Energy & Sustainability Statement

for

S2S Architects

238 Kilburn High Road

London Borough of Camden
London NW6 2BS

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ISSUE

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01	23.07.2021	1st Draft	P Dalapas	N Dabidian	
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03	17.08.2021	Final issue	P Dalapas	N Dabidian	Minor comments addressed

CONTENTS

EXECUTIVE SUMMARY

Mecserve Ltd have been appointed by S2S Architects to prepare an Energy and Sustainability Statement to support the planning application for the construction of a mixed-use development at 238 Kilburn High Road in the London Borough of Camden. The proposed scheme comprises a Class E unit on the ground floor with 7 no. apartments on 1st to 4th floors.

This Energy and Sustainability Statement, prepared in line with the Energy Assessment Guidance (April 2020) published by the Greater London Authority, outlines the key features and strategies adopted by the development team to enhance the energy performance of the proposed development at 238 Kilburn High Road. The scheme complies with all relevant policies with regards to energy and carbon emissions, set by the Camden Local Plan (2017). Sections 2 and 3 review these policies and demonstrate how the proposed design meets the planning targets and requirements to minimise its environmental impact.

The strategy for reducing energy use and associated carbon emissions through the design of the scheme follows the London Plan energy hierarchy, namely:

- Be Lean – Reduce energy demand through passive design strategies and best practice design of building services, lighting and controls;
- Be Clean – Reduce energy consumption further by connecting to an existing district heating system and exploit provision of Combined Heat and Power (CHP) systems;
- Be Green – Generate power on site through Renewable Energy Technologies.

The following passive and active energy efficiency features have been considered in the proposed strategy for 238 Kilburn High Road:

- High performance building fabric of low U-values that exceed Part L minimum standards;
- Double-glazed windows of low U-values will help reduce the heating demand further;
- All junctions will conform to Accredited Construction Details thus eliminating thermal bridging;
- Individual gas-fired condensing boilers of high efficiency will provide heating and domestic hot water to the newly built apartments;
- All apartments will feature Mechanical Ventilation with Heat Recovery (MVHR) to make use of wasted heat of the exhaust air by preheating the incoming air;
- Light fittings will be of low energy types;

The following Low/Zero Carbon technologies are proposed for the scheme:

- Photovoltaic (PV) panels will be installed to generate renewable energy on site.

Following the proposed energy strategy, the new-built residential units achieve significant carbon savings over the Target Emission Rate (TER) set by Part L of current Building Regulations, in line with the Council's carbon reduction target i.e. a 19% reduction over 2013 TER.

Table 1 demonstrates the overall reduction in the regulated carbon emission of the development after each stage of the London Plan Energy Hierarchy.

Table 1 Regulated carbon dioxide emissions after each stage of the energy hierarchy for domestic buildings

	Regulated domestic carbon dioxide emissions
	(Tonnes CO2 per annum)
Baseline CO2 emissions (Part L 2013 of the Building Regulations Compliant Development)	8.5
CO2 emissions after energy demand reduction (be lean)	8.2
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean)	8.2
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean) AND renewable energy (be green)	6.3

Table 2 demonstrates the total regulated CO_2 savings from each stage of the Energy Hierarchy. As demonstrated below, an overall 26% reduction in carbon emissions can be achieved over Part L 2013 TER when applying the proposed strategy, which exceeds the carbon reduction target set in the Camden Local Plan.

Table 2 Regulated carbon dioxide savings from each stage of the energy hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: Savings from energy demand reduction	0.3	4%
Be clean: Savings from heat network	0.0	0%
Be green: Savings from renewable energy	1.9	23%
Cumulative on-site savings	2.2	26%

The energy performance of the Class E unit on the ground floor has been also assessed. The following sections show that compliance with Part L of the 2013 Building Regulations is achieved.

Figure 1 below illustrates the total carbon savings achieved for the domestic elements of the scheme at each stage of the London Plan Energy Hierarchy for 238 Kilburn High Road. Overall, the apartments exceed the 19% carbon reduction required by the Camden Council.

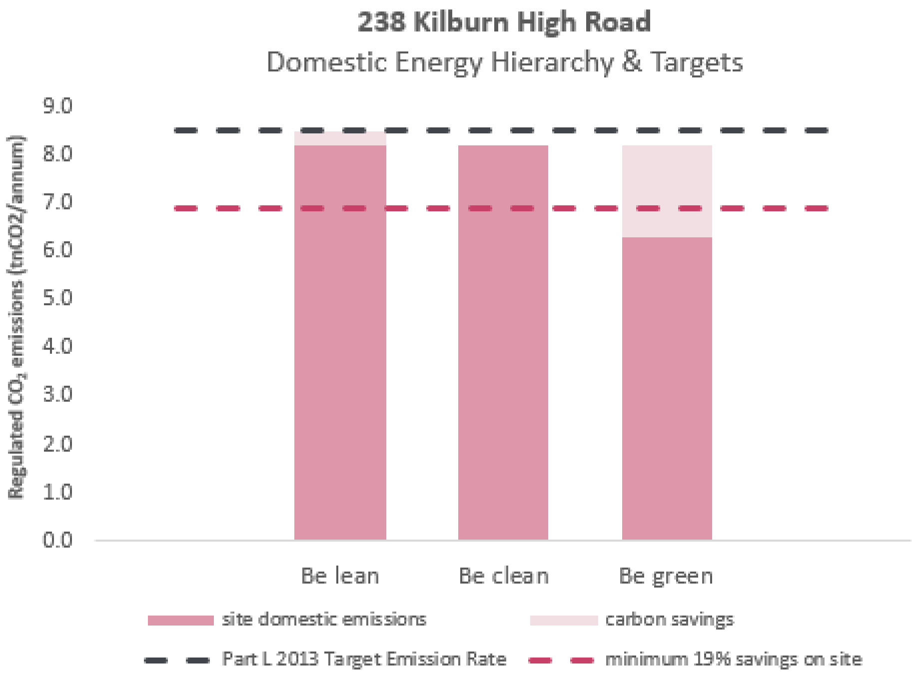


Figure 1 Total carbon savings achieved over Baseline Emissions

1. INTRODUCTION

Over recent years, global public opinion has been increasingly concerned with the state of the environment and the impact of climate change. Buildings are responsible for a significant proportion of the world's energy consumption. In the United Kingdom, domestic, commercial buildings and industry contribute 43%[1] of the total CO2 emissions. These figures highlight the need for building owners, developers and designers to design environmentally sustainable buildings.

This report provides a review of the sustainability and efficiency benchmarks for the scheme and sets out targets for the development in terms of both sustainability and energy. An overview of different sustainability and energy-efficiency technologies that are likely to be appropriate for the development are also included in this statement.

As the design progresses, the strategies outlined in this report will be further developed and subjected to detailed financial feasibility studies. The environmental strategies and options outlined in this report are based on the current information available and are likely to evolve with the design.

The energy calculations presented in this report will need to be continually updated through the detailed design stages to reflect any changes. The energy analysis presented here should be treated as preliminary information based on the currently available data.

1.1 PROPOSED DEVELOPMENT

The proposal is for the construction of a 5-storey building at 238 Kilburn High Road in the London Borough of Camden. The scheme comprises a Class E unit on the ground floor with 7 no. residential units (3no. 1-Bed units, 3no. 2-Bed units and 1no. 3-Bed unit) on the 1st to 4th floors.

For a detailed description of the proposed design, please refer to the Design and Access Statement prepared by S2S Architects.

[1] Department for Environment, Food and Rural Affairs, http://www.defra.gov.uk/, 2008

Figure 2 Bird's eye view of existing Building

Figure 3 Proposed elevation (S2S Architects)

2. OVERVIEW OF ENVIRONMENTAL STANDARDS, TARGETS AND POLICIES

2.1 NATIONAL POLICIES

ENERGY WHITE PAPER

The Energy White Paper: Our Energy Future – Creating a Low Carbon Economy[2] is an energy policy in response to the increasing challenges faced by the UK, including climate change, decreasing domestic supplies of fossil fuel and escalating energy prices. The Energy White Paper sets four priorities:

- Cutting the UK's carbon dioxide emissions - the main contributor to global warming - by some 60% by about 2050, with real progress by 2020;
- Security of supply;
- A competitive market for the benefit of businesses, industries and households;
- Affordable energy for the poor.

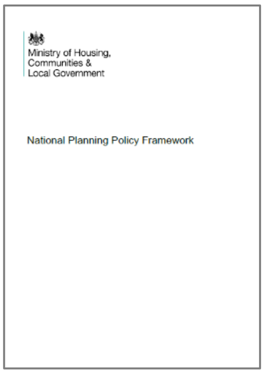
CLIMATE CHANGE ACT 2008

Published in 2008 by the UK Government, Climate Change Act[3] is the world's first long-term legally binding framework to mitigate against climate change. The Act sets legally binding targets to increase greenhouse gas emission reductions through action in the UK and abroad from the 60% target to 80% by 2050.

In addition to the standards, targets and policies discussed above, the relevant British Standards and CIBSE Guidelines were used to assist in determining the most appropriate Ecologically Sustainable Design (ESD) initiatives for the development.

[2] Dti, (2003); Energy White Paper Our Energy Future - Creating a Low Carbon Economy. TSO.
[3] OPSI, (2008); Climate Change Act. HMSO.

NATIONAL PLANNING POLICY FRAMEWORK (NPPF) (JULY 2021)

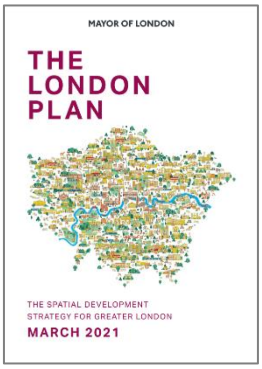


The Government has developed the National Planning Policy Framework (NPPF) which plays a key role in delivering the Government's objectives on sustainable development. The framework encourages ownership at the local level and provides guidance to promote effective environmental protection, economic growth and ensuring a better quality of life for all, both now and in future generations. Some of the main objectives of the Governments planning framework in relation to sustainability are:

- Build prosperous communities with opportunities for employment and economic growth across all areas of society;
- Reduce the need for car dependency and provide easy access to public transport;
- Maintain, and enhance or restore biodiversity and geological interests;
- Protect the condition of land, its use, and its development from potential hazards;
- Ensure that all new developments contribute to the Governments targets of carbon emission reductions.

2.2 REGIONAL POLICY

THE LONDON PLAN 2021



The London Plan 2021 is the Spatial Development Strategy for Greater London. It sets out a framework for how London will develop over the next 20-25 years and the Mayor's vision for Good Growth. Good Growth - growth that is socially and economically inclusive and environmentally sustainable – underpins the whole of the London Plan and each policy. It is the way in which sustainable development in London is to be achieved.

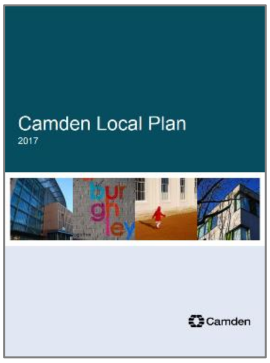
Chapter 9 'Sustainable Infrastructure', sets the policies to address climate change and help London become a more efficient and resilient city by:

- seeking to improve energy efficiency and support the move towards a low carbon circular economy, contributing towards London becoming a zero-carbon city by 2050;
- ensuring buildings and infrastructure are designed to adapt to a changing climate, making efficient use of water, reducing impacts from natural hazards like flooding and heatwaves, while mitigating and avoiding contributing to the urban heat island effect.

Supplementary Planning Guidance, Sustainable Design and Construction (April 2014) provides framework for implementing the London policies. This Energy and Sustainability Statement, has been prepared in line with the Energy Assessment Guidance (April 2020) published by the Greater London Authority.

2.3 LOCAL POLICIES

CAMDEN LOCAL PLAN (2017)



The Camden Local Plan sets out the Council's planning policies and replaces the Core Strategy and Development Policies planning documents (adopted in 2010). This sets out the key elements of the Council's planning vision and strategy of the borough.

Through its Camden Planning Guidance (CPG) on Energy efficiency and adaptation (Draft November 2018) the council provides additional information on key energy and resource issues within the borough.

The following is the review of the Camden Planning Policies for Climate Change mitigation and Climate Change Adaptation followed by measures implemented in the proposed development to meet the applicable policy requirements.

3. CLIMATE CHANGE MITIGATION AND ADAPTATION STRATEGY

Climate Change is the rise in average global temperature due to increasing levels of greenhouse gases in the earth's atmosphere (primarily CO2) that prevent the radiation of heat into space.

Buildings and spaces built today should respond to climate change issues and adapt to mitigation and adaptation measures. The London Plan through its policies addresses these issues and will require London Boroughs to consider how their developments will function in the future in the context of changing climate.

Through various policies, Camden Council encourages developments to meet the highest feasible environmental standards, where feasible and possible, in order to minimise the effects of and adapt to climate change. The climate change risks for the London Borough of Camden are summarised below:

- Hotter, drier summers;
- Milder, wetter winters;
- More frequent extreme high temperatures;
- More frequent heavy downpours of rain;
- Significant decreases in soil moisture content in summer;
- Sea level rise and increases in storm surge height;
- Possible higher wind speeds.

3.1 CLIMATE CHANGE MITIGATION

As per the definition of United Nations Environment Programme (UNEP), Climate Change Mitigation refers to efforts to reduce or prevent emission of greenhouse gases. Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behaviour.

The following policies from Camden's Local Plan relate to Climate Change Mitigation, in the context of this proposed development.

Policy CC1 Climate change mitigation
The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation. We 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, we will promote decentralised energy by: g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them; h. 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 i. 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.

Measures being considered in the project to meet the above policy requirements

According to the Camden Planning Guidance Energy efficiency and adaptation, the carbon reduction target set for a medium development applies to the domestic elements of the scheme, comprising 7 no. apartments. The carbon target set for a minor development applies to the single Class E unit on the ground floor. The energy strategy developed for the scheme follows the London Plan Energy Hierarchy and this report is written in line with GLA Energy Assessment Guidance.

In order to design an energy efficient, low carbon development, the design team has followed the London Plan Energy Hierarchy i.e.

- The development is designed to have highly efficient envelope and passive strategies, e.g. building fabric of high thermal performance and applying Accredited Construction Details to minimise thermal bridging, have been incorporated in the design where possible. Efficient building services including MVHR and low energy lighting are proposed to reduce energy consumption;
- The design team has carried out a feasibility study to assess the potential of connecting the scheme to a district heating network or provide a Combined Heat and Power to meet heating demand;
- A feasibility study to identify the most suitable renewable energy technologies has been carried out and presented in this report.

As a result of the proposed strategy, the apartments achieve an overall reduction of 26% over the 2013 TER, exceeding the reduction target set by the Camden Council. The Class E unit exceed the 2013 TER by 9%.

The scheme is expected to have a low heating demand due to its size, the high performance building fabric performance proposed and the low water use fittings to be specified. According to the London Heat Map (Figure 4), the site is not within a district heating opportunity area and there is no existing network in close proximity or one to become available in the future. Therefore, given also the small scale of the scheme, it is not feasible or viable to connect to a district heat network.

Installation of a Combined Heat and Power (CHP) unit has been also considered. However, there is not high heating and hot water demand throughout the year to enable the CHP unit to run continuously for long period thus ensuring maximum carbon and cost savings. As per GLA guidance on energy assessments, a higher number of residential units is required to justify installation of a CHP unit.

A feasibility study has been carried out to assess those renewable energy technologies that could be appropriate for the proposed development – please refer to Section 4 of the report. Photovoltaic panels are proposed to generate renewable energy on site. A VRF system comprising an Air Source Heat Pump is also proposed for the Class E unit to provide space heating.

Figure 4 Image of London Heat Map (https://maps.london.gov.uk/heatmap)

The development makes efficient use of land within the borough by providing additional residential units within the existing site. The site is well served by public transportation links thus reducing car usage.

The design and construction of the scheme will promote resource efficiency by prioritising use of recycled/reclaimed materials and specifying environmentally friendly materials of low embodied carbon where reuse is not feasible. Resource efficiency will be also promoted during construction by reducing waste, energy and water use on site.

More information can be found in the Design and Access Statement prepared by S2S Architects.

3.2 CLIMATE CHANGE ADAPTATION

For a long time, the main focus of climate change has been on mitigation, making sure we minimise our impact on the environment. Adaptation strategies are those that take into account climate change and ensure that the building is capable of dealing with future change in climate. Given the time lag associated with climate change, even if we change the way we live, there is likely to be noticeable change in the climate during the life of the building.

To ensure that buildings maintain their relevance, it is essential that adaptation strategies are addressed during the design phase. Adoption of these strategies will mean that, even as we undergo climate change, the buildings can still function as required.

The following policies from Camden's Local Plan relate to Climate Change Adaptation, in the context of this proposed development.

Policy CC2 Adapting to climate change
The Council will require development to be resilient to climate change. All development should adopt appropriate climate change adaptation measures such as: a. the protection of existing green spaces and promoting new appropriate green infrastructure; b. not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems; c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy. Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement. **Sustainable design and construction measures** The Council will promote and measure sustainable design and construction by: e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation; f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards; g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and

h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.

Measures being considered in the project to meet the above policy requirements

Even though the scheme is not classified as a major development, measures to eliminate the risk of overheating have been considered and integrated in the design of the new apartments. The following will be applied to ensure comfort during summer within the main living areas of the units:

- well insulated fabric elements and high airtightness to prevent heat transfer from the external environment.
- Openable windows to allow for natural cross ventilation.
- Windows will be of low g-value to avoid heat transmittance during summer but allow for passive heating in the winter.
- When required, additional flow rates can be provided through whole house mechanical ventilation, bypassing heat recovery.
- Energy efficiency light fittings that emit less heat than standard types thus reducing overheating will be also specified.
- Tenants will be advised to purchase A-rated appliances of low energy consumption to reduce internal heat gains.

Good practice sustainable development principles will be incorporated in the design to minimise the environmental impact of the scheme. A green roof is proposed for the scheme to enhance the ecological value of the site while reducing urban island heat effect and water runoff.

All new apartments will have low water use fittings to reduce water consumption on site. Installation of low flow rate showers, taps and dual flush toilets, together with smaller baths (where applicable) will mean that all apartments will achieve a maximum internal water use of 105 litres per person/day, with an additional 5 litres person/day for external water use.

For more information please refer to the Design and Access Statement prepared by S2S Architects.

Policy CC3 Water and flooding

The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible.

We will require development to:

a. incorporate water efficiency measures;
b. avoid harm to the water environment and improve water quality;

c. consider the impact of development in areas at risk of flooding (including drainage);
d. incorporate flood resilient measures in areas prone to flooding;
e. utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and
f. not locate vulnerable development in flood-prone areas.

Where an assessment of flood risk is required, developments should consider surface water flooding in detail and groundwater flooding where applicable.

The Council will protect the borough's existing drinking water and foul water infrastructure, including the reservoirs at Barrow Hill, Hampstead Heath, Highgate and Kidderpore.

Measures being considered in the project to meet the above policy requirements

The site is in a low flood risk zone according to the Environmental Agency Flood Map (Figure 5) below.

Based on Map 6: Historic flooding and Local Flood Risk Zones of the Local Plan, the site is close to those parts that have experienced significant sewer or surface water flooding and therefore considered to have the potential to be at risk of surface water flooding.

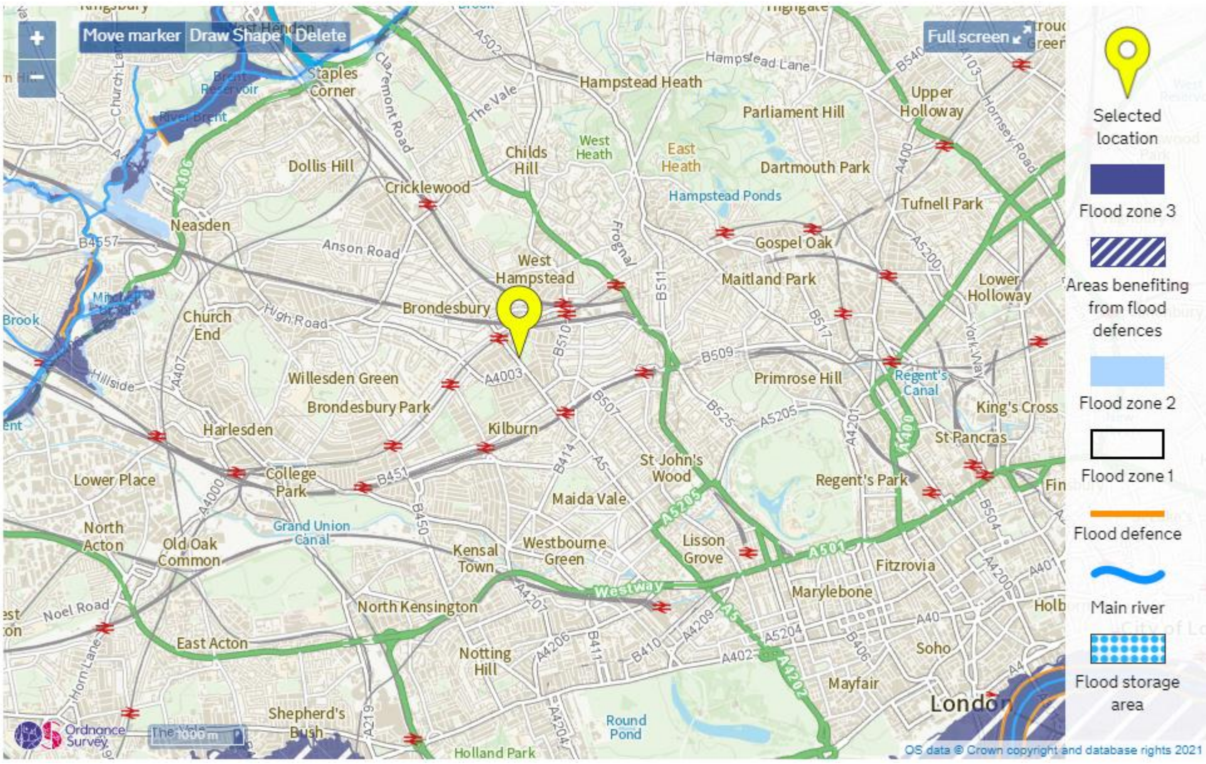


Figure 5 Environment Agency Flood Map

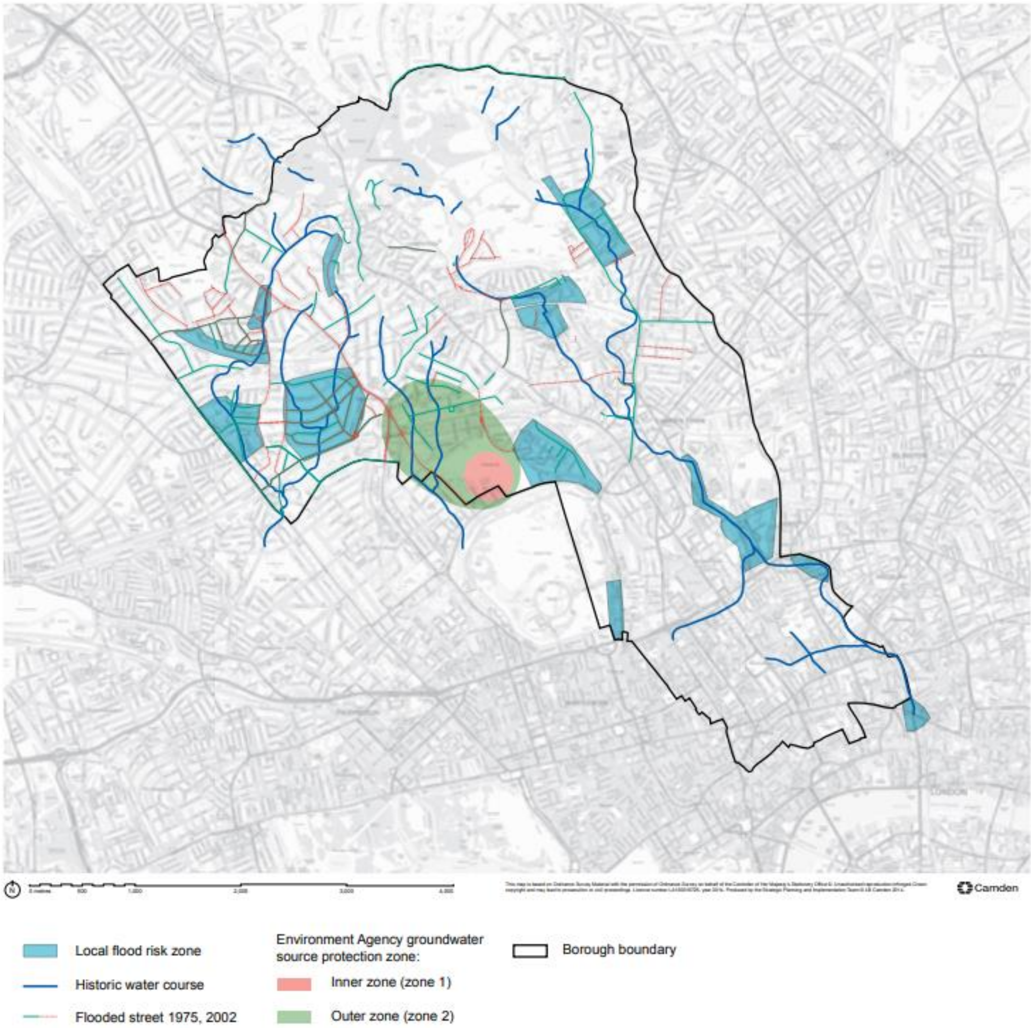


Figure 6 Map 6: Historic flooding and Local Flood Risk Zones of Camden's Local Plan

Policy CC4 Air quality
The Council will ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough. The Council will take into account the impact of air quality when assessing development proposals, through the consideration of both the exposure of occupants to air pollution and the effect of the development on air quality. Consideration must be taken to the actions identified in the Council's Air Quality Action Plan. Air Quality Assessments (AQAs) are required where development is likely to expose residents to high levels of air pollution. Where the AQA shows that a development would cause harm to air

quality, the Council will not grant planning permission unless measures are adopted to mitigate the impact. Similarly, developments that introduce sensitive receptors (i.e. housing, schools) in locations of poor air quality will not be acceptable unless designed to mitigate the impact.

Development that involves significant demolition, construction or earthworks will also be required to assess the risk of dust and emissions impacts in an AQA and include appropriate mitigation measures to be secured in a Construction Management Plan.

Measures being considered in the project to meet the above policy requirements

The proposed scheme will provide 7no. dwellings. Low NOx individual gas-fired boilers are proposed to provide heating to the new apartments, therefore, any impact on the air quality will be minimal.

Policy CC5 Waste
The Council will seek to make Camden a low waste borough. We will: a. aim to reduce the amount of waste produced in the borough and increase recycling and the reuse of materials to meet the London Plan targets of 50% of household waste recycled/composted by 2020 and aspiring to achieve 60% by 2031; b. deal with North London's waste by working with our partner boroughs in North London to produce a Waste Plan, which will ensure that sufficient land is allocated to manage the amount of waste apportioned to the area in the London Plan; c. safeguard Camden's existing waste site at Regis Road unless a suitable compensatory waste site is provided that replaces the maximum throughput achievable at the existing site; and d. make sure that developments include facilities for the storage and collection of waste and recycling.

