9x	0.77	x	4.37	x	67.96	x	0.76	x	0.7	=	109.48	(81)
Northwest	0.9x	0.77	x	4.37	x	91.35	x	0.76	x	0.7	=	147.17	(81)
Northwest	0.9x	0.77	x	4.37	x	97.38	x	0.76	x	0.7	=	156.9	(81)
Northwest	0.9x	0.77	x	4.37	x	91.1	x	0.76	x	0.7	=	146.77	(81)
Northwest	0.9x	0.77	x	4.37	x	72.63	x	0.76	x	0.7	=	117.01	(81)
Northwest	0.9x	0.77	x	4.37	x	50.42	x	0.76	x	0.7	=	81.23	(81)
Northwest	0.9x	0.77	x	4.37	x	28.07	x	0.76	x	0.7	=	45.22	(81)
Northwest	0.9x	0.77	x	4.37	x	14.2	x	0.76	x	0.7	=	22.87	(81)
Northwest	0.9x	0.77	x	4.37	x	9.21	x	0.76	x	0.7	=	14.85	(81)
Rooflights	0.9x	1	x	2.73	x	26	x	0.76	x	0.7	=	33.99	(82)
Rooflights	0.9x	1	x	2.73	x	54	x	0.76	x	0.7	=	70.58	(82)
Rooflights	0.9x	1	x	2.73	x	96	x	0.76	x	0.7	=	125.48	(82)
Rooflights	0.9x	1	x	2.73	x	150	x	0.76	x	0.7	=	196.07	(82)
Rooflights	0.9x	1	x	2.73	x	192	x	0.76	x	0.7	=	250.97	(82)

DER WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	2.73	x	200	x	0.76	x	0.7	=	261.42	(82)
Rooflights 0.9x	1	x	2.73	x	189	x	0.76	x	0.7	=	247.05	(82)
Rooflights 0.9x	1	x	2.73	x	157	x	0.76	x	0.7	=	205.22	(82)
Rooflights 0.9x	1	x	2.73	x	115	x	0.76	x	0.7	=	150.32	(82)
Rooflights 0.9x	1	x	2.73	x	66	x	0.76	x	0.7	=	86.27	(82)
Rooflights 0.9x	1	x	2.73	x	33	x	0.76	x	0.7	=	43.14	(82)
Rooflights 0.9x	1	x	2.73	x	21	x	0.76	x	0.7	=	27.45	(82)

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

(83)m=	236.36	437.46	686.33	989.65	1229.91	1272.9	1205.73	1019.56	790.81	507.62	289.57	198.03	(83)

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

(84)m=	678.59	877.47	1110.57	1388.26	1602.18	1619.99	1536.59	1356.85	1141.36	884.03	695.73	626.81	(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	0.99	0.97	0.91	0.77	0.59	0.44	0.52	0.79	0.96	0.99	1	(86)

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

(87)m=	19.33	19.57	19.96	20.45	20.8	20.95	20.99	20.98	20.84	20.33	19.73	19.29	(87)

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

(88)m=	19.68	19.68	19.68	19.69	19.69	19.7	19.7	19.7	19.7	19.69	19.69	19.69	(88)

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

(89)m=	1	0.99	0.96	0.88	0.7	0.48	0.32	0.38	0.69	0.94	0.99	1	(89)

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

(90)m=	17.49	17.85	18.41	19.08	19.51	19.67	19.7	19.7	19.58	18.95	18.09	17.44	(90)

fLA = Living area ÷ (4) = | 0.19 | (91)

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

(92)m=	17.84	18.17	18.7	19.34	19.75	19.91	19.94	19.94	19.82	19.21	18.4	17.78	(92)

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

(93)m=	17.84	18.17	18.7	19.34	19.75	19.91	19.94	19.94	19.82	19.21	18.4	17.78	(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	0.87	0.71	0.5	0.34	0.41	0.7	0.93	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	674.57	863.65	1060.79	1208.15	1133.23	813.56	524.84	550.86	803.28	826.4	687.11	624.07	(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=	2191.52	2144.36	1967.91	1669.06	1285.67	841.58	529.1	559.39	908.19	1373.94	1809.01	2182.94	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1128.61	860.64	674.89	331.86	113.41	0	0	0	0	407.36	807.77	1159.8	(98)

