ENERGY STATEMENT

551-557 Finchley Road

Proposed Residential-led Development

Produced by XCO2 for Hampstead Properties Ltd C/O Delta Properties

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EXECUTIVE SUMMARY

The energy strategy for the 551-557 Finchley Road development has been developed in line with the energy policies of the London Plan and of the London Borough of Camden Local Plan and Planning Guidance policies. The three-step Energy Hierarchy has been implemented and the estimated regulated CO_2 savings on site are 55.1% for the domestic part and 36.2% for the non-domestic part of the development, against mixed Part L 2013 and existing buildings compliant scheme with SAP10 carbon factors.

This report assesses the predicted energy performance and carbon dioxide emissions of the proposed development at 551-557 Finchley Road, located in the London Borough of Camden.

The proposed development comprises of a part change of use from Use Class E and F1 and remodelling of the existing building to provide residential apartments (C3) along with flexible commercial (Class E)/pub/wine bar/drinking establishments/pub with expanded food provision (Sui Generis) uses, alterations including partial demolition and extensions at the rear at lower ground, ground and first floor levels, extension to provide an additional storey at roof level, levelling of the lower ground floor level, remodelling and restoration of front façade, amenity space, cycle parking and all associated works (Site does not include 1st to 3rd floor of 551 Finchley Road).

The proposed development includes a series of measures to reduce the energy demand and ensure an efficient supply of energy.

A zero-carbon target for major new-build residential developments has been in place for London since October 2016 and applies to major new-build non-residential developments on final publication of the New London Plan. For the scheme to be considered major, either the new-build residential portion is to be more than 10 units or the new-build non-residential portion is to be greater than 1000sqm. Due to the refurbishment nature of the development, this is not deemed applicable.

Reduction of energy demand has been implemented through the adoption of passive and active design measures, including improved levels of insulation, improved air tightness levels as far as possible, efficient lighting as well as energy saving controls for space conditioning and lighting.

The development has also been designed in line with GLA Guidance on preparing energy assessments and the London Plan's three-step Energy Hierarchy (Policy 5.2A) as well as Camden Planning Guidance: Energy efficiency and adaptation where feasible. The guidance document includes a requirement of 20% reduction in carbon dioxide emissions from on-site renewables, including refurbishments. The 20% reduction should be calculated from the regulated CO2 emissions of the development after all proposed energy efficiency measures and any CO2 reduction from non-renewable decentralised energy (e.g. CHP) have been incorporated.

The energy strategy outlined in this report has been developed using the SAP10 emissions factors to enable the development to meet the upcoming version of the Building Regulations.

SITE CONSTRAINTS

The project being of a refurbishment nature has some site constraints which limit any alteration to the character of the building. High efficiency individual gas boilers have been proposed to provide heating and hot water for the non-domestic portion as well as for 11 of the 15 units, the 4 lower ground maisonette units will be served with highly-efficient individual ASHP. Following a detailed design exercise with the design team, this is the maximum renewables provision that can be achieved on site.

Photovoltaic panels were not considered in the development as these would alter the character of the building and the orientation and inclination of the pitched roof would not enable the generation of any notable CO2 savings

The shortfall from 20% reduction from low and zero carbon technologies is due to spatial limitations and the project being of a refurbishment nature with alteration to the character of the building being unsuitable.

However, high-performance thermal envelope and passive design measures have been implemented to improve the carbon savings through demand reduction measures. The carbon savings from the demand reduction exceeds the new efficiency target set by the GLA of 15% for non-domestic portion and 10% for the domestic portion at the Be Lean stage.

The methodology used to determine the expected operational CO_2 emissions for the development is in accordance with the London Plan's three-step Energy Hierarchy (Policy 5.2A) and the CO_2 savings achieved for each step are outlined below:

BE LEAN – USE LESS ENERGY

The first step addresses reduction in energy demand, through the adoption of passive and active design measures.

The proposed energy efficiency measures include levels of insulation beyond Building Regulation requirements, improved air tightness levels, efficient lighting as well as energy saving controls for space conditioning and lighting.

Mechanical ventilation heat recovery (MVHR) is proposed for both the residential and non-residential portions of the development. The mechanical ventilation system will include heat recovery in order to achieve ventilation in the most energy-efficient way. MVHR is predominantly aimed to be incorporated for acoustic reasons, but from energy efficiency perspective it is a less optimal solution given the refurbishment nature of the scheme and the associated challenges with achieving very low air permeability rates that suit MVHR systems.

By means of energy efficiency measures alone, regulated CO_2 emissions are shown to reduce by:

Regulated CO_2 Savings at Be Lean Stage (SAP 10)		
	%	t/yr
Domestic	47.5	22.0
Non-domestic	36.2	3.2
Site wide	45.7	25.2

BE CLEAN – SUPPLY ENERGY EFFICIENTLY

The application site is located in an area where district heating is not expected to be implemented in the future.

A site heat network has not been found to be feasible or viable for a development of this scale; a combination of high efficiency gas boilers and ASHP are instead proposed for the development.

BE GREEN – USE RENEWABLE ENERGY

The renewable technologies feasibility study carried out for the development identified source heat pumps as suitable technologies for the development.

The incorporation of renewable technologies will reduce CO_2 emissions by a further:

Regulated CO_2 Savings at Be Green Stage (SAP 10)		
	%	t/yr
Domestic	7.6	3.5
Non-domestic	0.0	0.0
Site wide	6.4	3.5

CUMULATIVE ON-SITE SAVINGS

The overall regulated CO_2 savings on site against a against a pre-refurbishment baseline are therefore:

Cumulative Regulated CO_2 Savings (SAP 10)		
	%	t/yr
Domestic	55.1	25.5
Non-domestic	36.2	3.2
Site wide	52.1	28.7

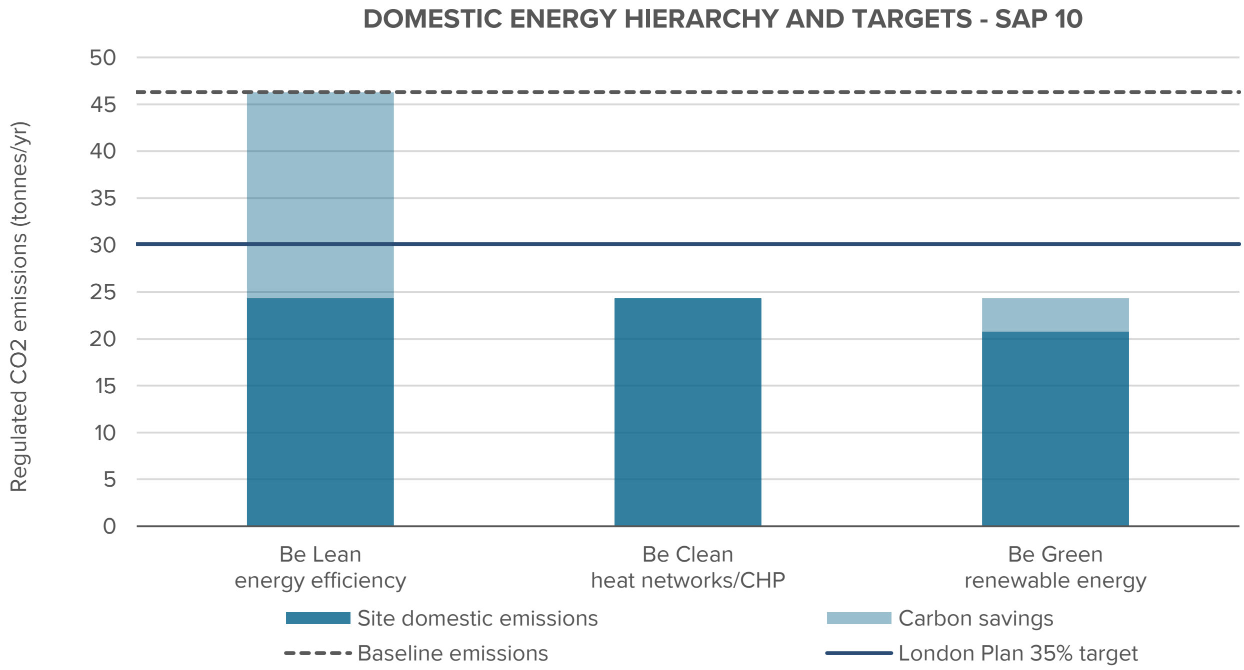


Figure 1: The Domestic Energy Hierarchy (SAP10 carbon factors)

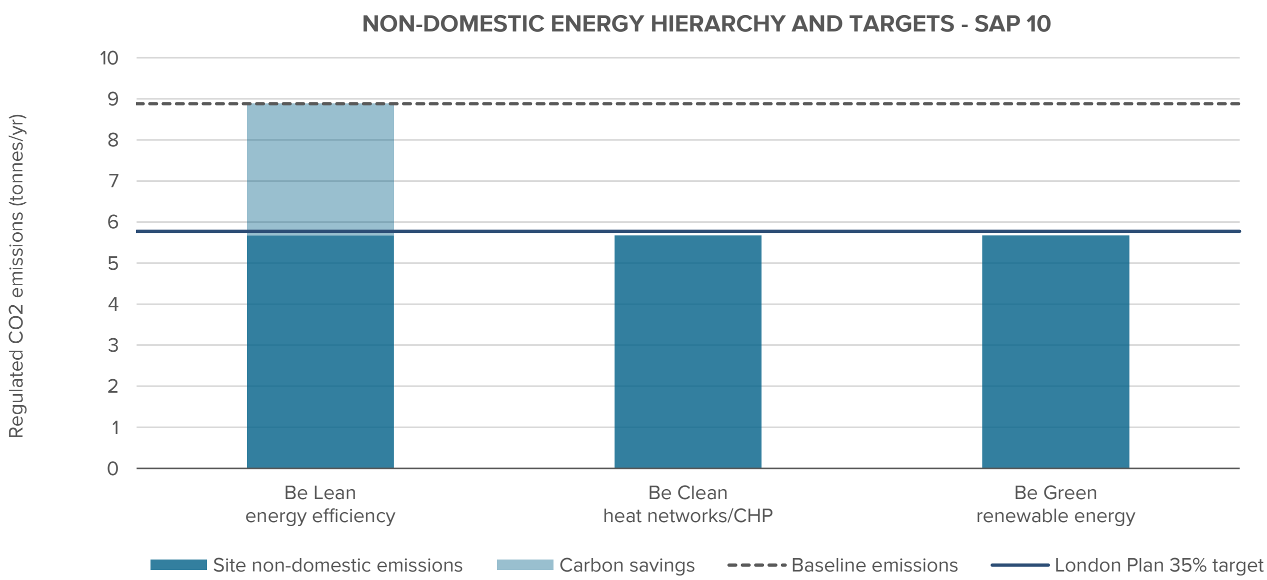


Figure 2: The Non-Domestic Energy Hierarchy (SAP10 carbon factors)

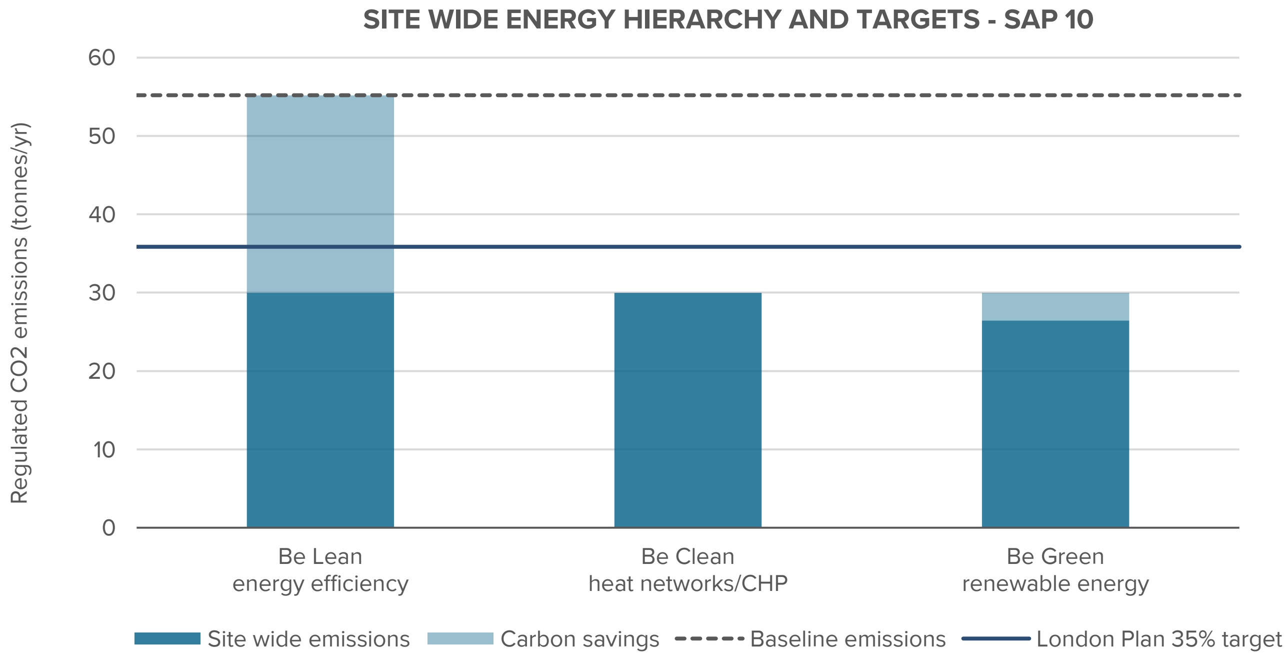


Figure 3: The Site Wide Energy Hierarchy (SAP10 carbon factors)

INTRODUCTION

This Chapter presents the description of the site and of the development proposal, the energy policy framework and the methodology employed for the energy assessment.

SITE & PROPOSAL

The site is located on Finchley Road Hampstead in the London Borough of Camden.

The site is bound by Finchley Road to the east, and mansion housing blocks to the west. The terrace of buildings continues to the north of 551-557, with detached three storey houses to the south.

The proposal is for part change of use from Use Class E and F1 and remodelling of the existing building to provide residential apartments (C3) along with flexible commercial (Class E)/ pub/ wine bar/ drinking establishments (Sui Generis) uses, alterations including partial demolition and extensions at the rear at lower ground, ground and first floor levels, extension to provide an additional storey at roof level, levelling of the lower ground floor level, remodelling and restoration of front façade, amenity space, cycle parking and all associated works (Site does not include 1st to 3rd floor of 551 Finchley Road).

Figure 4: Location of the application site.

POLICY FRAMEWORK

The proposal will seek to respond to the energy policies of the London Plan and of the policies within the London Borough of Camden.

The most relevant applicable energy policies in the context of the proposed development are presented below.

EMERGING LONDON PLAN (2019)

The current 2016 consolidation Plan is still the adopted Development Plan. However, the Draft London Plan, last updated in July 2019, is a material consideration in planning decisions. The New London Plan is scheduled to be published in 2020.

The following paragraphs highlight the key changes and additional requirements stemming from emerging policies.

GREENHOUSE GAS EMISSIONS

Policy GG6 (Increasing efficiency and resilience) sets a positive direction for the new draft Plan in terms of ambitious new greenhouse gas emission targets. At least 35% of this reduction must be made on site for major developments, with residential developments expected to achieve at least a 10% (and non-residential at least a 15%) reduction in emissions through energy efficiency measures alone (Policy SI2).

In a major departure from the previous London Plan, calculations will be required to include both regulated and unregulated emissions at each stage of the energy hierarchy. Furthermore, major developments will have to submit details of the method with energy performance and carbon dioxide emissions monitored post-construction for at least the first five years of building operation.

ENERGY INFRASTRUCTURE

In addition to upgrades to the lean and green stages of the energy hierarchy the clean stage has also been enhanced. A “be seen” stage has also been introduced so the development energy performance is monitored and reported. Most notably, all major developments within Heat Network Priority Areas will need to utilise a communal low-temperature heating system.

Policy SI3 (Energy infrastructure) recommends zero-emission or local secondary heat sources technology as step on the heating hierarchy but prioritises a connection to local existing or planned heat networks where feasible, for selecting communal heating systems. Where developments are utilising low-emission CHP this policy requires them to demonstrate that the CHP will *enable the delivery of an area-wide heat network, meet the development’s electricity demand and provide demand response to the local electricity network*.

MATERIALS, WASTE & LIFE-CYCLE CARBON

Policy SI2 (Minimising greenhouse gas emissions) mentions the requirement for Energy Strategies to include a *whole life-cycle carbon emissions assessment and actions to reduce life-cycle carbon emissions*. This is to fully capture the development’s carbon impact: unregulated and embodied emissions, and emissions associated with maintenance, repair and demolition will be considered. This may result in more sustainable material choices at design stage and could lead to straw, bamboo, clay and recycled materials alongside the more widely recognised cross-laminated timber becoming more commonplace in the capital. This section also links with Policy SI7 (Reducing waste and supporting the circular economy), whereby materials are retained in use at their highest value for as long as possible to minimise waste. All referable applications will be required to submit a Circular Economy Statement, intended to cover the whole life cycle of development.

AIR QUALITY

The new draft Plan addresses this crucial area by requiring large-scale development proposals to demonstrate how they maximise benefits to air quality and the measures or design solutions they will implement to minimise exposure to air pollution.

In practice this will mean that a preliminary Air Quality Assessment (AQA) will need to be carried out for all major developments prior to any design work taking place, with a full AQA submitted in support of the planning application. In addition, the new draft London Plan supports electric vehicle charging points and other transport alternatives to achieve carbon-free travel by 2050.

It should be noted that, as the policies in the draft London Plan are not yet adopted, the following sections demonstrate compliance with the current plan.

THE LONDON PLAN

The London Plan (2016) is the overall strategic plan for London, setting out an integrated economic, environmental, transport and social framework for the development of London over the next 20–25 years.

The overarching energy policies of the London Plan are included in Chapter Five *London's Response to Climate Change* and include Policies 5.2 to 5.9:

- Policy 5.2: Minimising carbon dioxide emissions;
- Policy 5.3: Sustainable Design and Construction;
- Policy 5.4: Retrofitting;
- Policy 5.4A: Electricity and gas supply;
- Policy 5.5: Decentralised energy networks;
- Policy 5.6: Decentralised energy in development proposals;
- Policy 5.7: Renewable energy;
- Policy 5.8: Innovative energy technologies, and,
- Policy 5.9: Overheating and cooling.

Extracts of Policies 5.2, 5.6, 5.7 and 5.9 are presented below as these are considered most relevant to the proposed scheme.

The London Plan also consists of a suite of guidance documents, most relevant of which are the Sustainable Design and Construction SPG (April 2014) & Energy Planning – GLA Guidance on preparing energy assessments (October 2018).

POLICY 5.2 MINIMISING CARBON DIOXIDE EMISSIONS

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

Be lean: use less energy
Be clean: supply energy efficiently
Be green: use renewable energy

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

POLICY 5.6 DECENTRALISED ENERGY IN DEVELOPMENT PROPOSALS

A. Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

B. Major development proposals should select energy systems in accordance with the following hierarchy:

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

C. Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

POLICY 5.7 RENEWABLE ENERGY

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

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

POLICY 5.9 OVERHEATING AND COOLING

B. Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

1. *Minimise internal heat generation through energy efficient design*
2. *Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls*
3. *Manage the heat within the building through exposed internal thermal mass and high ceilings*
4. *Passive ventilation*
5. *Mechanical ventilation*
6. *Active cooling systems (ensuring they are the lowest carbon options).*

GLA GUIDANCE ON PREPARING ENERGY ASSESSMENTS

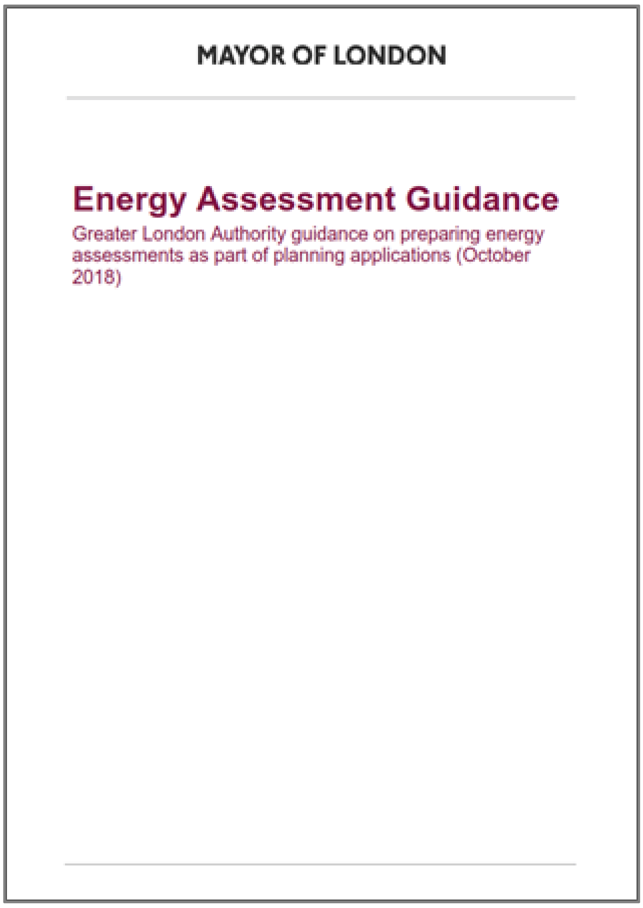
This document (last updated in October 2018) provides guidance on preparing energy assessments to accompany strategic planning applications; it contains clarifications on Policy 5.2 carbon reduction targets, as well as detailed guidelines on the content of the Energy Assessments undertaken for planning.

The guidance document specifies the emission reduction targets the GLA will apply to applications as follows:

The regulated carbon dioxide emissions reduction target for major domestic development is zero carbon and for non-domestic development it is 35 per cent beyond Part L 2013 of the Building Regulations.

The new guidance also includes changes to technical requirements relating to presenting carbon information separately for domestic and non-domestic elements of developments and the provision for cooling demand data where active cooling is required.

The structure of this report and the presentation of the carbon emission information for the development follows the guidance in this document.