Measures being considered in the project to meet the above policy requirements

Recycling and composting will be promoted by e.g. providing relevant facilities and information to the future tenants through a Home User Guide.

4. ENERGY ASSESSMENT

The energy performance of the proposed scheme has been assessed in line with the Standard Assessment Procedure (SAP) and the National Calculation Methodology (NCM) for the domestic and non-domestic elements of the scheme respectively.

This section, prepared in line with the GLA Energy Assessment Guidance (April 2020), outlines the energy strategy developed for the scheme and shows how significant carbon savings can be achieved by integrating energy efficiency measures and using renewable energy technologies on site. Appendices B-G provide the SAP 2012 Worksheets for the sample units assessed and the BRUKL output documents for the Class E unit.

4.1 BUILDING REGULATION COMPLIANCE

Part L (Conservation of Fuel and Power) of the Building Regulations applies to all components of the development. This was updated in 2013 and came into effect in April 2014.

All components of the development will be designed to exceed the requirements of the Building Regulations Part L. Compliance with Part L 2013 will be demonstrated by completing carbon emission calculations in line with the SAP 2012 and NCM methodologies. The energy assessment details a number of energy efficiency improvements and includes a renewable energy analysis which leads to a reduced carbon emission rate for the development.

Meeting the requirements of Part L will be achieved through:

1. Efficient Thermal Elements and Controlled fittings: the building fabric will be designed to improve on minimum Part L 2013 requirements;
2. Building Services and Lighting: The new building services will be designed and specified to perform better than the minimum standards detailed in both Domestic & Non-Domestic Building Services Compliance Guide (2013 edition).

4.2 ENERGY MODELLING

The Standard Assessment Procedure (SAP 2012) was used to model the residential elements of the scheme. The ground floor Class E unit has been modelled in IES-VE software (version 2021.1.0.0, Compliance 7.0.13.0).

The energy assessment has been completed by Mecserve’s energy modelling team who are accredited On Construction Domestic Energy Assessors and Low Carbon Energy Assessors (Level 3-4-5).

4.3 BASELINE CARBON EMISSION RATE

According to GLA's Energy Assessment Guidance, the Building Regulations Part L1A and Part L2A Target Emission Rate (TER) should be used to determine the baseline CO_2 emissions for the domestic and non-domestic elements of the scheme respectively. Table 3 below presents the baseline CO_2 emissions for the scheme.

Table 3 Baseline Carbon Dioxide emissions

Regulated Carbon dioxide emissions (Tonnes CO_2 per annum)	Domestic	Non-Domestic
Total Floor Area (sqm)	437.3	76.5
GLA Baseline: Part L 2013 of the Building Regulations Compliant Development	8.5	2.9

From 6 April 2014, Approved Document L1A has introduced a fabric energy efficiency target (FEE). This is the maximum space heating and cooling energy demand for a new home. It is measured as the amount of energy which would normally be needed to maintain comfortable internal temperatures in a home and is measured in kWh per m^2 per annum.

The table below presents the Target Fabric Energy Efficiency (TFEE) calculated by FSAP 2012 software.

Table 4 Dwellings Fabric Energy Efficiency

Fabric Energy Efficiency (kWh/sqm per annum)	Dwellings
Part L1A Target Fabric Energy Efficiency (TFEE) Rate	53.8

4.4 LONDON PLAN ENERGY HIERARCHY

To meet the requirements of Policy 5.2 Minimising Carbon Dioxide Emissions development proposals should minimise 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.

The hierarchy provides the mechanism through which the carbon dioxide (CO_2) emission reduction targets in Policy 5.2 of the London Plan are achieved. It also contributes to the implementation of strategic energy policies relating to decentralised networks and ensures opportunities for building occupants to receive efficient, secure and affordable energy.

GLA Energy Assessment Guidance states that the energy assessment must clearly identify the carbon footprint of the development after each stage of the energy hierarchy. Regulated emissions must be provided and, separately, those emissions associated with uses not covered by Building Regulations i.e. unregulated energy uses.

According to the Camden Planning Guidance Energy efficiency and adaptation, the carbon reduction target set for a medium development applies to the domestic elements of the scheme, comprising 7 no. apartments. The carbon target set for a minor development applies to the single Class E unit on the ground floor. The following sections demonstrate the carbon savings achieved at each step of the London Plan Energy Hierarchy.

4.5 BE LEAN – DEMAND REDUCTION

At the first ‘Be Lean’ stage of the Energy Hierarchy, the energy demand of the scheme is reduced through passive design measures such as optimising the orientation and form of the building and specifying building fabric of high thermal performance as well as proposing building services systems of high energy efficiency (active design).

The ‘Be Lean’ measures should demonstrate the extent to which the energy demand meets or exceeds the requirements of Part L of the Building Regulations. The following sections demonstrate how the proposed development will achieve energy and CO_2 savings over the GLA Baseline emission rate.

PASSIVE DESIGN

Passive design measures, including optimising orientation and site layout, natural ventilation and lighting, thermal mass and solar shading have been integrated in the design.

Energy demand reduction will be achieved through:

- **Building Orientation**: Most of the windows are facing due SE/SW. The majority of the units are dual aspect thus enjoying high daylight and sunlight levels throughout the year.
- **Passive Solar Design and Daylight**: The make-up of the proposed façades has balanced proportion of solid wall to glazing, thus providing optimum amount of daylight and sunlight, for winter passive heating, while limiting excessive solar gains in summer. High performance glass is proposed throughout the scheme for additional solar control. Combined with the shading effect of the balconies, the apartments receive lower solar gains.
- **Thermal performance of the fabric**: the proposed building fabric exceeds the requirements set in the Part L of the Building Regulations with regards to U-values to reduce heat losses.
- **Thermal bridging (domestic elements)**: where available, the psi values equivalent of that of Accredited Construction Details (ACD) have been used in the SAP calculation. An improvement over the Part L guidance is proposed for two specific junctions i.e. window lintels and bolt on balconies as shown in the following table. The psi values targeted for this development are not challenging and can be achieved via appropriate detailed design to allow for continuous insulation, in line with the building regulations and available guidance on Accredited Construction Details provided by the government.
- **Airtightness**: Robust construction details will be used to reduce heat losses through infiltration thus improving the air tightness of both the residential units and the commercial elements. An air permeability rate of 3 m^3/m^2hr @50Pa is targeted for the dwellings, which is achievable for a new construction of this standard.

Table 5 below shows initial assumptions on building fabric specifications including air permeability. These will be thoroughly reviewed by the design team at later stage.

Table 5 Proposed building fabric specifications

BUILDING FABRIC		
U-VALUE [W/m^2K]	WALL	0.18 – External walls 0.24 – Semi exposed walls (between apartments and communal areas, assumed to be unheated) 0.0 – Party walls (between apartments, assuming a fully filled cavity with effective sealing at all exposed edges and in line with insulation layers in abutting elements)
	FLOOR	0.13 – Ground floor 0.25 – Party floor (between apartments and unheated communal areas/ GF retail unit)
	ROOF	0.13 – Green roof 0.12 – Terraces

<table>
<tr><td rowspan="2"></td><td>WINDOWS/
GLAZED DOORS</td><td>1.20 (g-value: 0.40) – Apartments
1.60 (g-value: 0.40) – Class E unit</td></tr>
<tr><td>SOLID DOORS</td><td>1.00 – Flats’ main entrance door</td></tr>
<tr><td>AIR PERMEABILITY</td><td colspan="2">3 m^3/m^2hr @50Pa – Domestic elements
5 m^3/m^2hr @50Pa – Non-domestic elements</td></tr>
<tr><td>THERMAL BRIDGING (Residential units)</td><td colspan="2">We have assumed that Psi values in line with the Accredited Construction Details will be achievable for this development. These values are achievable if the relevant guidance is followed and the insulation is continuous in line with Part L of the Building Regulations.

The design team will complete the detailing of each junction at the next design phase during the detailed design stage in line with the relevant guidance provided by Part L of the Building Regulations on Accredited Construction Details (ACDs) – as shown in Table K1 of SAP 2012 with regards to eliminating thermal bridging.

An improvement over the Part L guidance is proposed for two specific junctions i.e. window lintels and bolt on balconies.

<table><tr><td>E01 Lintel</td><td>High performance lintel with pre-fitted expanded polystyrene insulation
e.g. Hi-therm+ lintel or similar
(Psi < 0.05 W/mK)</td></tr><tr><td>E23 Balcony between dwellings</td><td>The following product (or better) is proposed to reduce heat losses:
e.g. Schoeck - Isokorb KS 14 thermal break or similar
(Psi < 0.287 W/mK)</td></tr></table></td></tr>
</table>

Achieving the above values will reduce the energy demand of the development prior to considering further energy efficiency measures and renewable energy systems for the development.

ACTIVE DESIGN

After reducing the energy demand of the development, the next stage would be to use energy efficient building services systems, low energy lighting and controls throughout the scheme to reduce fuel consumption.

Our proposed energy strategy includes the following:

- **Space Heating and Hot Water:** Individual gas-fired boilers of high efficiency will be installed within each flat to provide space heating via radiators and domestic hot water.
- **Ventilation**: Fresh air will be provided to the dwellings via Mechanical Ventilation with Heat Recovery. All windows can be fully openable and the MVHR unit can be set on summer bypass mode during the warmer months.
- **Lighting:** Low energy light fittings of LED types will be used throughout the scheme.

Table 6 Proposed domestic building services systems

DOMESTIC BUILDING SERVICES SYSTEMS			
SPACE HEATING & DHW	Space heating and hot water will be provided by individual condensing gas-fired boilers SEDBUK 2009 efficiency: 88.6%		
HEATING CONTROLS	- Programmer, Thermostat & TRVs - Boiler interlock		
WATER CONSUMPTION	Dwellings designed to achieve a water use target less than 125 litres/person/day		
MECHANICAL VENTILATION	Whole house balanced mechanical ventilation with heat recovery (Approved installation scheme) with summer bypass		
	No. of wet fans (excl. kitchen)	SFP (W/l/s)	Efficiency (%)
	1	0.42	91%
	3	0.52	90%
LIGHTING	All light fittings will be dedicated low energy types i.e. LED fittings		

Table 7 Non-domestic building services systems (Shell & Core)

BUILDING SERVICES SYSTEMS (SHELL & CORE)		
HEATING & COOLING SYSTEMS	A Variable Refrigerant Flow (VRF) system, utilising reverse cycle heat pumps, will provide cooling and heating to the Class E unit. SCOP 3.0 / SEER 4.0	
DOMESTIC HOT WATER	Point of use direct electric heaters (100% efficiency)	
MECHANICAL VENTILATION	Central AHU	AHU SFP: 1.6 W/l/s
	Heat Recovery	75% efficiency
METERING	All systems and lighting systems have provision for metering	
POWER FACTOR	> 0.95	
LIGHTING (SHELL & CORE)		
LIGHTING EFFICACY & CONTROLS	General Lighting	80 Luminaire lm/W Daylight sensors (Dimming/Addressable)
	Display Lighting	22 Lamp lm/W Time switch

SAVINGS FROM 'BE LEAN' MEASURES

After implementing all the passive and active energy efficiency measures listed above, the carbon dioxide emissions of the proposed scheme are reduced by 4% and 7% for the domestic and non-domestic elements respectively. Subsequently, the reduction in Fabric Energy Efficiency of the domestic elements is 1%, as the following table demonstrates.

Table 8 Carbon Dioxide emissions reduction – Lean Stage

Regulated Carbon dioxide emissions (Tonnes CO_2 per annum)	Domestic	Non-Domestic
GLA Baseline Emissions	8.5	2.9
Be Lean: After energy demand reduction	8.2	2.7
Carbon Savings over Baseline	0.3	0.2
Carbon Reduction over Baseline	4%	7%

Table 9 Dwellings Fabric Energy Efficiency

Fabric Energy Efficiency (kWh/sqm per annum)	Dwellings
Part L1A Target Fabric Energy Efficiency (TFEE) Rate	53.8
Area-weighted average Dwelling Fabric Energy Efficiency (DFEE) Rate	53.1
Improvement over Part L1A 2013 TFEE	1.3%

4.6 OVERHEATING AND COOLING ASSESSMENT

The project design has followed the overheating and cooling hierarchy described in the London Plan Policy 5.9 Overheating and Cooling. The cooling hierarchy has been addressed to reduce potential overheating risk and reduce demand for active cooling.

Measures to eliminate the risk of overheating have been considered and integrated in the design of the apartments. The following will be applied along with the passive measure proposed to maintain thermal comfort during summer within the main living areas of the units:

- Openable windows to allow for natural cross ventilation. Windows can be left open during the night in hot summer periods to allow for night-time cooling for cooling down the structure by taking advantage of the lower external temperatures.
- Well insulated thermal envelope for preventing heat transfer during heat waves.
- High performance windows of low g-value combined with the shading effect of balconies for reducing solar gains.
- When required, additional flow rates can be provided through whole house mechanical ventilation, bypassing heat recovery.
- Tenants will be advised to purchase A-rated appliances of low energy consumption to reduce internal heat gains.
- Energy efficiency light fittings that emit less heat than standard types thus reducing overheating will be also specified.

4.7 NON-REGULATED ENERGY USE

Camden's Local Plan requires that the energy demand and carbon dioxide emissions of the non-regulated end uses should also be calculated and reported as part of the energy assessment.

In accordance with BRE SAP calculation and NCM methodology for estimating the non-regulated carbon emissions, the total carbon emissions from non-regulated energy are 8.4 $tnCO_2$ and 0.8 $tnCO_2$ for the residential units and the non-domestic elements of the scheme respectively.

The following strategies are proposed to reduce the non-regulated energy demand of the development:

- Information on energy efficiency of appliances will be provided to the future tenants along with recommendations on how to save energy by responsible behaviour.
- Within the flats, the kitchens will be fitted out with highly efficient A-rated appliances or alternatively information about high efficiency units will be provided to future owners.
- Installation of energy meters with display monitors for each flat. This will encourage the occupants to become more interested and involved in how energy is being used in their flat.

- Information will be provided to occupants which will explain the operations of the installed systems and PV panels and how energy efficient behaviour can reduce the cost/carbon emissions of the development.

It is estimated that proposed strategies may reduce the unregulated carbon emission by at least 10%. However, at this stage, this can only be an assumption as small power consumption depends mainly on occupant's behaviour.

4.8 BE CLEAN – SUPPLYING LOW CARBON ENERGY

As required by Camden's Local Plan, connection to existing district heat networks and incorporation of communal heating system in the buildings have been considered for the scheme.

DISTRICT ENERGY NETWORK

According to the London Heat Map (Figure 4) there is no existing district heating system currently available in close proximity to the site and this is not within a Heat Network Priority Area.

COMBINED HEAT AND POWER (CHP)

Installation of a Combined Heat and Power unit for the scheme has also been considered. According to the GLA guidance in relation to CHPs, due to the ongoing decarbonisation of the grid the carbon savings achieved from gas-engine CHP, has diminished. Accounting also for the potential impact of the technology on air quality, the option of utilising a CHP unit has been disregarded.

Due to the scale of the scheme and its low heating demand throughout the year, individual gas-fired boilers are proposed for each flat.

4.9 BE GREEN- RENEWABLE ENERGY TECHNOLOGIES

In order to further reduce emissions from the development in accordance with Camden's Local Plan and London Plan Energy Hierarchy, it is necessary to consider the introduction of renewable energy systems on site. A high-level assessment of the following renewable technologies was carried out as part of the feasibility study:

- Biomass Boilers;
- Wind Turbines;
- Heat Pumps (Ground/Water/Air);
- Solar Hot Water Heating;
- Photovoltaic panels.

Photovoltaic (PV) panels and Air Source Heat Pumps (ASHPs) were identified as the most appropriate technology for dwellings and the Class E unit respectively. Appendix A of this report provides brief commentary on the technologies not considered appropriate for the scheme.

PHOTOVOLTAIC (PV) PANELS

Installation of Photovoltaic panels on the roof has been considered. As there are no taller buildings or other topographical features in close proximity that could overshadow the roof, the installed PV panels would receive maximum solar energy throughout the day.

The proposed configuration of the PV array should allow enough space between the panels to avoid overshadowing during winter when the sun is at its lowest altitude (minimum 1m). A distance of at least 1m should be kept from the roof edge to provide access and address safety issues during installation and maintenance but also avoid the higher wind loads occurring closer to the roof edge and reduce the impact of wind uplift.

The details of the proposed PV panels will be confirmed at the detailed design stage by a Microgeneration Certification Scheme (MCS) accredited body responsible for design and installation of the PV array.

Table 10 Proposed Renewable Energy Technology (PV panels)

RENEWABLE ENERGY TECHNOLOGIES		
PHOTOVOLTAIC (PV) PANELS	No.	18
	Power output	4.5 kWp (250Wp per panel)
	Area	29.3 sqm (circa 1.63sqm per panel)
	Orientation	Southeast facing
	Inclination	15 degrees (to allow for self-cleaning)

The energy output of the PV panels, circa 3.7MWh, will be used to meet the demand of the development. PV panels will offer carbon savings of circa 1.9tnCO_2 per year, achieving a further reduction of 23%, in excess of Camden's Local Plan target of 20%.

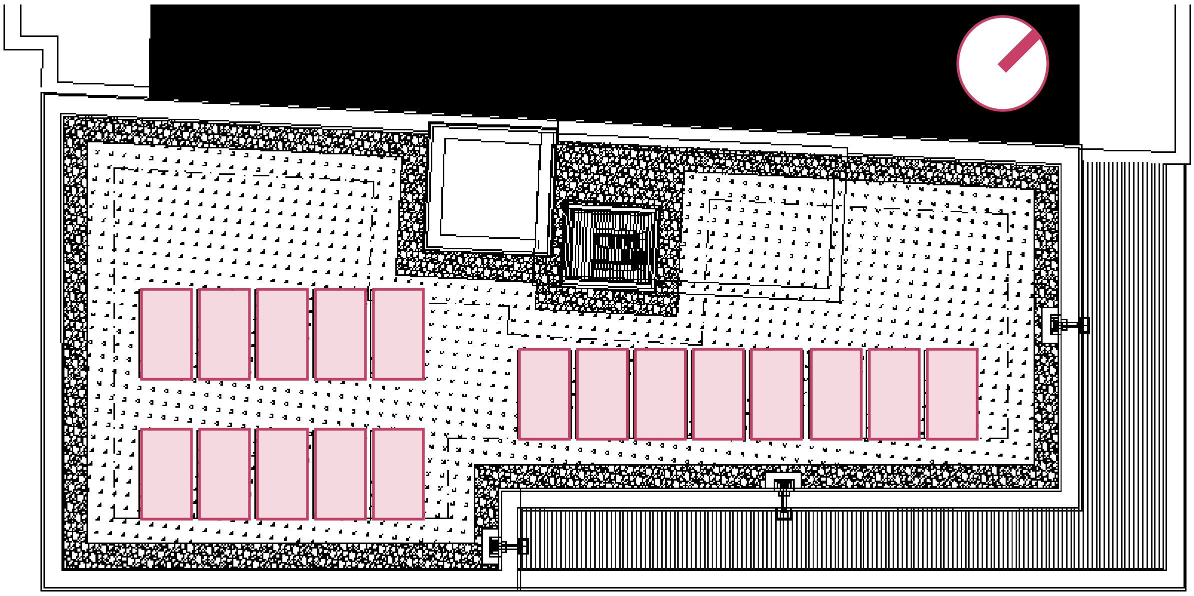


Figure 7 Indicative PV array

AIR SOURCE HEAT PUMP

A VRF system comprising an Air-Source Heat Pump is proposed for the Class E unit to provide space heating and comfort cooling.

Table 11 Class E unit (Shell & Core)

RENEWABLE ENERGY TECHNOLOGIES		
AIR SOURCE HEAT PUMP (ASHP)	SCOP	3.0
	SEER	4.0

The following table presents the carbon savings achieved after proposing renewable energy technologies on site.

Table 12 Carbon Dioxide emissions reduction for the development

Regulated Carbon dioxide emissions (Tonnes CO_2 per annum)	Domestic	Non-Domestic
GLA Baseline Emissions	8.5	2.9
Be Lean: After energy demand reduction	8.2	2.7
Be Clean: After heat network / CHP	8.2	2.7
Be Green: After renewable energy technologies	6.3	2.7
Carbon Savings over Clean stage	1.9	0.1
Carbon Reduction over Clean stage	23%	3%

5. CONCLUSION

This Energy Statement outlines the key features and strategies adopted by the development team to reduce energy use and carbon emissions for the scheme and demonstrate compliance with the London Borough of Camden Climate Change Mitigation and Adaptation Policies.

The strategy for reducing energy use and associated carbon emissions through the design of the scheme follows a three-step approach in line with the London Plan Energy Hierarchy.

- Reducing the energy demand through passive design strategies and provision of high-quality building envelope;
- Reducing the energy consumption through best practice design of building services, lighting and controls; and,
- Installation of on-site renewable energy technologies.

Passive and active energy efficiency features include:

- Building fabric of high thermal performance, in terms of U-values and air tightness, and use of Accredited Construction Details;
- Building services systems of high efficiency, including condensing boilers and MVHR units, and light fitting of low energy types;
- Photovoltaic (PV) panels will be installed to generate renewable energy on site.

Following the proposed energy strategy, the new-built residential units achieve significant carbon savings over the Target Emission Rate (TER) set by Part L of current Building Regulations, in line with the Council's carbon reduction target i.e. a 19% reduction over 2013 TER.

Table 13demonstrates the overall reduction in the regulated carbon emission of the development after each stage of the London Plan Energy Hierarchy.

Table 13 Regulated carbon dioxide emissions after each stage of the energy hierarchy for domestic buildings

	Regulated domestic carbon dioxide emissions (Tonnes CO2 per annum)
Baseline CO2 emissions (Part L 2013 of the Building Regulations Compliant Development)	8.5
CO2 emissions after energy demand reduction (be lean)	8.2
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean)	8.2
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean) AND renewable energy (be green)	6.3

Table 14demonstrates the total regulated CO_2 savings from each stage of the Energy Hierarchy. As demonstrated below, an overall 26% reduction in carbon emissions can be achieved over Part L 2013 TER when applying the proposed strategy, which exceeds the carbon reduction target set in the Camden Local Plan.

Table 14 Regulated carbon dioxide savings from each stage of the energy hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: Savings from energy demand reduction	0.3	4%
Be clean: Savings from heat network	0.0	0%
Be green: Savings from renewable energy	1.9	23%
Cumulative on-site savings	2.2	26%

The energy performance of the Class E unit on the ground floor has been also assessed. The following sections show that compliance with Part L of the 2013 Building Regulations is achieved.

Figure 1 below illustrates the total carbon savings achieved for the domestic elements of the scheme at each stage of the London Plan Energy Hierarchy for 238 Kilburn High Road. Overall, the apartments exceed the 19% carbon reduction required by the Camden Council.

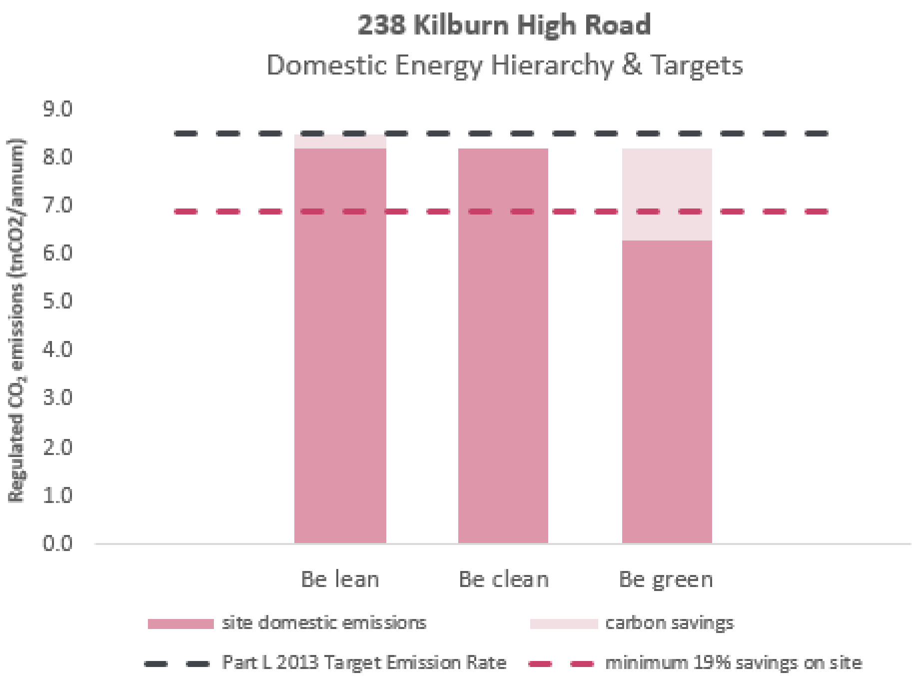


Figure 8 Total carbon savings achieved over Baseline Emissions

APPENDIX A. LOW/ZERO CARBON TECHNOLOGIES

- **BIOMASS BOILER**

A biomass boiler works effectively against a consistent heating load, however, adequate space dedicated for storing the fuel is required. Within inner London areas, there are concerns about the effect of small scale biomass systems on air-quality particularly with respect to particulates released through the boiler flue. For this reason, we would not recommend a biomass boiler for this development.

- **WIND TURBINES**

Wind turbines' performance in urban areas is normally not very good and unpredictable due to turbulences on air movement caused by the surrounding built environment. Wind turbines may also raise issues due to noise disturbance and their visual impact. Therefore, this technology is not suitable for this site.

- **GROUND SOURCE HEAT PUMP**

Ground source heat pumps have been considered for the development. With a closed loop borehole system, it would be possible to drop loops beneath the proposed extension. However, given that the heating demand for this development is low, the cost of installing a ground source heat pump would not make this system financially viable. Therefore, given that a ground source system would be complex, technically risky, costly and deliver limited carbon emissions savings, we would not recommend this approach for the development.

- **SOLAR HOT WATER HEATING**

Solar thermal hot water systems can work well on residential developments. However, compared to PV panels, they require higher maintenance and more space inside the apartments for risers and hot water storage. Therefore, we would recommend that the available roof space is utilised for the installation of a PV array.