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	5484.34	(98)
Space heating requirement in kWh/m²/year	51.21	(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		93.7	(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)	1128.61	860.64	674.89	331.86	113.41	0	0	0	0	407.36	807.77	1159.8		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1204.49	918.5	720.27	354.17	121.04	0	0	0	0	434.75	862.08	1237.78		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													5853.09	(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	kWh/year	
Output from water heater (calculated above)	193.29	169.88	177.27	157.32	153.01	135.06	128.14	142.78	143.21	163.21	174.57	188.1		
Efficiency of water heater													87	(216)
(217)m=	90.14	90.07	89.9	89.48	88.54	87	87	87	87	89.61	90.02	90.16		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	214.43	188.61	197.17	175.82	172.82	155.24	147.29	164.12	164.61	182.13	193.93	208.62		
Total = Sum(219a)$_{1...12}$ =													2164.79	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5853.09	
Water heating fuel used			2164.79	
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			420.86	(232)
Electricity generated by PVs			-745.28	(233)

12a. CO_2 emissions – Individual heating systems including micro-CHP

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

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	1264.27	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	467.6	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1731.86	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	218.42	(268)
Energy saving/generation technologies Item 1		0.519	=	-386.8	(269)
Total CO2, kg/year	sum of (265)…(271) =			1602.41	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			14.96	(273)
EI rating (section 14)				86	(274)

Part G Compliance Report

PROJECT DETAILS

Project Reference:	BE0764
Client:	StreetPlot Ltd
Property:	Garages to the south of 27a West End Lane London NW6 4QJ

Local Authority:	London Borough of Camden
Agent:	

Assessor:	Mitch Finn
Address:	Build Energy, BH23 3TA
Contact:	01202 280062
Software:	G-Calc 2015 version 3.0.2
Prepared on:	02-Sep-16

RESULT SUMMARY

By following the Government's national calculation methodology for assessing water efficiency in new dwellings this 3 bed dwelling, as designed, achieves a water consumption of Less than 110 litres per person per day using fittings approach.

Compliance with Building Regulation 36(1) has been demonstrated.

Maximum Fittings Consumption "As Designed"	
Water Fitting	**Maximum Consumption**
WCs	4/2.6 litres dual flush
Showers	8 l/min
Baths	170 litres
Basin taps	5l/min
Sink taps	6 l/min
Dishwasher	1.25 l/place setting
Washing machine	8.17 l/kilogram

The table below is to be filled in by the builder prior to completion. The descriptions, values and quantities should represent the 'as built' specification. Please note the values above represent design values and should not be exceeded without prior consultation with the agent/designer ().
The completed table should be returned to the assessor: Mitch Finn (Contact: 01202 280062).

Declaration of fitting types "As Built"	
Water Fitting	**Actual Consumption**
WCs	
Showers	
Baths	
Basin taps	
Sink taps	
Dishwasher	
Washing machine	

Project ref: BE0764 - Garages to the south of 27a West End Lane

The above declaration of fittings, values and quantities is a true reflection of those installed on this project.

Name: .... Signature: .... Date: ....