MAYOR OF LONDON

Energy Assessment Guidance

Greater London Authority guidance on preparing energy assessments as part of planning applications (October 2018)

CAMDEN LOCAL PLAN (2017)

Policy CC1 Climate change mitigation

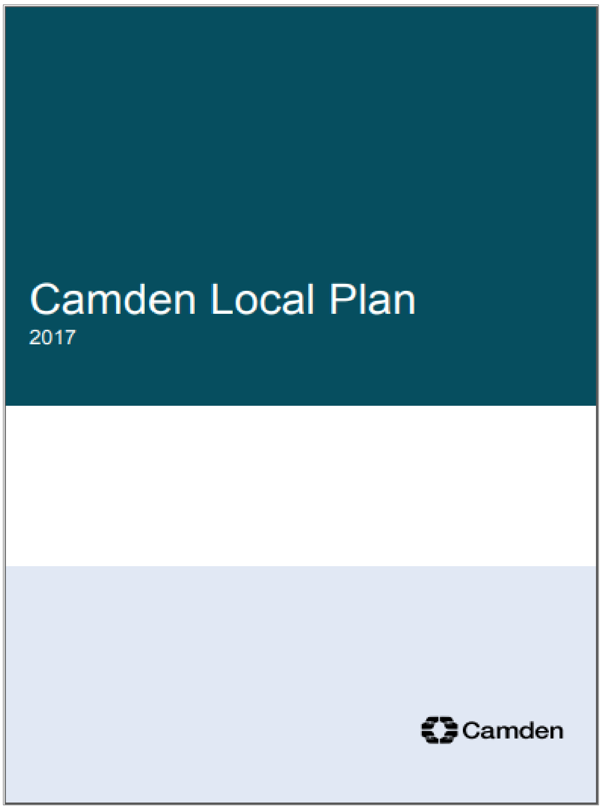
Camden Council will:

a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;
b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;
c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;
d. support and encourage sensitive energy efficiency improvements to existing buildings;
e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and
f. expect all developments to optimise resource efficiency

For decentralised energy networks, the council will promote decentralised energy by:

a. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;
b. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and
c. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.



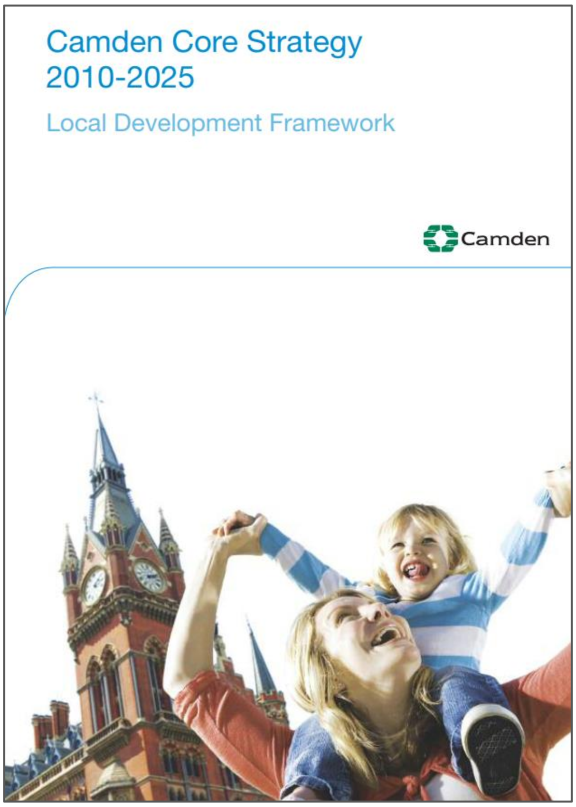
CAMDEN CORE STRATEGY (2010-2025)

CS13 – Tackling climate change through promoting higher environmental standards

Reducing the effects of and adapting to climate change
The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

a) ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;
b) promoting the efficient use of land and buildings;
c) minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:
    1. ensuring developments use less energy,
    2. making use of energy from efficient sources;
    3. generating renewable energy on-site; and
d) ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

The Council will have regard to the cost of installing measures to tackle climate change as well as the cumulative future costs of delaying reductions in carbon dioxide emissions.



CAMDEN PLANNING GUIDANCE: ENERGY EFFICIENCY AND ADAPTATION (2019)

Making buildings more energy efficient

Energy efficient design requires an integrated approach to solar gain, access to daylight, insulation, thermal materials, ventilation, heating and control systems. It is important that these aspects are considered in relation to each other when designing a scheme.

Energy efficient (passive) design measures should be considered prior to the inclusion of any active measures to ensure that the energy demand for developments is reduced as far as possible.

Developments should avoid electric heating systems unless there is no access to a gas connection, or where heating is required for very short periods in isolated locations.

Decentralised energy

The 'Be Clean' stage of the energy hierarchy aims to ensure that developments have an efficient supply of heat and power. It is the local supply of heat and energy which optimises supply to demand so is much more efficient. Until now, this step has typically been achieved through the installation of combined heat and power units (CHP) or connection to a Decentralised Energy Network (DEN) often powered by CHP and gas boilers.

Local Plan Policy CC1 requires all major developments to assess the feasibility of connecting to an existing decentralised energy network, and where this is not possible establishing a new network (see paragraph 8.25 Local Plan).

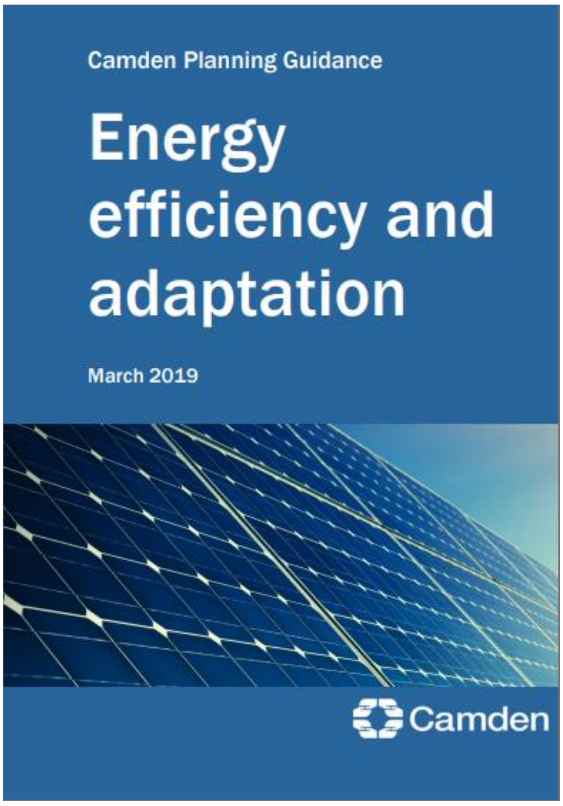
Renewable energy technologies

All developments should consider the feasibility of on-site renewable energy generation. Renewable energy generation should only be considered once the earlier stages of the energy hierarchy have been followed and energy demand has been reduced as far as possible.

Energy reduction

The following energy reduction requirements are set out in the Camden Planning Guidance report:

- All development in Camden is expected to reduce carbon dioxide emissions through the application of the energy hierarchy.
- All new build major development to demonstrate compliance with London Plan targets for carbon dioxide emissions.
- Deep refurbishments (i.e. refurbishments assessed under Building Regulations Part L1A/L2A) should also meet the London Plan carbon reduction targets for new buildings.
- Developments of five or more dwellings and/or more than 500sqm of any gross internal floorspace to achieve 20% reduction in carbon dioxide emissions from on-site renewable energy generation



Energy efficiency in existing buildings

There are many opportunities for reducing energy, the design, fixtures, and materials used can make a significant contribution. Installing condensing boilers, heating controls and energy saving light bulbs and appliances reduce energy use and carbon dioxide emissions significantly.

Heating and Hot water

Heating and hot water carbon emissions can be improved through:

- Replacing an old boiler (more than 10 years old) with a high efficiency condensing boiler and heating controls to provide heating and hot water could significantly cut energy consumption.
- New/upgraded central heating – if a new boiler is installed the rest of the central heating system may need upgrading, for example large, old radiators could be replaced with smaller, more efficient radiators that are better suited to the new boiler.
- Upgrading heating controls - install heating controls that allow control of the temperature in different parts of a building. These can be included as an electronic timer control.

METHODOLOGY

The sections below present the methodology followed in determining the on-site and off-site carbon savings for the proposed scheme.

ON-SITE CARBON SAVINGS – THE ENERGY HIERARCHY

The methodology employed to develop the energy strategy for the scheme and achieve on-site carbon savings is in line with the GLA's *Guidance on preparing energy assessments* and is as follows:

Given that the development is a major refurbishment project it is expected that an estimate of the CO2 savings from the refurbishment of the building is provided.

For this, a pre-refurbishment regulated CO2 emissions 'baseline' should be modelled to determine a baseline Building Emission Rate (BER), estimating fabric and services performance based on available existing information.

The software used to model and calculate the energy performance and carbon emissions of the domestic element is SAP2012 and SBEM for the non-domestic elements. The baseline emissions of the domestic element are established by modelling representative dwelling types and multiplying the Dwelling Emission Rate (DER) of each type in its existing condition with the cumulative floor area for that type to establish the total emissions for the domestic element of the proposal. Similarly, the baseline TER (derived from the BER of the building in its existing condition) for each non-domestic element is multiplied by its floor area to establish the total emissions.

The same approach is followed to determine the energy performance and CO_2 emissions of the proposed scheme for each of the steps of the **Energy Hierarchy**. The CO_2 emissions are estimated based on the SAP Dwelling Emission Rate (DER) and SBEM Building Emission Rate (BER) figures for the domestic and non-domestic elements respectively. The Energy Hierarchy aims at delivering significant carbon savings on-site.

The three consecutive steps of the Energy Hierarchy are:

- **Be Lean** whereby the demand for energy is reduced through a range of passive and active energy efficiency measures; as part of this step the Cooling Hierarchy (see Policy 5.9) is implemented and measures are proposed to reduce the demand for active cooling;
- **Be Clean** whereby as much of the remaining energy demand is supplied as efficiently as possible (e.g. by connecting to a district energy network or developing a site-wide CHP network), and,
- **Be Green** whereby renewable technologies are incorporated to offset part of the carbon emissions of the development. The uptake of renewable technologies is based on feasibility and viability considerations, including their compatibility with the energy system determined in the previous step.

The implementation of the Energy Hierarchy determines the total regulated carbon savings that can be feasibly and viably achieved on site.

The % improvement against the baseline emissions is compared to the relevant targets for each element and in case of a shortfall, savings through off-site measures should be achieved.

The structure of the main body of the assessment follows the Methodology presented above and comprises the sections:

- Be Lean;
- Be Clean;
- Be Green.

The Conclusions section summarises the energy strategy and associated carbon savings for the proposed development.

BE LEAN – USE LESS ENERGY

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water and lighting. Measures will also be put in place to reduce the risk of overheating. The regulated carbon saving achieved in this step of the Energy Hierarchy is 45.7% over the site wide baseline level with SAP10 emission factors.

PASSIVE DESIGN MEASURES

ENHANCED U-VALUES

The heat loss of different building fabric elements is dependent upon their U-value. A building with low U-values provides better levels of insulation and reduced heating demand during the cooler months.

The proposed development will incorporate high levels of insulation and high-performance glazing beyond Part L 2013 targets and Part L1B/2B targets, in order to reduce the demand for space heating.

The tables to the right demonstrate the improved performance of the proposed building fabric beyond the Building Regulations requirements for both domestic and non-domestic uses.

AIR TIGHTNESS IMPROVEMENT

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration.

The proposed development will aim to improve upon the Part L 2013 minimum standards for air tightness by targeting air permeability rates of 15m^3/m^2.h at 50Pa for all refurbished residential units and 15m^3/m^2.h at 50Pa for non-domestic areas.

Table 1: Thermal Envelope U-values

Refurbished Elements (U-values in W/m2.K)			
Element	**Baseline (SAP Appendix S)**	**Proposed***	**Improvement**
Walls	0.55	0.55	0%
Floor	0.73	0.25	66%
Roof	0.68	0.18	74%
Windows	3.1	1.6	48%
New Build Elements (U-values in W/m2.K)			
Element	**Building Regulations**	**Proposed****	**Improvement**
Walls	0.35	0.15	57%
Floor	0.25	0.1	60%
Roof	0.25	0.1	60%
Windows	2.2	1.3	41%

*Based on Part L1B and Part L2B

**Based on XCO2 Recommendations

REDUCING THE NEED FOR ARTIFICIAL LIGHTING

The development has been designed to maximise daylight in all habitable spaces as a way of improving the health and wellbeing of its occupants.

All of the habitable areas will benefit from large areas of glazing to increase the amount of daylight within the internal spaces where possible. This is expected to reduce the need for artificial lighting whilst delivering pleasant, healthy spaces for occupants.

ACTIVE DESIGN MEASURES

HIGH EFFICACY LIGHTING

The development intends to incorporate low energy lighting fittings throughout the residential and non-residential spaces. All light fittings will be specified as low energy lighting, and will accommodate LED, compact fluorescent (CFLs) or fluorescent luminaires only.

HEAT RECOVERY VENTILATION

Mechanical ventilation heat recovery (MVHR) is proposed for both the residential and non-residential portions of the development. The mechanical ventilation system will include heat recovery in order to achieve ventilation in the most energy-efficient way. MVHR is predominantly aimed to be incorporated for acoustic reasons, but from energy efficiency perspective it is a less optimal solution given the refurbishment nature of the scheme and the associated challenges with achieving very low air permeability rates that suit MVHR systems.

CONTROLS

Advanced lighting and space conditioning controls will be incorporated, specifically for residential communal and non-residential areas of infrequent use, occupant sensors will be fitted for lighting, whereas day lit areas will incorporate daylight sensors where appropriate.

MINIMISING OVERHEATING

The potential risk of overheating will be mitigated by incorporating passive and active design measures, in line with the London Plan Policy 5.9 and the Cooling Hierarchy, as follows.

THE COOLING HIERARCHY

MINIMISING INTERNAL HEAT GENERATION THROUGH ENERGY EFFICIENT DESIGN

The distribution of heat infrastructure within the residential parts of the development will be designed to reduce the lateral pipework lengths within the internal spaces to reduce heat loss.

USE OF THERMAL MASS AND HIGH CEILINGS TO MANAGE THE HEAT WITHIN THE BUILDING

During peak summer periods the thermal mass of the building will absorb and store excess heat. The building will release its heat in the cooler evenings to allow for cooler internal spaces dampening the peak diurnal weather conditions.

MECHANICAL VENTILATION

MVHR will be capable of operating in summer bypass mode allowing for the dissipation of any heat build-up during peak summer conditions.

OVERHEATING RISK ASSESSMENT

The potential risk of overheating was assessed via the Part L Building Regulation compliance tools SAP and SBEM.

A ‘not significant’ overheating risk was found for all representative dwelling types modelled in SAP. The SAP overheating risk assessment outputs for a sample of the dwelling types modelled can be found in Appendix A – SAP Results.

All non-domestic areas have been found to pass Criterion 3 ‘Limiting Solar Gains’ of Part L. The SBEM output for all non-domestic areas can be found in Appendix B – SBEM Results.

ENERGY USE

DWELLING EMISSION RATES AND ENERGY DEMAND

The table below shows a breakdown of carbon dioxide emissions associated with the proposed development's fossil fuel and electricity consumption along with total energy demand for the different uses. The site-wide data are presented, i.e. the sum of the demand for both the domestic and non-domestic parts of the development. The figures provide a comparison between the baseline condition and the proposed development once energy efficiency measures (Lean) have been applied.

This table demonstrates the energy savings achieved through energy efficiency measures (Lean stage of the Energy Hierarchy).

The subsequent table shows the breakdown of regulated energy demand for the residential and non-domestic portions of the scheme as requested by the GLA.

Table 2: Breakdown of energy consumption and CO_2 emissions for the baseline and the proposed schemes after 'Lean' measures are implemented

	Baseline			Lean		
	Energy (kWh/yr.)	$kgCO_2$ /yr.	$kgCO_2/m^2$	Energy (kWh/yr.)	$kgCO_2$ /yr.	$kgCO_2/m^2$
Hot Water	92,790	21,602	23.1	30,780	6,462	7.0
Space Heating	117,750	27,035	34.5	80,800	16,968	19.6
Cooling	0	0	0.0	0	0	0.0
Auxiliary	3,940	905	1.7	6,230	1,439	2.3
Lighting	24,740	5,647	13.4	22,400	5,116	12.0
Equipment	42,300	9,856	13.0	42,300	9,856	13.0
Total Part L	**239,220**	**55,188**	**72.8**	**140,210**	**29,986**	**40.9**
Total (incl. equipment)	**281,520**	**65,044**	**85.8**	**182,510**	**39,842**	**54.0**

BE LEAN CO_2 EMISSIONS

By means of energy efficiency measures alone, regulated CO2 emissions are shown to reduce by 45.7% (25.2 tonnes per annum) across the whole site.

BE CLEAN – SUPPLY ENERGY EFFICIENTLY

The proposed development site is located within an area where there is no existing district heat network within close proximity and an on-site wide CHP network is not feasible or viable for a development of this scale as well as in light of the new carbon emissions factors which are now much lower for electricity.

ENERGY SYSTEM HIERARCHY

The energy system for the development has been selected in accordance with the London Plan decentralised energy hierarchy. The hierarchy listed in Policy 5.6 states that energy systems should consider:

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

Local heat and power sources minimise distribution losses and achieve greater efficiencies when compared to separate energy systems, thus reducing CO_2 emissions.

In a communal energy system, energy in the form of heat, cooling, and/or electricity is generated from a central source and distributed via a network of insulated pipes to surrounding residences.

CONNECTION TO AN EXISTING NETWORK

The London Heat Map identifies existing and potential opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study.

An excerpt from the London Heat Map can be seen on the following page which shows existing and proposed district heating networks within the vicinity of the development.

A review of the map shows that the site is not in proximity of an existing or proposed district heating network. Due to this, it has not been found feasible or viable for the proposed development to incorporate the supply of low carbon heating or cooling through district heating.

SITE-WIDE CHP NETWORK

The use of CHP is not recommended for this development in light of the new carbon factors and future version of the Building Regulations which favour electrically driven heating systems.

COMMUNAL HEATING AND COOLING

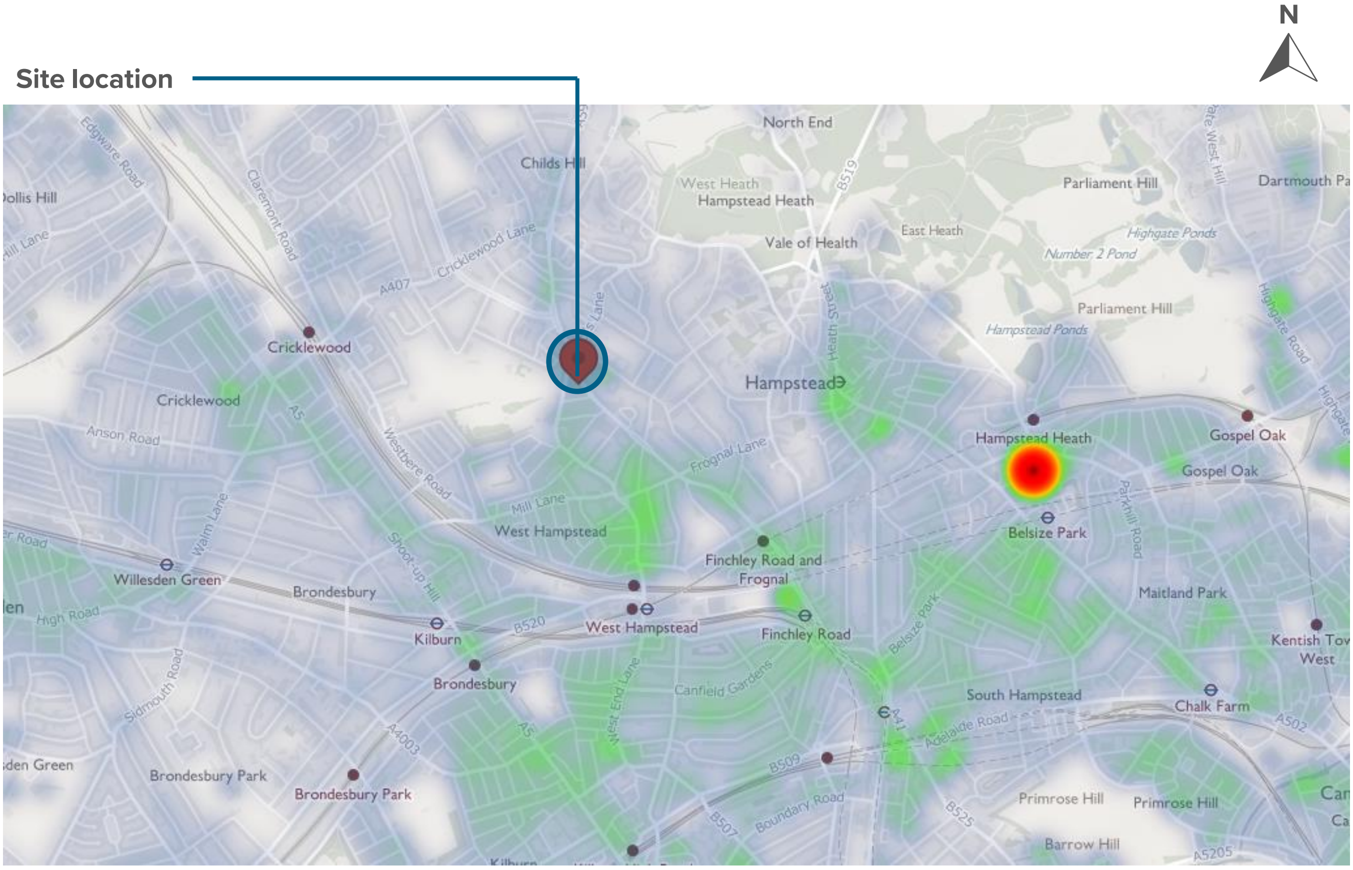
The design team have undergone through several design exercises to explore the possibility of having communal heating strategy for the scheme. The architects and MEP consultants have estimated the associated plant space requirements to accommodate a communal plantroom and it has not been deemed feasible to incorporate communal plantroom. The issue with having communal Air Source Heat Pumps serving the entire development is that there is limited roof space, and the acoustic attenuation requirements for large, communal ASHP require significant plant space which is simply not available in this refurbishment scheme. Communal boilers serving the development would also require large plant space and are against the general direction of policy, where renewable technology should be included in some form on site. In light of the new carbon factors, some form of electric driven heating system should be incorporated on site given than the roof orientation and pitch, together the concerns on the alterations of the character of the building, make PVs an unsuitable strategy for the building.