APPENDIX B. TER WORKSHEETS

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Lean-First Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.18	(1a) x	2.5	(2a) =	125.45	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.18	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	125.45	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.16	(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)	0.41	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

TER WorkSheet: New dwelling design stage

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

0.37	0.36	0.35	0.32	0.31	0.27	0.27	0.27	0.29	0.31	0.32	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			2.77	x1/[1/(1.4)+ 0.04]		=	3.67			(27)
Windows Type 2			2.77	x1/[1/(1.4)+ 0.04]		=	3.67			(27)
Windows Type 3			1.7	x1/[1/(1.4)+ 0.04]		=	2.25			(27)
Windows Type 4			1.45	x1/[1/(1.4)+ 0.04]		=	1.92			(27)
Windows Type 5			1.7	x1/[1/(1.4)+ 0.04]		=	2.25			(27)
Floor			50.18	x	0.13	=	6.5234			(28)
Walls Type1	53.68	10.39	43.29	x	0.18	=	7.79			(29)
Walls Type2	14.73	0	14.73	x	0.18	=	2.65			(29)
Walls Type3	3.34	2.15	1.19	x	0.18	=	0.21			(29)
Total area of elements, m²			121.93							(31)
Party wall			22.09	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.11 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10852.79 (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 14.45 (36)

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

TER WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 47.55 (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=	23.46	23.36	23.25	22.76	22.66	22.23	22.23	22.15	22.4	22.66	22.85	23.05	(38)

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

(39)m=	71.02	70.91	70.8	70.31	70.22	69.79	69.79	69.71	69.95	70.22	70.4	70.6	

Average = $Sum(39)_{1...12}$ /12= 70.31 (39)

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

(40)m=	1.42	1.41	1.41	1.4	1.4	1.39	1.39	1.39	1.39	1.4	1.4	1.41	

Average = $Sum(40)_{1...12}$ /12= 1.4 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.47 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	81.91	78.93	75.96	72.98	70	67.02	67.02	70	72.98	75.96	78.93	81.91	

Total = $Sum(44)_{1...12}$ = 893.59 (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=	121.47	106.24	109.63	95.58	91.71	79.14	73.33	84.15	85.16	99.24	108.33	117.64	

Total = $Sum(45)_{1...12}$ = 1171.64 (45)

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

(46)m=	18.22	15.94	16.44	14.34	13.76	11.87	11	12.62	12.77	14.89	16.25	17.65	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

TER WorkSheet: New dwelling design stage

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=	41.74	36.33	38.71	35.99	35.67	33.05	34.15	35.67	35.99	38.71	38.93	41.74	(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=	163.22	142.57	148.34	131.57	127.38	112.19	107.49	119.82	121.15	137.95	147.26	159.38	(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=	163.22	142.57	148.34	131.57	127.38	112.19	107.49	119.82	121.15	137.95	147.26	159.38

Output from water heater (annual)1…12 — 1618.31 (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=	50.83	44.41	46.13	40.78	39.41	34.58	32.92	36.9	37.31	42.67	45.75	49.55	(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=	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	(66)

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

(67)m=	13.22	11.74	9.55	7.23	5.4	4.56	4.93	6.41	8.6	10.92	12.74	13.59	(67)

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

(68)m=	147.7	149.23	145.37	137.15	126.77	117.02	110.5	108.97	112.83	121.05	131.43	141.18	(68)

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

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(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=	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	(71)

Water heating gains (Table 5)

(72)m=	68.31	66.08	62	56.64	52.97	48.02	44.25	49.59	51.82	57.36	63.54	66.6	(72)

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

(73)m=	280.66	278.49	268.35	252.44	236.58	221.03	211.11	216.4	224.68	240.76	259.15	272.8	(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)	
Northeast 0.9x	0.77	x	1.45	x	11.28	x	0.63	x	0.7	=	5	(75)
Northeast 0.9x	0.77	x	1.45	x	22.97	x	0.63	x	0.7	=	10.18	(75)
Northeast 0.9x	0.77	x	1.45	x	41.38	x	0.63	x	0.7	=	18.34	(75)
Northeast 0.9x	0.77	x	1.45	x	67.96	x	0.63	x	0.7	=	30.11	(75)
Northeast 0.9x	0.77	x	1.45	x	91.35	x	0.63	x	0.7	=	40.48	(75)
Northeast 0.9x	0.77	x	1.45	x	97.38	x	0.63	x	0.7	=	43.15	(75)
Northeast 0.9x	0.77	x	1.45	x	91.1	x	0.63	x	0.7	=	40.37	(75)
Northeast 0.9x	0.77	x	1.45	x	72.63	x	0.63	x	0.7	=	32.18	(75)
Northeast 0.9x	0.77	x	1.45	x	50.42	x	0.63	x	0.7	=	22.34	(75)
Northeast 0.9x	0.77	x	1.45	x	28.07	x	0.63	x	0.7	=	12.44	(75)
Northeast 0.9x	0.77	x	1.45	x	14.2	x	0.63	x	0.7	=	6.29	(75)
Northeast 0.9x	0.77	x	1.45	x	9.21	x	0.63	x	0.7	=	4.08	(75)
Southeast 0.9x	0.77	x	2.77	x	36.79	x	0.63	x	0.7	=	31.15	(77)
Southeast 0.9x	0.77	x	2.77	x	36.79	x	0.63	x	0.7	=	31.15	(77)
Southeast 0.9x	0.77	x	1.7	x	36.79	x	0.63	x	0.7	=	19.12	(77)
Southeast 0.9x	0.77	x	1.7	x	36.79	x	0.63	x	0.7	=	19.12	(77)
Southeast 0.9x	0.77	x	2.77	x	62.67	x	0.63	x	0.7	=	53.06	(77)
Southeast 0.9x	0.77	x	2.77	x	62.67	x	0.63	x	0.7	=	53.06	(77)
Southeast 0.9x	0.77	x	1.7	x	62.67	x	0.63	x	0.7	=	32.56	(77)
Southeast 0.9x	0.77	x	1.7	x	62.67	x	0.63	x	0.7	=	32.56	(77)
Southeast 0.9x	0.77	x	2.77	x	85.75	x	0.63	x	0.7	=	72.59	(77)
Southeast 0.9x	0.77	x	2.77	x	85.75	x	0.63	x	0.7	=	72.59	(77)
Southeast 0.9x	0.77	x	1.7	x	85.75	x	0.63	x	0.7	=	44.55	(77)
Southeast 0.9x	0.77	x	1.7	x	85.75	x	0.63	x	0.7	=	44.55	(77)
Southeast 0.9x	0.77	x	2.77	x	106.25	x	0.63	x	0.7	=	89.95	(77)
Southeast 0.9x	0.77	x	2.77	x	106.25	x	0.63	x	0.7	=	89.95	(77)
Southeast 0.9x	0.77	x	1.7	x	106.25	x	0.63	x	0.7	=	55.2	(77)
Southeast 0.9x	0.77	x	1.7	x	106.25	x	0.63	x	0.7	=	55.2	(77)
Southeast 0.9x	0.77	x	2.77	x	119.01	x	0.63	x	0.7	=	100.75	(77)
Southeast 0.9x	0.77	x	2.77	x	119.01	x	0.63	x	0.7	=	100.75	(77)
Southeast 0.9x	0.77	x	1.7	x	119.01	x	0.63	x	0.7	=	61.83	(77)
Southeast 0.9x	0.77	x	1.7	x	119.01	x	0.63	x	0.7	=	61.83	(77)
Southeast 0.9x	0.77	x	2.77	x	118.15	x	0.63	x	0.7	=	100.02	(77)
Southeast 0.9x	0.77	x	2.77	x	118.15	x	0.63	x	0.7	=	100.02	(77)
Southeast 0.9x	0.77	x	1.7	x	118.15	x	0.63	x	0.7	=	61.38	(77)
Southeast 0.9x	0.77	x	1.7	x	118.15	x	0.63	x	0.7	=	61.38	(77)
Southeast 0.9x	0.77	x	2.77	x	113.91	x	0.63	x	0.7	=	96.43	(77)
Southeast 0.9x	0.77	x	2.77	x	113.91	x	0.63	x	0.7	=	96.43	(77)
Southeast 0.9x	0.77	x	1.7	x	113.91	x	0.63	x	0.7	=	59.18	(77)

Southeast 0.9x	0.77	x	1.7	x	113.91	x	0.63	x	0.7	=	59.18	(77)
Southeast 0.9x	0.77	x	2.77	x	104.39	x	0.63	x	0.7	=	88.37	(77)
Southeast 0.9x	0.77	x	2.77	x	104.39	x	0.63	x	0.7	=	88.37	(77)
Southeast 0.9x	0.77	x	1.7	x	104.39	x	0.63	x	0.7	=	54.24	(77)
Southeast 0.9x	0.77	x	1.7	x	104.39	x	0.63	x	0.7	=	54.24	(77)
Southeast 0.9x	0.77	x	2.77	x	92.85	x	0.63	x	0.7	=	78.6	(77)
Southeast 0.9x	0.77	x	2.77	x	92.85	x	0.63	x	0.7	=	78.6	(77)
Southeast 0.9x	0.77	x	1.7	x	92.85	x	0.63	x	0.7	=	48.24	(77)
Southeast 0.9x	0.77	x	1.7	x	92.85	x	0.63	x	0.7	=	48.24	(77)
Southeast 0.9x	0.77	x	2.77	x	69.27	x	0.63	x	0.7	=	58.64	(77)
Southeast 0.9x	0.77	x	2.77	x	69.27	x	0.63	x	0.7	=	58.64	(77)
Southeast 0.9x	0.77	x	1.7	x	69.27	x	0.63	x	0.7	=	35.99	(77)
Southeast 0.9x	0.77	x	1.7	x	69.27	x	0.63	x	0.7	=	35.99	(77)
Southeast 0.9x	0.77	x	2.77	x	44.07	x	0.63	x	0.7	=	37.31	(77)
Southeast 0.9x	0.77	x	2.77	x	44.07	x	0.63	x	0.7	=	37.31	(77)
Southeast 0.9x	0.77	x	1.7	x	44.07	x	0.63	x	0.7	=	22.9	(77)
Southeast 0.9x	0.77	x	1.7	x	44.07	x	0.63	x	0.7	=	22.9	(77)
Southeast 0.9x	0.77	x	2.77	x	31.49	x	0.63	x	0.7	=	26.66	(77)
Southeast 0.9x	0.77	x	2.77	x	31.49	x	0.63	x	0.7	=	26.66	(77)
Southeast 0.9x	0.77	x	1.7	x	31.49	x	0.63	x	0.7	=	16.36	(77)
Southeast 0.9x	0.77	x	1.7	x	31.49	x	0.63	x	0.7	=	16.36	(77)

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

(83)m=	105.53	181.41	252.63	320.41	365.64	365.96	351.59	317.4	276.03	201.69	126.7	90.11	(83)

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

(84)m=	386.19	459.9	520.98	572.86	602.21	586.99	562.7	533.79	500.71	442.45	385.85	362.92	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.93	0.84	0.69	0.53	0.57	0.8	0.95	0.99	1	(86)

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

(87)m=	19.57	19.77	20.07	20.43	20.74	20.92	20.98	20.97	20.85	20.45	19.93	19.53	(87)

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

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

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

(89)m=	0.99	0.98	0.96	0.91	0.79	0.58	0.39	0.43	0.71	0.93	0.98	0.99	(89)

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

(90)m=	17.88	18.18	18.61	19.12	19.52	19.72	19.76	19.76	19.66	19.15	18.42	17.83	(90)

fLA = Living area ÷ (4) = 0.48 (91)

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

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(92)m=	18.7	18.95	19.31	19.75	20.11	20.3	20.35	20.35	20.23	19.78	19.15	18.64	(92)

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

(93)m=	18.7	18.95	19.31	19.75	20.11	20.3	20.35	20.35	20.23	19.78	19.15	18.64	(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	0.91	0.8	0.63	0.46	0.5	0.74	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	382.41	450.66	499.18	519.68	483.86	370.62	256.54	267.24	372.76	410.68	378.63	360.13	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1022.31	996.1	907.29	763.14	590.35	397.85	261.72	275	428.92	644.3	848.25	1019.8	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	476.09	366.54	303.63	175.29	79.23	0	0	0	0	173.82	338.13	490.8	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2403.53 (98)

Space heating requirement in kWh/m²/year 47.9 (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		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	476.09	366.54	303.63	175.29	79.23	0	0	0	0	173.82	338.13	490.8	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	509.73	392.44	325.09	187.68	84.83	0	0	0	0	186.1	362.03	525.48	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2573.37 (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)													
	163.22	142.57	148.34	131.57	127.38	112.19	107.49	119.82	121.15	137.95	147.26	159.38	
Efficiency of water heater												80.3	(216)
(217)m=	87.59	87.32	86.82	85.77	83.89	80.3	80.3	80.3	80.3	85.63	87.08	87.7	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	186.35	163.27	170.86	153.39	151.84	139.71	133.86	149.22	150.87	161.09	169.11	181.74	

Total = Sum(219a)$_{1...12}$ = 1911.3 (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			2573.37	
Water heating fuel used			1911.3	
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			233.43	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4793.11	(338)

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	=	555.85	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	412.84	(264)
Space and water heating	(261) + (262) + (263) + (264) =				968.69	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	121.15	(268)
Total CO2, kg/year			sum of (265)…(271) =		1128.77	(272)

TER = 22.49 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Lean-Second Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	61.28	(1a) x	2.5	(2a) =	153.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.28	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	153.2	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(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		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31

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

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

(25)m=	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.54	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			1.43		x1/[1/(1.4)+ 0.04]	=	1.9			(27)
Windows Type 2			1.43		x1/[1/(1.4)+ 0.04]	=	1.9			(27)
Windows Type 3			1.43		x1/[1/(1.4)+ 0.04]	=	1.9			(27)
Windows Type 4			1.43		x1/[1/(1.4)+ 0.04]	=	1.9			(27)
Windows Type 5			2.36		x1/[1/(1.4)+ 0.04]	=	3.13			(27)
Windows Type 6			1.43		x1/[1/(1.4)+ 0.04]	=	1.9			(27)
Windows Type 7			2.36		x1/[1/(1.4)+ 0.04]	=	3.13			(27)
Windows Type 8			1.27		x1/[1/(1.4)+ 0.04]	=	1.68			(27)
Walls Type1	59.88	13.14	46.74	x	0.18	=	8.41			(29)
Walls Type2	5.48	0	5.48	x	0.18	=	0.99			(29)
Walls Type3	16.37	2.15	14.22	x	0.18	=	2.56			(29)
Total area of elements, m²			81.73							(31)
Party wall			24.18	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 31.53 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7799.88 (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 | 6.59 | (36)

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

Total fabric heat loss (33) + (36) = | 38.12 | (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=	28.19	28.08	27.97	27.45	27.35	26.9	26.9	26.81	27.07	27.35	27.55	27.75	(38)

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

(39)m=	66.31	66.2	66.09	65.56	65.47	65.01	65.01	64.93	65.19	65.47	65.66	65.87	

Average = Sum(39)1…12 /12= | 65.56 | (39)

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

(40)m=	1.08	1.08	1.08	1.07	1.07	1.06	1.06	1.06	1.06	1.07	1.07	1.07	

Average = Sum(40)1…12 /12= | 1.07 | (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 | 2.02 | (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 | 82.12 | (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	90.33	87.04	83.76	80.48	77.19	73.91	73.91	77.19	80.48	83.76	87.04	90.33	

Total = Sum(44)1…12 = | 985.41 | (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=	133.96	117.16	120.9	105.4	101.13	87.27	80.87	92.8	93.91	109.44	119.46	129.73	

Total = Sum(45)1…12 = | 1292.03 | (45)

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

(46)m=	20.09	17.57	18.13	15.81	15.17	13.09	12.13	13.92	14.09	16.42	17.92	19.46	(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=	46.03	40.06	42.68	39.69	39.34	36.45	37.66	39.34	39.69	42.68	42.93	46.03	(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=	179.99	157.22	163.58	145.09	140.47	123.72	118.53	132.14	133.59	152.12	162.39	175.76	(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=	179.99	157.22	163.58	145.09	140.47	123.72	118.53	132.14	133.59	152.12	162.39	175.76

Output from water heater (annual)$_{1...12}$ 1784.6 (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=	56.05	48.97	50.87	44.97	43.46	38.13	36.3	40.69	41.15	47.06	50.45	54.64	(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=	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	(66)

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

(67)m=	15.73	13.97	11.36	8.6	6.43	5.43	5.86	7.62	10.23	12.99	15.16	16.16	(67)

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

(68)m=	176.16	177.99	173.38	163.58	151.2	139.56	131.79	129.96	134.57	144.38	156.76	168.39	(68)

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

(69)m=	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	(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=	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	(71)

Water heating gains (Table 5)

(72)m=	75.33	72.87	68.37	62.45	58.42	52.96	48.8	54.69	57.15	63.25	70.07	73.44	(72)

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

(73)m=	323.49	321.1	309.38	290.9	272.31	254.21	242.72	248.54	258.21	276.88	298.26	314.26	(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)	
Northeast 0.9x	0.77	x	1.27	x	11.28	x	0.63	x	0.7	=	4.38	(75)
Northeast 0.9x	0.77	x	1.27	x	22.97	x	0.63	x	0.7	=	8.91	(75)
Northeast 0.9x	0.77	x	1.27	x	41.38	x	0.63	x	0.7	=	16.06	(75)
Northeast 0.9x	0.77	x	1.27	x	67.96	x	0.63	x	0.7	=	26.38	(75)
Northeast 0.9x	0.77	x	1.27	x	91.35	x	0.63	x	0.7	=	35.45	(75)
Northeast 0.9x	0.77	x	1.27	x	97.38	x	0.63	x	0.7	=	37.8	(75)
Northeast 0.9x	0.77	x	1.27	x	91.1	x	0.63	x	0.7	=	35.36	(75)
Northeast 0.9x	0.77	x	1.27	x	72.63	x	0.63	x	0.7	=	28.19	(75)
Northeast 0.9x	0.77	x	1.27	x	50.42	x	0.63	x	0.7	=	19.57	(75)
Northeast 0.9x	0.77	x	1.27	x	28.07	x	0.63	x	0.7	=	10.89	(75)
Northeast 0.9x	0.77	x	1.27	x	14.2	x	0.63	x	0.7	=	5.51	(75)
Northeast 0.9x	0.77	x	1.27	x	9.21	x	0.63	x	0.7	=	3.58	(75)
Southeast 0.9x	0.77	x	1.43	x	36.79	x	0.63	x	0.7	=	16.08	(77)
Southeast 0.9x	0.77	x	2.36	x	36.79	x	0.63	x	0.7	=	26.54	(77)
Southeast 0.9x	0.77	x	1.43	x	36.79	x	0.63	x	0.7	=	16.08	(77)
Southeast 0.9x	0.77	x	2.36	x	36.79	x	0.63	x	0.7	=	26.54	(77)
Southeast 0.9x	0.77	x	1.43	x	62.67	x	0.63	x	0.7	=	27.39	(77)
Southeast 0.9x	0.77	x	2.36	x	62.67	x	0.63	x	0.7	=	45.2	(77)
Southeast 0.9x	0.77	x	1.43	x	62.67	x	0.63	x	0.7	=	27.39	(77)
Southeast 0.9x	0.77	x	2.36	x	62.67	x	0.63	x	0.7	=	45.2	(77)
Southeast 0.9x	0.77	x	1.43	x	85.75	x	0.63	x	0.7	=	37.48	(77)
Southeast 0.9x	0.77	x	2.36	x	85.75	x	0.63	x	0.7	=	61.85	(77)
Southeast 0.9x	0.77	x	1.43	x	85.75	x	0.63	x	0.7	=	37.48	(77)
Southeast 0.9x	0.77	x	2.36	x	85.75	x	0.63	x	0.7	=	61.85	(77)
Southeast 0.9x	0.77	x	1.43	x	106.25	x	0.63	x	0.7	=	46.43	(77)
Southeast 0.9x	0.77	x	2.36	x	106.25	x	0.63	x	0.7	=	76.63	(77)
Southeast 0.9x	0.77	x	1.43	x	106.25	x	0.63	x	0.7	=	46.43	(77)
Southeast 0.9x	0.77	x	2.36	x	106.25	x	0.63	x	0.7	=	76.63	(77)
Southeast 0.9x	0.77	x	1.43	x	119.01	x	0.63	x	0.7	=	52.01	(77)
Southeast 0.9x	0.77	x	2.36	x	119.01	x	0.63	x	0.7	=	85.84	(77)
Southeast 0.9x	0.77	x	1.43	x	119.01	x	0.63	x	0.7	=	52.01	(77)
Southeast 0.9x	0.77	x	2.36	x	119.01	x	0.63	x	0.7	=	85.84	(77)
Southeast 0.9x	0.77	x	1.43	x	118.15	x	0.63	x	0.7	=	51.63	(77)
Southeast 0.9x	0.77	x	2.36	x	118.15	x	0.63	x	0.7	=	85.22	(77)
Southeast 0.9x	0.77	x	1.43	x	118.15	x	0.63	x	0.7	=	51.63	(77)
Southeast 0.9x	0.77	x	2.36	x	118.15	x	0.63	x	0.7	=	85.22	(77)
Southeast 0.9x	0.77	x	1.43	x	113.91	x	0.63	x	0.7	=	49.78	(77)
Southeast 0.9x	0.77	x	2.36	x	113.91	x	0.63	x	0.7	=	82.16	(77)
Southeast 0.9x	0.77	x	1.43	x	113.91	x	0.63	x	0.7	=	49.78	(77)

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Southeast	0.9x	0.77	x	2.36	x	113.91	x	0.63	x	0.7	=	82.16	(77)
Southeast	0.9x	0.77	x	1.43	x	104.39	x	0.63	x	0.7	=	45.62	(77)
Southeast	0.9x	0.77	x	2.36	x	104.39	x	0.63	x	0.7	=	75.29	(77)
Southeast	0.9x	0.77	x	1.43	x	104.39	x	0.63	x	0.7	=	45.62	(77)
Southeast	0.9x	0.77	x	2.36	x	104.39	x	0.63	x	0.7	=	75.29	(77)
Southeast	0.9x	0.77	x	1.43	x	92.85	x	0.63	x	0.7	=	40.58	(77)
Southeast	0.9x	0.77	x	2.36	x	92.85	x	0.63	x	0.7	=	66.97	(77)
Southeast	0.9x	0.77	x	1.43	x	92.85	x	0.63	x	0.7	=	40.58	(77)
Southeast	0.9x	0.77	x	2.36	x	92.85	x	0.63	x	0.7	=	66.97	(77)
Southeast	0.9x	0.77	x	1.43	x	69.27	x	0.63	x	0.7	=	30.27	(77)
Southeast	0.9x	0.77	x	2.36	x	69.27	x	0.63	x	0.7	=	49.96	(77)
Southeast	0.9x	0.77	x	1.43	x	69.27	x	0.63	x	0.7	=	30.27	(77)
Southeast	0.9x	0.77	x	2.36	x	69.27	x	0.63	x	0.7	=	49.96	(77)
Southeast	0.9x	0.77	x	1.43	x	44.07	x	0.63	x	0.7	=	19.26	(77)
Southeast	0.9x	0.77	x	2.36	x	44.07	x	0.63	x	0.7	=	31.79	(77)
Southeast	0.9x	0.77	x	1.43	x	44.07	x	0.63	x	0.7	=	19.26	(77)
Southeast	0.9x	0.77	x	2.36	x	44.07	x	0.63	x	0.7	=	31.79	(77)
Southeast	0.9x	0.77	x	1.43	x	31.49	x	0.63	x	0.7	=	13.76	(77)
Southeast	0.9x	0.77	x	2.36	x	31.49	x	0.63	x	0.7	=	22.71	(77)
Southeast	0.9x	0.77	x	1.43	x	31.49	x	0.63	x	0.7	=	13.76	(77)
Southeast	0.9x	0.77	x	2.36	x	31.49	x	0.63	x	0.7	=	22.71	(77)
Southwest	0.9x	0.77	x	1.43	x	36.79		0.63	x	0.7	=	16.08	(79)
Southwest	0.9x	0.77	x	1.43	x	36.79		0.63	x	0.7	=	16.08	(79)
Southwest	0.9x	0.77	x	1.43	x	36.79		0.63	x	0.7	=	16.08	(79)
Southwest	0.9x	0.77	x	1.43	x	62.67		0.63	x	0.7	=	27.39	(79)
Southwest	0.9x	0.77	x	1.43	x	62.67		0.63	x	0.7	=	27.39	(79)
Southwest	0.9x	0.77	x	1.43	x	62.67		0.63	x	0.7	=	27.39	(79)
Southwest	0.9x	0.77	x	1.43	x	85.75		0.63	x	0.7	=	37.48	(79)
Southwest	0.9x	0.77	x	1.43	x	85.75		0.63	x	0.7	=	37.48	(79)
Southwest	0.9x	0.77	x	1.43	x	85.75		0.63	x	0.7	=	37.48	(79)
Southwest	0.9x	0.77	x	1.43	x	106.25		0.63	x	0.7	=	46.43	(79)
Southwest	0.9x	0.77	x	1.43	x	106.25		0.63	x	0.7	=	46.43	(79)
Southwest	0.9x	0.77	x	1.43	x	106.25		0.63	x	0.7	=	46.43	(79)
Southwest	0.9x	0.77	x	1.43	x	119.01		0.63	x	0.7	=	52.01	(79)
Southwest	0.9x	0.77	x	1.43	x	119.01		0.63	x	0.7	=	52.01	(79)
Southwest	0.9x	0.77	x	1.43	x	119.01		0.63	x	0.7	=	52.01	(79)
Southwest	0.9x	0.77	x	1.43	x	118.15		0.63	x	0.7	=	51.63	(79)
Southwest	0.9x	0.77	x	1.43	x	118.15		0.63	x	0.7	=	51.63	(79)
Southwest	0.9x	0.77	x	1.43	x	118.15		0.63	x	0.7	=	51.63	(79)
Southwest	0.9x	0.77	x	1.43	x	113.91		0.63	x	0.7	=	49.78	(79)
Southwest	0.9x	0.77	x	1.43	x	113.91		0.63	x	0.7	=	49.78	(79)

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Southwest	0.9x	0.77	x	1.43	x	113.91	0.63	x	0.7	=	49.78	(79)
Southwest	0.9x	0.77	x	1.43	x	104.39	0.63	x	0.7	=	45.62	(79)
Southwest	0.9x	0.77	x	1.43	x	104.39	0.63	x	0.7	=	45.62	(79)
Southwest	0.9x	0.77	x	1.43	x	104.39	0.63	x	0.7	=	45.62	(79)
Southwest	0.9x	0.77	x	1.43	x	92.85	0.63	x	0.7	=	40.58	(79)
Southwest	0.9x	0.77	x	1.43	x	92.85	0.63	x	0.7	=	40.58	(79)
Southwest	0.9x	0.77	x	1.43	x	92.85	0.63	x	0.7	=	40.58	(79)
Southwest	0.9x	0.77	x	1.43	x	69.27	0.63	x	0.7	=	30.27	(79)
Southwest	0.9x	0.77	x	1.43	x	69.27	0.63	x	0.7	=	30.27	(79)
Southwest	0.9x	0.77	x	1.43	x	69.27	0.63	x	0.7	=	30.27	(79)
Southwest	0.9x	0.77	x	1.43	x	44.07	0.63	x	0.7	=	19.26	(79)
Southwest	0.9x	0.77	x	1.43	x	44.07	0.63	x	0.7	=	19.26	(79)
Southwest	0.9x	0.77	x	1.43	x	44.07	0.63	x	0.7	=	19.26	(79)
Southwest	0.9x	0.77	x	1.43	x	31.49	0.63	x	0.7	=	13.76	(79)
Southwest	0.9x	0.77	x	1.43	x	31.49	0.63	x	0.7	=	13.76	(79)
Southwest	0.9x	0.77	x	1.43	x	31.49	0.63	x	0.7	=	13.76	(79)

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

(83)m=	137.85	236.27	327.14	411.82	467.18	466.4	448.58	406.88	356.4	262.17	165.38	117.8	(83)