------End of Report------

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 02 September 2016

Property Details: House 1 After Reducing Energy Demand

Dwelling type:	End-terrace House
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	3
Front of dwelling faces:	South East
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	
Ventilation rate during hot weather (ach):	8 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	838.02	**(P1)**
Transmission heat loss coefficient:	133.1	
Summer heat loss coefficient:	971.1	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
South East (SE)	0	1
South West (SW)	0	1
North East (NE)	0	1
(Roof)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
South East (SE)	1	0.9	1	0.9	**(P8)**
South West (SW)	1	0.9	1	0.9	**(P8)**
North East (NE)	1	0.9	1	0.9	**(P8)**
(Roof)	1	1	1	1	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South East (SE)	0.9 x	19.95	119.92	0.76	0.7	0.9	1030.95	
South West (SW)	0.9 x	10	119.92	0.76	0.7	0.9	516.77	
North East (NE)	0.9 x	14.07	98.85	0.76	0.7	0.9	599.3	
	1 x	2.73	203	0.76	0.7	1	265.35	
						Total	2412.37	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	530.01	507.87	517.19	
Total summer gains	3085.37	2920.25	2677.46	**(P5)**
Summer gain/loss ratio	3.18	3.01	2.76	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	19.43	21.16	20.81	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Slight**	**Slight**	

SAP 2012 Overheating Assessment

Assessment of likelihood of high internal temperature: <u>Slight</u>

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 02 September 2016

Property Details: House 2 After Reducing Energy Demand

Dwelling type:	Mid-terrace House
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	3
Front of dwelling faces:	North East
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	
Ventilation rate during hot weather (ach):	8 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	765.91	**(P1)**
Transmission heat loss coefficient:	77.6	
Summer heat loss coefficient:	843.56	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
South West (SW)	0	1
North East (NE)	0	1
(Roof)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
South West (SW)	1	0.9	1	0.9	**(P8)**
North East (NE)	1	0.9	1	0.9	**(P8)**
(Roof)	1	1	1	1	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South West (SW)	0.9 x	10	119.92	0.76	0.7	0.9	516.77	
North East (NE)	0.9 x	11.67	98.85	0.76	0.7	0.9	497.08	
	1 x	2.73	203	0.76	0.7	1	265.35	
						Total	1279.19	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	509.57	488.37	497.47	
Total summer gains	1872.32	1767.56	1612.35	**(P5)**
Summer gain/loss ratio	2.22	2.1	1.91	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.47	20.25	19.96	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 02 September 2016

Property Details: House 3 After Reducing Energy Demand

Dwelling type:	End-terrace House
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	3
Front of dwelling faces:	North East
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	
Ventilation rate during hot weather (ach):	8 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	754.13	**(P1)**
Transmission heat loss coefficient:	106.9	
Summer heat loss coefficient:	861.04	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
North West (NW)	0	1
South West (SW)	0	1
North East (NE)	0	1
(Roof)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
North West (NW)	1	0.9	1	0.9	**(P8)**
South West (SW)	1	0.9	1	0.9	**(P8)**
North East (NE)	1	0.9	1	0.9	**(P8)**
(Roof)	1	1	1	1	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
North West (NW)	0.9 x	4.37	98.85	0.76	0.7	0.9	186.14	
South West (SW)	0.9 x	10	119.92	0.76	0.7	0.9	516.77	
North East (NE)	0.9 x	11.67	98.85	0.76	0.7	0.9	497.08	
	1 x	2.73	203	0.76	0.7	1	265.35	
						Total	1465.33	**(P3/P4)**

Internal gains:

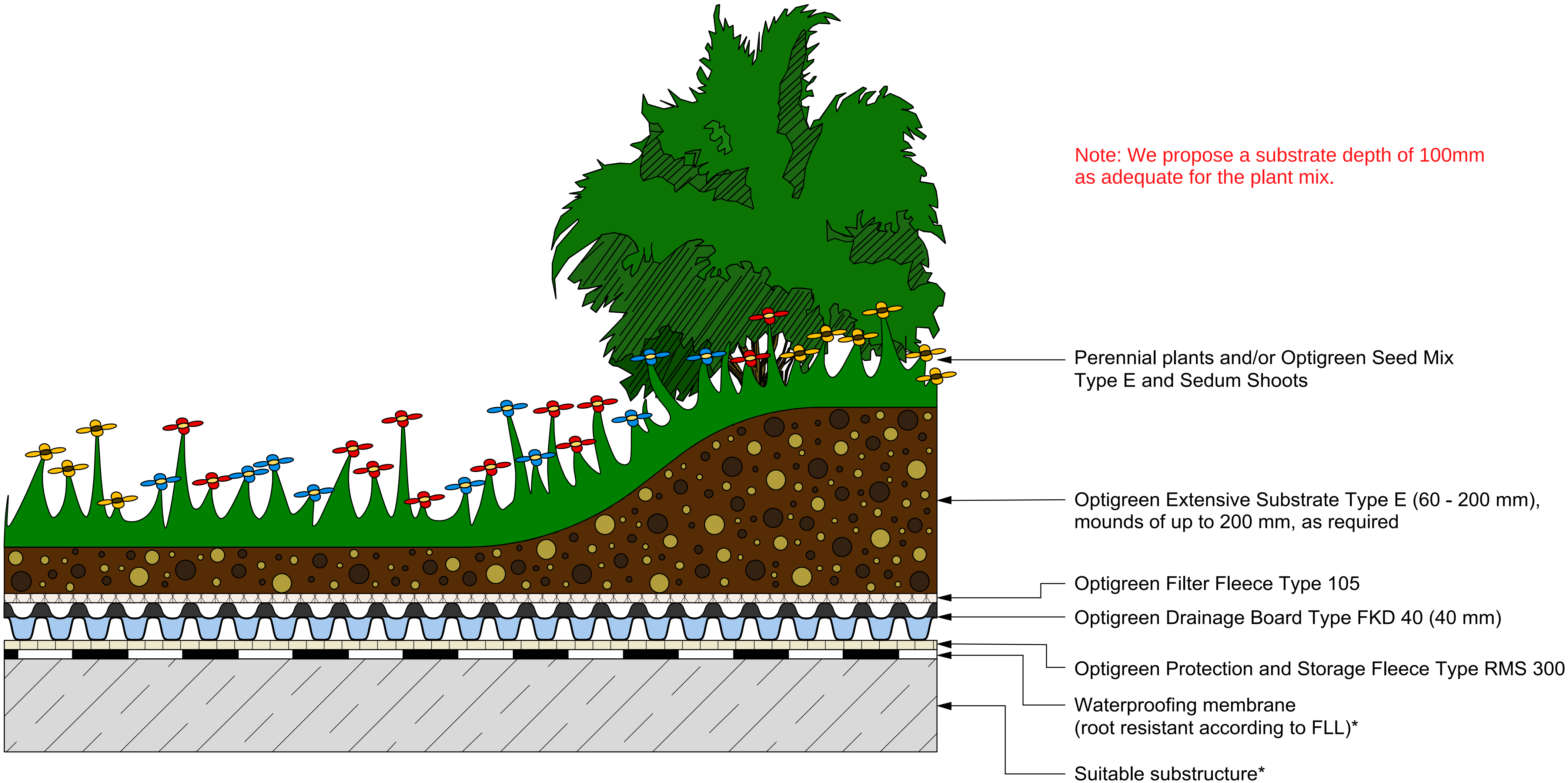
	June	**July**	**August**	
Internal gains	506.28	485.23	494.29	
Total summer gains	2069.97	1950.56	1761.46	**(P5)**
Summer gain/loss ratio	2.4	2.27	2.05	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.65	20.42	20.1	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

SAP 2012 Overheating Assessment

Assessment of likelihood of high internal temperature: Not significant

Optigreen System Type "Nature Roof"

Solution 1: 0 - 5° pitch / Drainage by FKD 40



* According to national regulations

OPTIGREEN® ROOF GREENING

The depicted solution is intended for use with green roof systems. Other construction tradework is simplified in this representation and should be constructed according to current industry standards. Optigreen reserves the right to make changes to its product solutions.

Approved:		drawn by:	scale:	update:	Rev.:	Detail-No.:
HV	O	ob/mh	not to scale	28.07.2014	3	1.050 O

OPTIGREEN® ROOF GREENING

Care Schedule for Optigreen Extensive Roofs

Vegetation Types: Sedum, Wildflower, Grasses or a mix of the three

Planting Method: Pre-Cultivated Mat, Plug Plants, Dry Seeding & Sedum Cuttings, Hydro-Seeding

Frequency: Minimum of twice per year – ideally in Spring (March-May) and Autumn (September-November)

Fertilising: Normally one application per year, ideally in Spring

Health & Safety: The roof should be accessed in accordance with health and safety legislation related to working at heights. Maintenance of green roofs should be carried out by trained personnel.