INDIVIDUAL HEATING

The project being of a refurbishment nature has many site constraints which limit any alteration to the character of the building. The design team and client's aspiration is to maximise the renewable provision on-site and as a result have been able to design in the following heating strategy. High efficiency gas boilers have been proposed to provide heating and hot water for the non-domestic portion and for 11 of the 15 units due to site limitations. Air source heat pumps (ASHP) require more plant space, noise attenuation measures and should be properly ventilated. In order to achieve the maximum carbon reduction on-site, the 4 lower ground maisonette units will be serviced with highly-efficient individual ASHP.

BE CLEAN CO_2 EMISSIONS

As there are no existing or proposed heat networks highlighted as in close proximity to the site, no connection to a 'Clean' supply of energy is deemed feasible and consequently there are no emission savings at this stage.



Proposed Heat Networks
Existing Heat Networks

Figure 5: Excerpt from the London Heat Map. Existing district networks outlined in red, proposed networks in orange.

BE GREEN – USE RENEWABLE ENERGY

The renewable technologies feasibility study carried out for the development identified air source heat pumps as suitable technologies for the development. The regulated carbon saving achieved in this step of the Energy Hierarchy is 6.4% over the site wide baseline level with SAP10 emission factors.

RENEWABLE TECHNOLOGIES FEASIBILITY STUDY

Methods of generating on-site renewable energy (Green) were assessed, once Lean and Clean measures were taken into account.

The development of 551-557 Finchley Road will benefit from an energy efficient building fabric which will reduce the energy consumption of the proposed development in the first instance. A range of renewable technologies were subsequently considered including:

- Biomass;
- Ground/water source heat pumps;
- Air source heat pump;
- Wind energy;
- Photovoltaic panels, and,
- Solar thermal panels.

In determining the appropriate renewable technology for the site, the following factors were considered:

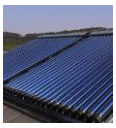
- CO_2 savings achieved;
- Site constraints; and
- Any potential visual impacts.

RENEWABLE ENERGY APPRAISAL SUMMARY

The table below summarises the factors taken into account in determining the appropriate renewable technologies for this project. This includes estimated capital cost, lifetime, level of maintenance and level of impact on external appearance. The final column indicates the feasibility of the technology in relation to the site conditions (10 being the most feasible and 0 being infeasible). It is important to note that the information provided is indicative and based upon early project stage estimates.

The feasibility study demonstrates that ASHP would be the most feasible renewable technology for the proposed 551-557 Finchley Road development. Detailed assessments for the proposed technologies can be found in the following sections.

Table 3. Summary of renewable technologies feasibility study

		Comments	Lifetime	Maintenance	Impact on external appearance	Site feasibility
Biomass		Not adopted -burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location.	20 yrs.	High	High	1
PV		Not adopted - PV panels mounted on the pitched roof would significantly alter the appearance and character of the building and output would be minimal due to pitch and orientation	25 yrs.	Low	Med	3
Solar thermal		Not adopted - Solar thermal array mounted on the pitched roof would significantly alter the appearance and character of the building.	25 yrs.	Low	Med	3
GSHP		Not adopted -the installation of ground loops requires significant space, additional time at the beginning of the construction process and very high capital costs.	20 yrs.	Med	Low	2
ASHP		**Adopted** – The improvement of the efficiencies of the ASHP in the Green stage will further reduce the carbon emissions of the building.	20 yrs.	Med	Med	5
Wind		Not adopted - Wind turbines located at the site will require significant space which is not available.	25 yrs.	Med	High	1

DETAILED ASSESSMENT OF AIR SOURCE HEAT PUMPS

Air source heat pumps (ASHPs) employ the same technology as ground source heat pump (GSHPs). However, instead of using heat exchangers buried in the ground, heat is extracted from the external ambient air.

The efficiency of heat pumps is very much dependent on the temperature difference between the heat source and the space required to be heated. As a result, ASHPs tend to have a lower COP than GSHPs. This is due to the varying levels of air temperature throughout the year when compared to the relatively stable ground temperature. The lower the difference between internal and external air temperature, the more efficient the system.

ASHP is considered a suitable technology for the development for the following reasons:

- It is a high efficiency system that can cater for the space heating and cooling of the most energy-intensive areas of the proposed development;
- Requires less capital cost than GSHP and other renewable technologies;
- It can be integrated with the proposed ventilation strategy; and,
- It is simple to install when compared to other renewable technologies.

The ASHP will be implemented for the 4 lower ground maisonette units where space is available in the courtyards to install and sufficiently attenuate acoustically the system if required

The table below summarises the technical data for the proposed ASHP and estimated CO_2 savings from the application of this technology. In total the ASHP technology would produce regulated CO_2 savings of 6.4% for the development.

Table 4: Summary of technical/operational data and estimated CO_2 savings for ASHP

ASHP for domestic spaces		
COP heating	1.7	
Carbon intensity of electricity	0.233	$kgCO_2/kWh$
Proportion of domestic space heating and hot water met by ASHP**	100	%
Energy met by ASHP	18,978	kWh/yr.
Energy used by ASHP	11,163	kWh/yr.
Total CO_2 savings	3.5	t/yr.
Regulated baseline CO_2 emissions	55.2	t/yr.
Total baseline CO_2 emissions	65.1	t/yr.
% Regulated CO_2 reduction*	6.4	%
% Total CO_2 reduction*	5.4	%

* % reduction from site baseline
** For the 4 maisonette units utilising ASHP

Figure 6: Outdoor units of ASHP

BE GREEN CO_2 EMISSIONS

Following the measures adopted at Lean stage, further savings can be obtained through the incorporation of the proposed ASHP. The incorporation of the renewable technologies will further reduce CO2 emissions by a further 6.4% (3.5 tonnes per annum) across the whole site.

Shortfall from the 20% reduction set out in the Camden Planning Guidance: Energy efficiency and adaptation is due to the limitations including:

Photovoltaic panels were deemed unsuitable since the building has a pitched roof with limited space for panels and panels would lead to alteration of the character of the building which is undesirable considering the project is a refurbishment by nature.

ASHP's were implemented where feasible, with high efficiencies. Individual ASHP were specified for 4 no. units on the lower ground floor.

CONCLUSIONS

Following the implementation of the three-step Energy Hierarchy, the cumulative CO_2 savings on site are estimated at 55.1% for the domestic part and 36.2% for the non-domestic part of the development, against a pre-refurbishment baseline. The regulated CO_2 savings for the site as a whole are 52.1% with SAP10 emission factors.

ON SITE CO_2 SAVINGS

By implementing the three step Energy Hierarchy as detailed in the previous sections, the Regulated CO_2 emissions for the development have been reduced against a pre-refurbishment baseline through on-site measures alone by:

Cumulative Regulated CO_2 Savings (SAP 10)		
	%	t/yr
Domestic	55.1	25.5
Non-domestic	36.2	3.2
Site wide	52.1	28.7

Overall, the proposed development has been designed to be in line with energy policies set out by the GLA and the London Borough of Camden which demonstrates the client and the design team's commitment to enhancing sustainability of the scheme.

A zero-carbon target for major new-build residential developments has been in place for London since October 2016 and applies to major new-build non-residential developments on final publication of the New London Plan. For the scheme to be considered major, either the new-build residential portion is to be more than 10 units or the new-build non-residential portion is to be greater than 1000sqm. Due to the refurbishment nature of the development, this is not deemed applicable.

The scheme exceeds the London Plan requirement of on-site carbon reduction of 35%.

The development has also been designed in line with Camden Planning Guidance: Energy efficiency and adaptation where feasible. The shortfall from 20% reduction from low and zero carbon technologies is due to spatial limitations. The project being of a refurbishment nature has some site constraints which limit any alteration to the character of the building. Individual gas boilers have been proposed to provide heating and hot water the non-domestic and the majority of the domestic development. Air source heat pumps (ASHP) have been utilised where possible to maximise on-site carbon reduction, the 4 lower ground maisonette units will be serviced with highly-efficient individual ASHP.

Photovoltaic panels were not considered in the development as these would alter the character of the building. Hence the development is not able to meet the 20% carbon savings from renewables.

However, high-performance thermal envelope and passive design measures have been implemented and the carbon savings through demand reduction measures alone exceeds the new efficiency target set by the GLA of 15% for non-domestic and 10% for domestic developments.

The tables in the following pages summarise the implementation of the Energy Hierarchy for the proposed scheme and detail the CO_2 emissions and savings against the baseline scheme for each step of the hierarchy; as well as the savings achieved through carbon offset.

Separate tables are presented for the domestic and non-domestic parts of the development; as well as for the site as a whole.

DOMESTIC CUMULATIVE SAVINGS

Table 5: CO_2 emissions after each step of the Energy Hierarchy for the domestic part of the development

	Carbon dioxide emissions for domestic buildings (tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline	46.3	8.3
After energy demand reduction	24.3	8.3
After heat network/CHP	24.3	8.3
After renewable energy	20.8	8.3

Table 6: Regulated CO_2 savings from each stage of the Energy Hierarchy for the domestic part of the development

	Regulated domestic carbon dioxide savings	
	Tonnes CO_2 per annum	% over baseline
Savings from energy demand reduction	22.0	47.5%
Savings from heat network/CHP	0.0	0.0%
Savings from renewable energy	3.5	7.6%
Cumulative on site savings	25.5	55.1%
Cumulative for offset payments	623.4 tonnes over 30 years	

NON-DOMESTIC CUMULATIVE SAVINGS

Table 7: CO_2 emissions after each step of the Energy Hierarchy for the non-domestic part of the development

	Carbon dioxide emissions for non-domestic buildings (tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline	8.9	1.6
After energy demand reduction	5.7	1.6
After heat network/CHP	5.7	1.6
After renewable energy	5.7	1.6

Table 8: Regulated CO_2 savings from each stage of the Energy Hierarchy for the non-domestic part of the development

	Regulated non-domestic carbon dioxide savings	
	Tonnes CO_2 per annum	% over baseline
Savings from energy demand reduction	3.2	36.2%
Savings from heat network/CHP	0.0	0.0%
Savings from renewable energy	0.0	0.0%
Cumulative on site savings	3.2	36.2%

SITE-WIDE CUMULATIVE SAVINGS

Table 9: Site wide regulated CO_2 emissions and savings

	Total regulated emissions (tonnes CO_2/year)	Regulated CO_2 savings (tonnes CO_2/year)	Percentage saving (%)
Baseline	55.2		
Be Lean	30.0	25.2	45.7%
Be Clean	30.0	0.0	0.0%
Be Green	26.5	3.5	6.4%
Total		28.7	52.1%

APPENDIX A – SAP RESULTS

The table below lists a sample of the typical flats that were modelled using SAP methodology, the TER and DER outputs and the % CO_2 reduction achieved after the Be Lean, Be Clean and Be Green measures have been applied.

The results from these 6 flats were extrapolated over the entire development, in order to predict the energy consumption and carbon dioxide emissions for the domestic spaces of the Development.

The following pages show the DER/TER FSAP2012 worksheets for a sample flat at the Be Lean and Be Green stages. The SAP outputs for all sample flats are available on request.

SAP Ref No.	Unit	TER ($kgCO_2/m^2/yr$)	Be Lean		Be Green		Overheating Risk
			DER ($kgCO_2/m^2/yr$)	% CO_2 reduction	DER ($kgCO_2/m^2/yr$)	% CO_2 reduction	
1	LG1	57.99	43.57	24.9%	49.90	14.0%	Not Significant
2	LG2	66.32	46.71	29.6%	52.25	21.2%	Not Significant
3	1A	63.77	48.68	23.7%	48.68	23.7%	Not Significant
4	2A	69.04	51.49	25.4%	51.49	25.4%	Not Significant
5	3A	75.66	51.91	31.4%	51.91	31.4%	Not Significant
6	4B	84.83	53.12	37.4%	53.12	37.4%	Not Significant

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.7

Property Address: LG1 Baseline

Address : , London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	67.4	(1a) x	2.8	(2a) =	188.72	(3a)
Ground floor	42.4	(1b) x	2.6	(2b) =	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	298.96	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.75	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.64	(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

SAP 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

0.81	0.8	0.78	0.7	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.75

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=	0.83	0.82	0.8	0.75	0.73	0.68	0.68	0.67	0.7	0.73	0.76	0.78	(24d)

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

(25)m=	0.83	0.82	0.8	0.75	0.73	0.68	0.68	0.67	0.7	0.73	0.76	0.78	(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			1.98	x	3	=	5.94			(26)
Windows Type 1			4.33	x1/[1/(3.1)+ 0.04]		=	11.94			(27)
Windows Type 2			1.92	x1/[1/(3.1)+ 0.04]		=	5.3			(27)
Windows Type 3			0.64	x1/[1/(3.1)+ 0.04]		=	1.77			(27)
Floor Type 1			30	x	0.25	=	7.5			(28)
Floor Type 2			37.4	x	0.73	=	27.302			(28)
Walls Type1	48.6	4.48	44.12	x	0.55	=	24.27			(29)
Walls Type2	32.8	17.32	15.48	x	0.35	=	5.42			(29)
Walls Type3	8.6	0	8.6	x	0.55	=	4.73			(29)
Walls Type4	3.1	1.98	1.12	x	0.55	=	0.62			(29)
Walls Type5	13.3	0	13.3	x	0.28	=	3.72			(29)
Total area of elements, m²			173.8							(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) = 139.62 (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 | (36)

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

Total fabric heat loss (33) + (36) = | 165.62 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	81.92	80.65	79.41	73.59	72.5	67.42	67.42	66.48	69.38	72.5	74.7	77.01	(38)

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

(39)m=	247.54	246.27	245.03	239.21	238.12	233.04	233.04	232.1	235	238.12	240.32	242.63	

Average = Sum(39)$_{1\ldots12}$ /12= | 239.2 | (39)

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

(40)m=	2.25	2.24	2.23	2.18	2.17	2.12	2.12	2.11	2.14	2.17	2.19	2.21	

Average = Sum(40)$_{1\ldots12}$ /12= | 2.18 | (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 | 106.34 | (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=	116.97	112.72	108.47	104.21	99.96	95.71	95.71	99.96	104.21	108.47	112.72	116.97	

Total = Sum(44)$_{1\ldots12}$ = | 1276.09 | (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=	173.47	151.72	156.56	136.49	130.97	113.01	104.72	120.17	121.61	141.72	154.7	168	

Total = Sum(45)$_{1\ldots12}$ = | 1673.15 | (45)

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

(46)m=	26.02	22.76	23.48	20.47	19.65	16.95	15.71	18.03	18.24	21.26	23.21	25.2	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 110 | (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) = | 110 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.08 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 1.03 | (52)

Temperature factor from Table 2b | 0.78 | (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 6.71 (54)

Enter (50) or (54) in (55) 6.71 (55)

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

(56)m=	208.01	187.88	208.01	201.3	208.01	201.3	208.01	208.01	201.3	208.01	201.3	208.01	(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=	208.01	187.88	208.01	201.3	208.01	201.3	208.01	208.01	201.3	208.01	201.3	208.01	(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=	128.38	115.95	128.38	124.24	128.38	41.92	43.31	43.31	41.92	128.38	124.24	128.38	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	509.85	455.55	492.94	462.02	467.35	356.23	356.04	371.49	364.82	478.11	480.23	504.38	(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=	509.85	455.55	492.94	462.02	467.35	356.23	356.04	371.49	364.82	478.11	480.23	504.38

Output from water heater (annual)1…12 5299.01 (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=	160.38	143.21	154.76	144.77	146.25	71.11	69.47	74.61	73.97	149.82	150.83	158.56	(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=	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	(66)

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

(67)m=	60.93	54.12	44.01	33.32	24.91	21.03	22.72	29.53	39.64	50.33	58.75	62.63	(67)

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

(68)m=	404.88	409.08	398.49	375.95	347.5	320.76	302.9	298.7	309.28	331.82	360.27	387.01	(68)

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

(69)m=	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)

Water heating gains (Table 5)

(72)m=	215.57	213.11	208.01	201.07	196.57	98.76	93.38	100.28	102.73	201.38	209.48	213.12	(72)

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

(73)m=	792.34	787.28	761.48	721.31	679.95	551.52	529.96	539.48	562.62	694.5	739.47	773.73	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.76	x	0.7	=	66.19	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.76	x	0.7	=	108.4	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.76	x	0.7	=	138.08	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.76	x	0.7	=	156.06	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.76	x	0.7	=	162.62	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.76	x	0.7	=	156.5	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.76	x	0.7	=	152.91	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.76	x	0.7	=	148.5	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.76	x	0.7	=	144.24	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.76	x	0.7	=	116.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.76	x	0.7	=	78.45	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.76	x	0.7	=	57.19	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.76	x	0.7	=	8.68	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.76	x	0.7	=	14.79	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.76	x	0.7	=	20.23	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.76	x	0.7	=	25.07	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.76	x	0.7	=	28.08	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.76	x	0.7	=	27.88	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.76	x	0.7	=	26.88	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.76	x	0.7	=	24.63	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.76	x	0.7	=	21.91	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.76	x	0.7	=	16.34	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.76	x	0.7	=	10.4	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.76	x	0.7	=	7.43	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.76	x	0.7	=	125.41	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.76	x	0.7	=	245.33	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.76	x	0.7	=	404.03	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.76	x	0.7	=	589.25	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.76	x	0.7	=	722.15	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.76	x	0.7	=	739.25	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.76	x	0.7	=	703.8	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.76	x	0.7	=	604.55	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.76	x	0.7	=	469.9	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.76	x	0.7	=	291.11	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.76	x	0.7	=	156.37	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.76	x	0.7	=	103.13	(80)

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

(83)m=	200.28	368.52	562.34	770.38	912.86	923.63	883.59	777.68	636.05	424.37	245.23	167.75	(83)

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

(84)m=	992.63	1155.8	1323.82	1491.7	1592.8	1475.15	1413.55	1317.16	1198.68	1118.87	984.7	941.48	(84)

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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	0.97	0.93	0.87	0.77	0.63	0.68	0.86	0.95	0.98	0.99	(86)

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

(87)m=	18.76	18.98	19.38	19.92	20.4	20.74	20.9	20.87	20.57	19.98	19.29	18.75	(87)

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

(88)m=	19.87	19.88	19.88	19.91	19.92	19.94	19.94	19.94	19.93	19.92	19.91	19.9	(88)

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

(89)m=	0.99	0.98	0.96	0.92	0.83	0.69	0.51	0.56	0.81	0.94	0.98	0.99	(89)

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

(90)m=	17.83	18.06	18.45	19	19.46	19.78	19.9	19.88	19.64	19.07	18.39	17.83	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

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

(92)m=	18.22	18.45	18.84	19.39	19.86	20.18	20.32	20.3	20.03	19.46	18.77	18.22	(92)

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

(93)m=	18.22	18.45	18.84	19.39	19.86	20.18	20.32	20.3	20.03	19.46	18.77	18.22	(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=	0.98	0.97	0.95	0.91	0.83	0.71	0.56	0.61	0.81	0.93	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	976.72	1126.06	1263.04	1356.83	1317.75	1049.02	785.95	797.59	975.52	1041.23	959.85	928.64	(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=	3445.76	3336.52	3024.61	2509.22	1941.96	1301.14	867.4	905.82	1394.47	2109.24	2804.78	3401.68	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1836.96	1485.43	1310.61	829.72	464.41	0	0	0	0	794.6	1328.35	1839.94	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 9890.02 | (98)

Space heating requirement in kWh/m²/year | 90.07 | (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		81	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	1836.96	1485.43	1310.61	829.72	464.41	0	0	0	0	794.6	1328.35	1839.94		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	2267.86	1833.86	1618.03	1024.35	573.35	0	0	0	0	980.98	1639.93	2271.53		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													12209.9	(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)	509.85	455.55	492.94	462.02	467.35	356.23	356.04	371.49	364.82	478.11	480.23	504.38		
Efficiency of water heater													81	(216)
(217)m=	81	81	81	81	81	81	81	81	81	81	81	81		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	629.45	562.4	608.57	570.4	576.98	439.79	439.56	458.63	450.4	590.25	592.88	622.69		
Total = Sum(219a)$_{1...12}$ =													6541.99	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			12209.9	
Water heating fuel used			6541.99	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		120		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		120	(231)
Electricity for lighting			430.44	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211)	x	3.48	x 0.01 =	424.9	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	6.61	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.48	x 0.01 =	227.66	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	15.83	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)		13.19	x 0.01 =	56.77	(250)
Additional standing charges (Table 12)					120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	845.17	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)			0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =		2.29	(257)
SAP rating (Section 12)			68.01	(258)

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	=	2637.34	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	1413.07	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4050.41	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	62.28	(267)
Electricity for lighting	(232) x	0.519	=	223.4	(268)
Total CO2, kg/year		sum of (265)…(271) =		4336.09	(272)
CO2 emissions per m²		(272) ÷ (4) =		39.49	(273)
EI rating (section 14)				62	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	14896.08	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	7981.23	(264)
Space and water heating	(261) + (262) + (263) + (264) =			22877.31	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	368.4	(267)
Electricity for lighting	(232) x	0	=	1321.44	(268)
‘Total Primary Energy		sum of (265)…(271) =		24567.15	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		223.74	(273)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.7

Property Address: LG1 Baseline

Address : , London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	67.4	(1a) x	2.8	(2a) =	188.72	(3a)
Ground floor	42.4	(1b) x	2.6	(2b) =	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		298.96	(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 *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(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

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	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=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(24d)

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

(25)m=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	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			1.98	x	1	=	1.98			(26)
Windows Type 1			4.33	x1/[1/(1.4)+ 0.04]		=	5.74			(27)
Windows Type 2			1.92	x1/[1/(1.4)+ 0.04]		=	2.55			(27)
Windows Type 3			0.64	x1/[1/(1.4)+ 0.04]		=	0.85			(27)
Floor Type 1			30	x	0.13	=	3.9			(28)
Floor Type 2			37.4	x	0.13	=	4.862			(28)
Walls Type1	48.6	4.48	44.12	x	0.18	=	7.94			(29)
Walls Type2	32.8	17.32	15.48	x	0.18	=	2.79			(29)
Walls Type3	8.6	0	8.6	x	0.18	=	1.55			(29)
Walls Type4	3.1	1.98	1.12	x	0.18	=	0.2			(29)
Walls Type5	13.3	0	13.3	x	0.18	=	2.39			(29)
Total area of elements, m²			173.8							(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) = 54.52 (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 | 16.25 | (36)

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

Total fabric heat loss — (33) + (36) = | 70.77 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	57.86	57.53	57.21	55.68	55.4	54.07	54.07	53.82	54.58	55.4	55.97	56.58	(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=	128.63	128.3	127.97	126.45	126.16	124.83	124.83	124.59	125.34	126.16	126.74	127.34