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

(84)m=	461.34	557.37	636.52	702.71	739.49	720.61	691.3	655.42	614.61	539.05	463.64	432.07	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.89	0.75	0.56	0.41	0.45	0.69	0.92	0.99	1	(86)

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

(87)m=	19.99	20.2	20.46	20.74	20.92	20.99	21	21	20.96	20.71	20.29	19.95	(87)

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

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

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

(89)m=	0.99	0.98	0.95	0.86	0.69	0.48	0.32	0.36	0.61	0.89	0.98	0.99	(89)

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

(90)m=	18.69	18.98	19.36	19.74	19.95	20.02	20.03	20.03	20	19.72	19.13	18.63	(90)

fLA = Living area ÷ (4) = 0.45 (91)

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

(92)m=	19.27	19.52	19.85	20.18	20.38	20.45	20.46	20.46	20.43	20.16	19.65	19.22	(92)

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

(93)m=	19.27	19.52	19.85	20.18	20.38	20.45	20.46	20.46	20.43	20.16	19.65	19.22	(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

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Utilisation factor for gains, hm:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(94)m=	0.99	0.98	0.94	0.86	0.71	0.52	0.36	0.4	0.64	0.9	0.98	0.99		(94)

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

(95)m=	456.98	544.18	600.38	606.26	528.55	374.56	250.44	262.58	395.11	483.97	453.86	429.05		(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=	992.68	968.11	882.12	739.74	568.39	380.5	251.14	263.78	412.56	626.02	823.9	989.19		(97)

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

(98)m=	398.56	284.88	209.62	96.11	29.64	0	0	0	0	105.69	266.43	416.74		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1807.66 (98)

Space heating requirement in kWh/m²/year 29.5 (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		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	398.56	284.88	209.62	96.11	29.64	0	0	0	0	105.69	266.43	416.74		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	426.72	305.01	224.43	102.9	31.74	0	0	0	0	113.15	285.25	446.19		(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1935.4 (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)

	179.99	157.22	163.58	145.09	140.47	123.72	118.53	132.14	133.59	152.12	162.39	175.76		

Efficiency of water heater 80.3 (216)

(217)m=	87	86.53	85.68	84.04	81.89	80.3	80.3	80.3	80.3	84.15	86.29	87.15		(217)

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

(219)m=	206.89	181.7	190.93	172.64	171.53	154.07	147.61	164.55	166.37	180.77	188.19	201.68		

Total = Sum(219a)$_{1...12}$ = 2126.92 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1935.4
Water heating fuel used		2126.92
Electricity for pumps, fans and electric keep-hot		

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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			277.76	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4415.07	(338)

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	=	418.05	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	459.42	(264)
Space and water heating	(261) + (262) + (263) + (264) =			877.46	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	144.16	(268)
Total CO2, kg/year		sum of (265)…(271) =		1060.54	(272)

TER =	17.31	(273)

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User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Lean-Top Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	102.92	(1a) x	2.45	(2a) =	252.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	102.92	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	252.15	(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) =	0.16	(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)	0.41	(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) =	0.35	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.44	0.43	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41

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=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(24d)

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

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x 1	= 2.15			(26)
Windows Type 1			1.75	x1/[1/(1.4)+ 0.04]	= 2.32			(27)
Windows Type 2			1.75	x1/[1/(1.4)+ 0.04]	= 2.32			(27)
Windows Type 3			1.75	x1/[1/(1.4)+ 0.04]	= 2.32			(27)
Windows Type 4			1.75	x1/[1/(1.4)+ 0.04]	= 2.32			(27)
Windows Type 5			1.75	x1/[1/(1.4)+ 0.04]	= 2.32			(27)
Windows Type 6			1.75	x1/[1/(1.4)+ 0.04]	= 2.32			(27)
Windows Type 7			1.75	x1/[1/(1.4)+ 0.04]	= 2.32			(27)
Windows Type 8			2.88	x1/[1/(1.4)+ 0.04]	= 3.82			(27)
Windows Type 9			2.88	x1/[1/(1.4)+ 0.04]	= 3.82			(27)
Windows Type 10			2.88	x1/[1/(1.4)+ 0.04]	= 3.82			(27)
Windows Type 11			1.65	x1/[1/(1.4)+ 0.04]	= 2.19			(27)
Windows Type 12			1.06	x1/[1/(1.4)+ 0.04]	= 1.41			(27)
Walls Type1	128.4	23.6	104.8	x 0.18	= 18.86			(29)
Walls Type2	22.83	0	22.83	x 0.18	= 4.11			(29)
Walls Type3	19.21	2.15	17.06	x 0.18	= 3.07			(29)
Roof	102.92	0	102.92	x 0.13	= 13.38			(30)
Total area of elements, m²			273.36					(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 72.86 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	17158.83	(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		38.03	(36)

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

Total fabric heat loss	(33) + (36) =	110.89	(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=	49.77	49.45	49.14	47.68	47.41	46.14	46.14	45.9	46.62	47.41	47.96	48.54	(38)

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

(39)m=	160.66	160.34	160.03	158.57	158.3	157.03	157.03	156.79	157.52	158.3	158.85	159.43	

Average = $Sum(39)_{1…12}$ /12= 158.57 (39)

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

(40)m=	1.56	1.56	1.55	1.54	1.54	1.53	1.53	1.52	1.53	1.54	1.54	1.55	

Average = $Sum(40)_{1…12}$ /12= 1.54 (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 2.76 (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 99.87 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	109.85	105.86	101.87	97.87	93.88	89.88	89.88	93.88	97.87	101.87	105.86	109.85	

Total = $Sum(44)_{1…12}$ = 1198.41 (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=	162.91	142.48	147.03	128.18	123	106.14	98.35	112.86	114.21	133.1	145.29	157.77	

Total = $Sum(45)_{1…12}$ = 1571.31 (45)

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

(46)m=	24.44	21.37	22.05	19.23	18.45	15.92	14.75	16.93	17.13	19.96	21.79	23.67	(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:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If community heating see section 4.3		
Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b	0	(53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)	0	(55)

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

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

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

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

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

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

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

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

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

(61)m=	50.96	46.03	50.96	48.26	47.84	44.32	45.8	47.84	48.26	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=	213.87	188.51	197.99	176.45	170.83	150.46	144.15	160.7	162.47	184.06	194.6	208.73	(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=	213.87	188.51	197.99	176.45	170.83	150.46	144.15	160.7	162.47	184.06	194.6	208.73	

Output from water heater (annual)$_{1...12}$ | 2152.82 | (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=	66.91	58.88	61.63	54.69	52.86	46.37	44.15	49.49	50.04	56.99	60.64	65.2	(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=	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	(66)

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

(67)m=	23.27	20.66	16.8	12.72	9.51	8.03	8.68	11.28	15.14	19.22	22.43	23.91	(67)

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

(68)m=	260.96	263.67	256.85	242.32	223.98	206.75	195.23	192.52	199.35	213.88	232.21	249.45	(68)

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

(69)m=	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	(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=	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	(71)

Water heating gains (Table 5)

(72)m=	89.93	87.62	82.83	75.95	71.04	64.4	59.34	66.51	69.5	76.61	84.22	87.63	(72)

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

(73)m=	441.63	439.43	423.96	398.47	372.01	346.65	330.73	337.79	351.46	377.17	406.34	428.47	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	1.65	x	11.28	x	0.63	x	0.7	=	5.69	(75)
Northeast	0.9x	0.77	x	1.06	x	11.28	x	0.63	x	0.7	=	3.66	(75)
Northeast	0.9x	0.77	x	1.65	x	22.97	x	0.63	x	0.7	=	11.58	(75)
Northeast	0.9x	0.77	x	1.06	x	22.97	x	0.63	x	0.7	=	7.44	(75)
Northeast	0.9x	0.77	x	1.65	x	41.38	x	0.63	x	0.7	=	20.87	(75)
Northeast	0.9x	0.77	x	1.06	x	41.38	x	0.63	x	0.7	=	13.4	(75)
Northeast	0.9x	0.77	x	1.65	x	67.96	x	0.63	x	0.7	=	34.27	(75)
Northeast	0.9x	0.77	x	1.06	x	67.96	x	0.63	x	0.7	=	22.01	(75)
Northeast	0.9x	0.77	x	1.65	x	91.35	x	0.63	x	0.7	=	46.06	(75)
Northeast	0.9x	0.77	x	1.06	x	91.35	x	0.63	x	0.7	=	29.59	(75)
Northeast	0.9x	0.77	x	1.65	x	97.38	x	0.63	x	0.7	=	49.11	(75)
Northeast	0.9x	0.77	x	1.06	x	97.38	x	0.63	x	0.7	=	31.55	(75)
Northeast	0.9x	0.77	x	1.65	x	91.1	x	0.63	x	0.7	=	45.94	(75)
Northeast	0.9x	0.77	x	1.06	x	91.1	x	0.63	x	0.7	=	29.51	(75)
Northeast	0.9x	0.77	x	1.65	x	72.63	x	0.63	x	0.7	=	36.62	(75)
Northeast	0.9x	0.77	x	1.06	x	72.63	x	0.63	x	0.7	=	23.53	(75)
Northeast	0.9x	0.77	x	1.65	x	50.42	x	0.63	x	0.7	=	25.43	(75)
Northeast	0.9x	0.77	x	1.06	x	50.42	x	0.63	x	0.7	=	16.33	(75)
Northeast	0.9x	0.77	x	1.65	x	28.07	x	0.63	x	0.7	=	14.15	(75)
Northeast	0.9x	0.77	x	1.06	x	28.07	x	0.63	x	0.7	=	9.09	(75)
Northeast	0.9x	0.77	x	1.65	x	14.2	x	0.63	x	0.7	=	7.16	(75)
Northeast	0.9x	0.77	x	1.06	x	14.2	x	0.63	x	0.7	=	4.6	(75)
Northeast	0.9x	0.77	x	1.65	x	9.21	x	0.63	x	0.7	=	4.65	(75)
Northeast	0.9x	0.77	x	1.06	x	9.21	x	0.63	x	0.7	=	2.98	(75)
Southeast	0.9x	0.77	x	1.75	x	36.79	x	0.63	x	0.7	=	19.68	(77)
Southeast	0.9x	0.77	x	1.75	x	36.79	x	0.63	x	0.7	=	19.68	(77)
Southeast	0.9x	0.77	x	1.75	x	36.79	x	0.63	x	0.7	=	19.68	(77)
Southeast	0.9x	0.77	x	1.75	x	36.79	x	0.63	x	0.7	=	19.68	(77)
Southeast	0.9x	0.77	x	2.88	x	36.79	x	0.63	x	0.7	=	32.38	(77)
Southeast	0.9x	0.77	x	2.88	x	36.79	x	0.63	x	0.7	=	32.38	(77)
Southeast	0.9x	0.77	x	2.88	x	36.79	x	0.63	x	0.7	=	32.38	(77)
Southeast	0.9x	0.77	x	1.75	x	62.67	x	0.63	x	0.7	=	33.52	(77)
Southeast	0.9x	0.77	x	1.75	x	62.67	x	0.63	x	0.7	=	33.52	(77)
Southeast	0.9x	0.77	x	1.75	x	62.67	x	0.63	x	0.7	=	33.52	(77)

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Southeast	0.9x	0.77	x	1.75	x	62.67	x	0.63	x	0.7	=	33.52	(77)
Southeast	0.9x	0.77	x	2.88	x	62.67	x	0.63	x	0.7	=	55.16	(77)
Southeast	0.9x	0.77	x	2.88	x	62.67	x	0.63	x	0.7	=	55.16	(77)
Southeast	0.9x	0.77	x	2.88	x	62.67	x	0.63	x	0.7	=	55.16	(77)
Southeast	0.9x	0.77	x	1.75	x	85.75	x	0.63	x	0.7	=	45.86	(77)
Southeast	0.9x	0.77	x	1.75	x	85.75	x	0.63	x	0.7	=	45.86	(77)
Southeast	0.9x	0.77	x	1.75	x	85.75	x	0.63	x	0.7	=	45.86	(77)
Southeast	0.9x	0.77	x	1.75	x	85.75	x	0.63	x	0.7	=	45.86	(77)
Southeast	0.9x	0.77	x	2.88	x	85.75	x	0.63	x	0.7	=	75.48	(77)
Southeast	0.9x	0.77	x	2.88	x	85.75	x	0.63	x	0.7	=	75.48	(77)
Southeast	0.9x	0.77	x	2.88	x	85.75	x	0.63	x	0.7	=	75.48	(77)
Southeast	0.9x	0.77	x	1.75	x	106.25	x	0.63	x	0.7	=	56.83	(77)
Southeast	0.9x	0.77	x	1.75	x	106.25	x	0.63	x	0.7	=	56.83	(77)
Southeast	0.9x	0.77	x	1.75	x	106.25	x	0.63	x	0.7	=	56.83	(77)
Southeast	0.9x	0.77	x	1.75	x	106.25	x	0.63	x	0.7	=	56.83	(77)
Southeast	0.9x	0.77	x	2.88	x	106.25	x	0.63	x	0.7	=	93.52	(77)
Southeast	0.9x	0.77	x	2.88	x	106.25	x	0.63	x	0.7	=	93.52	(77)
Southeast	0.9x	0.77	x	2.88	x	106.25	x	0.63	x	0.7	=	93.52	(77)
Southeast	0.9x	0.77	x	1.75	x	119.01	x	0.63	x	0.7	=	63.65	(77)
Southeast	0.9x	0.77	x	1.75	x	119.01	x	0.63	x	0.7	=	63.65	(77)
Southeast	0.9x	0.77	x	1.75	x	119.01	x	0.63	x	0.7	=	63.65	(77)
Southeast	0.9x	0.77	x	1.75	x	119.01	x	0.63	x	0.7	=	63.65	(77)
Southeast	0.9x	0.77	x	2.88	x	119.01	x	0.63	x	0.7	=	104.75	(77)
Southeast	0.9x	0.77	x	2.88	x	119.01	x	0.63	x	0.7	=	104.75	(77)
Southeast	0.9x	0.77	x	2.88	x	119.01	x	0.63	x	0.7	=	104.75	(77)
Southeast	0.9x	0.77	x	1.75	x	118.15	x	0.63	x	0.7	=	63.19	(77)
Southeast	0.9x	0.77	x	1.75	x	118.15	x	0.63	x	0.7	=	63.19	(77)
Southeast	0.9x	0.77	x	1.75	x	118.15	x	0.63	x	0.7	=	63.19	(77)
Southeast	0.9x	0.77	x	1.75	x	118.15	x	0.63	x	0.7	=	63.19	(77)
Southeast	0.9x	0.77	x	2.88	x	118.15	x	0.63	x	0.7	=	103.99	(77)
Southeast	0.9x	0.77	x	2.88	x	118.15	x	0.63	x	0.7	=	103.99	(77)
Southeast	0.9x	0.77	x	2.88	x	118.15	x	0.63	x	0.7	=	103.99	(77)
Southeast	0.9x	0.77	x	1.75	x	113.91	x	0.63	x	0.7	=	60.92	(77)
Southeast	0.9x	0.77	x	1.75	x	113.91	x	0.63	x	0.7	=	60.92	(77)
Southeast	0.9x	0.77	x	1.75	x	113.91	x	0.63	x	0.7	=	60.92	(77)
Southeast	0.9x	0.77	x	1.75	x	113.91	x	0.63	x	0.7	=	60.92	(77)
Southeast	0.9x	0.77	x	2.88	x	113.91	x	0.63	x	0.7	=	100.26	(77)
Southeast	0.9x	0.77	x	2.88	x	113.91	x	0.63	x	0.7	=	100.26	(77)
Southeast	0.9x	0.77	x	2.88	x	113.91	x	0.63	x	0.7	=	100.26	(77)
Southeast	0.9x	0.77	x	1.75	x	104.39	x	0.63	x	0.7	=	55.83	(77)
Southeast	0.9x	0.77	x	1.75	x	104.39	x	0.63	x	0.7	=	55.83	(77)

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Southeast	0.9x	0.77	x	1.75	x	104.39	x	0.63	x	0.7	=	55.83	(77)
Southeast	0.9x	0.77	x	1.75	x	104.39	x	0.63	x	0.7	=	55.83	(77)
Southeast	0.9x	0.77	x	2.88	x	104.39	x	0.63	x	0.7	=	91.88	(77)
Southeast	0.9x	0.77	x	2.88	x	104.39	x	0.63	x	0.7	=	91.88	(77)
Southeast	0.9x	0.77	x	2.88	x	104.39	x	0.63	x	0.7	=	91.88	(77)
Southeast	0.9x	0.77	x	1.75	x	92.85	x	0.63	x	0.7	=	49.66	(77)
Southeast	0.9x	0.77	x	1.75	x	92.85	x	0.63	x	0.7	=	49.66	(77)
Southeast	0.9x	0.77	x	1.75	x	92.85	x	0.63	x	0.7	=	49.66	(77)
Southeast	0.9x	0.77	x	1.75	x	92.85	x	0.63	x	0.7	=	49.66	(77)
Southeast	0.9x	0.77	x	2.88	x	92.85	x	0.63	x	0.7	=	81.73	(77)
Southeast	0.9x	0.77	x	2.88	x	92.85	x	0.63	x	0.7	=	81.73	(77)
Southeast	0.9x	0.77	x	2.88	x	92.85	x	0.63	x	0.7	=	81.73	(77)
Southeast	0.9x	0.77	x	1.75	x	69.27	x	0.63	x	0.7	=	37.05	(77)
Southeast	0.9x	0.77	x	1.75	x	69.27	x	0.63	x	0.7	=	37.05	(77)
Southeast	0.9x	0.77	x	1.75	x	69.27	x	0.63	x	0.7	=	37.05	(77)
Southeast	0.9x	0.77	x	1.75	x	69.27	x	0.63	x	0.7	=	37.05	(77)
Southeast	0.9x	0.77	x	2.88	x	69.27	x	0.63	x	0.7	=	60.97	(77)
Southeast	0.9x	0.77	x	2.88	x	69.27	x	0.63	x	0.7	=	60.97	(77)
Southeast	0.9x	0.77	x	2.88	x	69.27	x	0.63	x	0.7	=	60.97	(77)
Southeast	0.9x	0.77	x	1.75	x	44.07	x	0.63	x	0.7	=	23.57	(77)
Southeast	0.9x	0.77	x	1.75	x	44.07	x	0.63	x	0.7	=	23.57	(77)
Southeast	0.9x	0.77	x	1.75	x	44.07	x	0.63	x	0.7	=	23.57	(77)
Southeast	0.9x	0.77	x	1.75	x	44.07	x	0.63	x	0.7	=	23.57	(77)
Southeast	0.9x	0.77	x	2.88	x	44.07	x	0.63	x	0.7	=	38.79	(77)
Southeast	0.9x	0.77	x	2.88	x	44.07	x	0.63	x	0.7	=	38.79	(77)
Southeast	0.9x	0.77	x	2.88	x	44.07	x	0.63	x	0.7	=	38.79	(77)
Southeast	0.9x	0.77	x	1.75	x	31.49	x	0.63	x	0.7	=	16.84	(77)
Southeast	0.9x	0.77	x	1.75	x	31.49	x	0.63	x	0.7	=	16.84	(77)
Southeast	0.9x	0.77	x	1.75	x	31.49	x	0.63	x	0.7	=	16.84	(77)
Southeast	0.9x	0.77	x	1.75	x	31.49	x	0.63	x	0.7	=	16.84	(77)
Southeast	0.9x	0.77	x	2.88	x	31.49	x	0.63	x	0.7	=	27.71	(77)
Southeast	0.9x	0.77	x	2.88	x	31.49	x	0.63	x	0.7	=	27.71	(77)
Southeast	0.9x	0.77	x	2.88	x	31.49	x	0.63	x	0.7	=	27.71	(77)
Southwest	0.9x	0.77	x	1.75	x	36.79		0.63	x	0.7	=	19.68	(79)
Southwest	0.9x	0.77	x	1.75	x	36.79		0.63	x	0.7	=	19.68	(79)
Southwest	0.9x	0.77	x	1.75	x	36.79		0.63	x	0.7	=	19.68	(79)
Southwest	0.9x	0.77	x	1.75	x	62.67		0.63	x	0.7	=	33.52	(79)
Southwest	0.9x	0.77	x	1.75	x	62.67		0.63	x	0.7	=	33.52	(79)
Southwest	0.9x	0.77	x	1.75	x	62.67		0.63	x	0.7	=	33.52	(79)
Southwest	0.9x	0.77	x	1.75	x	85.75		0.63	x	0.7	=	45.86	(79)
Southwest	0.9x	0.77	x	1.75	x	85.75		0.63	x	0.7	=	45.86	(79)

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Southwest	0.9x	0.77	x	1.75	x	85.75	0.63	x	0.7	=	45.86	(79)
Southwest	0.9x	0.77	x	1.75	x	106.25	0.63	x	0.7	=	56.83	(79)
Southwest	0.9x	0.77	x	1.75	x	106.25	0.63	x	0.7	=	56.83	(79)
Southwest	0.9x	0.77	x	1.75	x	106.25	0.63	x	0.7	=	56.83	(79)
Southwest	0.9x	0.77	x	1.75	x	119.01	0.63	x	0.7	=	63.65	(79)
Southwest	0.9x	0.77	x	1.75	x	119.01	0.63	x	0.7	=	63.65	(79)
Southwest	0.9x	0.77	x	1.75	x	119.01	0.63	x	0.7	=	63.65	(79)
Southwest	0.9x	0.77	x	1.75	x	118.15	0.63	x	0.7	=	63.19	(79)
Southwest	0.9x	0.77	x	1.75	x	118.15	0.63	x	0.7	=	63.19	(79)
Southwest	0.9x	0.77	x	1.75	x	118.15	0.63	x	0.7	=	63.19	(79)
Southwest	0.9x	0.77	x	1.75	x	113.91	0.63	x	0.7	=	60.92	(79)
Southwest	0.9x	0.77	x	1.75	x	113.91	0.63	x	0.7	=	60.92	(79)
Southwest	0.9x	0.77	x	1.75	x	113.91	0.63	x	0.7	=	60.92	(79)
Southwest	0.9x	0.77	x	1.75	x	104.39	0.63	x	0.7	=	55.83	(79)
Southwest	0.9x	0.77	x	1.75	x	104.39	0.63	x	0.7	=	55.83	(79)
Southwest	0.9x	0.77	x	1.75	x	104.39	0.63	x	0.7	=	55.83	(79)
Southwest	0.9x	0.77	x	1.75	x	92.85	0.63	x	0.7	=	49.66	(79)
Southwest	0.9x	0.77	x	1.75	x	92.85	0.63	x	0.7	=	49.66	(79)
Southwest	0.9x	0.77	x	1.75	x	92.85	0.63	x	0.7	=	49.66	(79)
Southwest	0.9x	0.77	x	1.75	x	69.27	0.63	x	0.7	=	37.05	(79)
Southwest	0.9x	0.77	x	1.75	x	69.27	0.63	x	0.7	=	37.05	(79)
Southwest	0.9x	0.77	x	1.75	x	69.27	0.63	x	0.7	=	37.05	(79)
Southwest	0.9x	0.77	x	1.75	x	44.07	0.63	x	0.7	=	23.57	(79)
Southwest	0.9x	0.77	x	1.75	x	44.07	0.63	x	0.7	=	23.57	(79)
Southwest	0.9x	0.77	x	1.75	x	44.07	0.63	x	0.7	=	23.57	(79)
Southwest	0.9x	0.77	x	1.75	x	31.49	0.63	x	0.7	=	16.84	(79)
Southwest	0.9x	0.77	x	1.75	x	31.49	0.63	x	0.7	=	16.84	(79)
Southwest	0.9x	0.77	x	1.75	x	31.49	0.63	x	0.7	=	16.84	(79)

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

(83)m=	244.25	419.14	581.74	734.62	835.45	834.95	802.68	726.61	634.55	465.47	293.12	208.66	(83)

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

(84)m=	685.88	858.58	1005.7	1133.09	1207.46	1181.61	1133.4	1064.39	986.01	842.64	699.45	637.13	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.73	0.57	0.62	0.84	0.97	0.99	1	(86)

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

(87)m=	19.3	19.53	19.86	20.28	20.64	20.88	20.97	20.95	20.78	20.29	19.71	19.26	(87)

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

(88)m=	19.64	19.64	19.65	19.66	19.66	19.67	19.67	19.67	19.66	19.66	19.66	19.65	(88)

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

(89)m=	1	0.99	0.97	0.93	0.82	0.62	0.42	0.47	0.75	0.95	0.99	1	(89)

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

(90)m=	17.43	17.76	18.24	18.84	19.32	19.59	19.66	19.65	19.5	18.87	18.03	17.37	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	18.05	18.35	18.78	19.32	19.76	20.02	20.09	20.08	19.92	19.34	18.59	18	(92)

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

(93)m=	18.05	18.35	18.78	19.32	19.76	20.02	20.09	20.08	19.92	19.34	18.59	18	(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	0.82	0.65	0.47	0.52	0.77	0.94	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	681.29	845.11	970.26	1040.37	992.2	772.7	532.82	554.18	760.11	793.42	690.06	633.89	(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=	2209.01	2156.22	1965.61	1651.68	1275.53	851.09	548.35	577.64	916.95	1383.37	1825.15	2200.23	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1136.62	881.07	740.54	440.14	210.8	0	0	0	0	438.93	817.26	1165.35	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5830.72 (98)

Space heating requirement in kWh/m²/year 56.65 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	1136.62	881.07	740.54	440.14	210.8	0	0	0	0	438.93	817.26	1165.35	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1216.94	943.33	792.87	471.24	225.7	0	0	0	0	469.94	875.02	1247.7	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 6242.74 (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)

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Water heating

Output from water heater (calculated above)

213.87	188.51	197.99	176.45	170.83	150.46	144.15	160.7	162.47	184.06	194.6	208.73

Efficiency of water heater 80.3 (216)

(217)m=	88.63	88.44	88.06	87.26	85.58	80.3	80.3	80.3	80.3	87.16	88.26	88.71	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	241.29	213.15	224.83	202.21	199.62	187.37	179.52	200.12	202.33	211.17	220.47	235.31

Total = Sum(219a)$_{1...12}$ = 2517.39 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			6242.74	
Water heating fuel used			2517.39	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			410.87	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			9246	(338)

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	=	1348.43	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	543.76	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1892.19	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	213.24	(268)
Total CO2, kg/year		sum of (265)…(271) =		2144.35	(272)

TER = 20.84 (273)

APPENDIX C. TFEE WORKSHEETS

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Lean-First Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.18	(1a) x	2.5	(2a) =	125.45	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.18	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	125.45	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.16	(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)	0.41	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.37	0.36	0.35	0.32	0.31	0.27	0.27	0.27	0.29	0.31	0.32	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			2.77	x1/[1/(1.4)+ 0.04]		=	3.67			(27)
Windows Type 2			2.77	x1/[1/(1.4)+ 0.04]		=	3.67			(27)
Windows Type 3			1.7	x1/[1/(1.4)+ 0.04]		=	2.25			(27)
Windows Type 4			1.45	x1/[1/(1.4)+ 0.04]		=	1.92			(27)
Windows Type 5			1.7	x1/[1/(1.4)+ 0.04]		=	2.25			(27)
Floor			50.18	x	0.13	=	6.5234			(28)
Walls Type1	53.68	10.39	43.29	x	0.18	=	7.79			(29)
Walls Type2	14.73	0	14.73	x	0.18	=	2.65			(29)
Walls Type3	3.34	2.15	1.19	x	0.18	=	0.21			(29)
Total area of elements, m²			121.93							(31)
Party wall			22.09	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.11 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10852.79 (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 14.45 (36)