Introduction

Once a new green roof has been installed, the initial phase of aftercare is known as **Completion Care** and this will normally last for approximately 12 months. During this time the vegetation is developing and, depending on the planting method used, the green roof may need additional maintenance visits to those described above. This is more likely to be the case for plug planted and seeded roofs. Once this phase is complete the roof can then be maintained in accordance with the above schedule.

Please note that for a green roof to continue to perform in the long term it is vital that it receives the maintenance described within this document and at the frequency shown.

Care Operations

Removal of extraneous and unwanted plant growth.

Weeds and tree saplings should be removed as required. This is best achieved by pulling them out complete with the root and removing them from the roof area.

Pebble Borders

All pebble borders should be cleared of any vegetation. Weeds and tree saplings should be removed from the roof but sedum and/or wildfower vegetation that has spread from the adjacent green area can be re-planted, if required, where there are bare or sparsely covered areas.

Mowing

Dead seasonal wildflower foliage and grasses should be cut back in the Autumn once the seeds have fallen with a mowing/cutting height of 80-100mm. All cuttings should be removed from the roof area.

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Dead Leaves
Where there are trees adjacent to the roof, dead leaves should be removed from the green roof on each maintenance visit.

Inspection Chambers and Roof Drainage
Inspection chambers, roof outlets and gutters should be checked and cleaned out as necessary on each visit.

Adding Substrate
It is not normally necessary to add further substrate once the roof has been installed. However, if some erosion of the substrate subsequently takes place it may be necessary to add substrate to return the depth to that originally specified. This is more likely to be the case during the Completion Care phase and where plug plants or seeding methods have been used.

Re-Planting
If bare or sparsely vegetated areas of more than 0.5m2 are noted during a maintenance visit it may be necessary to carry out additional planting in these areas. This can be done using plug plants, sedum cuttings and dry seeding as appropriate. The most suitable time for this is the Spring and possibly September/October.

Fertilising
A slow-release fertiliser, such as Optigreen Opticote Slow Release Fertiliser, should be applied to the vegetated area on an annual basis in the Spring. If extensive moss growth and reddish sedum foliage is visible this indicates a likely nutrient deficiency.

Irrigation
Extensive green roofs will not normally require any irrigation beyond the Completion Care phase. Roofs that have been vegetated using pre-cultivated vegetation mats will not normally require any watering beyond 6-8 weeks after installation but roofs that have been plug planted or seeded may require irrigation for a longer period particularly if there is a long hot,dry spell of weather.
Exceptions to this can be roof build-up's where the overall depth is less that 70mm and steeply pitched, south-facing roofs with a build-up depth of less than 100mm.

Plug Plant Species

Typical species, subject to availability.

Note: The vegetation mix will be a mix of maximum of 25% sedum and minimum of 75% native wildflower plants (biodiverse)

Achillea millefolium

Galium verum

Daucus carota

Lotus corniculatus

Prunella vulgaris

Sanguisorba minor

Origanum vulgare

Plantago coronopus

Thymus polytrichus

Bellis perennis

Glechoma hederacea

Leontodon hispidus

Leucanthemum vulgare

Festuca rubra

Silene vulgaris

Hypochaeris radicata

Briza media

Carex flacca

Festuca ovina

Anthyllis vulneraria

Campanula glomerata

Campanula rotundifolia

Fragaria vesca

Geranium robertianum

Helianthemum nummularium

Hypericum perforatorum

Linaria vulgaris

Plantago lanceolata

Ranunculus bulbosus

Scabiosa columbaria

Viola tricolor

Armeria maritima

Leontodon autumnalis

Primula vulgaris

Silene latifolia ssp alba

Viola hirta

Viola riviniana