Average = Sum(39)$_{1…12}$ /12= | 126.44 | (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=	1.17	1.17	1.17	1.15	1.15	1.14	1.14	1.13	1.14	1.15	1.15	1.16

Average = Sum(40)$_{1…12}$ /12= | 1.15 | (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 | 101.02 | (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=	111.13	107.08	103.04	99	94.96	90.92	90.92	94.96	99	103.04	107.08	111.13

Total = Sum(44)$_{1…12}$ = | 1212.28 | (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=	164.8	144.13	148.73	129.67	124.42	107.36	99.49	114.16	115.53	134.64	146.97	159.6

Total = Sum(45)$_{1…12}$ = | 1589.49 | (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=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

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

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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=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	140.08	122.51	126.42	110.22	105.76	91.26	84.57	97.04	98.2	114.44	124.92	135.66	(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=	140.08	122.51	126.42	110.22	105.76	91.26	84.57	97.04	98.2	114.44	124.92	135.66	

Output from water heater (annual)$_{1...12}$ 1351.07 (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=	35.02	30.63	31.61	27.55	26.44	22.81	21.14	24.26	24.55	28.61	31.23	33.91	(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=	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	(66)

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

(67)m=	24.37	21.65	17.61	13.33	9.96	8.41	9.09	11.81	15.86	20.13	23.5	25.05	(67)

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

(68)m=	271.27	274.08	266.99	251.89	232.83	214.91	202.94	200.13	207.22	222.32	241.38	259.3	(68)

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

(69)m=	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)

Water heating gains (Table 5)

(72)m=	47.07	45.58	42.48	38.27	35.54	31.69	28.42	32.61	34.1	38.45	43.38	45.58	(72)

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

(73)m=	407.91	406.51	392.28	368.69	343.53	320.21	305.65	309.75	322.38	346.11	373.46	395.14	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	54.87	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	89.86	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	114.46	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	129.37	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	134.81	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	129.73	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	126.76	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	123.1	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	119.57	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	96.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	65.03	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	47.41	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.63	x	0.7	=	7.2	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.63	x	0.7	=	12.26	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.63	x	0.7	=	16.77	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.63	x	0.7	=	20.78	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.63	x	0.7	=	23.28	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.63	x	0.7	=	23.11	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.63	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.63	x	0.7	=	20.42	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.63	x	0.7	=	18.16	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.63	x	0.7	=	13.55	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.63	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.63	x	0.7	=	6.16	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.63	x	0.7	=	103.96	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.63	x	0.7	=	203.37	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.63	x	0.7	=	334.92	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.63	x	0.7	=	488.46	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.63	x	0.7	=	598.62	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.63	x	0.7	=	612.8	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.63	x	0.7	=	583.41	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.63	x	0.7	=	501.14	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.63	x	0.7	=	389.52	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.63	x	0.7	=	241.31	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.63	x	0.7	=	129.63	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.63	x	0.7	=	85.49	(80)

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

(83)m=	166.02	305.48	466.15	638.61	756.71	765.64	732.45	644.66	527.25	351.78	203.28	139.06	(83)

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

(84)m=	573.94	712	858.43	1007.3	1100.24	1085.85	1038.1	954.41	849.63	697.89	576.74	534.2	(84)

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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	0.86	0.69	0.52	0.58	0.84	0.98	1	1	(86)

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

(87)m=	19.66	19.84	20.14	20.51	20.81	20.95	20.99	20.98	20.87	20.46	19.99	19.63	(87)

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

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

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

(89)m=	1	1	0.98	0.94	0.81	0.6	0.4	0.46	0.77	0.97	1	1	(89)

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

(90)m=	18.72	18.9	19.2	19.57	19.83	19.95	19.97	19.97	19.9	19.53	19.06	18.7	(90)

fLA = Living area ÷ (4) = 0.42 (91)

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

(92)m=	19.12	19.3	19.6	19.97	20.24	20.38	20.4	20.4	20.31	19.92	19.45	19.09	(92)

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

(93)m=	19.12	19.3	19.6	19.97	20.24	20.38	20.4	20.4	20.31	19.92	19.45	19.09	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.83	0.63	0.45	0.51	0.8	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	572.88	708.13	843.12	944.49	908.25	687.9	469.66	489.25	676.53	676.43	574.29	533.51	(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=	1905.69	1847.74	1676.25	1399.76	1077.99	721.02	474.56	498.18	778.38	1176.41	1565.14	1896.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	991.61	765.82	619.85	327.8	126.28	0	0	0	0	371.99	713.42	1013.85	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4930.61 (98)

Space heating requirement in kWh/m²/year 44.91 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	1173.42	923.75	946.85	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.89	0.94	0.92	0	0	0	0	(101)

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

(102)m=	0	0	0	0	0	1050.05	872.68	873.47	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	1379.35	1321.11	1225.3	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	237.09	333.63	261.76	0	0	0	0

	Total = Sum(104)$_{6...8}$ =	832.49	(104)
Cooled fraction	f C = cooled area ÷ (4) =	1	(105)

Intermittency factor (Table 10b)

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

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

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

(107)m=	0	0	0	0	0	59.27	83.41	65.44	0	0	0	0

	Total = Sum(107)$_{6...8}$ =	208.12	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.9	(108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	46.8	(109)
Target Fabric Energy Efficiency (TFEE)		53.82	(109)

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.7

Property Address: LG1 Baseline

Address : , London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	67.4	(1a)	x	2.8	(2a)	=	188.72	(3a)
Ground floor	42.4	(1b)	x	2.6	(2b)	=	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	298.96	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.88	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.75	(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

0.96	0.94	0.92	0.83	0.81	0.71	0.71	0.69	0.75	0.81	0.85	0.88

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=	0.96	0.94	0.92	0.84	0.83	0.75	0.75	0.74	0.78	0.83	0.86	0.89	(24d)

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

(25)m=	0.96	0.94	0.92	0.84	0.83	0.75	0.75	0.74	0.78	0.83	0.86	0.89	(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			1.98	x	3	=	5.94			(26)
Windows Type 1			4.33	x1/[1/(3.1)+ 0.04]		=	11.94			(27)
Windows Type 2			1.92	x1/[1/(3.1)+ 0.04]		=	5.3			(27)
Windows Type 3			0.64	x1/[1/(3.1)+ 0.04]		=	1.77			(27)
Floor Type 1			30	x	0.25	=	7.5			(28)
Floor Type 2			37.4	x	0.73	=	27.302			(28)
Walls Type1	48.6	4.48	44.12	x	0.55	=	24.27			(29)
Walls Type2	32.8	17.32	15.48	x	0.35	=	5.42			(29)
Walls Type3	8.6	0	8.6	x	0.55	=	4.73			(29)
Walls Type4	3.1	1.98	1.12	x	0.55	=	0.62			(29)
Walls Type5	13.3	0	13.3	x	0.28	=	3.72			(29)
Total area of elements, m²			173.8							(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) = 139.62 (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 | (36)

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

Total fabric heat loss (33) + (36) = | 165.62 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	94.58	92.83	91.1	83.01	81.5	74.45	74.45	73.15	77.17	81.5	84.56	87.76	(38)

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

(39)m=	260.2	258.45	256.72	248.63	247.12	240.07	240.07	238.77	242.79	247.12	250.18	253.38	

Average = $Sum(39)_{1...12}$ /12= | 248.63 | (39)

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

(40)m=	2.37	2.35	2.34	2.26	2.25	2.19	2.19	2.17	2.21	2.25	2.28	2.31	

Average = $Sum(40)_{1...12}$ /12= | 2.26 | (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 | 106.34 | (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=	116.97	112.72	108.47	104.21	99.96	95.71	95.71	99.96	104.21	108.47	112.72	116.97	

Total = $Sum(44)_{1...12}$ = | 1276.09 | (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=	173.47	151.72	156.56	136.49	130.97	113.01	104.72	120.17	121.61	141.72	154.7	168	

Total = $Sum(45)_{1...12}$ = | 1673.15 | (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 110 | (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)

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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=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	147.45	128.96	133.08	116.02	111.32	96.06	89.02	102.15	103.37	120.46	131.5	142.8	(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=	147.45	128.96	133.08	116.02	111.32	96.06	89.02	102.15	103.37	120.46	131.5	142.8	

Output from water heater (annual)$_{1...12}$ 1422.18 (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=	36.86	32.24	33.27	29	27.83	24.02	22.25	25.54	25.84	30.12	32.87	35.7	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	24.37	21.65	17.61	13.33	9.96	8.41	9.09	11.81	15.86	20.13	23.5	25.05	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	271.27	274.08	266.99	251.89	232.83	214.91	202.94	200.13	207.22	222.32	241.38	259.3	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)
Water heating gains (Table 5)													
(72)m=	49.55	47.98	44.72	40.28	37.41	33.36	29.91	34.32	35.89	40.48	45.66	47.98	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	410.39	408.91	394.52	370.71	345.4	321.88	307.15	311.47	324.17	348.14	375.74	397.54	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.76	x	0.7	=	66.19	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.76	x	0.7	=	108.4	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.76	x	0.7	=	138.08	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.76	x	0.7	=	156.06	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.76	x	0.7	=	162.62	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.76	x	0.7	=	156.5	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.76	x	0.7	=	152.91	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.76	x	0.7	=	148.5	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.76	x	0.7	=	144.24	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.76	x	0.7	=	116.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.76	x	0.7	=	78.45	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.76	x	0.7	=	57.19	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.76	x	0.7	=	8.68	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.76	x	0.7	=	14.79	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.76	x	0.7	=	20.23	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.76	x	0.7	=	25.07	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.76	x	0.7	=	28.08	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.76	x	0.7	=	27.88	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.76	x	0.7	=	26.88	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.76	x	0.7	=	24.63	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.76	x	0.7	=	21.91	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.76	x	0.7	=	16.34	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.76	x	0.7	=	10.4	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.76	x	0.7	=	7.43	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.76	x	0.7	=	125.41	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.76	x	0.7	=	245.33	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.76	x	0.7	=	404.03	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.76	x	0.7	=	589.25	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.76	x	0.7	=	722.15	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.76	x	0.7	=	739.25	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.76	x	0.7	=	703.8	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.76	x	0.7	=	604.55	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.76	x	0.7	=	469.9	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.76	x	0.7	=	291.11	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.76	x	0.7	=	156.37	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.76	x	0.7	=	103.13	(80)

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

(83)m=	200.28	368.52	562.34	770.38	912.86	923.63	883.59	777.68	636.05	424.37	245.23	167.75	(83)

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

(84)m=	610.67	777.43	956.86	1141.09	1258.26	1245.51	1190.73	1089.15	960.22	772.51	620.97	565.29	(84)

DFEE WorkSheet: New dwelling design stage

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.92	0.83	0.71	0.76	0.92	0.98	1	1	(86)

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

(87)m=	18.39	18.62	19.05	19.65	20.19	20.64	20.85	20.81	20.43	19.71	18.97	18.39	(87)

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

(88)m=	19.1	19.11	19.12	19.16	19.17	19.21	19.21	19.22	19.2	19.17	19.15	19.14	(88)

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

(89)m=	1	0.99	0.98	0.95	0.87	0.71	0.49	0.56	0.84	0.97	0.99	1	(89)

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

(90)m=	16.83	17.07	17.5	18.12	18.64	19.05	19.18	19.17	18.89	18.2	17.45	16.86	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

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

(92)m=	17.49	17.73	18.15	18.77	19.3	19.72	19.89	19.86	19.54	18.84	18.1	17.51	(92)

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

(93)m=	17.49	17.73	18.15	18.77	19.3	19.72	19.89	19.86	19.54	18.84	18.1	17.51	(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	0.99	0.98	0.95	0.88	0.75	0.59	0.65	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	607.61	769.36	934.85	1078.9	1106.11	937.13	698.68	703.2	826.14	747.22	615.69	563.1	(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=	3431.6	3315.75	2992.09	2452.97	1877.13	1230.13	789.11	827.04	1321.01	2035.56	2750.87	3372.31	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	2101.05	1711.17	1530.59	989.33	573.64	0	0	0	0	958.53	1537.34	2090.05	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = | 11491.7 | (98)

Space heating requirement in kWh/m²/year | 104.66 | (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	2256.68	1776.54	1814.64	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.61	0.69	0.65	0	0	0	0	(101)

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

(102)m=	0	0	0	0	0	1368.54	1225.04	1174.16	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	1565.68	1499.26	1382.5	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m

set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	141.94	204.02	155	0	0	0	0

Total = Sum(104)$_{6..8}$ = 500.96 (104)

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

Intermittency factor (Table 10b)

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

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

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

(107)m=	0	0	0	0	0	35.48	51.01	38.75	0	0	0	0

Total = Sum(107)$_{6..8}$ = 125.24 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.14 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 105.8 (109)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.7

Property Address: LG1 Baseline

Address : , London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	67.4	(1a) x	2.8	(2a) =	188.72	(3a)
Ground floor	42.4	(1b) x	2.6	(2b) =	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	298.96	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.75	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.64	(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

0.81	0.8	0.78	0.7	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.75

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=	0.83	0.82	0.8	0.75	0.73	0.68	0.68	0.67	0.7	0.73	0.76	0.78	(24d)

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

(25)m=	0.83	0.82	0.8	0.75	0.73	0.68	0.68	0.67	0.7	0.73	0.76	0.78	(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			1.98	x	3	=	5.94			(26)
Windows Type 1			4.33	x1/[1/(3.1)+ 0.04]		=	11.94			(27)
Windows Type 2			1.92	x1/[1/(3.1)+ 0.04]		=	5.3			(27)
Windows Type 3			0.64	x1/[1/(3.1)+ 0.04]		=	1.77			(27)
Floor Type 1			30	x	0.25	=	7.5			(28)
Floor Type 2			37.4	x	0.73	=	27.302			(28)
Walls Type1	48.6	4.48	44.12	x	0.55	=	24.27			(29)
Walls Type2	32.8	17.32	15.48	x	0.35	=	5.42			(29)
Walls Type3	8.6	0	8.6	x	0.55	=	4.73			(29)
Walls Type4	3.1	1.98	1.12	x	0.55	=	0.62			(29)
Walls Type5	13.3	0	13.3	x	0.28	=	3.72			(29)
Total area of elements, m²			173.8							(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) =	139.62	(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 | (36)

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

Total fabric heat loss (33) + (36) = | 165.62 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	81.92	80.65	79.41	73.59	72.5	67.42	67.42	66.48	69.38	72.5	74.7	77.01	(38)

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

(39)m=	247.54	246.27	245.03	239.21	238.12	233.04	233.04	232.1	235	238.12	240.32	242.63	

Average = Sum(39)$_{1…12}$ /12= | 239.2 | (39)

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

(40)m=	2.25	2.24	2.23	2.18	2.17	2.12	2.12	2.11	2.14	2.17	2.19	2.21

Average = Sum(40)$_{1…12}$ /12= | 2.18 | (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 | 106.34 | (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=	116.97	112.72	108.47	104.21	99.96	95.71	95.71	99.96	104.21	108.47	112.72	116.97

Total = Sum(44)$_{1…12}$ = | 1276.09 | (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=	173.47	151.72	156.56	136.49	130.97	113.01	104.72	120.17	121.61	141.72	154.7	168

Total = Sum(45)$_{1…12}$ = | 1673.15 | (45)

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

(46)m=	26.02	22.76	23.48	20.47	19.65	16.95	15.71	18.03	18.24	21.26	23.21	25.2	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 110 | (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) = | 110 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.08 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 1.03 | (52)

Temperature factor from Table 2b | 0.78 | (53)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	6.71	(54)
Enter (50) or (54) in (55)		6.71	(55)

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

(56)m=	208.01	187.88	208.01	201.3	208.01	201.3	208.01	208.01	201.3	208.01	201.3	208.01	(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=	208.01	187.88	208.01	201.3	208.01	201.3	208.01	208.01	201.3	208.01	201.3	208.01	(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=	128.38	115.95	128.38	124.24	128.38	41.92	43.31	43.31	41.92	128.38	124.24	128.38	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	509.85	455.55	492.94	462.02	467.35	356.23	356.04	371.49	364.82	478.11	480.23	504.38	(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=	509.85	455.55	492.94	462.02	467.35	356.23	356.04	371.49	364.82	478.11	480.23	504.38	

Output from water heater (annual)$_{1...12}$ | 5299.01 | (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=	160.38	143.21	154.76	144.77	146.25	71.11	69.47	74.61	73.97	149.82	150.83	158.56	(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=	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	(66)

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

(67)m=	24.37	21.65	17.61	13.33	9.96	8.41	9.09	11.81	15.86	20.13	23.5	25.05	(67)

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

(68)m=	271.27	274.08	266.99	251.89	232.83	214.91	202.94	200.13	207.22	222.32	241.38	259.3	(68)

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

(69)m=	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)

Water heating gains (Table 5)

(72)m=	215.57	213.11	208.01	201.07	196.57	98.76	93.38	100.28	102.73	201.38	209.48	213.12	(72)

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

(73)m=	576.41	574.04	557.81	531.49	504.56	387.29	370.61	377.42	391.01	509.04	539.57	562.67	(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.76	x	0.7	=	66.19	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.76	x	0.7	=	108.4	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.76	x	0.7	=	138.08	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.76	x	0.7	=	156.06	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.76	x	0.7	=	162.62	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.76	x	0.7	=	156.5	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.76	x	0.7	=	152.91	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.76	x	0.7	=	148.5	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.76	x	0.7	=	144.24	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.76	x	0.7	=	116.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.76	x	0.7	=	78.45	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.76	x	0.7	=	57.19	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.76	x	0.7	=	8.68	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.76	x	0.7	=	14.79	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.76	x	0.7	=	20.23	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.76	x	0.7	=	25.07	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.76	x	0.7	=	28.08	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.76	x	0.7	=	27.88	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.76	x	0.7	=	26.88	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.76	x	0.7	=	24.63	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.76	x	0.7	=	21.91	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.76	x	0.7	=	16.34	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.76	x	0.7	=	10.4	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.76	x	0.7	=	7.43	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.76	x	0.7	=	125.41	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.76	x	0.7	=	245.33	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.76	x	0.7	=	404.03	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.76	x	0.7	=	589.25	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.76	x	0.7	=	722.15	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.76	x	0.7	=	739.25	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.76	x	0.7	=	703.8	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.76	x	0.7	=	604.55	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.76	x	0.7	=	469.9	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.76	x	0.7	=	291.11	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.76	x	0.7	=	156.37	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.76	x	0.7	=	103.13	(80)

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

(83)m=	200.28	368.52	562.34	770.38	912.86	923.63	883.59	777.68	636.05	424.37	245.23	167.75	(83)

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

(84)m=	776.69	942.56	1120.15	1301.88	1417.42	1310.92	1254.2	1155.11	1027.06	933.41	784.8	730.43	(84)

DER WorkSheet: New dwelling design stage

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.89	0.81	0.68	0.73	0.9	0.97	0.99	1	(86)

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

(87)m=	18.61	18.84	19.25	19.81	20.32	20.69	20.87	20.84	20.49	19.87	19.16	18.6	(87)

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

(88)m=	19.87	19.88	19.88	19.91	19.92	19.94	19.94	19.94	19.93	19.92	19.91	19.9	(88)

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

(89)m=	0.99	0.99	0.98	0.94	0.86	0.74	0.56	0.62	0.86	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=	17.68	17.91	18.32	18.9	19.39	19.74	19.88	19.87	19.57	18.96	18.25	17.69	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

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

(92)m=	18.07	18.3	18.71	19.28	19.78	20.14	20.3	20.28	19.96	19.35	18.63	18.07	(92)

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

(93)m=	18.07	18.3	18.71	19.28	19.78	20.14	20.3	20.28	19.96	19.35	18.63	18.07	(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	0.97	0.93	0.86	0.76	0.61	0.66	0.86	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	770.12	928.01	1085.35	1213.41	1217.85	989.79	759.39	761.73	880.8	890.21	773.69	725.36	(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=	3408.85	3301.03	2992.56	2483.52	1924.25	1291.16	863.09	899.96	1377.91	2082.38	2771.99	3365.91	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1963.22	1594.67	1418.96	914.48	525.57	0	0	0	0	886.97	1438.77	1964.56	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 10707.2 | (98)

Space heating requirement in kWh/m²/year | 97.52 | (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		81	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	1963.22	1594.67	1418.96	914.48	525.57	0	0	0	0	886.97	1438.77	1964.56		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	2423.72	1968.73	1751.8	1128.99	648.85	0	0	0	0	1095.02	1776.26	2425.39		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													13218.76	(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)	509.85	455.55	492.94	462.02	467.35	356.23	356.04	371.49	364.82	478.11	480.23	504.38		
Efficiency of water heater													81	(216)
(217)m=	81	81	81	81	81	81	81	81	81	81	81	81		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	629.45	562.4	608.57	570.4	576.98	439.79	439.56	458.63	450.4	590.25	592.88	622.69		
Total = Sum(219a)$_{1...12}$ =													6541.99	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			13218.76	
Water heating fuel used			6541.99	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		120		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		120	(231)
Electricity for lighting			430.44	(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	=	2855.25	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	1413.07	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4268.32	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	62.28	(267)
Electricity for lighting	(232)	x	0.519	=	223.4	(268)
Total CO2, kg/year			sum of (265)…(271) =		4554	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		41.48	(273)
EI rating (section 14)					60	(274)

TER WorkSheet: New dwelling design stage

User Details:			
Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.7

Property Address: LG1 Baseline

Address : , London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	67.4	(1a)	x	2.8	(2a)	=	188.72	(3a)
Ground floor	42.4	(1b)	x	2.6	(2b)	=	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	298.96	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.13	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(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

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	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=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(24d)

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

(25)m=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	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			1.98	x	1	=	1.98			(26)
Windows Type 1			4.33	x1/[1/(1.4)+ 0.04]		=	5.74			(27)
Windows Type 2			1.92	x1/[1/(1.4)+ 0.04]		=	2.55			(27)
Windows Type 3			0.64	x1/[1/(1.4)+ 0.04]		=	0.85			(27)
Floor Type 1			30	x	0.13	=	3.9			(28)
Floor Type 2			37.4	x	0.13	=	4.862			(28)
Walls Type1	48.6	4.48	44.12	x	0.18	=	7.94			(29)
Walls Type2	32.8	17.32	15.48	x	0.18	=	2.79			(29)
Walls Type3	8.6	0	8.6	x	0.18	=	1.55			(29)
Walls Type4	3.1	1.98	1.12	x	0.18	=	0.2			(29)
Walls Type5	13.3	0	13.3	x	0.18	=	2.39			(29)
Total area of elements, m²			173.8							(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) = 54.52 (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 | 16.25 | (36)