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

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Total fabric heat loss (33) + (36) = 47.55 (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=	23.46	23.36	23.25	22.76	22.66	22.23	22.23	22.15	22.4	22.66	22.85	23.05	(38)

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

(39)m=	71.02	70.91	70.8	70.31	70.22	69.79	69.79	69.71	69.95	70.22	70.4	70.6

Average = $Sum(39)_{1...12}$ /12= 70.31 (39)

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

(40)m=	1.42	1.41	1.41	1.4	1.4	1.39	1.39	1.39	1.39	1.4	1.4	1.41

Average = $Sum(40)_{1...12}$ /12= 1.4 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (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 74.47 (43)

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

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

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

(44)m=	81.91	78.93	75.96	72.98	70	67.02	67.02	70	72.98	75.96	78.93	81.91

Total = $Sum(44)_{1...12}$ = 893.59 (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=	121.47	106.24	109.63	95.58	91.71	79.14	73.33	84.15	85.16	99.24	108.33	117.64

Total = $Sum(45)_{1...12}$ = 1171.64 (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)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

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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=	103.25	90.31	93.19	81.24	77.95	67.27	62.33	71.53	72.38	84.36	92.08	99.99	(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=	103.25	90.31	93.19	81.24	77.95	67.27	62.33	71.53	72.38	84.36	92.08	99.99	

Output from water heater (annual)1…12 995.89 (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=	25.81	22.58	23.3	20.31	19.49	16.82	15.58	17.88	18.1	21.09	23.02	25	(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=	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	(66)

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

(67)m=	13.22	11.74	9.55	7.23	5.4	4.56	4.93	6.41	8.6	10.92	12.74	13.59	(67)

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

(68)m=	147.7	149.23	145.37	137.15	126.77	117.02	110.5	108.97	112.83	121.05	131.43	141.18	(68)

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

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(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=	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	(71)

Water heating gains (Table 5)

(72)m=	34.7	33.6	31.31	28.21	26.19	23.36	20.95	24.04	25.13	28.35	31.97	33.6	(72)

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

(73)m=	244.05	243	234.66	221.02	206.8	193.36	184.8	187.84	194.99	208.75	224.58	236.8	(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)	
Northeast 0.9x	0.77	x	1.45	x	11.28	x	0.63	x	0.7	=	5	(75)
Northeast 0.9x	0.77	x	1.45	x	22.97	x	0.63	x	0.7	=	10.18	(75)
Northeast 0.9x	0.77	x	1.45	x	41.38	x	0.63	x	0.7	=	18.34	(75)
Northeast 0.9x	0.77	x	1.45	x	67.96	x	0.63	x	0.7	=	30.11	(75)
Northeast 0.9x	0.77	x	1.45	x	91.35	x	0.63	x	0.7	=	40.48	(75)
Northeast 0.9x	0.77	x	1.45	x	97.38	x	0.63	x	0.7	=	43.15	(75)
Northeast 0.9x	0.77	x	1.45	x	91.1	x	0.63	x	0.7	=	40.37	(75)
Northeast 0.9x	0.77	x	1.45	x	72.63	x	0.63	x	0.7	=	32.18	(75)
Northeast 0.9x	0.77	x	1.45	x	50.42	x	0.63	x	0.7	=	22.34	(75)
Northeast 0.9x	0.77	x	1.45	x	28.07	x	0.63	x	0.7	=	12.44	(75)
Northeast 0.9x	0.77	x	1.45	x	14.2	x	0.63	x	0.7	=	6.29	(75)
Northeast 0.9x	0.77	x	1.45	x	9.21	x	0.63	x	0.7	=	4.08	(75)
Southeast 0.9x	0.77	x	2.77	x	36.79	x	0.63	x	0.7	=	31.15	(77)
Southeast 0.9x	0.77	x	2.77	x	36.79	x	0.63	x	0.7	=	31.15	(77)
Southeast 0.9x	0.77	x	1.7	x	36.79	x	0.63	x	0.7	=	19.12	(77)
Southeast 0.9x	0.77	x	1.7	x	36.79	x	0.63	x	0.7	=	19.12	(77)
Southeast 0.9x	0.77	x	2.77	x	62.67	x	0.63	x	0.7	=	53.06	(77)
Southeast 0.9x	0.77	x	2.77	x	62.67	x	0.63	x	0.7	=	53.06	(77)
Southeast 0.9x	0.77	x	1.7	x	62.67	x	0.63	x	0.7	=	32.56	(77)
Southeast 0.9x	0.77	x	1.7	x	62.67	x	0.63	x	0.7	=	32.56	(77)
Southeast 0.9x	0.77	x	2.77	x	85.75	x	0.63	x	0.7	=	72.59	(77)
Southeast 0.9x	0.77	x	2.77	x	85.75	x	0.63	x	0.7	=	72.59	(77)
Southeast 0.9x	0.77	x	1.7	x	85.75	x	0.63	x	0.7	=	44.55	(77)
Southeast 0.9x	0.77	x	1.7	x	85.75	x	0.63	x	0.7	=	44.55	(77)
Southeast 0.9x	0.77	x	2.77	x	106.25	x	0.63	x	0.7	=	89.95	(77)
Southeast 0.9x	0.77	x	2.77	x	106.25	x	0.63	x	0.7	=	89.95	(77)
Southeast 0.9x	0.77	x	1.7	x	106.25	x	0.63	x	0.7	=	55.2	(77)
Southeast 0.9x	0.77	x	1.7	x	106.25	x	0.63	x	0.7	=	55.2	(77)
Southeast 0.9x	0.77	x	2.77	x	119.01	x	0.63	x	0.7	=	100.75	(77)
Southeast 0.9x	0.77	x	2.77	x	119.01	x	0.63	x	0.7	=	100.75	(77)
Southeast 0.9x	0.77	x	1.7	x	119.01	x	0.63	x	0.7	=	61.83	(77)
Southeast 0.9x	0.77	x	1.7	x	119.01	x	0.63	x	0.7	=	61.83	(77)
Southeast 0.9x	0.77	x	2.77	x	118.15	x	0.63	x	0.7	=	100.02	(77)
Southeast 0.9x	0.77	x	2.77	x	118.15	x	0.63	x	0.7	=	100.02	(77)
Southeast 0.9x	0.77	x	1.7	x	118.15	x	0.63	x	0.7	=	61.38	(77)
Southeast 0.9x	0.77	x	1.7	x	118.15	x	0.63	x	0.7	=	61.38	(77)
Southeast 0.9x	0.77	x	2.77	x	113.91	x	0.63	x	0.7	=	96.43	(77)
Southeast 0.9x	0.77	x	2.77	x	113.91	x	0.63	x	0.7	=	96.43	(77)
Southeast 0.9x	0.77	x	1.7	x	113.91	x	0.63	x	0.7	=	59.18	(77)

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Southeast	0.9x	0.77	x	1.7	x	113.91	x	0.63	x	0.7	=	59.18	(77)
Southeast	0.9x	0.77	x	2.77	x	104.39	x	0.63	x	0.7	=	88.37	(77)
Southeast	0.9x	0.77	x	2.77	x	104.39	x	0.63	x	0.7	=	88.37	(77)
Southeast	0.9x	0.77	x	1.7	x	104.39	x	0.63	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	1.7	x	104.39	x	0.63	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	2.77	x	92.85	x	0.63	x	0.7	=	78.6	(77)
Southeast	0.9x	0.77	x	2.77	x	92.85	x	0.63	x	0.7	=	78.6	(77)
Southeast	0.9x	0.77	x	1.7	x	92.85	x	0.63	x	0.7	=	48.24	(77)
Southeast	0.9x	0.77	x	1.7	x	92.85	x	0.63	x	0.7	=	48.24	(77)
Southeast	0.9x	0.77	x	2.77	x	69.27	x	0.63	x	0.7	=	58.64	(77)
Southeast	0.9x	0.77	x	2.77	x	69.27	x	0.63	x	0.7	=	58.64	(77)
Southeast	0.9x	0.77	x	1.7	x	69.27	x	0.63	x	0.7	=	35.99	(77)
Southeast	0.9x	0.77	x	1.7	x	69.27	x	0.63	x	0.7	=	35.99	(77)
Southeast	0.9x	0.77	x	2.77	x	44.07	x	0.63	x	0.7	=	37.31	(77)
Southeast	0.9x	0.77	x	2.77	x	44.07	x	0.63	x	0.7	=	37.31	(77)
Southeast	0.9x	0.77	x	1.7	x	44.07	x	0.63	x	0.7	=	22.9	(77)
Southeast	0.9x	0.77	x	1.7	x	44.07	x	0.63	x	0.7	=	22.9	(77)
Southeast	0.9x	0.77	x	2.77	x	31.49	x	0.63	x	0.7	=	26.66	(77)
Southeast	0.9x	0.77	x	2.77	x	31.49	x	0.63	x	0.7	=	26.66	(77)
Southeast	0.9x	0.77	x	1.7	x	31.49	x	0.63	x	0.7	=	16.36	(77)
Southeast	0.9x	0.77	x	1.7	x	31.49	x	0.63	x	0.7	=	16.36	(77)

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

(83)m=	105.53	181.41	252.63	320.41	365.64	365.96	351.59	317.4	276.03	201.69	126.7	90.11	(83)

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

(84)m=	349.57	424.41	487.29	541.43	572.44	559.33	536.39	505.24	471.02	410.43	351.28	326.91	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.86	0.71	0.55	0.6	0.82	0.96	0.99	1	(86)

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

(87)m=	19.5	19.71	20.02	20.39	20.71	20.91	20.98	20.97	20.83	20.4	19.87	19.46	(87)

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

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

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

(89)m=	0.99	0.99	0.97	0.92	0.81	0.61	0.41	0.46	0.74	0.94	0.99	1	(89)

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

(90)m=	18.41	18.62	18.92	19.29	19.58	19.73	19.77	19.76	19.68	19.3	18.79	18.38	(90)

fLA = Living area ÷ (4) = 0.48 (91)

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

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(92)m=	18.94	19.15	19.45	19.82	20.12	20.3	20.35	20.34	20.23	19.83	19.31	18.9	(92)

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

(93)m=	18.94	19.15	19.45	19.82	20.12	20.3	20.35	20.34	20.23	19.83	19.31	18.9	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.92	0.82	0.66	0.48	0.53	0.77	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	347.36	418.32	471.48	499.33	472.09	366.45	255.53	265.56	363.77	387.38	346.81	325.33	(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=	1039.6	1010.2	916.89	767.73	591.54	397.85	261.66	274.89	429	648.23	859.65	1037.77	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	515.03	397.74	331.39	193.25	88.87	0	0	0	0	194.07	369.25	530.05	

Total per year (kWh/year) = $\text{Sum}(98)_{1...5,9...12}$ = 2619.65 (98)

Space heating requirement in kWh/m²/year 52.21 (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	655.99	516.42	529.77	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.91	0.89	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	555.67	469.29	470.02	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	717.93	689.92	654.45	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	116.83	164.15	137.21	0	0	0	0

Total = $\text{Sum}(104)_{6...8}$ = 418.19 (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 = $\text{Sum}(104)_{6...8}$ = 0 (106)

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

(107)m=	0	0	0	0	0	29.21	41.04	34.3	0	0	0	0

Total = $\text{Sum}(107)_{6...8}$ = 104.55 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 2.08 (108)

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

Fabric Energy Efficiency — (99) + (108) = 54.29 (109)

Target Fabric Energy Efficiency (TFEE) 62.43 (109)

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TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Lean-Second Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	61.28	(1a) x	2.5	(2a) =	153.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.28	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	153.2	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(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		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31

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

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

(25)m=	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.54	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			1.43		x1/[1/(1.4)+ 0.04]	=	1.9			(27)
Windows Type 2			1.43		x1/[1/(1.4)+ 0.04]	=	1.9			(27)
Windows Type 3			1.43		x1/[1/(1.4)+ 0.04]	=	1.9			(27)
Windows Type 4			1.43		x1/[1/(1.4)+ 0.04]	=	1.9			(27)
Windows Type 5			2.36		x1/[1/(1.4)+ 0.04]	=	3.13			(27)
Windows Type 6			1.43		x1/[1/(1.4)+ 0.04]	=	1.9			(27)
Windows Type 7			2.36		x1/[1/(1.4)+ 0.04]	=	3.13			(27)
Windows Type 8			1.27		x1/[1/(1.4)+ 0.04]	=	1.68			(27)
Walls Type1	59.88	13.14	46.74	x	0.18	=	8.41			(29)
Walls Type2	5.48	0	5.48	x	0.18	=	0.99			(29)
Walls Type3	16.37	2.15	14.22	x	0.18	=	2.56			(29)
Total area of elements, m²			81.73							(31)
Party wall			24.18	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 31.53 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7799.88 (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 | 6.59 | (36)

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

Total fabric heat loss (33) + (36) = | 38.12 | (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=	28.19	28.08	27.97	27.45	27.35	26.9	26.9	26.81	27.07	27.35	27.55	27.75	(38)

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

(39)m=	66.31	66.2	66.09	65.56	65.47	65.01	65.01	64.93	65.19	65.47	65.66	65.87	

Average = Sum(39)$_{1...12}$ /12= | 65.56 | (39)

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

(40)m=	1.08	1.08	1.08	1.07	1.07	1.06	1.06	1.06	1.06	1.07	1.07	1.07	

Average = Sum(40)$_{1...12}$ /12= | 1.07 | (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 | 2.02 | (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 | 82.12 | (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=	90.33	87.04	83.76	80.48	77.19	73.91	73.91	77.19	80.48	83.76	87.04	90.33

Total = Sum(44)$_{1...12}$ = | 985.41 | (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=	133.96	117.16	120.9	105.4	101.13	87.27	80.87	92.8	93.91	109.44	119.46	129.73

Total = Sum(45)$_{1...12}$ = | 1292.03 | (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=	113.86	99.58	102.76	89.59	85.96	74.18	68.74	78.88	79.82	93.02	101.54	110.27	(62)

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

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

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

Output from water heater

(64)m=	113.86	99.58	102.76	89.59	85.96	74.18	68.74	78.88	79.82	93.02	101.54	110.27

Output from water heater (annual)$_{1...12}$ — 1098.23 (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=	28.47	24.9	25.69	22.4	21.49	18.55	17.18	19.72	19.96	23.26	25.39	27.57	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.73	13.97	11.36	8.6	6.43	5.43	5.86	7.62	10.23	12.99	15.16	16.16	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	176.16	177.99	173.38	163.58	151.2	139.56	131.79	129.96	134.57	144.38	156.76	168.39	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	(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=	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	(71)
Water heating gains (Table 5)													
(72)m=	38.26	37.05	34.53	31.11	28.89	25.76	23.1	26.51	27.72	31.26	35.26	37.05	(72)
Total internal gains =	(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m												
(73)m=	283.41	282.27	272.54	256.55	239.78	224.01	214.02	217.36	225.78	241.89	260.44	274.87	(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)	
Northeast	0.9x	0.77	x	1.27	x	11.28	x	0.63	x	0.7	=	4.38	(75)
Northeast	0.9x	0.77	x	1.27	x	22.97	x	0.63	x	0.7	=	8.91	(75)
Northeast	0.9x	0.77	x	1.27	x	41.38	x	0.63	x	0.7	=	16.06	(75)
Northeast	0.9x	0.77	x	1.27	x	67.96	x	0.63	x	0.7	=	26.38	(75)
Northeast	0.9x	0.77	x	1.27	x	91.35	x	0.63	x	0.7	=	35.45	(75)
Northeast	0.9x	0.77	x	1.27	x	97.38	x	0.63	x	0.7	=	37.8	(75)
Northeast	0.9x	0.77	x	1.27	x	91.1	x	0.63	x	0.7	=	35.36	(75)
Northeast	0.9x	0.77	x	1.27	x	72.63	x	0.63	x	0.7	=	28.19	(75)
Northeast	0.9x	0.77	x	1.27	x	50.42	x	0.63	x	0.7	=	19.57	(75)
Northeast	0.9x	0.77	x	1.27	x	28.07	x	0.63	x	0.7	=	10.89	(75)
Northeast	0.9x	0.77	x	1.27	x	14.2	x	0.63	x	0.7	=	5.51	(75)
Northeast	0.9x	0.77	x	1.27	x	9.21	x	0.63	x	0.7	=	3.58	(75)
Southeast	0.9x	0.77	x	1.43	x	36.79	x	0.63	x	0.7	=	16.08	(77)
Southeast	0.9x	0.77	x	2.36	x	36.79	x	0.63	x	0.7	=	26.54	(77)
Southeast	0.9x	0.77	x	1.43	x	36.79	x	0.63	x	0.7	=	16.08	(77)
Southeast	0.9x	0.77	x	2.36	x	36.79	x	0.63	x	0.7	=	26.54	(77)
Southeast	0.9x	0.77	x	1.43	x	62.67	x	0.63	x	0.7	=	27.39	(77)
Southeast	0.9x	0.77	x	2.36	x	62.67	x	0.63	x	0.7	=	45.2	(77)
Southeast	0.9x	0.77	x	1.43	x	62.67	x	0.63	x	0.7	=	27.39	(77)
Southeast	0.9x	0.77	x	2.36	x	62.67	x	0.63	x	0.7	=	45.2	(77)
Southeast	0.9x	0.77	x	1.43	x	85.75	x	0.63	x	0.7	=	37.48	(77)
Southeast	0.9x	0.77	x	2.36	x	85.75	x	0.63	x	0.7	=	61.85	(77)
Southeast	0.9x	0.77	x	1.43	x	85.75	x	0.63	x	0.7	=	37.48	(77)
Southeast	0.9x	0.77	x	2.36	x	85.75	x	0.63	x	0.7	=	61.85	(77)
Southeast	0.9x	0.77	x	1.43	x	106.25	x	0.63	x	0.7	=	46.43	(77)
Southeast	0.9x	0.77	x	2.36	x	106.25	x	0.63	x	0.7	=	76.63	(77)
Southeast	0.9x	0.77	x	1.43	x	106.25	x	0.63	x	0.7	=	46.43	(77)
Southeast	0.9x	0.77	x	2.36	x	106.25	x	0.63	x	0.7	=	76.63	(77)
Southeast	0.9x	0.77	x	1.43	x	119.01	x	0.63	x	0.7	=	52.01	(77)
Southeast	0.9x	0.77	x	2.36	x	119.01	x	0.63	x	0.7	=	85.84	(77)
Southeast	0.9x	0.77	x	1.43	x	119.01	x	0.63	x	0.7	=	52.01	(77)
Southeast	0.9x	0.77	x	2.36	x	119.01	x	0.63	x	0.7	=	85.84	(77)
Southeast	0.9x	0.77	x	1.43	x	118.15	x	0.63	x	0.7	=	51.63	(77)
Southeast	0.9x	0.77	x	2.36	x	118.15	x	0.63	x	0.7	=	85.22	(77)
Southeast	0.9x	0.77	x	1.43	x	118.15	x	0.63	x	0.7	=	51.63	(77)
Southeast	0.9x	0.77	x	2.36	x	118.15	x	0.63	x	0.7	=	85.22	(77)
Southeast	0.9x	0.77	x	1.43	x	113.91	x	0.63	x	0.7	=	49.78	(77)
Southeast	0.9x	0.77	x	2.36	x	113.91	x	0.63	x	0.7	=	82.16	(77)
Southeast	0.9x	0.77	x	1.43	x	113.91	x	0.63	x	0.7	=	49.78	(77)

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Southeast	0.9x	0.77	x	2.36	x	113.91	x	0.63	x	0.7	=	82.16	(77)
Southeast	0.9x	0.77	x	1.43	x	104.39	x	0.63	x	0.7	=	45.62	(77)
Southeast	0.9x	0.77	x	2.36	x	104.39	x	0.63	x	0.7	=	75.29	(77)
Southeast	0.9x	0.77	x	1.43	x	104.39	x	0.63	x	0.7	=	45.62	(77)
Southeast	0.9x	0.77	x	2.36	x	104.39	x	0.63	x	0.7	=	75.29	(77)
Southeast	0.9x	0.77	x	1.43	x	92.85	x	0.63	x	0.7	=	40.58	(77)
Southeast	0.9x	0.77	x	2.36	x	92.85	x	0.63	x	0.7	=	66.97	(77)
Southeast	0.9x	0.77	x	1.43	x	92.85	x	0.63	x	0.7	=	40.58	(77)
Southeast	0.9x	0.77	x	2.36	x	92.85	x	0.63	x	0.7	=	66.97	(77)
Southeast	0.9x	0.77	x	1.43	x	69.27	x	0.63	x	0.7	=	30.27	(77)
Southeast	0.9x	0.77	x	2.36	x	69.27	x	0.63	x	0.7	=	49.96	(77)
Southeast	0.9x	0.77	x	1.43	x	69.27	x	0.63	x	0.7	=	30.27	(77)
Southeast	0.9x	0.77	x	2.36	x	69.27	x	0.63	x	0.7	=	49.96	(77)
Southeast	0.9x	0.77	x	1.43	x	44.07	x	0.63	x	0.7	=	19.26	(77)
Southeast	0.9x	0.77	x	2.36	x	44.07	x	0.63	x	0.7	=	31.79	(77)
Southeast	0.9x	0.77	x	1.43	x	44.07	x	0.63	x	0.7	=	19.26	(77)
Southeast	0.9x	0.77	x	2.36	x	44.07	x	0.63	x	0.7	=	31.79	(77)
Southeast	0.9x	0.77	x	1.43	x	31.49	x	0.63	x	0.7	=	13.76	(77)
Southeast	0.9x	0.77	x	2.36	x	31.49	x	0.63	x	0.7	=	22.71	(77)
Southeast	0.9x	0.77	x	1.43	x	31.49	x	0.63	x	0.7	=	13.76	(77)
Southeast	0.9x	0.77	x	2.36	x	31.49	x	0.63	x	0.7	=	22.71	(77)
Southwest	0.9x	0.77	x	1.43	x	36.79		0.63	x	0.7	=	16.08	(79)
Southwest	0.9x	0.77	x	1.43	x	36.79		0.63	x	0.7	=	16.08	(79)
Southwest	0.9x	0.77	x	1.43	x	36.79		0.63	x	0.7	=	16.08	(79)
Southwest	0.9x	0.77	x	1.43	x	62.67		0.63	x	0.7	=	27.39	(79)
Southwest	0.9x	0.77	x	1.43	x	62.67		0.63	x	0.7	=	27.39	(79)
Southwest	0.9x	0.77	x	1.43	x	62.67		0.63	x	0.7	=	27.39	(79)
Southwest	0.9x	0.77	x	1.43	x	85.75		0.63	x	0.7	=	37.48	(79)
Southwest	0.9x	0.77	x	1.43	x	85.75		0.63	x	0.7	=	37.48	(79)
Southwest	0.9x	0.77	x	1.43	x	85.75		0.63	x	0.7	=	37.48	(79)
Southwest	0.9x	0.77	x	1.43	x	106.25		0.63	x	0.7	=	46.43	(79)
Southwest	0.9x	0.77	x	1.43	x	106.25		0.63	x	0.7	=	46.43	(79)
Southwest	0.9x	0.77	x	1.43	x	106.25		0.63	x	0.7	=	46.43	(79)
Southwest	0.9x	0.77	x	1.43	x	119.01		0.63	x	0.7	=	52.01	(79)
Southwest	0.9x	0.77	x	1.43	x	119.01		0.63	x	0.7	=	52.01	(79)
Southwest	0.9x	0.77	x	1.43	x	119.01		0.63	x	0.7	=	52.01	(79)
Southwest	0.9x	0.77	x	1.43	x	118.15		0.63	x	0.7	=	51.63	(79)
Southwest	0.9x	0.77	x	1.43	x	118.15		0.63	x	0.7	=	51.63	(79)
Southwest	0.9x	0.77	x	1.43	x	118.15		0.63	x	0.7	=	51.63	(79)
Southwest	0.9x	0.77	x	1.43	x	113.91		0.63	x	0.7	=	49.78	(79)
Southwest	0.9x	0.77	x	1.43	x	113.91		0.63	x	0.7	=	49.78	(79)

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Southwest0.9x	0.77	x	1.43	x	113.91		0.63	x	0.7	=	49.78	(79)
Southwest0.9x	0.77	x	1.43	x	104.39		0.63	x	0.7	=	45.62	(79)
Southwest0.9x	0.77	x	1.43	x	104.39		0.63	x	0.7	=	45.62	(79)
Southwest0.9x	0.77	x	1.43	x	104.39		0.63	x	0.7	=	45.62	(79)
Southwest0.9x	0.77	x	1.43	x	92.85		0.63	x	0.7	=	40.58	(79)
Southwest0.9x	0.77	x	1.43	x	92.85		0.63	x	0.7	=	40.58	(79)
Southwest0.9x	0.77	x	1.43	x	92.85		0.63	x	0.7	=	40.58	(79)
Southwest0.9x	0.77	x	1.43	x	69.27		0.63	x	0.7	=	30.27	(79)
Southwest0.9x	0.77	x	1.43	x	69.27		0.63	x	0.7	=	30.27	(79)
Southwest0.9x	0.77	x	1.43	x	69.27		0.63	x	0.7	=	30.27	(79)
Southwest0.9x	0.77	x	1.43	x	44.07		0.63	x	0.7	=	19.26	(79)
Southwest0.9x	0.77	x	1.43	x	44.07		0.63	x	0.7	=	19.26	(79)
Southwest0.9x	0.77	x	1.43	x	44.07		0.63	x	0.7	=	19.26	(79)
Southwest0.9x	0.77	x	1.43	x	31.49		0.63	x	0.7	=	13.76	(79)
Southwest0.9x	0.77	x	1.43	x	31.49		0.63	x	0.7	=	13.76	(79)
Southwest0.9x	0.77	x	1.43	x	31.49		0.63	x	0.7	=	13.76	(79)

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

(83)m=	137.85	236.27	327.14	411.82	467.18	466.4	448.58	406.88	356.4	262.17	165.38	117.8	(83)

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

(84)m=	421.27	518.54	599.68	668.37	706.96	690.41	662.6	624.23	582.18	504.06	425.82	392.67	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.9	0.77	0.59	0.43	0.47	0.72	0.94	0.99	1	(86)

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

(87)m=	19.93	20.14	20.41	20.71	20.9	20.98	21	21	20.95	20.68	20.24	19.89	(87)

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

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

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

(89)m=	0.99	0.98	0.96	0.88	0.72	0.5	0.34	0.38	0.64	0.91	0.99	1	(89)

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

(90)m=	19.05	19.26	19.52	19.8	19.97	20.03	20.03	20.03	20.01	19.78	19.36	19.01	(90)

fLA = Living area ÷ (4) = 0.45 (91)

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

(92)m=	19.44	19.65	19.92	20.21	20.38	20.45	20.46	20.46	20.43	20.18	19.75	19.4	(92)

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

(93)m=	19.44	19.65	19.92	20.21	20.38	20.45	20.46	20.46	20.43	20.18	19.75	19.4	(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

TFEE WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.88	0.74	0.54	0.38	0.42	0.67	0.92	0.99	1	(94)

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

(95)m=	418.76	509.81	572.92	589.56	522.02	373.33	250.27	262.26	391.06	462.93	419.8	391.01	(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=	1004.15	976.48	886.83	741.24	568.55	380.48	251.13	263.76	412.47	627.3	830.67	1001.38	(97)

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

(98)m=	435.53	313.61	233.55	109.21	34.62	0	0	0	0	122.29	295.82	454.12

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1998.74 (98)

Space heating requirement in kWh/m²/year 32.62 (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	611.12	481.1	493.46	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.95	0.98	0.97	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	582.12	470.88	479	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	882.25	848.25	804.58	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	216.1	280.77	242.24	0	0	0	0

Total = Sum(104)$_{6...8}$ = 739.1 (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	54.02	70.19	60.56	0	0	0	0

Total = Sum(107)$_{6...8}$ = 184.78 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 3.02 (108)

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

Fabric Energy Efficiency — (99) + (108) = 35.63 (109)

Target Fabric Energy Efficiency (TFEE) 40.98 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Lean-Top Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	102.92	(1a) x	2.45	(2a) =	252.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	102.92	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	252.15	(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) =	0.16	(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)	0.41	(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) =	0.35	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

MECSERVE

TFEE WorkSheet: New dwelling design stage

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

0.44	0.43	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41

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=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(24d)

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

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			1.75	x1/[1/(1.4)+ 0.04]		=	2.32			(27)
Windows Type 2			1.75	x1/[1/(1.4)+ 0.04]		=	2.32			(27)
Windows Type 3			1.75	x1/[1/(1.4)+ 0.04]		=	2.32			(27)
Windows Type 4			1.75	x1/[1/(1.4)+ 0.04]		=	2.32			(27)
Windows Type 5			1.75	x1/[1/(1.4)+ 0.04]		=	2.32			(27)
Windows Type 6			1.75	x1/[1/(1.4)+ 0.04]		=	2.32			(27)
Windows Type 7			1.75	x1/[1/(1.4)+ 0.04]		=	2.32			(27)
Windows Type 8			2.88	x1/[1/(1.4)+ 0.04]		=	3.82			(27)
Windows Type 9			2.88	x1/[1/(1.4)+ 0.04]		=	3.82			(27)
Windows Type 10			2.88	x1/[1/(1.4)+ 0.04]		=	3.82			(27)
Windows Type 11			1.65	x1/[1/(1.4)+ 0.04]		=	2.19			(27)
Windows Type 12			1.06	x1/[1/(1.4)+ 0.04]		=	1.41			(27)
Walls Type1	128.4	23.6	104.8	x	0.18	=	18.86			(29)
Walls Type2	22.83	0	22.83	x	0.18	=	4.11			(29)
Walls Type3	19.21	2.15	17.06	x	0.18	=	3.07			(29)
Roof	102.92	0	102.92	x	0.13	=	13.38			(30)
Total area of elements, m²			273.36							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 72.86 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	17158.83	(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		38.03	(36)

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

Total fabric heat loss	(33) + (36) =	110.89	(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=	49.77	49.45	49.14	47.68	47.41	46.14	46.14	45.9	46.62	47.41	47.96	48.54	(38)

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

(39)m=	160.66	160.34	160.03	158.57	158.3	157.03	157.03	156.79	157.52	158.3	158.85	159.43	

Average = $Sum(39)_{1…12}$ /12= 158.57 (39)

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

(40)m=	1.56	1.56	1.55	1.54	1.54	1.53	1.53	1.52	1.53	1.54	1.54	1.55	

Average = $Sum(40)_{1…12}$ /12= 1.54 (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 2.76 (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 99.87 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	109.85	105.86	101.87	97.87	93.88	89.88	89.88	93.88	97.87	101.87	105.86	109.85	

Total = $Sum(44)_{1…12}$ = 1198.41 (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=	162.91	142.48	147.03	128.18	123	106.14	98.35	112.86	114.21	133.1	145.29	157.77	

Total = $Sum(45)_{1…12}$ = 1571.31 (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:

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

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = | 0 | (54)

Enter (50) or (54) in (55) | 0 | (55)

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

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

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

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

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

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

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

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

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

(61)m=	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=	138.47	121.11	124.98	108.96	104.55	90.22	83.6	95.93	97.08	113.13	123.49	134.11	(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=	138.47	121.11	124.98	108.96	104.55	90.22	83.6	95.93	97.08	113.13	123.49	134.11

Output from water heater (annual)$_{1...12}$ | 1335.61 | (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=	34.62	30.28	31.24	27.24	26.14	22.55	20.9	23.98	24.27	28.28	30.87	33.53	(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=	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	(66)

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

(67)m=	23.27	20.66	16.8	12.72	9.51	8.03	8.68	11.28	15.14	19.22	22.43	23.91	(67)

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

(68)m=	260.96	263.67	256.85	242.32	223.98	206.75	195.23	192.52	199.35	213.88	232.21	249.45	(68)

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

(69)m=	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	(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=	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	(71)

Water heating gains (Table 5)

(72)m=	46.53	45.06	41.99	37.83	35.13	31.32	28.09	32.23	33.71	38.01	42.88	45.06	(72)

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

(73)m=	395.23	393.87	380.12	357.35	333.1	310.57	296.47	300.51	312.66	335.58	362	382.9	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	1.65	x	11.28	x	0.63	x	0.7	=	5.69	(75)
Northeast	0.9x	0.77	x	1.06	x	11.28	x	0.63	x	0.7	=	3.66	(75)
Northeast	0.9x	0.77	x	1.65	x	22.97	x	0.63	x	0.7	=	11.58	(75)
Northeast	0.9x	0.77	x	1.06	x	22.97	x	0.63	x	0.7	=	7.44	(75)
Northeast	0.9x	0.77	x	1.65	x	41.38	x	0.63	x	0.7	=	20.87	(75)
Northeast	0.9x	0.77	x	1.06	x	41.38	x	0.63	x	0.7	=	13.4	(75)
Northeast	0.9x	0.77	x	1.65	x	67.96	x	0.63	x	0.7	=	34.27	(75)
Northeast	0.9x	0.77	x	1.06	x	67.96	x	0.63	x	0.7	=	22.01	(75)
Northeast	0.9x	0.77	x	1.65	x	91.35	x	0.63	x	0.7	=	46.06	(75)
Northeast	0.9x	0.77	x	1.06	x	91.35	x	0.63	x	0.7	=	29.59	(75)
Northeast	0.9x	0.77	x	1.65	x	97.38	x	0.63	x	0.7	=	49.11	(75)
Northeast	0.9x	0.77	x	1.06	x	97.38	x	0.63	x	0.7	=	31.55	(75)
Northeast	0.9x	0.77	x	1.65	x	91.1	x	0.63	x	0.7	=	45.94	(75)
Northeast	0.9x	0.77	x	1.06	x	91.1	x	0.63	x	0.7	=	29.51	(75)
Northeast	0.9x	0.77	x	1.65	x	72.63	x	0.63	x	0.7	=	36.62	(75)
Northeast	0.9x	0.77	x	1.06	x	72.63	x	0.63	x	0.7	=	23.53	(75)
Northeast	0.9x	0.77	x	1.65	x	50.42	x	0.63	x	0.7	=	25.43	(75)
Northeast	0.9x	0.77	x	1.06	x	50.42	x	0.63	x	0.7	=	16.33	(75)
Northeast	0.9x	0.77	x	1.65	x	28.07	x	0.63	x	0.7	=	14.15	(75)
Northeast	0.9x	0.77	x	1.06	x	28.07	x	0.63	x	0.7	=	9.09	(75)
Northeast	0.9x	0.77	x	1.65	x	14.2	x	0.63	x	0.7	=	7.16	(75)
Northeast	0.9x	0.77	x	1.06	x	14.2	x	0.63	x	0.7	=	4.6	(75)
Northeast	0.9x	0.77	x	1.65	x	9.21	x	0.63	x	0.7	=	4.65	(75)
Northeast	0.9x	0.77	x	1.06	x	9.21	x	0.63	x	0.7	=	2.98	(75)
Southeast	0.9x	0.77	x	1.75	x	36.79	x	0.63	x	0.7	=	19.68	(77)
Southeast	0.9x	0.77	x	1.75	x	36.79	x	0.63	x	0.7	=	19.68	(77)
Southeast	0.9x	0.77	x	1.75	x	36.79	x	0.63	x	0.7	=	19.68	(77)
Southeast	0.9x	0.77	x	1.75	x	36.79	x	0.63	x	0.7	=	19.68	(77)
Southeast	0.9x	0.77	x	2.88	x	36.79	x	0.63	x	0.7	=	32.38	(77)
Southeast	0.9x	0.77	x	2.88	x	36.79	x	0.63	x	0.7	=	32.38	(77)
Southeast	0.9x	0.77	x	2.88	x	36.79	x	0.63	x	0.7	=	32.38	(77)
Southeast	0.9x	0.77	x	1.75	x	62.67	x	0.63	x	0.7	=	33.52	(77)
Southeast	0.9x	0.77	x	1.75	x	62.67	x	0.63	x	0.7	=	33.52	(77)
Southeast	0.9x	0.77	x	1.75	x	62.67	x	0.63	x	0.7	=	33.52	(77)

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Southeast	0.9x	0.77	x	1.75	x	62.67	x	0.63	x	0.7	=	33.52	(77)
Southeast	0.9x	0.77	x	2.88	x	62.67	x	0.63	x	0.7	=	55.16	(77)
Southeast	0.9x	0.77	x	2.88	x	62.67	x	0.63	x	0.7	=	55.16	(77)
Southeast	0.9x	0.77	x	2.88	x	62.67	x	0.63	x	0.7	=	55.16	(77)
Southeast	0.9x	0.77	x	1.75	x	85.75	x	0.63	x	0.7	=	45.86	(77)
Southeast	0.9x	0.77	x	1.75	x	85.75	x	0.63	x	0.7	=	45.86	(77)
Southeast	0.9x	0.77	x	1.75	x	85.75	x	0.63	x	0.7	=	45.86	(77)
Southeast	0.9x	0.77	x	1.75	x	85.75	x	0.63	x	0.7	=	45.86	(77)
Southeast	0.9x	0.77	x	2.88	x	85.75	x	0.63	x	0.7	=	75.48	(77)
Southeast	0.9x	0.77	x	2.88	x	85.75	x	0.63	x	0.7	=	75.48	(77)
Southeast	0.9x	0.77	x	2.88	x	85.75	x	0.63	x	0.7	=	75.48	(77)
Southeast	0.9x	0.77	x	1.75	x	106.25	x	0.63	x	0.7	=	56.83	(77)
Southeast	0.9x	0.77	x	1.75	x	106.25	x	0.63	x	0.7	=	56.83	(77)
Southeast	0.9x	0.77	x	1.75	x	106.25	x	0.63	x	0.7	=	56.83	(77)
Southeast	0.9x	0.77	x	1.75	x	106.25	x	0.63	x	0.7	=	56.83	(77)
Southeast	0.9x	0.77	x	2.88	x	106.25	x	0.63	x	0.7	=	93.52	(77)
Southeast	0.9x	0.77	x	2.88	x	106.25	x	0.63	x	0.7	=	93.52	(77)
Southeast	0.9x	0.77	x	2.88	x	106.25	x	0.63	x	0.7	=	93.52	(77)
Southeast	0.9x	0.77	x	1.75	x	119.01	x	0.63	x	0.7	=	63.65	(77)
Southeast	0.9x	0.77	x	1.75	x	119.01	x	0.63	x	0.7	=	63.65	(77)
Southeast	0.9x	0.77	x	1.75	x	119.01	x	0.63	x	0.7	=	63.65	(77)
Southeast	0.9x	0.77	x	1.75	x	119.01	x	0.63	x	0.7	=	63.65	(77)
Southeast	0.9x	0.77	x	2.88	x	119.01	x	0.63	x	0.7	=	104.75	(77)
Southeast	0.9x	0.77	x	2.88	x	119.01	x	0.63	x	0.7	=	104.75	(77)
Southeast	0.9x	0.77	x	2.88	x	119.01	x	0.63	x	0.7	=	104.75	(77)
Southeast	0.9x	0.77	x	1.75	x	118.15	x	0.63	x	0.7	=	63.19	(77)
Southeast	0.9x	0.77	x	1.75	x	118.15	x	0.63	x	0.7	=	63.19	(77)
Southeast	0.9x	0.77	x	1.75	x	118.15	x	0.63	x	0.7	=	63.19	(77)
Southeast	0.9x	0.77	x	1.75	x	118.15	x	0.63	x	0.7	=	63.19	(77)
Southeast	0.9x	0.77	x	2.88	x	118.15	x	0.63	x	0.7	=	103.99	(77)
Southeast	0.9x	0.77	x	2.88	x	118.15	x	0.63	x	0.7	=	103.99	(77)
Southeast	0.9x	0.77	x	2.88	x	118.15	x	0.63	x	0.7	=	103.99	(77)
Southeast	0.9x	0.77	x	1.75	x	113.91	x	0.63	x	0.7	=	60.92	(77)
Southeast	0.9x	0.77	x	1.75	x	113.91	x	0.63	x	0.7	=	60.92	(77)
Southeast	0.9x	0.77	x	1.75	x	113.91	x	0.63	x	0.7	=	60.92	(77)
Southeast	0.9x	0.77	x	1.75	x	113.91	x	0.63	x	0.7	=	60.92	(77)
Southeast	0.9x	0.77	x	2.88	x	113.91	x	0.63	x	0.7	=	100.26	(77)
Southeast	0.9x	0.77	x	2.88	x	113.91	x	0.63	x	0.7	=	100.26	(77)
Southeast	0.9x	0.77	x	2.88	x	113.91	x	0.63	x	0.7	=	100.26	(77)
Southeast	0.9x	0.77	x	1.75	x	104.39	x	0.63	x	0.7	=	55.83	(77)
Southeast	0.9x	0.77	x	1.75	x	104.39	x	0.63	x	0.7	=	55.83	(77)

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Southeast	0.9x	0.77	x	1.75	x	104.39	x	0.63	x	0.7	=	55.83	(77)
Southeast	0.9x	0.77	x	1.75	x	104.39	x	0.63	x	0.7	=	55.83	(77)
Southeast	0.9x	0.77	x	2.88	x	104.39	x	0.63	x	0.7	=	91.88	(77)
Southeast	0.9x	0.77	x	2.88	x	104.39	x	0.63	x	0.7	=	91.88	(77)
Southeast	0.9x	0.77	x	2.88	x	104.39	x	0.63	x	0.7	=	91.88	(77)
Southeast	0.9x	0.77	x	1.75	x	92.85	x	0.63	x	0.7	=	49.66	(77)
Southeast	0.9x	0.77	x	1.75	x	92.85	x	0.63	x	0.7	=	49.66	(77)
Southeast	0.9x	0.77	x	1.75	x	92.85	x	0.63	x	0.7	=	49.66	(77)
Southeast	0.9x	0.77	x	1.75	x	92.85	x	0.63	x	0.7	=	49.66	(77)
Southeast	0.9x	0.77	x	2.88	x	92.85	x	0.63	x	0.7	=	81.73	(77)
Southeast	0.9x	0.77	x	2.88	x	92.85	x	0.63	x	0.7	=	81.73	(77)
Southeast	0.9x	0.77	x	2.88	x	92.85	x	0.63	x	0.7	=	81.73	(77)
Southeast	0.9x	0.77	x	1.75	x	69.27	x	0.63	x	0.7	=	37.05	(77)
Southeast	0.9x	0.77	x	1.75	x	69.27	x	0.63	x	0.7	=	37.05	(77)
Southeast	0.9x	0.77	x	1.75	x	69.27	x	0.63	x	0.7	=	37.05	(77)
Southeast	0.9x	0.77	x	1.75	x	69.27	x	0.63	x	0.7	=	37.05	(77)
Southeast	0.9x	0.77	x	2.88	x	69.27	x	0.63	x	0.7	=	60.97	(77)
Southeast	0.9x	0.77	x	2.88	x	69.27	x	0.63	x	0.7	=	60.97	(77)
Southeast	0.9x	0.77	x	2.88	x	69.27	x	0.63	x	0.7	=	60.97	(77)
Southeast	0.9x	0.77	x	1.75	x	44.07	x	0.63	x	0.7	=	23.57	(77)
Southeast	0.9x	0.77	x	1.75	x	44.07	x	0.63	x	0.7	=	23.57	(77)
Southeast	0.9x	0.77	x	1.75	x	44.07	x	0.63	x	0.7	=	23.57	(77)
Southeast	0.9x	0.77	x	1.75	x	44.07	x	0.63	x	0.7	=	23.57	(77)
Southeast	0.9x	0.77	x	2.88	x	44.07	x	0.63	x	0.7	=	38.79	(77)
Southeast	0.9x	0.77	x	2.88	x	44.07	x	0.63	x	0.7	=	38.79	(77)
Southeast	0.9x	0.77	x	2.88	x	44.07	x	0.63	x	0.7	=	38.79	(77)
Southeast	0.9x	0.77	x	1.75	x	31.49	x	0.63	x	0.7	=	16.84	(77)
Southeast	0.9x	0.77	x	1.75	x	31.49	x	0.63	x	0.7	=	16.84	(77)
Southeast	0.9x	0.77	x	1.75	x	31.49	x	0.63	x	0.7	=	16.84	(77)
Southeast	0.9x	0.77	x	1.75	x	31.49	x	0.63	x	0.7	=	16.84	(77)
Southeast	0.9x	0.77	x	2.88	x	31.49	x	0.63	x	0.7	=	27.71	(77)
Southeast	0.9x	0.77	x	2.88	x	31.49	x	0.63	x	0.7	=	27.71	(77)
Southeast	0.9x	0.77	x	2.88	x	31.49	x	0.63	x	0.7	=	27.71	(77)
Southwest	0.9x	0.77	x	1.75	x	36.79		0.63	x	0.7	=	19.68	(79)
Southwest	0.9x	0.77	x	1.75	x	36.79		0.63	x	0.7	=	19.68	(79)
Southwest	0.9x	0.77	x	1.75	x	36.79		0.63	x	0.7	=	19.68	(79)
Southwest	0.9x	0.77	x	1.75	x	62.67		0.63	x	0.7	=	33.52	(79)
Southwest	0.9x	0.77	x	1.75	x	62.67		0.63	x	0.7	=	33.52	(79)
Southwest	0.9x	0.77	x	1.75	x	62.67		0.63	x	0.7	=	33.52	(79)
Southwest	0.9x	0.77	x	1.75	x	85.75		0.63	x	0.7	=	45.86	(79)
Southwest	0.9x	0.77	x	1.75	x	85.75		0.63	x	0.7	=	45.86	(79)

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Southwest	0.9x	0.77	x	1.75	x	85.75	0.63	x	0.7	=	45.86	(79)
Southwest	0.9x	0.77	x	1.75	x	106.25	0.63	x	0.7	=	56.83	(79)
Southwest	0.9x	0.77	x	1.75	x	106.25	0.63	x	0.7	=	56.83	(79)
Southwest	0.9x	0.77	x	1.75	x	106.25	0.63	x	0.7	=	56.83	(79)
Southwest	0.9x	0.77	x	1.75	x	119.01	0.63	x	0.7	=	63.65	(79)
Southwest	0.9x	0.77	x	1.75	x	119.01	0.63	x	0.7	=	63.65	(79)
Southwest	0.9x	0.77	x	1.75	x	119.01	0.63	x	0.7	=	63.65	(79)
Southwest	0.9x	0.77	x	1.75	x	118.15	0.63	x	0.7	=	63.19	(79)
Southwest	0.9x	0.77	x	1.75	x	118.15	0.63	x	0.7	=	63.19	(79)
Southwest	0.9x	0.77	x	1.75	x	118.15	0.63	x	0.7	=	63.19	(79)
Southwest	0.9x	0.77	x	1.75	x	113.91	0.63	x	0.7	=	60.92	(79)
Southwest	0.9x	0.77	x	1.75	x	113.91	0.63	x	0.7	=	60.92	(79)
Southwest	0.9x	0.77	x	1.75	x	113.91	0.63	x	0.7	=	60.92	(79)
Southwest	0.9x	0.77	x	1.75	x	104.39	0.63	x	0.7	=	55.83	(79)
Southwest	0.9x	0.77	x	1.75	x	104.39	0.63	x	0.7	=	55.83	(79)
Southwest	0.9x	0.77	x	1.75	x	104.39	0.63	x	0.7	=	55.83	(79)
Southwest	0.9x	0.77	x	1.75	x	92.85	0.63	x	0.7	=	49.66	(79)
Southwest	0.9x	0.77	x	1.75	x	92.85	0.63	x	0.7	=	49.66	(79)
Southwest	0.9x	0.77	x	1.75	x	92.85	0.63	x	0.7	=	49.66	(79)
Southwest	0.9x	0.77	x	1.75	x	69.27	0.63	x	0.7	=	37.05	(79)
Southwest	0.9x	0.77	x	1.75	x	69.27	0.63	x	0.7	=	37.05	(79)
Southwest	0.9x	0.77	x	1.75	x	69.27	0.63	x	0.7	=	37.05	(79)
Southwest	0.9x	0.77	x	1.75	x	44.07	0.63	x	0.7	=	23.57	(79)
Southwest	0.9x	0.77	x	1.75	x	44.07	0.63	x	0.7	=	23.57	(79)
Southwest	0.9x	0.77	x	1.75	x	44.07	0.63	x	0.7	=	23.57	(79)
Southwest	0.9x	0.77	x	1.75	x	31.49	0.63	x	0.7	=	16.84	(79)
Southwest	0.9x	0.77	x	1.75	x	31.49	0.63	x	0.7	=	16.84	(79)
Southwest	0.9x	0.77	x	1.75	x	31.49	0.63	x	0.7	=	16.84	(79)

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

(83)m=	244.25	419.14	581.74	734.62	835.45	834.95	802.68	726.61	634.55	465.47	293.12	208.66	(83)

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

(84)m=	639.48	813.01	961.86	1091.97	1168.54	1145.53	1099.15	1027.12	947.21	801.05	655.11	591.56	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.88	0.75	0.59	0.64	0.85	0.97	0.99	1	(86)

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

(87)m=	19.26	19.49	19.83	20.25	20.62	20.87	20.96	20.95	20.76	20.26	19.67	19.22	(87)

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

(88)m=	19.64	19.64	19.65	19.66	19.66	19.67	19.67	19.67	19.66	19.66	19.66	19.65	(88)

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

(89)m=	1	0.99	0.98	0.93	0.83	0.64	0.43	0.48	0.77	0.95	0.99	1	(89)

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

(90)m=	18.09	18.32	18.66	19.07	19.41	19.61	19.66	19.66	19.54	19.09	18.51	18.06	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	18.48	18.71	19.05	19.46	19.81	20.03	20.09	20.09	19.94	19.48	18.9	18.44	(92)

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

(93)m=	18.48	18.71	19.05	19.46	19.81	20.03	20.09	20.09	19.94	19.48	18.9	18.44	(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	0.93	0.84	0.67	0.48	0.54	0.79	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	636.49	803.33	934.32	1014.34	977.29	767.07	531.31	551.62	747.76	762.59	648.71	589.51	(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=	2278.19	2214.31	2007.8	1675.06	1284.4	852.68	548.47	577.82	920.62	1405.35	1874	2271.05	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1221.43	948.18	798.67	475.72	228.49	0	0	0	0	478.21	882.21	1251.07	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6283.97 (98)

Space heating requirement in kWh/m²/year 61.06 (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	1476.07	1162.01	1191.63	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.79	0.87	0.84	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	1170.38	1006.05	997	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1445.55	1389.02	1306.71	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	198.12	284.93	230.42	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 713.47 (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)

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

(107)m=	0	0	0	0	0	49.53	71.23	57.61	0	0	0	0

Total = Sum(107)$_{6...8}$ = 178.37 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.73 (108)

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

Fabric Energy Efficiency (99) + (108) = 62.79 (109)

Target Fabric Energy Efficiency (TFEE) 72.21 (109)

APPENDIX D. DER WORKSHEETS (BE LEAN)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Lean-First Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.18	(1a) x	2.5	(2a) =	125.45	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.18	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	125.45	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.1	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.13	0.13	0.13	0.12	0.11	0.1	0.1	0.1	0.1	0.11	0.12	0.12

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) = 77.35 (23c)

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

(24a)m=	0.25	0.24	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.25	0.24	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 3			2	x1/[1/(1.2)+ 0.04]		=	2.29			(27)
Windows Type 4			1.7	x1/[1/(1.2)+ 0.04]		=	1.95			(27)
Windows Type 5			2	x1/[1/(1.2)+ 0.04]		=	2.29			(27)
Floor			50.18	x	0.15	=	7.527			(28)
Walls Type1	53.68	12.22	41.46	x	0.18	=	7.46			(29)
Walls Type2	14.73	0	14.73	x	0.2	=	2.91			(29)
Walls Type3	3.34	2.15	1.19	x	0.22	=	0.26			(29)
Total area of elements, m²			121.93							(31)
Party wall			22.09	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.3 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10578.29 (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 16.37 (36)

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

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Total fabric heat loss	(33) + (36) =	50.67	(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=	10.23	10.12	10.01	9.47	9.36	8.82	8.82	8.71	9.04	9.36	9.58	9.8	(38)

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

(39)m=	60.9	60.79	60.68	60.14	60.03	59.49	59.49	59.38	59.7	60.03	60.25	60.46	

Average = $Sum(39)_{1...12}$ /12= 60.11 (39)

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

(40)m=	1.21	1.21	1.21	1.2	1.2	1.19	1.19	1.18	1.19	1.2	1.2	1.2	

Average = $Sum(40)_{1...12}$ /12= 1.2 (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 1.7 (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 74.47 (43)

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

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

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

(44)m=	81.91	78.93	75.96	72.98	70	67.02	67.02	70	72.98	75.96	78.93	81.91

Total = $Sum(44)_{1...12}$ = 893.59 (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=	121.47	106.24	109.63	95.58	91.71	79.14	73.33	84.15	85.16	99.24	108.33	117.64

Total = $Sum(45)_{1...12}$ = 1171.64 (45)

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

(46)m=	18.22	15.94	16.44	14.34	13.76	11.87	11	12.62	12.77	14.89	16.25	17.65	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		0	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)			
Water storage loss:			
a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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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=	32.02	28.88	31.9	30.8	31.77	30.68	31.66	31.73	30.74	31.85	30.91	32	(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=	153.49	135.12	141.53	126.38	123.48	109.82	104.99	115.88	115.9	131.09	139.24	149.64	(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=	153.49	135.12	141.53	126.38	123.48	109.82	104.99	115.88	115.9	131.09	139.24	149.64

Output from water heater (annual)$_{1...12}$ | 1546.55 | (64)

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

(65)m=	48.39	42.54	44.43	39.48	38.44	33.98	32.3	35.91	36	40.96	43.75	47.11	(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=	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	(66)