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

Total fabric heat loss (33) + (36) = | 70.77 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	57.86	57.53	57.21	55.68	55.4	54.07	54.07	53.82	54.58	55.4	55.97	56.58	(38)

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

(39)m=	128.63	128.3	127.97	126.45	126.16	124.83	124.83	124.59	125.34	126.16	126.74	127.34	

Average = $Sum(39)_{1...12}$ /12= | 126.44 | (39)

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

(40)m=	1.17	1.17	1.17	1.15	1.15	1.14	1.14	1.13	1.14	1.15	1.15	1.16	

Average = $Sum(40)_{1...12}$ /12= | 1.15 | (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 | 101.02 | (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=	111.13	107.08	103.04	99	94.96	90.92	90.92	94.96	99	103.04	107.08	111.13	

Total = $Sum(44)_{1...12}$ = | 1212.28 | (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=	164.8	144.13	148.73	129.67	124.42	107.36	99.49	114.16	115.53	134.64	146.97	159.6	

Total = $Sum(45)_{1...12}$ = | 1589.49 | (45)

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

(46)m=	24.72	21.62	22.31	19.45	18.66	16.1	14.92	17.12	17.33	20.2	22.05	23.94	(46)

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 1.17 | (48)

Temperature factor from Table 2b | 0.54 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0.63 | (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)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0.63	(55)

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

(56)m=	19.51	17.62	19.51	18.88	19.51	18.88	19.51	19.51	18.88	19.51	18.88	19.51	(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=	19.51	17.62	19.51	18.88	19.51	18.88	19.51	19.51	18.88	19.51	18.88	19.51	(57)

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

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	207.56	182.76	191.5	171.06	167.19	148.75	142.26	156.93	156.92	177.41	188.36	202.36	(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=	207.56	182.76	191.5	171.06	167.19	148.75	142.26	156.93	156.92	177.41	188.36	202.36	

Output from water heater (annual)$_{1…12}$ 2093.05 (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=	89.01	78.83	83.67	76.23	75.58	68.81	67.29	72.17	71.52	78.98	81.98	87.28	(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=	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	(66)

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

(67)m=	24.37	21.65	17.61	13.33	9.96	8.41	9.09	11.81	15.86	20.13	23.5	25.05	(67)

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

(68)m=	271.27	274.08	266.99	251.89	232.83	214.91	202.94	200.13	207.22	222.32	241.38	259.3	(68)

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

(69)m=	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	(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=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)

Water heating gains (Table 5)

(72)m=	119.64	117.3	112.46	105.87	101.59	95.57	90.45	97.01	99.34	106.16	113.86	117.31	(72)

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

(73)m=	483.48	481.24	465.26	439.29	412.58	387.09	370.68	377.15	390.62	416.82	446.94	469.87	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	54.87	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	89.86	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	114.46	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	129.37	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	134.81	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	129.73	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	126.76	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	123.1	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	119.57	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	96.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	65.03	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	47.41	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.63	x	0.7	=	7.2	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.63	x	0.7	=	12.26	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.63	x	0.7	=	16.77	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.63	x	0.7	=	20.78	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.63	x	0.7	=	23.28	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.63	x	0.7	=	23.11	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.63	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.63	x	0.7	=	20.42	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.63	x	0.7	=	18.16	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.63	x	0.7	=	13.55	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.63	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.63	x	0.7	=	6.16	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.63	x	0.7	=	103.96	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.63	x	0.7	=	203.37	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.63	x	0.7	=	334.92	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.63	x	0.7	=	488.46	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.63	x	0.7	=	598.62	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.63	x	0.7	=	612.8	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.63	x	0.7	=	583.41	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.63	x	0.7	=	501.14	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.63	x	0.7	=	389.52	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.63	x	0.7	=	241.31	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.63	x	0.7	=	129.63	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.63	x	0.7	=	85.49	(80)

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

(83)m=	166.02	305.48	466.15	638.61	756.71	765.64	732.45	644.66	527.25	351.78	203.28	139.06	(83)

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

(84)m=	649.5	786.72	931.41	1077.9	1169.29	1152.74	1103.13	1021.81	917.87	768.6	650.22	608.93	(84)

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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	0.84	0.66	0.49	0.55	0.81	0.97	1	1	(86)

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

(87)m=	19.72	19.91	20.2	20.56	20.83	20.96	20.99	20.99	20.9	20.52	20.05	19.69	(87)

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

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

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

(89)m=	1	0.99	0.98	0.92	0.78	0.57	0.38	0.43	0.73	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=	18.24	18.51	18.94	19.45	19.8	19.95	19.97	19.97	19.89	19.4	18.73	18.2	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

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

(92)m=	18.87	19.1	19.47	19.92	20.24	20.38	20.4	20.4	20.31	19.87	19.29	18.83	(92)

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

(93)m=	18.87	19.1	19.47	19.92	20.24	20.38	20.4	20.4	20.31	19.87	19.29	18.83	(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	0.43	0.48	0.76	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	647.27	779.75	907.54	992.44	933.26	694.67	470.87	491.61	697.22	733.98	645.26	607.38	(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=	1873.84	1822.03	1659.85	1393.57	1077.18	721.23	474.65	498.35	778.82	1170	1544.4	1863.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	912.57	700.42	559.72	288.81	107.08	0	0	0	0	324.4	647.38	934.6	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 4474.96 | (98)

Space heating requirement in kWh/m²/year | 40.76 | (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	912.57	700.42	559.72	288.81	107.08	0	0	0	0	324.4	647.38	934.6		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	976.01	749.11	598.63	308.89	114.52	0	0	0	0	346.95	692.38	999.57		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													4786.06	(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)	207.56	182.76	191.5	171.06	167.19	148.75	142.26	156.93	156.92	177.41	188.36	202.36		
Efficiency of water heater													79.8	(216)
(217)m=	88.31	88.06	87.51	86.2	83.66	79.8	79.8	79.8	79.8	86.4	87.85	88.39		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	235.05	207.55	218.83	198.44	199.84	186.41	178.27	196.66	196.64	205.32	214.42	228.94		
Total = Sum(219a)$_{1...12}$ =													2466.36	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4786.06	
Water heating fuel used			2466.36	
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			430.44	(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	=	1033.79	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	532.73	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1566.52	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	223.4	(268)
Total CO2, kg/year			sum of (265)…(271) =		1828.84	(272)

TER = 16.66 (273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.7

Property Address: LG1 Lean

Address : , London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	67.4	(1a) x	2.8	(2a) =	188.72	(3a)
Ground floor	42.4	(1b) x	2.6	(2b) =	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		298.96	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.75	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.64	(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

0.81	0.8	0.78	0.7	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.75

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	58.65	(23c)

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

(24a)m=	1.02	1	0.99	0.91	0.89	0.81	0.81	0.8	0.84	0.89	0.92	0.96	(24a)

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

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

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	1.02	1	0.99	0.91	0.89	0.81	0.81	0.8	0.84	0.89	0.92	0.96	(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			1.98	x	1.8	=	3.564			(26)
Windows Type 1			4.33	x1/[1/(1.6)+ 0.04]		=	6.51			(27)
Windows Type 2			1.92	x1/[1/(1.6)+ 0.04]		=	2.89			(27)
Windows Type 3			0.64	x1/[1/(1.6)+ 0.04]		=	0.96			(27)
Floor Type 1			30	x	0.1	=	3			(28)
Floor Type 2			37.4	x	0.25	=	9.35			(28)
Walls Type1	48.6	4.48	44.12	x	0.55	=	24.27			(29)
Walls Type2	32.8	17.32	15.48	x	0.15	=	2.32			(29)
Walls Type3	8.6	0	8.6	x	0.55	=	4.73			(29)
Walls Type4	3.1	1.98	1.12	x	0.55	=	0.62			(29)
Walls Type5	13.3	0	13.3	x	0.15	=	2			(29)
Total area of elements, m²			173.8							(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) =	82.62	(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 | (36)

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

Total fabric heat loss (33) + (36) = | 108.62 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	100.59	99.01	97.44	89.58	88.01	80.15	80.15	78.57	83.29	88.01	91.15	94.3	(38)

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

(39)m=	209.21	207.64	206.07	198.21	196.63	188.77	188.77	187.2	191.92	196.63	199.78	202.92	

Average = $Sum(39)_{1...12}$ /12= | 197.81 | (39)

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

(40)m=	1.91	1.89	1.88	1.81	1.79	1.72	1.72	1.7	1.75	1.79	1.82	1.85

Average = $Sum(40)_{1...12}$ /12= | 1.8 | (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 | 101.02 | (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=	111.13	107.08	103.04	99	94.96	90.92	90.92	94.96	99	103.04	107.08	111.13

Total = $Sum(44)_{1...12}$ = | 1212.28 | (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=	164.8	144.13	148.73	129.67	124.42	107.36	99.49	114.16	115.53	134.64	146.97	159.6

Total = $Sum(45)_{1...12}$ = | 1589.49 | (45)

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

(46)m=	24.72	21.62	22.31	19.45	18.66	16.1	14.92	17.12	17.33	20.2	22.05	23.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 110 | (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)

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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=	50.96	46.03	50.96	48.82	48.39	44.84	46.33	48.39	48.82	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=	215.76	190.16	199.69	178.49	172.81	152.2	145.82	162.56	164.35	185.6	196.28	210.56	(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=	215.76	190.16	199.69	178.49	172.81	152.2	145.82	162.56	164.35	185.6	196.28	210.56	

Output from water heater (annual)$_{1...12}$ 2174.27 (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=	67.53	59.43	62.19	55.32	53.47	46.91	44.66	50.06	50.62	57.51	61.2	65.81	(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=	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	60.93	54.12	44.01	33.32	24.91	21.03	22.72	29.53	39.64	50.33	58.75	62.63	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	404.88	409.08	398.49	375.95	347.5	320.76	302.9	298.7	309.28	331.82	360.27	387.01	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	(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=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)
Water heating gains (Table 5)													
(72)m=	90.77	88.44	83.59	76.83	71.86	65.15	60.03	67.28	70.3	77.29	84.99	88.45	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	670.55	665.61	640.07	600.08	558.24	520.91	499.62	509.48	533.2	573.42	617.98	652.06	(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)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	54.87	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	89.86	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	114.46	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	129.37	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	134.81	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	129.73	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	126.76	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	123.1	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	119.57	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	96.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	65.03	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	47.41	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.63	x	0.7	=	7.2	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.63	x	0.7	=	12.26	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.63	x	0.7	=	16.77	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.63	x	0.7	=	20.78	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.63	x	0.7	=	23.28	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.63	x	0.7	=	23.11	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.63	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.63	x	0.7	=	20.42	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.63	x	0.7	=	18.16	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.63	x	0.7	=	13.55	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.63	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.63	x	0.7	=	6.16	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.63	x	0.7	=	103.96	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.63	x	0.7	=	203.37	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.63	x	0.7	=	334.92	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.63	x	0.7	=	488.46	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.63	x	0.7	=	598.62	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.63	x	0.7	=	612.8	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.63	x	0.7	=	583.41	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.63	x	0.7	=	501.14	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.63	x	0.7	=	389.52	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.63	x	0.7	=	241.31	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.63	x	0.7	=	129.63	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.63	x	0.7	=	85.49	(80)

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

(83)m=	166.02	305.48	466.15	638.61	756.71	765.64	732.45	644.66	527.25	351.78	203.28	139.06	(83)

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

(84)m=	836.57	971.09	1106.22	1238.68	1314.95	1286.55	1232.06	1154.14	1060.45	925.2	821.26	791.12	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.89	0.76	0.61	0.66	0.86	0.97	0.99	1	(86)

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

(87)m=	19	19.21	19.56	20.07	20.5	20.82	20.94	20.92	20.68	20.12	19.5	19.01	(87)

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

(88)m=	19.4	19.41	19.42	19.47	19.48	19.53	19.53	19.54	19.51	19.48	19.46	19.44	(88)

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

(89)m=	0.99	0.99	0.97	0.93	0.84	0.65	0.44	0.49	0.78	0.95	0.99	0.99	(89)

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

(90)m=	16.83	17.14	17.66	18.41	19	19.41	19.51	19.51	19.26	18.5	17.6	16.87	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

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

(92)m=	17.75	18.01	18.47	19.11	19.63	20.01	20.12	20.11	19.87	19.19	18.41	17.78	(92)

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

(93)m=	17.6	17.86	18.32	18.96	19.48	19.86	19.97	19.96	19.72	19.04	18.26	17.63	(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	0.92	0.84	0.68	0.49	0.54	0.79	0.94	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	827.04	952.43	1065.86	1141.77	1100.46	869.28	607.43	626.62	839.01	871.05	806.04	783.73	(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=	2782.53	2691.87	2434.88	1994.73	1529.91	993.09	635.35	666.12	1077.73	1659.11	2229.24	2725	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1454.88	1168.9	1018.55	614.13	319.51	0	0	0	0	586.32	1024.71	1444.3	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 7631.3 | (98)

Space heating requirement in kWh/m²/year | 69.5 | (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		91.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	1454.88	1168.9	1018.55	614.13	319.51	0	0	0	0	586.32	1024.71	1444.3		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1584.84	1273.31	1109.53	668.99	348.05	0	0	0	0	638.69	1116.24	1573.31		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													8312.96	(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)	215.76	190.16	199.69	178.49	172.81	152.2	145.82	162.56	164.35	185.6	196.28	210.56		
Efficiency of water heater													82.5	(216)
(217)m=	90.48	90.37	90.13	89.53	88.31	82.5	82.5	82.5	82.5	89.38	90.17	90.5		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	238.45	210.41	221.55	199.37	195.7	184.49	176.75	197.04	199.21	207.65	217.69	232.65		
Total = Sum(219a)$_{1...12}$ =													2480.96	(219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			8312.96	
Water heating fuel used			2480.96	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		360.17		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		435.17	(231)
Electricity for lighting			430.44	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	289.29	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	86.34	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	57.4	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	56.77	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			609.8	(255)

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11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.65	(257)
SAP rating (Section 12)		76.92	(258)

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	=	1795.6	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	535.89	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2331.49	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	225.85	(267)
Electricity for lighting	(232)	x	0.519	=	223.4	(268)
Total CO2, kg/year			sum of (265)…(271) =		2780.74	(272)
CO2 emissions per m²			(272) ÷ (4) =		25.33	(273)
EI rating (section 14)					76	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	10141.82	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	3026.78	(264)
Space and water heating	(261) + (262) + (263) + (264) =				13168.59	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	1335.98	(267)
Electricity for lighting	(232)	x	0	=	1321.44	(268)
'Total Primary Energy			sum of (265)…(271) =		15826.01	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		144.13	(273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.7

Property Address: LG1 Lean

Address : , London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	67.4	(1a) x	2.8	(2a) =	188.72	(3a)
Ground floor	42.4	(1b) x	2.6	(2b) =	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		298.96	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.13	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(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

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

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	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=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(24d)

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

(25)m=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	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			1.98	x	1	=	1.98			(26)
Windows Type 1			4.33	x1/[1/(1.4)+ 0.04]		=	5.74			(27)
Windows Type 2			1.92	x1/[1/(1.4)+ 0.04]		=	2.55			(27)
Windows Type 3			0.64	x1/[1/(1.4)+ 0.04]		=	0.85			(27)
Floor Type 1			30	x	0.13	=	3.9			(28)
Floor Type 2			37.4	x	0.13	=	4.862			(28)
Walls Type1	48.6	4.48	44.12	x	0.18	=	7.94			(29)
Walls Type2	32.8	17.32	15.48	x	0.18	=	2.79			(29)
Walls Type3	8.6	0	8.6	x	0.18	=	1.55			(29)
Walls Type4	3.1	1.98	1.12	x	0.18	=	0.2			(29)
Walls Type5	13.3	0	13.3	x	0.18	=	2.39			(29)
Total area of elements, m²			173.8							(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) = 54.52 (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 | 16.25 | (36)

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

Total fabric heat loss (33) + (36) = | 70.77 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	57.86	57.53	57.21	55.68	55.4	54.07	54.07	53.82	54.58	55.4	55.97	56.58	(38)

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

(39)m=	128.63	128.3	127.97	126.45	126.16	124.83	124.83	124.59	125.34	126.16	126.74	127.34	

Average = Sum(39)$_{1…12}$ /12= | 126.44 | (39)

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

(40)m=	1.17	1.17	1.17	1.15	1.15	1.14	1.14	1.13	1.14	1.15	1.15	1.16	

Average = Sum(40)$_{1…12}$ /12= | 1.15 | (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 | 101.02 | (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=	111.13	107.08	103.04	99	94.96	90.92	90.92	94.96	99	103.04	107.08	111.13	

Total = Sum(44)$_{1…12}$ = | 1212.28 | (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=	164.8	144.13	148.73	129.67	124.42	107.36	99.49	114.16	115.53	134.64	146.97	159.6	

Total = Sum(45)$_{1…12}$ = | 1589.49 | (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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)

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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=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	140.08	122.51	126.42	110.22	105.76	91.26	84.57	97.04	98.2	114.44	124.92	135.66	(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=	140.08	122.51	126.42	110.22	105.76	91.26	84.57	97.04	98.2	114.44	124.92	135.66	

Output from water heater (annual)$_{1...12}$ 1351.07 (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=	35.02	30.63	31.61	27.55	26.44	22.81	21.14	24.26	24.55	28.61	31.23	33.91	(65)

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

DRAFT

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=	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	(66)

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

(67)m=	24.37	21.65	17.61	13.33	9.96	8.41	9.09	11.81	15.86	20.13	23.5	25.05	(67)

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

(68)m=	271.27	274.08	266.99	251.89	232.83	214.91	202.94	200.13	207.22	222.32	241.38	259.3	(68)

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

(69)m=	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)

Water heating gains (Table 5)

(72)m=	47.07	45.58	42.48	38.27	35.54	31.69	28.42	32.61	34.1	38.45	43.38	45.58	(72)

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

(73)m=	407.91	406.51	392.28	368.69	343.53	320.21	305.65	309.75	322.38	346.11	373.46	395.14	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	54.87	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	89.86	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	114.46	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	129.37	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	134.81	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	129.73	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	126.76	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	123.1	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	119.57	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	96.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	65.03	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	47.41	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.63	x	0.7	=	7.2	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.63	x	0.7	=	12.26	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.63	x	0.7	=	16.77	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.63	x	0.7	=	20.78	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.63	x	0.7	=	23.28	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.63	x	0.7	=	23.11	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.63	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.63	x	0.7	=	20.42	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.63	x	0.7	=	18.16	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.63	x	0.7	=	13.55	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.63	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.63	x	0.7	=	6.16	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.63	x	0.7	=	103.96	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.63	x	0.7	=	203.37	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.63	x	0.7	=	334.92	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.63	x	0.7	=	488.46	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.63	x	0.7	=	598.62	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.63	x	0.7	=	612.8	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.63	x	0.7	=	583.41	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.63	x	0.7	=	501.14	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.63	x	0.7	=	389.52	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.63	x	0.7	=	241.31	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.63	x	0.7	=	129.63	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.63	x	0.7	=	85.49	(80)

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

(83)m=	166.02	305.48	466.15	638.61	756.71	765.64	732.45	644.66	527.25	351.78	203.28	139.06	(83)

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

(84)m=	573.94	712	858.43	1007.3	1100.24	1085.85	1038.1	954.41	849.63	697.89	576.74	534.2	(84)

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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	0.86	0.69	0.52	0.58	0.84	0.98	1	1	(86)

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

(87)m=	19.66	19.84	20.14	20.51	20.81	20.95	20.99	20.98	20.87	20.46	19.99	19.63	(87)

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

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

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

(89)m=	1	1	0.98	0.94	0.81	0.6	0.4	0.46	0.77	0.97	1	1	(89)

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

(90)m=	18.72	18.9	19.2	19.57	19.83	19.95	19.97	19.97	19.9	19.53	19.06	18.7	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

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

(92)m=	19.12	19.3	19.6	19.97	20.24	20.38	20.4	20.4	20.31	19.92	19.45	19.09	(92)

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

(93)m=	19.12	19.3	19.6	19.97	20.24	20.38	20.4	20.4	20.31	19.92	19.45	19.09	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.83	0.63	0.45	0.51	0.8	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	572.88	708.13	843.12	944.49	908.25	687.9	469.66	489.25	676.53	676.43	574.29	533.51	(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=	1905.69	1847.74	1676.25	1399.76	1077.99	721.02	474.56	498.18	778.38	1176.41	1565.14	1896.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	991.61	765.82	619.85	327.8	126.28	0	0	0	0	371.99	713.42	1013.85	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 4930.61 | (98)

Space heating requirement in kWh/m²/year | 44.91 | (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	1173.42	923.75	946.85	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.89	0.94	0.92	0	0	0	0	(101)

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

(102)m=	0	0	0	0	0	1050.05	872.68	873.47	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	1379.35	1321.11	1225.3	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	237.09	333.63	261.76	0	0	0	0

Total = Sum(104)$_{6...8}$ = 832.49 (104)

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

Intermittency factor (Table 10b)

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

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

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

(107)m=	0	0	0	0	0	59.27	83.41	65.44	0	0	0	0

Total = Sum(107)$_{6...8}$ = 208.12 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.9 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 46.8 (109)

Target Fabric Energy Efficiency (TFEE) 53.82 (109)

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.7

Property Address: LG1 Lean

Address : , London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	67.4	(1a)	x	2.8	(2a)	=	188.72	(3a)
Ground floor	42.4	(1b)	x	2.6	(2b)	=	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	298.96	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.88	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.75	(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

DFEE 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

0.96	0.94	0.92	0.83	0.81	0.71	0.71	0.69	0.75	0.81	0.85	0.88

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=	0.96	0.94	0.92	0.84	0.83	0.75	0.75	0.74	0.78	0.83	0.86	0.89	(24d)

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

(25)m=	0.96	0.94	0.92	0.84	0.83	0.75	0.75	0.74	0.78	0.83	0.86	0.89	(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			1.98	x	1.8	=	3.564			(26)
Windows Type 1			4.33	x1/[1/(1.6)+ 0.04]		=	6.51			(27)
Windows Type 2			1.92	x1/[1/(1.6)+ 0.04]		=	2.89			(27)
Windows Type 3			0.64	x1/[1/(1.6)+ 0.04]		=	0.96			(27)
Floor Type 1			30	x	0.1	=	3			(28)
Floor Type 2			37.4	x	0.25	=	9.35			(28)
Walls Type1	48.6	4.48	44.12	x	0.55	=	24.27			(29)
Walls Type2	32.8	17.32	15.48	x	0.15	=	2.32			(29)
Walls Type3	8.6	0	8.6	x	0.55	=	4.73			(29)
Walls Type4	3.1	1.98	1.12	x	0.55	=	0.62			(29)
Walls Type5	13.3	0	13.3	x	0.15	=	2			(29)
Total area of elements, m²			173.8							(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) = 82.62 (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 | (36)