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

(67)m=	13.17	11.7	9.51	7.2	5.38	4.54	4.91	6.38	8.57	10.88	12.7	13.53	(67)

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

(68)m=	147.7	149.23	145.37	137.15	126.77	117.02	110.5	108.97	112.83	121.05	131.43	141.18	(68)

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

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(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=	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	(71)

Water heating gains (Table 5)

(72)m=	65.05	63.31	59.72	54.83	51.66	47.2	43.41	48.27	50	55.05	60.76	63.33	(72)

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

(73)m=	277.35	275.67	266.03	250.61	235.24	220.19	210.25	215.05	222.83	238.41	256.32	269.48	(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)	
Northeast	0.9x	0.77	x	1.7	x	11.28	x	0.4	x	0.7	=	3.72	(75)
Northeast	0.9x	0.77	x	1.7	x	22.97	x	0.4	x	0.7	=	7.58	(75)
Northeast	0.9x	0.77	x	1.7	x	41.38	x	0.4	x	0.7	=	13.65	(75)
Northeast	0.9x	0.77	x	1.7	x	67.96	x	0.4	x	0.7	=	22.42	(75)
Northeast	0.9x	0.77	x	1.7	x	91.35	x	0.4	x	0.7	=	30.13	(75)
Northeast	0.9x	0.77	x	1.7	x	97.38	x	0.4	x	0.7	=	32.12	(75)
Northeast	0.9x	0.77	x	1.7	x	91.1	x	0.4	x	0.7	=	30.05	(75)
Northeast	0.9x	0.77	x	1.7	x	72.63	x	0.4	x	0.7	=	23.96	(75)
Northeast	0.9x	0.77	x	1.7	x	50.42	x	0.4	x	0.7	=	16.63	(75)
Northeast	0.9x	0.77	x	1.7	x	28.07	x	0.4	x	0.7	=	9.26	(75)
Northeast	0.9x	0.77	x	1.7	x	14.2	x	0.4	x	0.7	=	4.68	(75)
Northeast	0.9x	0.77	x	1.7	x	9.21	x	0.4	x	0.7	=	3.04	(75)
Southeast	0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast	0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast	0.9x	0.77	x	2	x	36.79	x	0.4	x	0.7	=	14.28	(77)
Southeast	0.9x	0.77	x	2	x	36.79	x	0.4	x	0.7	=	14.28	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	2	x	62.67	x	0.4	x	0.7	=	24.32	(77)
Southeast	0.9x	0.77	x	2	x	62.67	x	0.4	x	0.7	=	24.32	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	2	x	85.75	x	0.4	x	0.7	=	33.28	(77)
Southeast	0.9x	0.77	x	2	x	85.75	x	0.4	x	0.7	=	33.28	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	2	x	106.25	x	0.4	x	0.7	=	41.23	(77)
Southeast	0.9x	0.77	x	2	x	106.25	x	0.4	x	0.7	=	41.23	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	2	x	119.01	x	0.4	x	0.7	=	46.19	(77)
Southeast	0.9x	0.77	x	2	x	119.01	x	0.4	x	0.7	=	46.19	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	2	x	118.15	x	0.4	x	0.7	=	45.85	(77)
Southeast	0.9x	0.77	x	2	x	118.15	x	0.4	x	0.7	=	45.85	(77)
Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	2	x	113.91	x	0.4	x	0.7	=	44.21	(77)

DER WorkSheet: New dwelling design stage

Southeast	0.9x	0.77	x	2	x	113.91	x	0.4	x	0.7	=	44.21	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	2	x	104.39	x	0.4	x	0.7	=	40.51	(77)
Southeast	0.9x	0.77	x	2	x	104.39	x	0.4	x	0.7	=	40.51	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	2	x	92.85	x	0.4	x	0.7	=	36.03	(77)
Southeast	0.9x	0.77	x	2	x	92.85	x	0.4	x	0.7	=	36.03	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	2	x	69.27	x	0.4	x	0.7	=	26.88	(77)
Southeast	0.9x	0.77	x	2	x	69.27	x	0.4	x	0.7	=	26.88	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	2	x	44.07	x	0.4	x	0.7	=	17.1	(77)
Southeast	0.9x	0.77	x	2	x	44.07	x	0.4	x	0.7	=	17.1	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast	0.9x	0.77	x	2	x	31.49	x	0.4	x	0.7	=	12.22	(77)
Southeast	0.9x	0.77	x	2	x	31.49	x	0.4	x	0.7	=	12.22	(77)

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

(83)m=	78.83	135.51	188.7	239.31	273.07	273.3	262.57	237.05	206.17	150.65	94.64	67.32	(83)

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

(84)m=	356.18	411.18	454.73	489.92	508.31	493.49	472.83	452.1	429	389.07	350.96	336.79	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.71	0.54	0.58	0.81	0.96	0.99	1	(86)

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

(87)m=	19.77	19.94	20.2	20.51	20.78	20.94	20.99	20.98	20.88	20.53	20.09	19.74	(87)

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

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

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

(89)m=	0.99	0.99	0.97	0.93	0.82	0.61	0.42	0.46	0.73	0.94	0.99	1	(89)

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

(90)m=	18.81	18.97	19.22	19.53	19.78	19.91	19.93	19.93	19.87	19.56	19.13	18.78	(90)

fLA = Living area ÷ (4) = | 0.48 | (91)

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

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(92)m=	19.27	19.44	19.69	20	20.26	20.4	20.44	20.44	20.36	20.03	19.59	19.24	(92)

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

(93)m=	19.27	19.44	19.69	20	20.26	20.4	20.44	20.44	20.36	20.03	19.59	19.24	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.93	0.83	0.66	0.48	0.52	0.77	0.94	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	353.82	405.63	441.43	455.37	424.01	324.84	224.98	234.55	329.51	367.05	346.3	335.06	(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=	911.81	883.93	800.53	667.84	513.92	345.32	228.35	239.65	373.5	566.16	752.71	909.42	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	415.15	321.42	267.17	152.98	66.89	0	0	0	0	148.14	292.62	427.33	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2091.69 (98)

Space heating requirement in kWh/m²/year 41.68 (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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	415.15	321.42	267.17	152.98	66.89	0	0	0	0	148.14	292.62	427.33	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	463.85	359.13	298.51	170.92	74.74	0	0	0	0	165.52	326.95	477.46	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2337.08 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)

	153.49	135.12	141.53	126.38	123.48	109.82	104.99	115.88	115.9	131.09	139.24	149.64	
Efficiency of water heater												86.7	(216)
(217)m=	88.73	88.65	88.51	88.21	87.66	86.7	86.7	86.7	86.7	88.16	88.58	88.76	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	173	152.41	159.91	143.26	140.85	126.66	121.1	133.66	133.68	148.69	157.2	168.59

Total = Sum(219a)$_{1...12}$ = 1759.01 (219)

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Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2337.08	
Water heating fuel used			1759.01	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		80.35		(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) =		155.35	(231)
Electricity for lighting			232.55	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4483.99	(338)

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	=	504.81	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	379.95	(264)
Space and water heating	(261) + (262) + (263) + (264) =			884.76	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	80.63	(267)
Electricity for lighting	(232) x	0.519	=	120.69	(268)
Total CO2, kg/year		sum of (265)…(271) =		1086.07	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		21.64	(273)
EI rating (section 14)				85	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Lean-Second Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	61.28	(1a) x	2.5	(2a) =	153.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.28	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	153.2	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.1	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.13	0.13	0.13	0.12	0.11	0.1	0.1	0.1	0.1	0.11	0.12	0.12

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) = 77.35 (23c)

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

(24a)m=	0.25	0.24	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.25	0.24	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 2			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 3			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 4			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 5			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 6			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 7			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 8			1.76	x1/[1/(1.2)+ 0.04]		=	2.02			(27)
Walls Type1	59.88	18.18	41.7	x	0.18	=	7.51			(29)
Walls Type2	5.48	0	5.48	x	0.2	=	1.08			(29)
Walls Type3	16.37	2.15	14.22	x	0.22	=	3.09			(29)
Total area of elements, m²			81.73							(31)
Party wall			24.18	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.65 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7043.88 (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 | 11.59 | (36)

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

Total fabric heat loss (33) + (36) = | 46.24 | (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=	12.49	12.36	12.23	11.56	11.43	10.77	10.77	10.64	11.03	11.43	11.7	11.96	(38)

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

(39)m=	58.73	58.6	58.47	57.8	57.67	57.01	57.01	56.87	57.27	57.67	57.94	58.2	

Average = Sum(39)$_{1…12}$ /12= | 57.77 | (39)

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

(40)m=	0.96	0.96	0.95	0.94	0.94	0.93	0.93	0.93	0.93	0.94	0.95	0.95	

Average = Sum(40)$_{1…12}$ /12= | 0.94 | (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 | 2.02 | (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 | 82.12 | (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	90.33	87.04	83.76	80.48	77.19	73.91	73.91	77.19	80.48	83.76	87.04	90.33

Total = Sum(44)$_{1…12}$ = | 985.41 | (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=	133.96	117.16	120.9	105.4	101.13	87.27	80.87	92.8	93.91	109.44	119.46	129.73

Total = Sum(45)$_{1…12}$ = | 1292.03 | (45)

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

(46)m=	20.09	17.57	18.13	15.81	15.17	13.09	12.13	13.92	14.09	16.42	17.92	19.46	(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=	32.17	29.01	32.03	30.9	31.87	30.76	31.73	31.82	30.84	31.96	31.04	32.15	(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=	166.13	146.17	152.93	136.31	133	118.03	112.6	124.62	124.75	141.4	150.51	161.88	(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=	166.13	146.17	152.93	136.31	133	118.03	112.6	124.62	124.75	141.4	150.51	161.88

Output from water heater (annual)$_{1...12}$ | 1668.32 | (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=	52.58	46.21	48.21	42.77	41.59	36.71	34.82	38.81	38.93	44.38	47.48	51.17	(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=	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	15.71	13.95	11.34	8.59	6.42	5.42	5.86	7.61	10.22	12.97	15.14	16.14	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	176.16	177.99	173.38	163.58	151.2	139.56	131.79	129.96	134.57	144.38	156.76	168.39	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	(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=	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	(71)
Water heating gains (Table 5)													
(72)m=	70.68	68.76	64.79	59.41	55.91	50.98	46.8	52.16	54.07	59.65	65.95	68.78	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	318.81	316.97	305.79	287.84	269.79	252.23	240.72	246	255.13	273.26	294.11	309.57	(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)	
Northeast	0.9x	0.77	x	1.76	x	11.28	x	0.4	x	0.7	=	3.85	(75)
Northeast	0.9x	0.77	x	1.76	x	22.97	x	0.4	x	0.7	=	7.84	(75)
Northeast	0.9x	0.77	x	1.76	x	41.38	x	0.4	x	0.7	=	14.13	(75)
Northeast	0.9x	0.77	x	1.76	x	67.96	x	0.4	x	0.7	=	23.21	(75)
Northeast	0.9x	0.77	x	1.76	x	91.35	x	0.4	x	0.7	=	31.2	(75)
Northeast	0.9x	0.77	x	1.76	x	97.38	x	0.4	x	0.7	=	33.26	(75)
Northeast	0.9x	0.77	x	1.76	x	91.1	x	0.4	x	0.7	=	31.11	(75)
Northeast	0.9x	0.77	x	1.76	x	72.63	x	0.4	x	0.7	=	24.8	(75)
Northeast	0.9x	0.77	x	1.76	x	50.42	x	0.4	x	0.7	=	17.22	(75)
Northeast	0.9x	0.77	x	1.76	x	28.07	x	0.4	x	0.7	=	9.59	(75)
Northeast	0.9x	0.77	x	1.76	x	14.2	x	0.4	x	0.7	=	4.85	(75)
Northeast	0.9x	0.77	x	1.76	x	9.21	x	0.4	x	0.7	=	3.15	(75)
Southeast	0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast	0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast	0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast	0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast	0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)

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Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25		0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25		0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25		0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01		0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01		0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01		0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15		0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15		0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15		0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91		0.4	x	0.7	=	43.76	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91		0.4	x	0.7	=	43.76	(79)

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Southwest	0.9x	0.77	x	1.98	x	113.91	0.4	x	0.7	=	43.76	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)

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

(83)m=	121.08	207.53	287.35	361.74	410.38	409.7	394.04	357.41	313.06	230.28	145.26	103.47	(83)

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

(84)m=	439.89	524.49	593.14	649.58	680.17	661.93	634.76	603.41	568.18	503.54	439.37	413.05	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.88	0.74	0.54	0.39	0.43	0.67	0.92	0.99	1	(86)

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

(87)m=	20.14	20.32	20.56	20.8	20.95	20.99	21	21	20.98	20.78	20.41	20.1	(87)

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

(88)m=	20.12	20.12	20.12	20.13	20.13	20.14	20.14	20.14	20.14	20.13	20.13	20.13	(88)

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

(89)m=	0.99	0.98	0.95	0.85	0.68	0.47	0.32	0.35	0.6	0.89	0.98	1	(89)

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

(90)m=	19.34	19.52	19.75	19.98	20.1	20.14	20.14	20.14	20.13	19.97	19.61	19.3	(90)

fLA = Living area ÷ (4) = 0.45 (91)

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

(92)m=	19.69	19.88	20.11	20.35	20.48	20.52	20.52	20.52	20.51	20.33	19.97	19.66	(92)

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

(93)m=	19.69	19.88	20.11	20.35	20.48	20.52	20.52	20.52	20.51	20.33	19.97	19.66	(93)

8. Space heating requirement

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

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

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Utilisation factor for gains, hm:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(94)m=	0.99	0.98	0.95	0.86	0.71	0.51	0.35	0.39	0.63	0.9	0.98	0.99		(94)

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

(95)m=	436.48	513.75	561.91	560.6	480.28	334.48	223.42	234.09	356.77	451.97	431.18	410.73		(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=	904.12	877.72	795.71	661.7	506.15	337.46	223.71	234.59	366.86	561.29	745.56	899.76		(97)

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

(98)m=	347.92	244.59	173.95	72.79	19.25	0	0	0	0	81.34	226.36	363.84		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1530.03 (98)

Space heating requirement in kWh/m²/year 24.97 (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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	347.92	244.59	173.95	72.79	19.25	0	0	0	0	81.34	226.36	363.84		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	388.74	273.28	194.35	81.33	21.5	0	0	0	0	90.88	252.92	406.52		(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1709.53 (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)

166.13	146.17	152.93	136.31	133	118.03	112.6	124.62	124.75	141.4	150.51	161.88

Efficiency of water heater 86.7 (216)

(217)m=	88.58	88.43	88.17	87.65	87.04	86.7	86.7	86.7	86.7	87.7	88.36	88.62	(217)

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

(219)m=	187.56	165.29	173.45	155.5	152.8	136.14	129.88	143.74	143.88	161.23	170.33	182.67

Total = Sum(219a)$_{1...12}$ = 1902.46 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1709.53
Water heating fuel used		1902.46
Electricity for pumps, fans and electric keep-hot		

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mechanical ventilation - balanced, extract or positive input from outside		98.12		(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) =		173.12	(231)
Electricity for lighting			277.36	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4062.47	(338)

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	=	369.26	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	410.93	(264)
Space and water heating	(261) + (262) + (263) + (264) =				780.19	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	89.85	(267)
Electricity for lighting	(232)	x	0.519	=	143.95	(268)
Total CO2, kg/year			sum of (265)…(271) =		1013.99	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		16.55	(273)
EI rating (section 14)					87	(274)

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User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Lean-Top Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	102.92	(1a)	x	2.45	(2a)	=	252.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	102.92	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	252.15	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 2			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 3			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 4			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 5			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 6			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 7			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 8			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 9			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 10			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 11			1.87	x1/[1/(1.2)+ 0.04]		=	2.14			(27)
Windows Type 12			1.2	x1/[1/(1.2)+ 0.04]		=	1.37			(27)
Walls Type1	128.4	26.71	101.69	x	0.18	=	18.3			(29)
Walls Type2	22.83	0	22.83	x	0.2	=	4.51			(29)
Walls Type3	19.21	2.15	17.06	x	0.22	=	3.71			(29)
Roof	102.92	0	102.92	x	0.13	=	13.38			(30)
Total area of elements, m²			273.36							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 72.64 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	16692.33	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		39.78	(36)

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

Total fabric heat loss	(33) + (36) =	112.41	(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=	23.3	23.04	22.77	21.45	21.18	19.86	19.86	19.59	20.39	21.18	21.71	22.24	(38)

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

(39)m=	135.72	135.45	135.19	133.86	133.6	132.27	132.27	132	132.8	133.6	134.13	134.66	

Average = Sum(39)$_{1…12}$ /12= 133.79 (39)

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

(40)m=	1.32	1.32	1.31	1.3	1.3	1.29	1.29	1.28	1.29	1.3	1.3	1.31	

Average = Sum(40)$_{1…12}$ /12= 1.3 (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 2.76 (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 99.87 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	109.85	105.86	101.87	97.87	93.88	89.88	89.88	93.88	97.87	101.87	105.86	109.85	

Total = Sum(44)$_{1…12}$ = 1198.41 (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=	162.91	142.48	147.03	128.18	123	106.14	98.35	112.86	114.21	133.1	145.29	157.77	

Total = Sum(45)$_{1…12}$ = 1571.31 (45)

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

(46)m=	24.44	21.37	22.05	19.23	18.45	15.92	14.75	16.93	17.13	19.96	21.79	23.67	(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:

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Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

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

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

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

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

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

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

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

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

(61)m=	32.48	29.3	32.36	31.2	32.13	30.98	31.94	32.07	31.1	32.26	31.34	32.44	(61)

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

(62)m=	195.39	171.78	179.39	159.38	155.13	137.12	130.29	144.93	145.31	165.36	176.63	190.21	(62)

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

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

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

Output from water heater

(64)m=	195.39	171.78	179.39	159.38	155.13	137.12	130.29	144.93	145.31	165.36	176.63	190.21	

Output from water heater (annual)$_{1...12}$ — 1950.91 (64)

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

(65)m=	62.29	54.7	56.98	50.42	48.93	43.04	40.69	45.54	45.75	52.32	56.14	60.57	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	23.27	20.66	16.8	12.72	9.51	8.03	8.68	11.28	15.14	19.22	22.43	23.91	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	260.96	263.67	256.85	242.32	223.98	206.75	195.23	192.52	199.35	213.88	232.21	249.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	(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=	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	(71)
Water heating gains (Table 5)													
(72)m=	83.72	81.4	76.58	70.03	65.77	59.77	54.69	61.21	63.54	70.32	77.98	81.41	(72)

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

(73)m=	435.42	433.21	417.71	392.55	366.73	342.02	326.07	332.49	345.5	370.89	400.09	422.24	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	1.87	x	11.28	x	0.4	x	0.7	=	4.09	(75)
Northeast 0.9x	0.77	x	1.2	x	11.28	x	0.4	x	0.7	=	2.63	(75)
Northeast 0.9x	0.77	x	1.87	x	22.97	x	0.4	x	0.7	=	8.33	(75)
Northeast 0.9x	0.77	x	1.2	x	22.97	x	0.4	x	0.7	=	5.35	(75)
Northeast 0.9x	0.77	x	1.87	x	41.38	x	0.4	x	0.7	=	15.01	(75)
Northeast 0.9x	0.77	x	1.2	x	41.38	x	0.4	x	0.7	=	9.63	(75)
Northeast 0.9x	0.77	x	1.87	x	67.96	x	0.4	x	0.7	=	24.66	(75)
Northeast 0.9x	0.77	x	1.2	x	67.96	x	0.4	x	0.7	=	15.82	(75)
Northeast 0.9x	0.77	x	1.87	x	91.35	x	0.4	x	0.7	=	33.15	(75)
Northeast 0.9x	0.77	x	1.2	x	91.35	x	0.4	x	0.7	=	21.27	(75)
Northeast 0.9x	0.77	x	1.87	x	97.38	x	0.4	x	0.7	=	35.34	(75)
Northeast 0.9x	0.77	x	1.2	x	97.38	x	0.4	x	0.7	=	22.68	(75)
Northeast 0.9x	0.77	x	1.87	x	91.1	x	0.4	x	0.7	=	33.06	(75)
Northeast 0.9x	0.77	x	1.2	x	91.1	x	0.4	x	0.7	=	21.21	(75)
Northeast 0.9x	0.77	x	1.87	x	72.63	x	0.4	x	0.7	=	26.35	(75)
Northeast 0.9x	0.77	x	1.2	x	72.63	x	0.4	x	0.7	=	16.91	(75)
Northeast 0.9x	0.77	x	1.87	x	50.42	x	0.4	x	0.7	=	18.3	(75)
Northeast 0.9x	0.77	x	1.2	x	50.42	x	0.4	x	0.7	=	11.74	(75)
Northeast 0.9x	0.77	x	1.87	x	28.07	x	0.4	x	0.7	=	10.18	(75)
Northeast 0.9x	0.77	x	1.2	x	28.07	x	0.4	x	0.7	=	6.54	(75)
Northeast 0.9x	0.77	x	1.87	x	14.2	x	0.4	x	0.7	=	5.15	(75)
Northeast 0.9x	0.77	x	1.2	x	14.2	x	0.4	x	0.7	=	3.31	(75)
Northeast 0.9x	0.77	x	1.87	x	9.21	x	0.4	x	0.7	=	3.34	(75)
Northeast 0.9x	0.77	x	1.2	x	9.21	x	0.4	x	0.7	=	2.15	(75)
Southeast 0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast 0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast 0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast 0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast 0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast 0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast 0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast 0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast 0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast 0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)

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Southeast	0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast	0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast	0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast	0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast	0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast	0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast	0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast	0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast	0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast	0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast	0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast	0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast	0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast	0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast	0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast	0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)

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Southeast 0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast 0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast 0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast 0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast 0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast 0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast 0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast 0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast 0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast 0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast 0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast 0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast 0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast 0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast 0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast 0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast 0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast 0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast 0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast 0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast 0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast 0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast 0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast 0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast 0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast 0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast 0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast 0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast 0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast 0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast 0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast 0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast 0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southwest 0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest 0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest 0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest 0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest 0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest 0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest 0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)
Southwest 0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)

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Southwest	0.9x	0.77	x	1.98	x	85.75	0.4	x	0.7	=	32.95	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25	0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25	0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25	0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01	0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01	0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01	0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15	0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15	0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15	0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91	0.4	x	0.7	=	43.76	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91	0.4	x	0.7	=	43.76	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91	0.4	x	0.7	=	43.76	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)

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

(83)m=	175.5	301.17	418.01	527.87	600.33	599.98	576.78	522.11	455.96	334.46	210.61	149.93	(83)

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

(84)m=	610.92	734.38	835.72	920.41	967.06	942	902.85	854.6	801.45	705.35	610.71	572.17	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.78	0.61	0.66	0.87	0.98	1	1	(86)

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

(87)m=	19.53	19.72	19.99	20.35	20.67	20.9	20.97	20.96	20.81	20.38	19.88	19.5	(87)

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

(88)m=	19.83	19.83	19.83	19.84	19.84	19.85	19.85	19.85	19.85	19.84	19.84	19.83	(88)

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

(89)m=	1	0.99	0.98	0.95	0.87	0.68	0.47	0.52	0.8	0.97	0.99	1	(89)

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

(90)m=	18.5	18.68	18.96	19.32	19.62	19.8	19.85	19.84	19.74	19.35	18.86	18.47	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	18.84	19.03	19.3	19.66	19.97	20.17	20.22	20.22	20.09	19.69	19.2	18.81	(92)

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

(93)m=	18.84	19.03	19.3	19.66	19.97	20.17	20.22	20.22	20.09	19.69	19.2	18.81	(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=	1	0.99	0.98	0.95	0.87	0.71	0.52	0.57	0.82	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	608.79	728.37	819.4	873.4	841.68	667.18	466.37	484.58	655.79	679.37	606.24	570.68	(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=	1973.8	1913.47	1731.04	1440.47	1104.82	736.3	478.87	503.64	796.04	1214.61	1623.05	1967.97	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1015.57	796.38	678.26	408.29	195.77	0	0	0	0	398.22	732.1	1039.59	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5264.19 (98)

Space heating requirement in kWh/m²/year 51.15 (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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	1015.57	796.38	678.26	408.29	195.77	0	0	0	0	398.22	732.1	1039.59	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1134.71	889.81	757.83	456.19	218.74	0	0	0	0	444.94	817.99	1161.55	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 5881.77 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

195.39	171.78	179.39	159.38	155.13	137.12	130.29	144.93	145.31	165.36	176.63	190.21

Efficiency of water heater 86.7 (216)

(217)m=	89.04	88.99	88.9	88.7	88.24	86.7	86.7	86.7	86.7	88.66	88.94	89.06	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	219.45	193.04	201.79	179.69	175.81	158.15	150.28	167.16	167.6	186.51	198.59	213.59

Total = Sum(219a)$_{1...12}$ = 2211.64 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		5881.77	
Water heating fuel used		2211.64	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	199.96		(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) =		274.96	(231)
Electricity for lighting		410.87	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		8779.24	(338)

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	=	1270.46	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	477.71	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1748.18	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	142.7	(267)
Electricity for lighting	(232) x	0.519	=	213.24	(268)
Total CO2, kg/year		sum of (265)…(271) =		2104.12	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		20.44	(273)
EI rating (section 14)				81	(274)

APPENDIX E. DER WORKSHEETS (BE GREEN)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Green-First Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.18	(1a) x	2.5	(2a) =	125.45	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.18	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.45	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.1	(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

DER WorkSheet: New dwelling design stage

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

0.13	0.13	0.13	0.12	0.11	0.1	0.1	0.1	0.1	0.11	0.12	0.12

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) = 77.35 (23c)

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

(24a)m=	0.25	0.24	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.25	0.24	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 3			2	x1/[1/(1.2)+ 0.04]		=	2.29			(27)
Windows Type 4			1.7	x1/[1/(1.2)+ 0.04]		=	1.95			(27)
Windows Type 5			2	x1/[1/(1.2)+ 0.04]		=	2.29			(27)
Floor			50.18	x	0.15	=	7.527			(28)
Walls Type1	53.68	12.22	41.46	x	0.18	=	7.46			(29)
Walls Type2	14.73	0	14.73	x	0.2	=	2.91			(29)
Walls Type3	3.34	2.15	1.19	x	0.22	=	0.26			(29)
Total area of elements, m²			121.93							(31)
Party wall			22.09	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.3 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10578.29 (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 16.37 (36)

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

DER WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 50.67 (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=	10.23	10.12	10.01	9.47	9.36	8.82	8.82	8.71	9.04	9.36	9.58	9.8	(38)

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

(39)m=	60.9	60.79	60.68	60.14	60.03	59.49	59.49	59.38	59.7	60.03	60.25	60.46	

Average = Sum(39)$_{1...12}$ /12= 60.11 (39)

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

(40)m=	1.21	1.21	1.21	1.2	1.2	1.19	1.19	1.18	1.19	1.2	1.2	1.2	

Average = Sum(40)$_{1...12}$ /12= 1.2 (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 1.7 (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 74.47 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	81.91	78.93	75.96	72.98	70	67.02	67.02	70	72.98	75.96	78.93	81.91	