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

Total fabric heat loss (33) + (36) = | 108.62 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	94.58	92.83	91.1	83.01	81.5	74.45	74.45	73.15	77.17	81.5	84.56	87.76	(38)

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

(39)m=	203.21	201.45	199.73	191.64	190.12	183.08	183.08	181.77	185.79	190.12	193.19	196.39	

Average = Sum(39)1…12 /12= | 191.63 | (39)

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

(40)m=	1.85	1.83	1.82	1.75	1.73	1.67	1.67	1.66	1.69	1.73	1.76	1.79	

Average = Sum(40)1…12 /12= | 1.75 | (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 | 101.02 | (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=	111.13	107.08	103.04	99	94.96	90.92	90.92	94.96	99	103.04	107.08	111.13	

Total = Sum(44)1…12 = | 1212.28 | (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=	164.8	144.13	148.73	129.67	124.42	107.36	99.49	114.16	115.53	134.64	146.97	159.6	

Total = Sum(45)1…12 = | 1589.49 | (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 110 | (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)

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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=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	140.08	122.51	126.42	110.22	105.76	91.26	84.57	97.04	98.2	114.44	124.92	135.66	(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=	140.08	122.51	126.42	110.22	105.76	91.26	84.57	97.04	98.2	114.44	124.92	135.66	

Output from water heater (annual)$_{1...12}$ 1351.07 (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=	35.02	30.63	31.61	27.55	26.44	22.81	21.14	24.26	24.55	28.61	31.23	33.91	(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=	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	(66)

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

(67)m=	24.37	21.65	17.61	13.33	9.96	8.41	9.09	11.81	15.86	20.13	23.5	25.05	(67)

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

(68)m=	271.27	274.08	266.99	251.89	232.83	214.91	202.94	200.13	207.22	222.32	241.38	259.3	(68)

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

(69)m=	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)

Water heating gains (Table 5)

(72)m=	47.07	45.58	42.48	38.27	35.54	31.69	28.42	32.61	34.1	38.45	43.38	45.58	(72)

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

(73)m=	407.91	406.51	392.28	368.69	343.53	320.21	305.65	309.75	322.38	346.11	373.46	395.14	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	54.87	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	89.86	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	114.46	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	129.37	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	134.81	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	129.73	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	126.76	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	123.1	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	119.57	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	96.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	65.03	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	47.41	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.63	x	0.7	=	7.2	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.63	x	0.7	=	12.26	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.63	x	0.7	=	16.77	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.63	x	0.7	=	20.78	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.63	x	0.7	=	23.28	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.63	x	0.7	=	23.11	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.63	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.63	x	0.7	=	20.42	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.63	x	0.7	=	18.16	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.63	x	0.7	=	13.55	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.63	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.63	x	0.7	=	6.16	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.63	x	0.7	=	103.96	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.63	x	0.7	=	203.37	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.63	x	0.7	=	334.92	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.63	x	0.7	=	488.46	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.63	x	0.7	=	598.62	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.63	x	0.7	=	612.8	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.63	x	0.7	=	583.41	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.63	x	0.7	=	501.14	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.63	x	0.7	=	389.52	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.63	x	0.7	=	241.31	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.63	x	0.7	=	129.63	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.63	x	0.7	=	85.49	(80)

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

(83)m=	166.02	305.48	466.15	638.61	756.71	765.64	732.45	644.66	527.25	351.78	203.28	139.06	(83)

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

(84)m=	573.94	712	858.43	1007.3	1100.24	1085.85	1038.1	954.41	849.63	697.89	576.74	534.2	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.93	0.82	0.68	0.74	0.92	0.99	1	1	(86)

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

(87)m=	18.86	19.07	19.44	19.97	20.42	20.78	20.92	20.9	20.61	20	19.38	18.88	(87)

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

(88)m=	19.43	19.45	19.46	19.51	19.52	19.56	19.56	19.57	19.55	19.52	19.5	19.48	(88)

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

(89)m=	1	0.99	0.99	0.96	0.89	0.72	0.5	0.57	0.85	0.98	1	1	(89)

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

(90)m=	17.54	17.76	18.13	18.69	19.12	19.46	19.55	19.54	19.32	18.73	18.1	17.59	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

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

(92)m=	18.1	18.31	18.68	19.23	19.67	20.02	20.13	20.12	19.87	19.27	18.64	18.14	(92)

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

(93)m=	18.1	18.31	18.68	19.23	19.67	20.02	20.13	20.12	19.87	19.27	18.64	18.14	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.89	0.75	0.58	0.64	0.87	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	572.17	707.21	844.49	963.44	980.48	818.29	600.69	609.86	738.7	680.47	573.58	532.97	(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=	2803.67	2702.2	2433.59	1979.26	1515.7	992.19	646.1	675.52	1071.36	1648.66	2229.01	2736.72	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1660.24	1340.63	1182.29	731.39	398.2	0	0	0	0	720.33	1191.91	1639.59	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 8864.57 | (98)

Space heating requirement in kWh/m²/year | 80.73 | (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	1720.93	1354.77	1381.47	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.7	0.78	0.74	0	0	0	0	(101)

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

(102)m=	0	0	0	0	0	1197.39	1057.52	1024.53	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	1379.35	1321.11	1225.3	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	131.01	196.11	149.37	0	0	0	0

Total = Sum(104)$_{6...8}$ = 476.5 (104)

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

Intermittency factor (Table 10b)

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

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

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

(107)m=	0	0	0	0	0	32.75	49.03	37.34	0	0	0	0

Total = Sum(107)$_{6...8}$ = 119.12 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.08 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 81.82 (109)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.7

Property Address: LG1 Lean

Address : , London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	67.4	(1a)	x	2.8	(2a)	=	188.72	(3a)
Ground floor	42.4	(1b)	x	2.6	(2b)	=	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	298.96	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.75	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.64	(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

0.81	0.8	0.78	0.7	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.75

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 58.65 (23c)

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

(24a)m=	1.02	1	0.99	0.91	0.89	0.81	0.81	0.8	0.84	0.89	0.92	0.96	(24a)

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

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

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	1.02	1	0.99	0.91	0.89	0.81	0.81	0.8	0.84	0.89	0.92	0.96	(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			1.98	x	1.8	=	3.564			(26)
Windows Type 1			4.33	x1/[1/(1.6)+ 0.04]		=	6.51			(27)
Windows Type 2			1.92	x1/[1/(1.6)+ 0.04]		=	2.89			(27)
Windows Type 3			0.64	x1/[1/(1.6)+ 0.04]		=	0.96			(27)
Floor Type 1			30	x	0.1	=	3			(28)
Floor Type 2			37.4	x	0.25	=	9.35			(28)
Walls Type1	48.6	4.48	44.12	x	0.55	=	24.27			(29)
Walls Type2	32.8	17.32	15.48	x	0.15	=	2.32			(29)
Walls Type3	8.6	0	8.6	x	0.55	=	4.73			(29)
Walls Type4	3.1	1.98	1.12	x	0.55	=	0.62			(29)
Walls Type5	13.3	0	13.3	x	0.15	=	2			(29)
Total area of elements, m²			173.8							(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) = 82.62 (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

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 26 (36)

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

Total fabric heat loss — (33) + (36) = 108.62 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	100.59	99.01	97.44	89.58	88.01	80.15	80.15	78.57	83.29	88.01	91.15	94.3	(38)

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

(39)m=	209.21	207.64	206.07	198.21	196.63	188.77	188.77	187.2	191.92	196.63	199.78	202.92	

Average = Sum(39)$_{1...12}$ /12= 197.81 (39)

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

(40)m=	1.91	1.89	1.88	1.81	1.79	1.72	1.72	1.7	1.75	1.79	1.82	1.85	

Average = Sum(40)$_{1...12}$ /12= 1.8 (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 — 101.02 (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=	111.13	107.08	103.04	99	94.96	90.92	90.92	94.96	99	103.04	107.08	111.13

Total = Sum(44)$_{1...12}$ = 1212.28 (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=	164.8	144.13	148.73	129.67	124.42	107.36	99.49	114.16	115.53	134.64	146.97	159.6

Total = Sum(45)$_{1...12}$ = 1589.49 (45)

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

(46)m=	24.72	21.62	22.31	19.45	18.66	16.1	14.92	17.12	17.33	20.2	22.05	23.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 110 (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)

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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=	50.96	46.03	50.96	48.82	48.39	44.84	46.33	48.39	48.82	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=	215.76	190.16	199.69	178.49	172.81	152.2	145.82	162.56	164.35	185.6	196.28	210.56	(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=	215.76	190.16	199.69	178.49	172.81	152.2	145.82	162.56	164.35	185.6	196.28	210.56	

Output from water heater (annual)$_{1...12}$ 2174.27 (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=	67.53	59.43	62.19	55.32	53.47	46.91	44.66	50.06	50.62	57.51	61.2	65.81	(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=	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	(66)

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

(67)m=	24.37	21.65	17.61	13.33	9.96	8.41	9.09	11.81	15.86	20.13	23.5	25.05	(67)

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

(68)m=	271.27	274.08	266.99	251.89	232.83	214.91	202.94	200.13	207.22	222.32	241.38	259.3	(68)

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

(69)m=	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	(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=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)

Water heating gains (Table 5)

(72)m=	90.77	88.44	83.59	76.83	71.86	65.15	60.03	67.28	70.3	77.29	84.99	88.45	(72)

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

(73)m=	454.62	452.37	436.39	410.25	382.86	356.68	340.26	347.43	361.58	387.95	418.08	441	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	54.87	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	89.86	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	114.46	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	129.37	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	134.81	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	129.73	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	126.76	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	123.1	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	119.57	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	96.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	65.03	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	47.41	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.63	x	0.7	=	7.2	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.63	x	0.7	=	12.26	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.63	x	0.7	=	16.77	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.63	x	0.7	=	20.78	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.63	x	0.7	=	23.28	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.63	x	0.7	=	23.11	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.63	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.63	x	0.7	=	20.42	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.63	x	0.7	=	18.16	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.63	x	0.7	=	13.55	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.63	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.63	x	0.7	=	6.16	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.63	x	0.7	=	103.96	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.63	x	0.7	=	203.37	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.63	x	0.7	=	334.92	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.63	x	0.7	=	488.46	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.63	x	0.7	=	598.62	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.63	x	0.7	=	612.8	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.63	x	0.7	=	583.41	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.63	x	0.7	=	501.14	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.63	x	0.7	=	389.52	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.63	x	0.7	=	241.31	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.63	x	0.7	=	129.63	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.63	x	0.7	=	85.49	(80)

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

(83)m=	166.02	305.48	466.15	638.61	756.71	765.64	732.45	644.66	527.25	351.78	203.28	139.06	(83)

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

(84)m=	620.64	757.86	902.54	1048.86	1139.57	1122.32	1072.71	992.08	888.84	739.73	621.36	580.06	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.92	0.81	0.68	0.73	0.91	0.98	1	1	(86)

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

(87)m=	18.84	19.05	19.42	19.94	20.4	20.77	20.92	20.89	20.6	19.99	19.35	18.85	(87)

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

(88)m=	19.4	19.41	19.42	19.47	19.48	19.53	19.53	19.54	19.51	19.48	19.46	19.44	(88)

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

(89)m=	1	0.99	0.98	0.96	0.88	0.71	0.49	0.55	0.84	0.97	0.99	1	(89)

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

(90)m=	16.6	16.91	17.45	18.24	18.89	19.37	19.5	19.49	19.18	18.33	17.39	16.64	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

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

(92)m=	17.55	17.82	18.29	18.96	19.53	19.97	20.1	20.09	19.78	19.03	18.22	17.58	(92)

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

(93)m=	17.4	17.67	18.14	18.81	19.38	19.82	19.95	19.94	19.63	18.88	18.07	17.43	(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	0.98	0.95	0.88	0.73	0.55	0.61	0.85	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	617.69	750.62	883.28	993.55	998.96	822.27	592.25	604.54	754.23	715.22	616.24	577.94	(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=	2740.3	2651.1	2397.78	1965.08	1509.94	984.56	632.53	662.11	1061.6	1628.29	2191.97	2684.44	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1579.22	1277.12	1126.79	699.51	380.17	0	0	0	0	679.33	1134.53	1567.23	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 8443.9 | (98)

Space heating requirement in kWh/m²/year | 76.9 | (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		91.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	1579.22	1277.12	1126.79	699.51	380.17	0	0	0	0	679.33	1134.53	1567.23		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1720.29	1391.2	1227.44	761.99	414.12	0	0	0	0	740.01	1235.87	1707.23		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													9198.14	(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)	215.76	190.16	199.69	178.49	172.81	152.2	145.82	162.56	164.35	185.6	196.28	210.56		
Efficiency of water heater													82.5	(216)
(217)m=	90.57	90.48	90.27	89.74	88.68	82.5	82.5	82.5	82.5	89.63	90.3	90.59		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	238.21	210.17	221.22	198.89	194.88	184.49	176.75	197.04	199.21	207.06	217.37	232.43		
Total = Sum(219a)$_{1...12}$ =													2477.72	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		9198.14	
Water heating fuel used		2477.72	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	360.17		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		435.17	(231)
Electricity for lighting		430.44	(232)

12a. CO_2 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	=	1986.8	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	535.19	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2521.99	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	225.85	(267)
Electricity for lighting	(232)	x	0.519	=	223.4	(268)
Total CO2, kg/year			sum of (265)…(271) =		2971.24	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		27.06	(273)
EI rating (section 14)					74	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.7

Property Address: LG1 Lean

Address : , London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	67.4	(1a) x	2.8	(2a) =	188.72	(3a)
Ground floor	42.4	(1b) x	2.6	(2b) =	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		298.96	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(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

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	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=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(24d)

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

(25)m=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	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			1.98	x	1	=	1.98			(26)
Windows Type 1			4.33	x1/[1/(1.4)+ 0.04]		=	5.74			(27)
Windows Type 2			1.92	x1/[1/(1.4)+ 0.04]		=	2.55			(27)
Windows Type 3			0.64	x1/[1/(1.4)+ 0.04]		=	0.85			(27)
Floor Type 1			30	x	0.13	=	3.9			(28)
Floor Type 2			37.4	x	0.13	=	4.862			(28)
Walls Type1	48.6	4.48	44.12	x	0.18	=	7.94			(29)
Walls Type2	32.8	17.32	15.48	x	0.18	=	2.79			(29)
Walls Type3	8.6	0	8.6	x	0.18	=	1.55			(29)
Walls Type4	3.1	1.98	1.12	x	0.18	=	0.2			(29)
Walls Type5	13.3	0	13.3	x	0.18	=	2.39			(29)
Total area of elements, m²			173.8							(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) =	54.52	(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

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 16.25 | (36)

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

Total fabric heat loss (33) + (36) = | 70.77 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	57.86	57.53	57.21	55.68	55.4	54.07	54.07	53.82	54.58	55.4	55.97	56.58	(38)

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

(39)m=	128.63	128.3	127.97	126.45	126.16	124.83	124.83	124.59	125.34	126.16	126.74	127.34	

Average = Sum(39)$_{1\ldots12}$ /12= | 126.44 | (39)

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

(40)m=	1.17	1.17	1.17	1.15	1.15	1.14	1.14	1.13	1.14	1.15	1.15	1.16	

Average = Sum(40)$_{1\ldots12}$ /12= | 1.15 | (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 | 101.02 | (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=	111.13	107.08	103.04	99	94.96	90.92	90.92	94.96	99	103.04	107.08	111.13

Total = Sum(44)$_{1\ldots12}$ = | 1212.28 | (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=	164.8	144.13	148.73	129.67	124.42	107.36	99.49	114.16	115.53	134.64	146.97	159.6

Total = Sum(45)$_{1\ldots12}$ = | 1589.49 | (45)

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

(46)m=	24.72	21.62	22.31	19.45	18.66	16.1	14.92	17.12	17.33	20.2	22.05	23.94	(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)

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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=	50.96	46.03	50.96	48.82	48.39	44.84	46.33	48.39	48.82	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=	215.76	190.16	199.69	178.49	172.81	152.2	145.82	162.56	164.35	185.6	196.28	210.56	(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=	215.76	190.16	199.69	178.49	172.81	152.2	145.82	162.56	164.35	185.6	196.28	210.56	

Output from water heater (annual)$_{1...12}$ — 2174.27 (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=	67.53	59.43	62.19	55.32	53.47	46.91	44.66	50.06	50.62	57.51	61.2	65.81	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	(66)

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

(67)m=	24.37	21.65	17.61	13.33	9.96	8.41	9.09	11.81	15.86	20.13	23.5	25.05	(67)

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

(68)m=	271.27	274.08	266.99	251.89	232.83	214.91	202.94	200.13	207.22	222.32	241.38	259.3	(68)

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

(69)m=	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	(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=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)

Water heating gains (Table 5)

(72)m=	90.77	88.44	83.59	76.83	71.86	65.15	60.03	67.28	70.3	77.29	84.99	88.45	(72)

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

(73)m=	454.62	452.37	436.39	410.25	382.86	356.68	340.26	347.43	361.58	387.95	418.08	441	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	54.87	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	89.86	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	114.46	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	129.37	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	134.81	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	129.73	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	126.76	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	123.1	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	119.57	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	96.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	65.03	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	47.41	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.63	x	0.7	=	7.2	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.63	x	0.7	=	12.26	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.63	x	0.7	=	16.77	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.63	x	0.7	=	20.78	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.63	x	0.7	=	23.28	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.63	x	0.7	=	23.11	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.63	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.63	x	0.7	=	20.42	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.63	x	0.7	=	18.16	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.63	x	0.7	=	13.55	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.63	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.63	x	0.7	=	6.16	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.63	x	0.7	=	103.96	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.63	x	0.7	=	203.37	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.63	x	0.7	=	334.92	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.63	x	0.7	=	488.46	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.63	x	0.7	=	598.62	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.63	x	0.7	=	612.8	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.63	x	0.7	=	583.41	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.63	x	0.7	=	501.14	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.63	x	0.7	=	389.52	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.63	x	0.7	=	241.31	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.63	x	0.7	=	129.63	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.63	x	0.7	=	85.49	(80)

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

(83)m=	166.02	305.48	466.15	638.61	756.71	765.64	732.45	644.66	527.25	351.78	203.28	139.06	(83)

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

(84)m=	620.64	757.86	902.54	1048.86	1139.57	1122.32	1072.71	992.08	888.84	739.73	621.36	580.06	(84)

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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	0.67	0.5	0.56	0.82	0.97	1	1	(86)

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

(87)m=	19.7	19.88	20.18	20.54	20.82	20.96	20.99	20.99	20.89	20.49	20.02	19.67	(87)

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

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

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

(89)m=	1	0.99	0.98	0.93	0.79	0.58	0.39	0.44	0.75	0.96	1	1	(89)

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

(90)m=	18.2	18.48	18.9	19.43	19.79	19.94	19.97	19.97	19.88	19.37	18.69	18.17	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

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

(92)m=	18.84	19.07	19.44	19.9	20.23	20.37	20.4	20.4	20.3	19.85	19.26	18.8	(92)

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

(93)m=	18.84	19.07	19.44	19.9	20.23	20.37	20.4	20.4	20.3	19.85	19.26	18.8	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.93	0.81	0.62	0.44	0.49	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	618.88	752.08	881.92	972.31	922.14	691.56	470.32	490.61	688.46	710.49	617.43	578.87	(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=	1869.88	1818.16	1656.24	1390.77	1075.73	720.85	474.58	498.22	777.7	1166.73	1540.54	1859.62	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	930.75	716.41	576.09	301.29	114.27	0	0	0	0	339.44	664.64	952.88	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 4595.76 | (98)

Space heating requirement in kWh/m²/year | 41.86 | (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)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	930.75	716.41	576.09	301.29	114.27	0	0	0	0	339.44	664.64	952.88		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	996.52	767.03	616.8	322.58	122.34	0	0	0	0	363.43	711.61	1020.21		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													4920.51	(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)														
	215.76	190.16	199.69	178.49	172.81	152.2	145.82	162.56	164.35	185.6	196.28	210.56		
Efficiency of water heater													80.3	(216)
(217)m=	88.31	88.08	87.56	86.36	84.04	80.3	80.3	80.3	80.3	86.55	87.88	88.39		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	244.32	215.9	228.05	206.68	205.64	189.54	181.6	202.44	204.67	214.43	223.35	238.22		
Total = Sum(219a)$_{1...12}$ =													2554.84	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4920.51	
Water heating fuel used			2554.84	
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			430.44	(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	=	1062.83	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	551.84	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1614.68	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	223.4	(268)
Total CO2, kg/year			sum of (265)…(271) =		1877	(272)

TER =	17.09	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.7

Property Address: LG1 Green

Address : , London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	67.4	(1a)	x	2.8	(2a)	=	188.72	(3a)
Ground floor	42.4	(1b)	x	2.6	(2b)	=	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	298.96	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.75	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.64	(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

0.81	0.8	0.78	0.7	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.75

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 58.65 (23c)

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

(24a)m=	1.02	1	0.99	0.91	0.89	0.81	0.81	0.8	0.84	0.89	0.92	0.96	(24a)

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

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

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	1.02	1	0.99	0.91	0.89	0.81	0.81	0.8	0.84	0.89	0.92	0.96	(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			1.98	x	1.8	=	3.564			(26)
Windows Type 1			4.33	x1/[1/(1.6)+ 0.04]		=	6.51			(27)
Windows Type 2			1.92	x1/[1/(1.6)+ 0.04]		=	2.89			(27)
Windows Type 3			0.64	x1/[1/(1.6)+ 0.04]		=	0.96			(27)
Floor Type 1			30	x	0.1	=	3			(28)
Floor Type 2			37.4	x	0.25	=	9.35			(28)
Walls Type1	48.6	4.48	44.12	x	0.55	=	24.27			(29)
Walls Type2	32.8	17.32	15.48	x	0.15	=	2.32			(29)
Walls Type3	8.6	0	8.6	x	0.55	=	4.73			(29)
Walls Type4	3.1	1.98	1.12	x	0.55	=	0.62			(29)
Walls Type5	13.3	0	13.3	x	0.15	=	2			(29)
Total area of elements, m²			173.8							(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) = 82.62 (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

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 26 | (36)

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

Total fabric heat loss (33) + (36) = | 108.62 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	100.59	99.01	97.44	89.58	88.01	80.15	80.15	78.57	83.29	88.01	91.15	94.3	(38)

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

(39)m=	209.21	207.64	206.07	198.21	196.63	188.77	188.77	187.2	191.92	196.63	199.78	202.92	

Average = Sum(39)$_{1...12}$ /12= | 197.81 | (39)

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

(40)m=	1.91	1.89	1.88	1.81	1.79	1.72	1.72	1.7	1.75	1.79	1.82	1.85	

Average = Sum(40)$_{1...12}$ /12= | 1.8 | (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 | 101.02 | (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=	111.13	107.08	103.04	99	94.96	90.92	90.92	94.96	99	103.04	107.08	111.13	

Total = Sum(44)$_{1...12}$ = | 1212.28 | (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=	164.8	144.13	148.73	129.67	124.42	107.36	99.49	114.16	115.53	134.64	146.97	159.6	

Total = Sum(45)$_{1...12}$ = | 1589.49 | (45)

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

(46)m=	24.72	21.62	22.31	19.45	18.66	16.1	14.92	17.12	17.33	20.2	22.05	23.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 110 | (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) = | 110 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.01 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 1.03 | (52)

Temperature factor from Table 2b | 0.54 | (53)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0.76	(54)
Enter (50) or (54) in (55)		0.76	(55)

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

(56)m=	23.57	21.29	23.57	22.81	23.57	22.81	23.57	23.57	22.81	23.57	22.81	23.57	(56)

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

(57)m=	23.57	21.29	23.57	22.81	23.57	22.81	23.57	23.57	22.81	23.57	22.81	23.57	(57)

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

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	211.63	186.43	195.56	174.99	171.25	152.68	146.32	160.99	160.85	181.47	192.29	206.43	(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=	211.63	186.43	195.56	174.99	171.25	152.68	146.32	160.99	160.85	181.47	192.29	206.43	

Output from water heater (annual)$_{1…12}$ — 2140.87 (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=	92.26	81.76	86.92	79.37	78.83	71.95	70.54	75.42	74.67	82.23	85.12	90.53	(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=	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	168.82	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	60.93	54.12	44.01	33.32	24.91	21.03	22.72	29.53	39.64	50.33	58.75	62.63	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	404.88	409.08	398.49	375.95	347.5	320.76	302.9	298.7	309.28	331.82	360.27	387.01	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	54.7	(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=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)
Water heating gains (Table 5)													
(72)m=	124	121.67	116.82	110.24	105.96	99.94	94.82	101.38	103.71	110.52	118.22	121.68	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	703.78	698.84	673.3	633.48	592.33	555.69	534.4	543.57	566.6	606.65	651.21	685.29	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	54.87	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	89.86	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	114.46	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	129.37	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	134.81	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	129.73	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	126.76	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	123.1	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	119.57	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	96.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	65.03	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	47.41	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.63	x	0.7	=	7.2	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.63	x	0.7	=	12.26	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.63	x	0.7	=	16.77	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.63	x	0.7	=	20.78	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.63	x	0.7	=	23.28	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.63	x	0.7	=	23.11	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.63	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.63	x	0.7	=	20.42	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.63	x	0.7	=	18.16	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.63	x	0.7	=	13.55	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.63	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.63	x	0.7	=	6.16	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.63	x	0.7	=	103.96	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.63	x	0.7	=	203.37	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.63	x	0.7	=	334.92	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.63	x	0.7	=	488.46	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.63	x	0.7	=	598.62	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.63	x	0.7	=	612.8	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.63	x	0.7	=	583.41	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.63	x	0.7	=	501.14	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.63	x	0.7	=	389.52	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.63	x	0.7	=	241.31	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.63	x	0.7	=	129.63	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.63	x	0.7	=	85.49	(80)

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

(83)m=	166.02	305.48	466.15	638.61	756.71	765.64	732.45	644.66	527.25	351.78	203.28	139.06	(83)

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

(84)m=	869.8	1004.32	1139.45	1272.08	1349.04	1321.33	1266.85	1188.23	1093.85	958.43	854.49	824.35	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.88	0.75	0.6	0.65	0.85	0.96	0.99	0.99	(86)

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

(87)m=	19.02	19.23	19.58	20.09	20.51	20.83	20.95	20.93	20.7	20.14	19.53	19.04	(87)

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

(88)m=	19.4	19.41	19.42	19.47	19.48	19.53	19.53	19.54	19.51	19.48	19.46	19.44	(88)

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

(89)m=	0.99	0.98	0.97	0.93	0.83	0.63	0.42	0.48	0.76	0.94	0.98	0.99	(89)

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

(90)m=	16.87	17.17	17.69	18.44	19.01	19.42	19.51	19.51	19.28	18.53	17.64	16.91	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

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

(92)m=	17.78	18.04	18.49	19.14	19.65	20.02	20.12	20.11	19.88	19.21	18.44	17.81	(92)

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

(93)m=	17.78	18.04	18.49	19.14	19.65	20.02	20.12	20.11	19.88	19.21	18.44	17.81	(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	0.92	0.84	0.68	0.5	0.55	0.79	0.94	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	859.1	983.87	1096.17	1170.19	1127.07	894.52	633.56	652.14	864.49	900.12	837.49	815.96	(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=	2820.34	2729.26	2471.67	2029.39	1562.9	1022.9	664.14	694.85	1109.19	1693.83	2265.29	2761.76	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1459.16	1172.9	1023.37	618.62	324.26	0	0	0	0	590.52	1028.01	1447.68	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 7664.52 | (98)

Space heating requirement in kWh/m²/year | 69.8 | (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		170	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	1459.16	1172.9	1023.37	618.62	324.26	0	0	0	0	590.52	1028.01	1447.68		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	858.33	689.94	601.98	363.9	190.74	0	0	0	0	347.36	604.71	851.57		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													4508.54	(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)	211.63	186.43	195.56	174.99	171.25	152.68	146.32	160.99	160.85	181.47	192.29	206.43		
Efficiency of water heater													170	(216)
(217)m=	170	170	170	170	170	170	170	170	170	170	170	170		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	124.49	109.66	115.04	102.93	100.73	89.81	86.07	94.7	94.62	106.74	113.11	121.43		
Total = Sum(219a)$_{1...12}$ =													1259.33	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4508.54	
Water heating fuel used			1259.33	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		360.17		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		390.17	(231)
Electricity for lighting			430.44	(232)

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10a. Fuel costs - individual heating systems:

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211)	x	13.19	x 0.01 =	594.68	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		13.19	x 0.01 =	166.11	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	51.46	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)		13.19	x 0.01 =	56.77	(250)
Additional standing charges (Table 12)					0	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	869.02	(255)

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11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	2.36	(257)
SAP rating (Section 12)		67.11	(258)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	2339.93	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	653.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2993.53	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	202.5	(267)
Electricity for lighting	(232)	x	0.519	=	223.4	(268)
Total CO2, kg/year			sum of (265)…(271) =		3419.42	(272)
CO2 emissions per m²			(272) ÷ (4) =		31.14	(273)
EI rating (section 14)					70	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	3.07	=	13841.22	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	3.07	=	3866.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =				17707.37	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	1197.83	(267)
Electricity for lighting	(232)	x	0	=	1321.44	(268)
'Total Primary Energy			sum of (265)…(271) =		20226.64	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		184.21	(273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.7

Property Address: LG1 Green

Address : , London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	67.4	(1a) x	2.8	(2a) =	188.72	(3a)
Ground floor	42.4	(1b) x	2.6	(2b) =	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	298.96	(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)

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			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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(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

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	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=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(24d)

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

(25)m=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	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			1.98	x	1	=	1.98			(26)
Windows Type 1			4.33	x1/[1/(1.4)+ 0.04]		=	5.74			(27)
Windows Type 2			1.92	x1/[1/(1.4)+ 0.04]		=	2.55			(27)
Windows Type 3			0.64	x1/[1/(1.4)+ 0.04]		=	0.85			(27)
Floor Type 1			30	x	0.13	=	3.9			(28)
Floor Type 2			37.4	x	0.13	=	4.862			(28)
Walls Type1	48.6	4.48	44.12	x	0.18	=	7.94			(29)
Walls Type2	32.8	17.32	15.48	x	0.18	=	2.79			(29)
Walls Type3	8.6	0	8.6	x	0.18	=	1.55			(29)
Walls Type4	3.1	1.98	1.12	x	0.18	=	0.2			(29)
Walls Type5	13.3	0	13.3	x	0.18	=	2.39			(29)
Total area of elements, m²			173.8							(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) = 54.52 (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 | 16.25 | (36)

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

Total fabric heat loss (33) + (36) = | 70.77 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	57.86	57.53	57.21	55.68	55.4	54.07	54.07	53.82	54.58	55.4	55.97	56.58	(38)

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

(39)m=	128.63	128.3	127.97	126.45	126.16	124.83	124.83	124.59	125.34	126.16	126.74	127.34	

Average = $Sum(39)_{1...12}$ /12= | 126.44 | (39)

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

(40)m=	1.17	1.17	1.17	1.15	1.15	1.14	1.14	1.13	1.14	1.15	1.15	1.16

Average = $Sum(40)_{1...12}$ /12= | 1.15 | (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 | 101.02 | (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=	111.13	107.08	103.04	99	94.96	90.92	90.92	94.96	99	103.04	107.08	111.13

Total = $Sum(44)_{1...12}$ = | 1212.28 | (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=	164.8	144.13	148.73	129.67	124.42	107.36	99.49	114.16	115.53	134.64	146.97	159.6

Total = $Sum(45)_{1...12}$ = | 1589.49 | (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

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

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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=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	140.08	122.51	126.42	110.22	105.76	91.26	84.57	97.04	98.2	114.44	124.92	135.66	(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=	140.08	122.51	126.42	110.22	105.76	91.26	84.57	97.04	98.2	114.44	124.92	135.66	

Output from water heater (annual)$_{1...12}$ — 1351.07 (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=	35.02	30.63	31.61	27.55	26.44	22.81	21.14	24.26	24.55	28.61	31.23	33.91	(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=	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	24.37	21.65	17.61	13.33	9.96	8.41	9.09	11.81	15.86	20.13	23.5	25.05	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	271.27	274.08	266.99	251.89	232.83	214.91	202.94	200.13	207.22	222.32	241.38	259.3	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)
Water heating gains (Table 5)													
(72)m=	47.07	45.58	42.48	38.27	35.54	31.69	28.42	32.61	34.1	38.45	43.38	45.58	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	407.91	406.51	392.28	368.69	343.53	320.21	305.65	309.75	322.38	346.11	373.46	395.14	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	54.87	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	89.86	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	114.46	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	129.37	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	134.81	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	129.73	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	126.76	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	123.1	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	119.57	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	96.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	65.03	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	47.41	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.63	x	0.7	=	7.2	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.63	x	0.7	=	12.26	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.63	x	0.7	=	16.77	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.63	x	0.7	=	20.78	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.63	x	0.7	=	23.28	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.63	x	0.7	=	23.11	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.63	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.63	x	0.7	=	20.42	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.63	x	0.7	=	18.16	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.63	x	0.7	=	13.55	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.63	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.63	x	0.7	=	6.16	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.63	x	0.7	=	103.96	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.63	x	0.7	=	203.37	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.63	x	0.7	=	334.92	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.63	x	0.7	=	488.46	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.63	x	0.7	=	598.62	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.63	x	0.7	=	612.8	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.63	x	0.7	=	583.41	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.63	x	0.7	=	501.14	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.63	x	0.7	=	389.52	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.63	x	0.7	=	241.31	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.63	x	0.7	=	129.63	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.63	x	0.7	=	85.49	(80)

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

(83)m=	166.02	305.48	466.15	638.61	756.71	765.64	732.45	644.66	527.25	351.78	203.28	139.06	(83)

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

(84)m=	573.94	712	858.43	1007.3	1100.24	1085.85	1038.1	954.41	849.63	697.89	576.74	534.2	(84)

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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	0.86	0.69	0.52	0.58	0.84	0.98	1	1	(86)

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

(87)m=	19.66	19.84	20.14	20.51	20.81	20.95	20.99	20.98	20.87	20.46	19.99	19.63	(87)

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

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

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

(89)m=	1	1	0.98	0.94	0.81	0.6	0.4	0.46	0.77	0.97	1	1	(89)

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

(90)m=	18.72	18.9	19.2	19.57	19.83	19.95	19.97	19.97	19.9	19.53	19.06	18.7	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

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

(92)m=	19.12	19.3	19.6	19.97	20.24	20.38	20.4	20.4	20.31	19.92	19.45	19.09	(92)

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

(93)m=	19.12	19.3	19.6	19.97	20.24	20.38	20.4	20.4	20.31	19.92	19.45	19.09	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.83	0.63	0.45	0.51	0.8	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	572.88	708.13	843.12	944.49	908.25	687.9	469.66	489.25	676.53	676.43	574.29	533.51	(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=	1905.69	1847.74	1676.25	1399.76	1077.99	721.02	474.56	498.18	778.38	1176.41	1565.14	1896.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	991.61	765.82	619.85	327.8	126.28	0	0	0	0	371.99	713.42	1013.85	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 4930.61 | (98)

Space heating requirement in kWh/m²/year | 44.91 | (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	1173.42	923.75	946.85	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.89	0.94	0.92	0	0	0	0	(101)

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

(102)m=	0	0	0	0	0	1050.05	872.68	873.47	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	1379.35	1321.11	1225.3	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	237.09	333.63	261.76	0	0	0	0

Total = Sum(104)$_{6...8}$ = 832.49 (104)

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

Intermittency factor (Table 10b)

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

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

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

(107)m=	0	0	0	0	0	59.27	83.41	65.44	0	0	0	0

Total = Sum(107)$_{6...8}$ = 208.12 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.9 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 46.8 (109)

Target Fabric Energy Efficiency (TFEE) 53.82 (109)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.7

Property Address: LG1 Green

Address : , London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	67.4	(1a) x	2.8	(2a) =	188.72	(3a)
Ground floor	42.4	(1b) x	2.6	(2b) =	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	298.96	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.13	(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		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.88	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.75	(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

0.96	0.94	0.92	0.83	0.81	0.71	0.71	0.69	0.75	0.81	0.85	0.88

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=	0.96	0.94	0.92	0.84	0.83	0.75	0.75	0.74	0.78	0.83	0.86	0.89	(24d)

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

(25)m=	0.96	0.94	0.92	0.84	0.83	0.75	0.75	0.74	0.78	0.83	0.86	0.89	(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			1.98	x	1.8	=	3.564			(26)
Windows Type 1			4.33	x1/[1/(1.6)+ 0.04]		=	6.51			(27)
Windows Type 2			1.92	x1/[1/(1.6)+ 0.04]		=	2.89			(27)
Windows Type 3			0.64	x1/[1/(1.6)+ 0.04]		=	0.96			(27)
Floor Type 1			30	x	0.1	=	3			(28)
Floor Type 2			37.4	x	0.25	=	9.35			(28)
Walls Type1	48.6	4.48	44.12	x	0.55	=	24.27			(29)
Walls Type2	32.8	17.32	15.48	x	0.15	=	2.32			(29)
Walls Type3	8.6	0	8.6	x	0.55	=	4.73			(29)
Walls Type4	3.1	1.98	1.12	x	0.55	=	0.62			(29)
Walls Type5	13.3	0	13.3	x	0.15	=	2			(29)
Total area of elements, m²			173.8							(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) = 82.62 (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

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K	26	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)		
Total fabric heat loss (33) + (36) =	108.62	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	94.58	92.83	91.1	83.01	81.5	74.45	74.45	73.15	77.17	81.5	84.56	87.76	(38)

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

(39)m=	203.21	201.45	199.73	191.64	190.12	183.08	183.08	181.77	185.79	190.12	193.19	196.39	

Average = Sum(39)1…12 /12= 191.63 (39)

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

(40)m=	1.85	1.83	1.82	1.75	1.73	1.67	1.67	1.66	1.69	1.73	1.76	1.79	

Average = Sum(40)1…12 /12= 1.75 (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) + 36 101.02 (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=	111.13	107.08	103.04	99	94.96	90.92	90.92	94.96	99	103.04	107.08	111.13	

Total = Sum(44)1…12 = 1212.28 (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=	164.8	144.13	148.73	129.67	124.42	107.36	99.49	114.16	115.53	134.64	146.97	159.6	

Total = Sum(45)1…12 = 1589.49 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	110	(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)

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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=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	140.08	122.51	126.42	110.22	105.76	91.26	84.57	97.04	98.2	114.44	124.92	135.66	(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=	140.08	122.51	126.42	110.22	105.76	91.26	84.57	97.04	98.2	114.44	124.92	135.66	

Output from water heater (annual)$_{1...12}$ — 1351.07 (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=	35.02	30.63	31.61	27.55	26.44	22.81	21.14	24.26	24.55	28.61	31.23	33.91	(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=	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	(66)

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

(67)m=	24.37	21.65	17.61	13.33	9.96	8.41	9.09	11.81	15.86	20.13	23.5	25.05	(67)

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

(68)m=	271.27	274.08	266.99	251.89	232.83	214.91	202.94	200.13	207.22	222.32	241.38	259.3	(68)

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

(69)m=	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)

Water heating gains (Table 5)

(72)m=	47.07	45.58	42.48	38.27	35.54	31.69	28.42	32.61	34.1	38.45	43.38	45.58	(72)

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

(73)m=	407.91	406.51	392.28	368.69	343.53	320.21	305.65	309.75	322.38	346.11	373.46	395.14	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	54.87	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	89.86	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	114.46	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	129.37	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	134.81	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	129.73	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	126.76	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	123.1	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	119.57	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	96.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	65.03	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	47.41	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.63	x	0.7	=	7.2	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.63	x	0.7	=	12.26	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.63	x	0.7	=	16.77	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.63	x	0.7	=	20.78	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.63	x	0.7	=	23.28	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.63	x	0.7	=	23.11	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.63	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.63	x	0.7	=	20.42	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.63	x	0.7	=	18.16	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.63	x	0.7	=	13.55	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.63	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.63	x	0.7	=	6.16	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.63	x	0.7	=	103.96	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.63	x	0.7	=	203.37	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.63	x	0.7	=	334.92	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.63	x	0.7	=	488.46	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.63	x	0.7	=	598.62	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.63	x	0.7	=	612.8	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.63	x	0.7	=	583.41	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.63	x	0.7	=	501.14	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.63	x	0.7	=	389.52	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.63	x	0.7	=	241.31	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.63	x	0.7	=	129.63	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.63	x	0.7	=	85.49	(80)

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

(83)m=	166.02	305.48	466.15	638.61	756.71	765.64	732.45	644.66	527.25	351.78	203.28	139.06	(83)

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

(84)m=	573.94	712	858.43	1007.3	1100.24	1085.85	1038.1	954.41	849.63	697.89	576.74	534.2	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.93	0.82	0.68	0.74	0.92	0.99	1	1	(86)

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

(87)m=	18.86	19.07	19.44	19.97	20.42	20.78	20.92	20.9	20.61	20	19.38	18.88	(87)

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

(88)m=	19.43	19.45	19.46	19.51	19.52	19.56	19.56	19.57	19.55	19.52	19.5	19.48	(88)

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

(89)m=	1	0.99	0.99	0.96	0.89	0.72	0.5	0.57	0.85	0.98	1	1	(89)

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

(90)m=	17.54	17.76	18.13	18.69	19.12	19.46	19.55	19.54	19.32	18.73	18.1	17.59	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

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

(92)m=	18.1	18.31	18.68	19.23	19.67	20.02	20.13	20.12	19.87	19.27	18.64	18.14	(92)

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

(93)m=	18.1	18.31	18.68	19.23	19.67	20.02	20.13	20.12	19.87	19.27	18.64	18.14	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.89	0.75	0.58	0.64	0.87	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	572.17	707.21	844.49	963.44	980.48	818.29	600.69	609.86	738.7	680.47	573.58	532.97	(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=	2803.67	2702.2	2433.59	1979.26	1515.7	992.19	646.1	675.52	1071.36	1648.66	2229.01	2736.72	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1660.24	1340.63	1182.29	731.39	398.2	0	0	0	0	720.33	1191.91	1639.59	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 8864.57 | (98)

Space heating requirement in kWh/m²/year | 80.73 | (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	1720.93	1354.77	1381.47	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.7	0.78	0.74	0	0	0	0	(101)

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

(102)m=	0	0	0	0	0	1197.39	1057.52	1024.53	0	0	0	0	(102)

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

(103)m=	0	0	0	0	0	1379.35	1321.11	1225.3	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	131.01	196.11	149.37	0	0	0	0

Total = Sum(104)$_{6..8}$ = 476.5 (104)

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

Intermittency factor (Table 10b)

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

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

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

(107)m=	0	0	0	0	0	32.75	49.03	37.34	0	0	0	0

Total = Sum(107)$_{6..8}$ = 119.12 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.08 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 81.82 (109)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.5.7

Property Address: LG1 Green

Address : , London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	67.4	(1a) x	2.8	(2a) =	188.72	(3a)
Ground floor	42.4	(1b) x	2.6	(2b) =	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	298.96	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.75	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.64	(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

0.81	0.8	0.78	0.7	0.69	0.61	0.61	0.59	0.64	0.69	0.72	0.75

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 58.65 (23c)

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

(24a)m=	1.02	1	0.99	0.91	0.89	0.81	0.81	0.8	0.84	0.89	0.92	0.96	(24a)

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

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

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	1.02	1	0.99	0.91	0.89	0.81	0.81	0.8	0.84	0.89	0.92	0.96	(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			1.98	x	1.8	=	3.564			(26)
Windows Type 1			4.33	x1/[1/(1.6)+ 0.04]		=	6.51			(27)
Windows Type 2			1.92	x1/[1/(1.6)+ 0.04]		=	2.89			(27)
Windows Type 3			0.64	x1/[1/(1.6)+ 0.04]		=	0.96			(27)
Floor Type 1			30	x	0.1	=	3			(28)
Floor Type 2			37.4	x	0.25	=	9.35			(28)
Walls Type1	48.6	4.48	44.12	x	0.55	=	24.27			(29)
Walls Type2	32.8	17.32	15.48	x	0.15	=	2.32			(29)
Walls Type3	8.6	0	8.6	x	0.55	=	4.73			(29)
Walls Type4	3.1	1.98	1.12	x	0.55	=	0.62			(29)
Walls Type5	13.3	0	13.3	x	0.15	=	2			(29)
Total area of elements, m²			173.8							(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) = 82.62 (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 | (36)

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

Total fabric heat loss (33) + (36) = | 108.62 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	100.59	99.01	97.44	89.58	88.01	80.15	80.15	78.57	83.29	88.01	91.15	94.3	(38)

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

(39)m=	209.21	207.64	206.07	198.21	196.63	188.77	188.77	187.2	191.92	196.63	199.78	202.92	

Average = Sum(39)$_{1...12}$ /12= | 197.81 | (39)

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

(40)m=	1.91	1.89	1.88	1.81	1.79	1.72	1.72	1.7	1.75	1.79	1.82	1.85

Average = Sum(40)$_{1...12}$ /12= | 1.8 | (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 | 101.02 | (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=	111.13	107.08	103.04	99	94.96	90.92	90.92	94.96	99	103.04	107.08	111.13

Total = Sum(44)$_{1...12}$ = | 1212.28 | (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=	164.8	144.13	148.73	129.67	124.42	107.36	99.49	114.16	115.53	134.64	146.97	159.6

Total = Sum(45)$_{1...12}$ = | 1589.49 | (45)

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

(46)m=	24.72	21.62	22.31	19.45	18.66	16.1	14.92	17.12	17.33	20.2	22.05	23.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 110 | (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) = | 110 | (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.01 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 1.03 | (52)

Temperature factor from Table 2b | 0.54 | (53)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0.76	(54)
Enter (50) or (54) in (55)		0.76	(55)

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

(56)m=	23.57	21.29	23.57	22.81	23.57	22.81	23.57	23.57	22.81	23.57	22.81	23.57	(56)

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

(57)m=	23.57	21.29	23.57	22.81	23.57	22.81	23.57	23.57	22.81	23.57	22.81	23.57	(57)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	211.63	186.43	195.56	174.99	171.25	152.68	146.32	160.99	160.85	181.47	192.29	206.43	(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=	211.63	186.43	195.56	174.99	171.25	152.68	146.32	160.99	160.85	181.47	192.29	206.43	

Output from water heater (annual)$_{1\ldots12}$ 2140.87 (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=	92.26	81.76	86.92	79.37	78.83	71.95	70.54	75.42	74.67	82.23	85.12	90.53	(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=	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	24.37	21.65	17.61	13.33	9.96	8.41	9.09	11.81	15.86	20.13	23.5	25.05	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	271.27	274.08	266.99	251.89	232.83	214.91	202.94	200.13	207.22	222.32	241.38	259.3	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	(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=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)
Water heating gains (Table 5)													
(72)m=	124	121.67	116.82	110.24	105.96	99.94	94.82	101.38	103.71	110.52	118.22	121.68	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	487.85	485.6	469.62	443.66	416.95	391.46	375.05	381.52	394.99	421.18	451.31	474.23	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	54.87	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	89.86	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	114.46	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	129.37	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	134.81	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	129.73	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	126.76	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	123.1	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	119.57	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	96.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	65.03	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	47.41	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.63	x	0.7	=	7.2	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.63	x	0.7	=	12.26	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.63	x	0.7	=	16.77	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.63	x	0.7	=	20.78	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.63	x	0.7	=	23.28	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.63	x	0.7	=	23.11	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.63	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.63	x	0.7	=	20.42	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.63	x	0.7	=	18.16	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.63	x	0.7	=	13.55	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.63	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.63	x	0.7	=	6.16	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.63	x	0.7	=	103.96	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.63	x	0.7	=	203.37	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.63	x	0.7	=	334.92	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.63	x	0.7	=	488.46	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.63	x	0.7	=	598.62	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.63	x	0.7	=	612.8	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.63	x	0.7	=	583.41	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.63	x	0.7	=	501.14	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.63	x	0.7	=	389.52	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.63	x	0.7	=	241.31	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.63	x	0.7	=	129.63	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.63	x	0.7	=	85.49	(80)

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

(83)m=	166.02	305.48	466.15	638.61	756.71	765.64	732.45	644.66	527.25	351.78	203.28	139.06	(83)

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

(84)m=	653.87	791.09	935.77	1082.26	1173.66	1157.1	1107.5	1026.18	922.24	772.96	654.59	613.29	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.92	0.8	0.66	0.71	0.9	0.98	1	1	(86)

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

(87)m=	18.86	19.07	19.44	19.97	20.42	20.78	20.92	20.9	20.62	20.01	19.38	18.88	(87)

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

(88)m=	19.4	19.41	19.42	19.47	19.48	19.53	19.53	19.54	19.51	19.48	19.46	19.44	(88)

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

(89)m=	1	0.99	0.98	0.95	0.87	0.69	0.48	0.54	0.83	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=	16.64	16.95	17.49	18.28	18.91	19.38	19.5	19.5	19.2	18.36	17.43	16.68	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

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

(92)m=	17.58	17.85	18.32	18.99	19.55	19.98	20.1	20.09	19.8	19.06	18.25	17.61	(92)

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

(93)m=	17.58	17.85	18.32	18.99	19.55	19.98	20.1	20.09	19.8	19.06	18.25	17.61	(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	0.99	0.98	0.95	0.87	0.73	0.56	0.61	0.85	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	650.37	782.83	914.55	1023.06	1026.41	847.67	617.95	629.67	780.5	745.64	648.55	610.73	(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=	2778.23	2688.67	2434.86	2000.22	1543.58	1014.9	661.57	691.18	1093.86	1663.5	2228.21	2721.3	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1583.13	1280.72	1131.11	703.56	384.77	0	0	0	0	682.89	1137.35	1570.27	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 8473.8 | (98)

Space heating requirement in kWh/m²/year | 77.17 | (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		170	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	1583.13	1280.72	1131.11	703.56	384.77	0	0	0	0	682.89	1137.35	1570.27		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	931.25	753.36	665.36	413.86	226.34	0	0	0	0	401.7	669.03	923.69		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													4984.59	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	211.63	186.43	195.56	174.99	171.25	152.68	146.32	160.99	160.85	181.47	192.29	206.43		
Efficiency of water heater													170	(216)
(217)m=	170	170	170	170	170	170	170	170	170	170	170	170		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	124.49	109.66	115.04	102.93	100.73	89.81	86.07	94.7	94.62	106.74	113.11	121.43		
Total = Sum(219a)$_{1...12}$ =													1259.33	(219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			4984.59	
Water heating fuel used			1259.33	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		360.17		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		390.17	(231)
Electricity for lighting			430.44	(232)

DRAFT

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	2587	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	653.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3240.6	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	202.5	(267)
Electricity for lighting	(232) x	0.519	=	223.4	(268)
Total CO2, kg/year		sum of (265)…(271) =		3666.49	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		33.39	(273)
EI rating (section 14)				68	(274)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.7

Property Address: LG1 Green

Address : , London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	67.4	(1a)	x	2.8	(2a)	=	188.72	(3a)
Ground floor	42.4	(1b)	x	2.6	(2b)	=	110.24	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	109.8	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	298.96	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40	=	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20	=	0	(6b)
Number of intermittent fans							4	x 10	=	40	(7a)
Number of passive vents							0	x 10	=	0	(7b)
Number of flueless gas fires							0	x 40	=	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.13	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(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

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	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=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(24d)

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

(25)m=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	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			1.98	x	1	=	1.98			(26)
Windows Type 1			4.33	x1/[1/(1.4)+ 0.04]		=	5.74			(27)
Windows Type 2			1.92	x1/[1/(1.4)+ 0.04]		=	2.55			(27)
Windows Type 3			0.64	x1/[1/(1.4)+ 0.04]		=	0.85			(27)
Floor Type 1			30	x	0.13	=	3.9			(28)
Floor Type 2			37.4	x	0.13	=	4.862			(28)
Walls Type1	48.6	4.48	44.12	x	0.18	=	7.94			(29)
Walls Type2	32.8	17.32	15.48	x	0.18	=	2.79			(29)
Walls Type3	8.6	0	8.6	x	0.18	=	1.55			(29)
Walls Type4	3.1	1.98	1.12	x	0.18	=	0.2			(29)
Walls Type5	13.3	0	13.3	x	0.18	=	2.39			(29)
Total area of elements, m²			173.8							(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) = | 54.52 | (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 — 16.25 (36)

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

Total fabric heat loss — (33) + (36) = 70.77 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	57.86	57.53	57.21	55.68	55.4	54.07	54.07	53.82	54.58	55.4	55.97	56.58	(38)

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

(39)m=	128.63	128.3	127.97	126.45	126.16	124.83	124.83	124.59	125.34	126.16	126.74	127.34	

Average = $Sum(39)_{1...12}$ /12= 126.44 (39)

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

(40)m=	1.17	1.17	1.17	1.15	1.15	1.14	1.14	1.13	1.14	1.15	1.15	1.16	

Average = $Sum(40)_{1...12}$ /12= 1.15 (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 — 101.02 (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=	111.13	107.08	103.04	99	94.96	90.92	90.92	94.96	99	103.04	107.08	111.13	

Total = $Sum(44)_{1...12}$ = 1212.28 (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=	164.8	144.13	148.73	129.67	124.42	107.36	99.49	114.16	115.53	134.64	146.97	159.6	

Total = $Sum(45)_{1...12}$ = 1589.49 (45)

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

(46)m=	24.72	21.62	22.31	19.45	18.66	16.1	14.92	17.12	17.33	20.2	22.05	23.94	(46)

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.17 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.63 (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)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0.63	(55)

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

(56)m=	19.51	17.62	19.51	18.88	19.51	18.88	19.51	19.51	18.88	19.51	18.88	19.51	(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=	19.51	17.62	19.51	18.88	19.51	18.88	19.51	19.51	18.88	19.51	18.88	19.51	(57)

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

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	207.56	182.76	191.5	171.06	167.19	148.75	142.26	156.93	156.92	177.41	188.36	202.36	(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=	207.56	182.76	191.5	171.06	167.19	148.75	142.26	156.93	156.92	177.41	188.36	202.36	

Output from water heater (annual)$_{1...12}$ | 2093.05 | (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=	89.01	78.83	83.67	76.23	75.58	68.81	67.29	72.17	71.52	78.98	81.98	87.28	(65)

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

DRAFT

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=	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	140.68	(66)

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

(67)m=	24.37	21.65	17.61	13.33	9.96	8.41	9.09	11.81	15.86	20.13	23.5	25.05	(67)

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

(68)m=	271.27	274.08	266.99	251.89	232.83	214.91	202.94	200.13	207.22	222.32	241.38	259.3	(68)

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

(69)m=	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	37.07	(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=	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	-112.54	(71)

Water heating gains (Table 5)

(72)m=	119.64	117.3	112.46	105.87	101.59	95.57	90.45	97.01	99.34	106.16	113.86	117.31	(72)

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

(73)m=	483.48	481.24	465.26	439.29	412.58	387.09	370.68	377.15	390.62	416.82	446.94	469.87	(73)

6. Solar gains:

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

TER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	1.92	x	46.75	x	0.63	x	0.7	=	54.87	(78)
South	0.9x	0.77	x	1.92	x	76.57	x	0.63	x	0.7	=	89.86	(78)
South	0.9x	0.77	x	1.92	x	97.53	x	0.63	x	0.7	=	114.46	(78)
South	0.9x	0.77	x	1.92	x	110.23	x	0.63	x	0.7	=	129.37	(78)
South	0.9x	0.77	x	1.92	x	114.87	x	0.63	x	0.7	=	134.81	(78)
South	0.9x	0.77	x	1.92	x	110.55	x	0.63	x	0.7	=	129.73	(78)
South	0.9x	0.77	x	1.92	x	108.01	x	0.63	x	0.7	=	126.76	(78)
South	0.9x	0.77	x	1.92	x	104.89	x	0.63	x	0.7	=	123.1	(78)
South	0.9x	0.77	x	1.92	x	101.89	x	0.63	x	0.7	=	119.57	(78)
South	0.9x	0.77	x	1.92	x	82.59	x	0.63	x	0.7	=	96.92	(78)
South	0.9x	0.77	x	1.92	x	55.42	x	0.63	x	0.7	=	65.03	(78)
South	0.9x	0.77	x	1.92	x	40.4	x	0.63	x	0.7	=	47.41	(78)
Southwest	0.9x	0.77	x	0.64	x	36.79		0.63	x	0.7	=	7.2	(79)
Southwest	0.9x	0.77	x	0.64	x	62.67		0.63	x	0.7	=	12.26	(79)
Southwest	0.9x	0.77	x	0.64	x	85.75		0.63	x	0.7	=	16.77	(79)
Southwest	0.9x	0.77	x	0.64	x	106.25		0.63	x	0.7	=	20.78	(79)
Southwest	0.9x	0.77	x	0.64	x	119.01		0.63	x	0.7	=	23.28	(79)
Southwest	0.9x	0.77	x	0.64	x	118.15		0.63	x	0.7	=	23.11	(79)
Southwest	0.9x	0.77	x	0.64	x	113.91		0.63	x	0.7	=	22.28	(79)
Southwest	0.9x	0.77	x	0.64	x	104.39		0.63	x	0.7	=	20.42	(79)
Southwest	0.9x	0.77	x	0.64	x	92.85		0.63	x	0.7	=	18.16	(79)
Southwest	0.9x	0.77	x	0.64	x	69.27		0.63	x	0.7	=	13.55	(79)
Southwest	0.9x	0.77	x	0.64	x	44.07		0.63	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	0.64	x	31.49		0.63	x	0.7	=	6.16	(79)
West	0.9x	0.77	x	4.33	x	19.64	x	0.63	x	0.7	=	103.96	(80)
West	0.9x	0.77	x	4.33	x	38.42	x	0.63	x	0.7	=	203.37	(80)
West	0.9x	0.77	x	4.33	x	63.27	x	0.63	x	0.7	=	334.92	(80)
West	0.9x	0.77	x	4.33	x	92.28	x	0.63	x	0.7	=	488.46	(80)
West	0.9x	0.77	x	4.33	x	113.09	x	0.63	x	0.7	=	598.62	(80)
West	0.9x	0.77	x	4.33	x	115.77	x	0.63	x	0.7	=	612.8	(80)
West	0.9x	0.77	x	4.33	x	110.22	x	0.63	x	0.7	=	583.41	(80)
West	0.9x	0.77	x	4.33	x	94.68	x	0.63	x	0.7	=	501.14	(80)
West	0.9x	0.77	x	4.33	x	73.59	x	0.63	x	0.7	=	389.52	(80)
West	0.9x	0.77	x	4.33	x	45.59	x	0.63	x	0.7	=	241.31	(80)
West	0.9x	0.77	x	4.33	x	24.49	x	0.63	x	0.7	=	129.63	(80)
West	0.9x	0.77	x	4.33	x	16.15	x	0.63	x	0.7	=	85.49	(80)

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

(83)m=	166.02	305.48	466.15	638.61	756.71	765.64	732.45	644.66	527.25	351.78	203.28	139.06	(83)

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

(84)m=	649.5	786.72	931.41	1077.9	1169.29	1152.74	1103.13	1021.81	917.87	768.6	650.22	608.93	(84)

TER WorkSheet: New dwelling design stage

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.84	0.66	0.49	0.55	0.81	0.97	1	1	(86)

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

(87)m=	19.72	19.91	20.2	20.56	20.83	20.96	20.99	20.99	20.9	20.52	20.05	19.69	(87)

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

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

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

(89)m=	1	0.99	0.98	0.92	0.78	0.57	0.38	0.43	0.73	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=	18.24	18.51	18.94	19.45	19.8	19.95	19.97	19.97	19.89	19.4	18.73	18.2	(90)

fLA = Living area ÷ (4) = 0.42 (91)

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

(92)m=	18.87	19.1	19.47	19.92	20.24	20.38	20.4	20.4	20.31	19.87	19.29	18.83	(92)

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

(93)m=	18.87	19.1	19.47	19.92	20.24	20.38	20.4	20.4	20.31	19.87	19.29	18.83	(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	0.43	0.48	0.76	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	647.27	779.75	907.54	992.44	933.26	694.67	470.87	491.61	697.22	733.98	645.26	607.38	(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=	1873.84	1822.03	1659.85	1393.57	1077.18	721.23	474.65	498.35	778.82	1170	1544.4	1863.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	912.57	700.42	559.72	288.81	107.08	0	0	0	0	324.4	647.38	934.6	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4474.96 (98)

Space heating requirement in kWh/m²/year — 40.76 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

TER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	912.57	700.42	559.72	288.81	107.08	0	0	0	0	324.4	647.38	934.6		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	976.01	749.11	598.63	308.89	114.52	0	0	0	0	346.95	692.38	999.57		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													4786.06	(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)	207.56	182.76	191.5	171.06	167.19	148.75	142.26	156.93	156.92	177.41	188.36	202.36		
Efficiency of water heater													79.8	(216)
(217)m=	88.31	88.06	87.51	86.2	83.66	79.8	79.8	79.8	79.8	86.4	87.85	88.39		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	235.05	207.55	218.83	198.44	199.84	186.41	178.27	196.66	196.64	205.32	214.42	228.94		
Total = Sum(219a)$_{1...12}$ =													2466.36	(219)

Annual totals	kWh/year	kWh/year	
Space heating fuel used, main system 1		4786.06	
Water heating fuel used		2466.36	
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		430.44	(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	=	1033.79	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	532.73	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1566.52	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	223.4	(268)
Total CO2, kg/year		sum of (265)…(271) =		1828.84	(272)

TER = 24.5 (273)

APPENDIX B – SBEM RESULTS

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

551-557 Finchley Road Baseline

As designed

Date: Tue Oct 06 14:05:50 2020

Administrative information

Building Details

Address: Address 1, Address 2, City, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.a.2

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	31.6
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	31.6
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	40.7
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.55	0.55	SP000002_W1
Floor	0.25	0.73	0.73	SP000002_F
Roof	0.25	0.68	0.68	SP000003_C
Windows***, roof windows, and rooflights	2.2	5.6	5.6	SP000009_W4_O0
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	15*

* Buildings with less than 500 m^2 total useful floor area may avoid the need for a pressure test provided that the air permeability is taken as 15 $m^3/(h.m^2)$ at 50 Pa.

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Baseline System

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.81	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- SYST0000-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.7	-
Standard value	0.9*	N/A
* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.		

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
LG Plant	-	-	-	0.7	-	-	-	-	-	0.7	0.5
LG COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5
LG COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5
LG COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5
LG COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5
GF COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5
CIRCULATION	-	-	-	0.7	-	-	-	-	-	0.7	0.5
GF COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5
GF COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
LG Plant	-	90	30	574

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
LG COM	-	90	30	706
LG COM	-	90	30	645
LG COM	-	90	30	942
LG COM	-	90	30	869
GF COM	-	90	30	758
CIRCULATION	-	90	-	185
GF COM	-	90	30	796
GF COM	-	90	30	661

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
LG Plant	N/A	N/A
LG COM	N/A	N/A
LG COM	N/A	N/A
LG COM	N/A	N/A
LG COM	N/A	N/A
GF COM	YES (+169.9%)	NO
GF COM	YES (+168.2%)	NO
GF COM	YES (+154.3%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	374.1	374.1
External area [m²]	418.6	418.6
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	15	3
Average conductance [W/K]	572.79	186.88
Average U-value [W/m²K]	1.37	0.45
Alpha value* [%]	6.71	19.8

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	46.45	4.08
Cooling	0	0
Auxiliary	5.71	4.89
Lighting	53.99	55.09
Hot water	2.05	1.66
Equipment*	18.4	18.4
TOTAL**	**108.2**	**65.72**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	314.18	232.14
Primary energy* [kWh/m²]	237.86	186.53
Total emissions [kg/m²]	40.7	31.6

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	120.9	193.3	46.5	0	5.7	0.72	0	0.81	0
	Notional	12.1	220.1	4.1	0	4.9	0.82	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.55	SP000002_W1
Floor	0.2	0.73	SP000002_F
Roof	0.15	0.68	SP000003_C
Windows, roof windows, and rooflights	1.5	5.6	SP000009_W4_O0
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]

$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	15

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

551-557 Finchley Road Lean

As designed

Date: Tue Oct 06 08:22:57 2020

Administrative information

Building Details

Address: Address 1, Address 2, City, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.a.2

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	31.6
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	31.6
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	30.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.55	0.55	SP000002_W1
Floor	0.25	0.25	0.25	SP000002_F
Roof	0.25	0.18	0.18	SP000003_C
Windows***, roof windows, and rooflights	2.2	1.6	1.6	SP000009_W4_O0
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	15*

* Buildings with less than 500 m^2 total useful floor area may avoid the need for a pressure test provided that the air permeability is taken as 15 $m^3/(h.m^2)$ at 50 Pa.

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Lean System

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- SYST0001-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
LG Plant	-	-	-	0.7	-	-	-	-	-	0.7	0.5
LG COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5
LG COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5
LG COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5
LG COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5
GF COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5
CIRCULATION	-	-	-	0.7	-	-	-	-	-	0.7	0.5
GF COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5
GF COM	-	-	-	0.7	-	-	-	-	-	0.7	0.5

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
LG Plant	-	80	30	484

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
LG COM	-	80	30	596
LG COM	-	80	30	544
LG COM	-	80	30	795
LG COM	-	80	30	733
GF COM	-	80	30	639
CIRCULATION	-	80	-	156
GF COM	-	80	30	672
GF COM	-	80	30	557

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
LG Plant	N/A	N/A
LG COM	N/A	N/A
LG COM	N/A	N/A
LG COM	N/A	N/A
LG COM	N/A	N/A
GF COM	YES (+31%)	NO
GF COM	YES (+30.2%)	NO
GF COM	YES (+23.4%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	374.1	374.1
External area [m^2]	418.6	418.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	15	3
Average conductance [W/K]	220.1	186.88
Average U-value [W/m^{2}K]	0.53	0.45
Alpha value* [%]	17.45	19.8

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
100	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	13.05	4.08
Cooling	0	0
Auxiliary	5.59	4.89
Lighting	47.75	55.09
Hot water	1.44	1.66
Equipment*	18.4	18.4
TOTAL**	**67.82**	**65.72**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	201.99	232.14
Primary energy* [kWh/m^2]	177.32	186.53
Total emissions [kg/m^2]	30.1	31.6

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	40.2	161.8	13	0	5.6	0.86	0	0.91	0
	Notional	12.1	220.1	4.1	0	4.9	0.82	0	----	----

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$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	**Typical value**	**This building**
$m^3/(h.m^2)$ at 50 Pa	5	15

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