Total = Sum(44)$_{1...12}$ = 893.59 (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=	121.47	106.24	109.63	95.58	91.71	79.14	73.33	84.15	85.16	99.24	108.33	117.64	

Total = Sum(45)$_{1...12}$ = 1171.64 (45)

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

(46)m=	18.22	15.94	16.44	14.34	13.76	11.87	11	12.62	12.77	14.89	16.25	17.65	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

DER WorkSheet: New dwelling design stage

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=	32.02	28.88	31.9	30.8	31.77	30.68	31.66	31.73	30.74	31.85	30.91	32	(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=	153.49	135.12	141.53	126.38	123.48	109.82	104.99	115.88	115.9	131.09	139.24	149.64	(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=	153.49	135.12	141.53	126.38	123.48	109.82	104.99	115.88	115.9	131.09	139.24	149.64

Output from water heater (annual)$_{1...12}$ | 1546.55 | (64)

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

(65)m=	48.39	42.54	44.43	39.48	38.44	33.98	32.3	35.91	36	40.96	43.75	47.11	(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=	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	(66)

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

(67)m=	13.17	11.7	9.51	7.2	5.38	4.54	4.91	6.38	8.57	10.88	12.7	13.53	(67)

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

(68)m=	147.7	149.23	145.37	137.15	126.77	117.02	110.5	108.97	112.83	121.05	131.43	141.18	(68)

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

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(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=	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	(71)

Water heating gains (Table 5)

(72)m=	65.05	63.31	59.72	54.83	51.66	47.2	43.41	48.27	50	55.05	60.76	63.33	(72)

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

(73)m=	277.35	275.67	266.03	250.61	235.24	220.19	210.25	215.05	222.83	238.41	256.32	269.48	(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)	
Northeast 0.9x	0.77	x	1.7	x	11.28	x	0.4	x	0.7	=	3.72	(75)
Northeast 0.9x	0.77	x	1.7	x	22.97	x	0.4	x	0.7	=	7.58	(75)
Northeast 0.9x	0.77	x	1.7	x	41.38	x	0.4	x	0.7	=	13.65	(75)
Northeast 0.9x	0.77	x	1.7	x	67.96	x	0.4	x	0.7	=	22.42	(75)
Northeast 0.9x	0.77	x	1.7	x	91.35	x	0.4	x	0.7	=	30.13	(75)
Northeast 0.9x	0.77	x	1.7	x	97.38	x	0.4	x	0.7	=	32.12	(75)
Northeast 0.9x	0.77	x	1.7	x	91.1	x	0.4	x	0.7	=	30.05	(75)
Northeast 0.9x	0.77	x	1.7	x	72.63	x	0.4	x	0.7	=	23.96	(75)
Northeast 0.9x	0.77	x	1.7	x	50.42	x	0.4	x	0.7	=	16.63	(75)
Northeast 0.9x	0.77	x	1.7	x	28.07	x	0.4	x	0.7	=	9.26	(75)
Northeast 0.9x	0.77	x	1.7	x	14.2	x	0.4	x	0.7	=	4.68	(75)
Northeast 0.9x	0.77	x	1.7	x	9.21	x	0.4	x	0.7	=	3.04	(75)
Southeast 0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast 0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast 0.9x	0.77	x	2	x	36.79	x	0.4	x	0.7	=	14.28	(77)
Southeast 0.9x	0.77	x	2	x	36.79	x	0.4	x	0.7	=	14.28	(77)
Southeast 0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast 0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast 0.9x	0.77	x	2	x	62.67	x	0.4	x	0.7	=	24.32	(77)
Southeast 0.9x	0.77	x	2	x	62.67	x	0.4	x	0.7	=	24.32	(77)
Southeast 0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast 0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast 0.9x	0.77	x	2	x	85.75	x	0.4	x	0.7	=	33.28	(77)
Southeast 0.9x	0.77	x	2	x	85.75	x	0.4	x	0.7	=	33.28	(77)
Southeast 0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast 0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast 0.9x	0.77	x	2	x	106.25	x	0.4	x	0.7	=	41.23	(77)
Southeast 0.9x	0.77	x	2	x	106.25	x	0.4	x	0.7	=	41.23	(77)
Southeast 0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast 0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast 0.9x	0.77	x	2	x	119.01	x	0.4	x	0.7	=	46.19	(77)
Southeast 0.9x	0.77	x	2	x	119.01	x	0.4	x	0.7	=	46.19	(77)
Southeast 0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast 0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast 0.9x	0.77	x	2	x	118.15	x	0.4	x	0.7	=	45.85	(77)
Southeast 0.9x	0.77	x	2	x	118.15	x	0.4	x	0.7	=	45.85	(77)
Southeast 0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast 0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast 0.9x	0.77	x	2	x	113.91	x	0.4	x	0.7	=	44.21	(77)

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Southeast	0.9x	0.77	x	2	x	113.91	x	0.4	x	0.7	=	44.21	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	2	x	104.39	x	0.4	x	0.7	=	40.51	(77)
Southeast	0.9x	0.77	x	2	x	104.39	x	0.4	x	0.7	=	40.51	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	2	x	92.85	x	0.4	x	0.7	=	36.03	(77)
Southeast	0.9x	0.77	x	2	x	92.85	x	0.4	x	0.7	=	36.03	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	2	x	69.27	x	0.4	x	0.7	=	26.88	(77)
Southeast	0.9x	0.77	x	2	x	69.27	x	0.4	x	0.7	=	26.88	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	2	x	44.07	x	0.4	x	0.7	=	17.1	(77)
Southeast	0.9x	0.77	x	2	x	44.07	x	0.4	x	0.7	=	17.1	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast	0.9x	0.77	x	2	x	31.49	x	0.4	x	0.7	=	12.22	(77)
Southeast	0.9x	0.77	x	2	x	31.49	x	0.4	x	0.7	=	12.22	(77)

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

(83)m=	78.83	135.51	188.7	239.31	273.07	273.3	262.57	237.05	206.17	150.65	94.64	67.32	(83)

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

(84)m=	356.18	411.18	454.73	489.92	508.31	493.49	472.83	452.1	429	389.07	350.96	336.79	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.71	0.54	0.58	0.81	0.96	0.99	1	(86)

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

(87)m=	19.77	19.94	20.2	20.51	20.78	20.94	20.99	20.98	20.88	20.53	20.09	19.74	(87)

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

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

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

(89)m=	0.99	0.99	0.97	0.93	0.82	0.61	0.42	0.46	0.73	0.94	0.99	1	(89)

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

(90)m=	18.81	18.97	19.22	19.53	19.78	19.91	19.93	19.93	19.87	19.56	19.13	18.78	(90)

fLA = Living area ÷ (4) = 0.48 (91)

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

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(92)m=	19.27	19.44	19.69	20	20.26	20.4	20.44	20.44	20.36	20.03	19.59	19.24	(92)

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

(93)m=	19.27	19.44	19.69	20	20.26	20.4	20.44	20.44	20.36	20.03	19.59	19.24	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.93	0.83	0.66	0.48	0.52	0.77	0.94	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	353.82	405.63	441.43	455.37	424.01	324.84	224.98	234.55	329.51	367.05	346.3	335.06	(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=	911.81	883.93	800.53	667.84	513.92	345.32	228.35	239.65	373.5	566.16	752.71	909.42	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	415.15	321.42	267.17	152.98	66.89	0	0	0	0	148.14	292.62	427.33	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2091.69 (98)

Space heating requirement in kWh/m²/year 41.68 (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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	415.15	321.42	267.17	152.98	66.89	0	0	0	0	148.14	292.62	427.33	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	463.85	359.13	298.51	170.92	74.74	0	0	0	0	165.52	326.95	477.46	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2337.08 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)

	153.49	135.12	141.53	126.38	123.48	109.82	104.99	115.88	115.9	131.09	139.24	149.64

Efficiency of water heater 86.7 (216)

(217)m=	88.73	88.65	88.51	88.21	87.66	86.7	86.7	86.7	86.7	88.16	88.58	88.76	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	173	152.41	159.91	143.26	140.85	126.66	121.1	133.66	133.68	148.69	157.2	168.59

Total = Sum(219a)$_{1...12}$ = 1759.01 (219)

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Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2337.08	
Water heating fuel used			1759.01	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		80.35		(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) =		155.35	(231)
Electricity for lighting			232.55	(232)
Electricity generated by PVs			-424.85	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4059.14	(338)

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	=	504.81	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	379.95	(264)
Space and water heating	(261) + (262) + (263) + (264) =			884.76	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	80.63	(267)
Electricity for lighting	(232) x	0.519	=	120.69	(268)
Energy saving/generation technologies Item 1		0.519	=	-220.5	(269)
Total CO2, kg/year		sum of (265)…(271) =		865.58	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.25	(273)
EI rating (section 14)				88	(274)

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User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Green-Second Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	61.28	(1a)	x	2.5	(2a)	=	153.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.28	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			153.2	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.1	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.13	0.13	0.13	0.12	0.11	0.1	0.1	0.1	0.1	0.11	0.12	0.12

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) =	77.35	(23c)

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

(24a)m=	0.25	0.24	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(24a)

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

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

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

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

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

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

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

(25)m=	0.25	0.24	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 2			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 3			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 4			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 5			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 6			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 7			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 8			1.76	x1/[1/(1.2)+ 0.04]		=	2.02			(27)
Walls Type1	59.88	18.18	41.7	x	0.18	=	7.51			(29)
Walls Type2	5.48	0	5.48	x	0.2	=	1.08			(29)
Walls Type3	16.37	2.15	14.22	x	0.22	=	3.09			(29)
Total area of elements, m²			81.73							(31)
Party wall			24.18	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	34.65	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	7043.88	(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 — 11.59 (36)

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

Total fabric heat loss — (33) + (36) = — 46.24 (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=	12.49	12.36	12.23	11.56	11.43	10.77	10.77	10.64	11.03	11.43	11.7	11.96	(38)

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

(39)m=	58.73	58.6	58.47	57.8	57.67	57.01	57.01	56.87	57.27	57.67	57.94	58.2	

Average = Sum(39)$_{1…12}$ /12= 57.77 (39)

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

(40)m=	0.96	0.96	0.95	0.94	0.94	0.93	0.93	0.93	0.93	0.94	0.95	0.95	

Average = Sum(40)$_{1…12}$ /12= 0.94 (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 — 2.02 (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 — 82.12 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	90.33	87.04	83.76	80.48	77.19	73.91	73.91	77.19	80.48	83.76	87.04	90.33	

Total = Sum(44)$_{1…12}$ = 985.41 (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=	133.96	117.16	120.9	105.4	101.13	87.27	80.87	92.8	93.91	109.44	119.46	129.73	

Total = Sum(45)$_{1…12}$ = 1292.03 (45)

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

(46)m=	20.09	17.57	18.13	15.81	15.17	13.09	12.13	13.92	14.09	16.42	17.92	19.46	(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=	32.17	29.01	32.03	30.9	31.87	30.76	31.73	31.82	30.84	31.96	31.04	32.15	(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=	166.13	146.17	152.93	136.31	133	118.03	112.6	124.62	124.75	141.4	150.51	161.88	(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=	166.13	146.17	152.93	136.31	133	118.03	112.6	124.62	124.75	141.4	150.51	161.88	

Output from water heater (annual)$_{1...12}$ | 1668.32 | (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=	52.58	46.21	48.21	42.77	41.59	36.71	34.82	38.81	38.93	44.38	47.48	51.17	(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=	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	(66)

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

(67)m=	15.71	13.95	11.34	8.59	6.42	5.42	5.86	7.61	10.22	12.97	15.14	16.14	(67)

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

(68)m=	176.16	177.99	173.38	163.58	151.2	139.56	131.79	129.96	134.57	144.38	156.76	168.39	(68)

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

(69)m=	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	(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=	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	(71)

Water heating gains (Table 5)

(72)m=	70.68	68.76	64.79	59.41	55.91	50.98	46.8	52.16	54.07	59.65	65.95	68.78	(72)

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

(73)m=	318.81	316.97	305.79	287.84	269.79	252.23	240.72	246	255.13	273.26	294.11	309.57	(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)	
Northeast	0.9x	0.77	x	1.76	x	11.28	x	0.4	x	0.7	=	3.85	(75)
Northeast	0.9x	0.77	x	1.76	x	22.97	x	0.4	x	0.7	=	7.84	(75)
Northeast	0.9x	0.77	x	1.76	x	41.38	x	0.4	x	0.7	=	14.13	(75)
Northeast	0.9x	0.77	x	1.76	x	67.96	x	0.4	x	0.7	=	23.21	(75)
Northeast	0.9x	0.77	x	1.76	x	91.35	x	0.4	x	0.7	=	31.2	(75)
Northeast	0.9x	0.77	x	1.76	x	97.38	x	0.4	x	0.7	=	33.26	(75)
Northeast	0.9x	0.77	x	1.76	x	91.1	x	0.4	x	0.7	=	31.11	(75)
Northeast	0.9x	0.77	x	1.76	x	72.63	x	0.4	x	0.7	=	24.8	(75)
Northeast	0.9x	0.77	x	1.76	x	50.42	x	0.4	x	0.7	=	17.22	(75)
Northeast	0.9x	0.77	x	1.76	x	28.07	x	0.4	x	0.7	=	9.59	(75)
Northeast	0.9x	0.77	x	1.76	x	14.2	x	0.4	x	0.7	=	4.85	(75)
Northeast	0.9x	0.77	x	1.76	x	9.21	x	0.4	x	0.7	=	3.15	(75)
Southeast	0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast	0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast	0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast	0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast	0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)

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Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25		0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25		0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25		0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01		0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01		0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01		0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15		0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15		0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15		0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91		0.4	x	0.7	=	43.76	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91		0.4	x	0.7	=	43.76	(79)

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Southwest	0.9x	0.77	x	1.98	x	113.91	0.4	x	0.7	=	43.76	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)

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

(83)m=	121.08	207.53	287.35	361.74	410.38	409.7	394.04	357.41	313.06	230.28	145.26	103.47	(83)

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

(84)m=	439.89	524.49	593.14	649.58	680.17	661.93	634.76	603.41	568.18	503.54	439.37	413.05	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.88	0.74	0.54	0.39	0.43	0.67	0.92	0.99	1	(86)

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

(87)m=	20.14	20.32	20.56	20.8	20.95	20.99	21	21	20.98	20.78	20.41	20.1	(87)

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

(88)m=	20.12	20.12	20.12	20.13	20.13	20.14	20.14	20.14	20.14	20.13	20.13	20.13	(88)

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

(89)m=	0.99	0.98	0.95	0.85	0.68	0.47	0.32	0.35	0.6	0.89	0.98	1	(89)

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

(90)m=	19.34	19.52	19.75	19.98	20.1	20.14	20.14	20.14	20.13	19.97	19.61	19.3	(90)

fLA = Living area ÷ (4) = 0.45 (91)

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

(92)m=	19.69	19.88	20.11	20.35	20.48	20.52	20.52	20.52	20.51	20.33	19.97	19.66	(92)

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

(93)m=	19.69	19.88	20.11	20.35	20.48	20.52	20.52	20.52	20.51	20.33	19.97	19.66	(93)

8. Space heating requirement

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

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

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Utilisation factor for gains, hm:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	0.99	0.98	0.95	0.86	0.71	0.51	0.35	0.39	0.63	0.9	0.98	0.99	(94)

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

(95)m=	436.48	513.75	561.91	560.6	480.28	334.48	223.42	234.09	356.77	451.97	431.18	410.73	(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=	904.12	877.72	795.71	661.7	506.15	337.46	223.71	234.59	366.86	561.29	745.56	899.76	(97)

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

(98)m=	347.92	244.59	173.95	72.79	19.25	0	0	0	0	81.34	226.36	363.84

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1530.03 (98)

Space heating requirement in kWh/m²/year 24.97 (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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	347.92	244.59	173.95	72.79	19.25	0	0	0	0	81.34	226.36	363.84	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	388.74	273.28	194.35	81.33	21.5	0	0	0	0	90.88	252.92	406.52	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1709.53 (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)

166.13	146.17	152.93	136.31	133	118.03	112.6	124.62	124.75	141.4	150.51	161.88

Efficiency of water heater 86.7 (216)

(217)m=	88.58	88.43	88.17	87.65	87.04	86.7	86.7	86.7	86.7	87.7	88.36	88.62	(217)

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

(219)m=	187.56	165.29	173.45	155.5	152.8	136.14	129.88	143.74	143.88	161.23	170.33	182.67

Total = Sum(219a)$_{1...12}$ = 1902.46 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1709.53
Water heating fuel used		1902.46
Electricity for pumps, fans and electric keep-hot		

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mechanical ventilation - balanced, extract or positive input from outside		98.12	(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) =	173.12	(231)
Electricity for lighting		277.36	(232)
Electricity generated by PVs		-519.53	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3542.94	(338)

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	=	369.26	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	410.93	(264)
Space and water heating	(261) + (262) + (263) + (264) =			780.19	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	89.85	(267)
Electricity for lighting	(232) x	0.519	=	143.95	(268)
Energy saving/generation technologies Item 1		0.519	=	-269.64	(269)
Total CO2, kg/year		sum of (265)…(271) =		744.35	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		12.15	(273)
EI rating (section 14)				91	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Green-Top Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	102.92	(1a) x	2.45	(2a) =	252.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	102.92	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	252.15	(5)

2. Ventilation rate:

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

Air changes per hour

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

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(24a)

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

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

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

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

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

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

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

(25)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	0.27	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 2			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 3			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 4			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 5			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 6			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 7			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 8			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 9			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 10			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 11			1.87	x1/[1/(1.2)+ 0.04]		=	2.14			(27)
Windows Type 12			1.2	x1/[1/(1.2)+ 0.04]		=	1.37			(27)
Walls Type1	128.4	26.71	101.69	x	0.18	=	18.3			(29)
Walls Type2	22.83	0	22.83	x	0.2	=	4.51			(29)
Walls Type3	19.21	2.15	17.06	x	0.22	=	3.71			(29)
Roof	102.92	0	102.92	x	0.13	=	13.38			(30)
Total area of elements, m²			273.36							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 72.64 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	16692.33	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		39.78	(36)

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

Total fabric heat loss	(33) + (36) =	112.41	(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=	23.3	23.04	22.77	21.45	21.18	19.86	19.86	19.59	20.39	21.18	21.71	22.24	(38)

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

(39)m=	135.72	135.45	135.19	133.86	133.6	132.27	132.27	132	132.8	133.6	134.13	134.66	

Average = $Sum(39)_{1…12}$ /12= 133.79 (39)

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

(40)m=	1.32	1.32	1.31	1.3	1.3	1.29	1.29	1.28	1.29	1.3	1.3	1.31	

Average = $Sum(40)_{1…12}$ /12= 1.3 (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 — 2.76 (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 — 99.87 (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=	109.85	105.86	101.87	97.87	93.88	89.88	89.88	93.88	97.87	101.87	105.86	109.85	

Total = $Sum(44)_{1…12}$ = 1198.41 (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=	162.91	142.48	147.03	128.18	123	106.14	98.35	112.86	114.21	133.1	145.29	157.77	

Total = $Sum(45)_{1…12}$ = 1571.31 (45)

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

(46)m=	24.44	21.37	22.05	19.23	18.45	15.92	14.75	16.93	17.13	19.96	21.79	23.67	(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:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If community heating see section 4.3		
Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b	0	(53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)	0	(55)

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

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

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

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

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

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

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

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

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

(61)m=	32.48	29.3	32.36	31.2	32.13	30.98	31.94	32.07	31.1	32.26	31.34	32.44	(61)

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

(62)m=	195.39	171.78	179.39	159.38	155.13	137.12	130.29	144.93	145.31	165.36	176.63	190.21	(62)

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

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

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

Output from water heater

(64)m=	195.39	171.78	179.39	159.38	155.13	137.12	130.29	144.93	145.31	165.36	176.63	190.21

Output from water heater (annual)$_{1...12}$ — 1950.91 (64)

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

(65)m=	62.29	54.7	56.98	50.42	48.93	43.04	40.69	45.54	45.75	52.32	56.14	60.57	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	(66)

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

(67)m=	23.27	20.66	16.8	12.72	9.51	8.03	8.68	11.28	15.14	19.22	22.43	23.91	(67)

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

(68)m=	260.96	263.67	256.85	242.32	223.98	206.75	195.23	192.52	199.35	213.88	232.21	249.45	(68)

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

(69)m=	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	(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=	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	(71)

Water heating gains (Table 5)

(72)m=	83.72	81.4	76.58	70.03	65.77	59.77	54.69	61.21	63.54	70.32	77.98	81.41	(72)

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

(73)m=	435.42	433.21	417.71	392.55	366.73	342.02	326.07	332.49	345.5	370.89	400.09	422.24	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	1.87	x	11.28	x	0.4	x	0.7	=	4.09	(75)
Northeast 0.9x	0.77	x	1.2	x	11.28	x	0.4	x	0.7	=	2.63	(75)
Northeast 0.9x	0.77	x	1.87	x	22.97	x	0.4	x	0.7	=	8.33	(75)
Northeast 0.9x	0.77	x	1.2	x	22.97	x	0.4	x	0.7	=	5.35	(75)
Northeast 0.9x	0.77	x	1.87	x	41.38	x	0.4	x	0.7	=	15.01	(75)
Northeast 0.9x	0.77	x	1.2	x	41.38	x	0.4	x	0.7	=	9.63	(75)
Northeast 0.9x	0.77	x	1.87	x	67.96	x	0.4	x	0.7	=	24.66	(75)
Northeast 0.9x	0.77	x	1.2	x	67.96	x	0.4	x	0.7	=	15.82	(75)
Northeast 0.9x	0.77	x	1.87	x	91.35	x	0.4	x	0.7	=	33.15	(75)
Northeast 0.9x	0.77	x	1.2	x	91.35	x	0.4	x	0.7	=	21.27	(75)
Northeast 0.9x	0.77	x	1.87	x	97.38	x	0.4	x	0.7	=	35.34	(75)
Northeast 0.9x	0.77	x	1.2	x	97.38	x	0.4	x	0.7	=	22.68	(75)
Northeast 0.9x	0.77	x	1.87	x	91.1	x	0.4	x	0.7	=	33.06	(75)
Northeast 0.9x	0.77	x	1.2	x	91.1	x	0.4	x	0.7	=	21.21	(75)
Northeast 0.9x	0.77	x	1.87	x	72.63	x	0.4	x	0.7	=	26.35	(75)
Northeast 0.9x	0.77	x	1.2	x	72.63	x	0.4	x	0.7	=	16.91	(75)
Northeast 0.9x	0.77	x	1.87	x	50.42	x	0.4	x	0.7	=	18.3	(75)
Northeast 0.9x	0.77	x	1.2	x	50.42	x	0.4	x	0.7	=	11.74	(75)
Northeast 0.9x	0.77	x	1.87	x	28.07	x	0.4	x	0.7	=	10.18	(75)
Northeast 0.9x	0.77	x	1.2	x	28.07	x	0.4	x	0.7	=	6.54	(75)
Northeast 0.9x	0.77	x	1.87	x	14.2	x	0.4	x	0.7	=	5.15	(75)
Northeast 0.9x	0.77	x	1.2	x	14.2	x	0.4	x	0.7	=	3.31	(75)
Northeast 0.9x	0.77	x	1.87	x	9.21	x	0.4	x	0.7	=	3.34	(75)
Northeast 0.9x	0.77	x	1.2	x	9.21	x	0.4	x	0.7	=	2.15	(75)
Southeast 0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast 0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast 0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast 0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast 0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast 0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast 0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast 0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast 0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast 0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)

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Southeast 0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast 0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast 0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast 0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast 0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast 0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast 0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast 0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast 0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast 0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast 0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast 0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast 0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast 0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast 0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast 0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast 0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast 0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast 0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast 0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast 0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast 0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast 0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast 0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast 0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast 0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast 0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast 0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast 0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast 0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast 0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast 0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast 0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast 0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast 0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast 0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast 0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast 0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast 0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast 0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast 0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)

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Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)

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Southwest	0.9x	0.77	x	1.98	x	85.75	0.4	x	0.7	=	32.95	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25	0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25	0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25	0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01	0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01	0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01	0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15	0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15	0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15	0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91	0.4	x	0.7	=	43.76	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91	0.4	x	0.7	=	43.76	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91	0.4	x	0.7	=	43.76	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)

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

(83)m=	175.5	301.17	418.01	527.87	600.33	599.98	576.78	522.11	455.96	334.46	210.61	149.93	(83)

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

(84)m=	610.92	734.38	835.72	920.41	967.06	942	902.85	854.6	801.45	705.35	610.71	572.17	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.78	0.61	0.66	0.87	0.98	1	1	(86)

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

(87)m=	19.53	19.72	19.99	20.35	20.67	20.9	20.97	20.96	20.81	20.38	19.88	19.5	(87)

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

(88)m=	19.83	19.83	19.83	19.84	19.84	19.85	19.85	19.85	19.85	19.84	19.84	19.83	(88)

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

(89)m=	1	0.99	0.98	0.95	0.87	0.68	0.47	0.52	0.8	0.97	0.99	1	(89)

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

(90)m=	18.5	18.68	18.96	19.32	19.62	19.8	19.85	19.84	19.74	19.35	18.86	18.47	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	18.84	19.03	19.3	19.66	19.97	20.17	20.22	20.22	20.09	19.69	19.2	18.81	(92)

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

(93)m=	18.84	19.03	19.3	19.66	19.97	20.17	20.22	20.22	20.09	19.69	19.2	18.81	(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=	1	0.99	0.98	0.95	0.87	0.71	0.52	0.57	0.82	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	608.79	728.37	819.4	873.4	841.68	667.18	466.37	484.58	655.79	679.37	606.24	570.68	(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=	1973.8	1913.47	1731.04	1440.47	1104.82	736.3	478.87	503.64	796.04	1214.61	1623.05	1967.97	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1015.57	796.38	678.26	408.29	195.77	0	0	0	0	398.22	732.1	1039.59	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5264.19 (98)

Space heating requirement in kWh/m²/year 51.15 (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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	1015.57	796.38	678.26	408.29	195.77	0	0	0	0	398.22	732.1	1039.59	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1134.71	889.81	757.83	456.19	218.74	0	0	0	0	444.94	817.99	1161.55	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 5881.77 (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)

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Water heating

Output from water heater (calculated above)

	195.39	171.78	179.39	159.38	155.13	137.12	130.29	144.93	145.31	165.36	176.63	190.21	
Efficiency of water heater													86.7 (216)
(217)m=	89.04	88.99	88.9	88.7	88.24	86.7	86.7	86.7	86.7	88.66	88.94	89.06	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	219.45	193.04	201.79	179.69	175.81	158.15	150.28	167.16	167.6	186.51	198.59	213.59	

Total = Sum(219a)$_{1...12}$ = 2211.64 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		5881.77	
Water heating fuel used		2211.64	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	199.96		(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) =		274.96	(231)
Electricity for lighting		410.87	(232)
Electricity generated by PVs		-871.93	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		7907.31	(338)

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	=	1270.46	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	477.71	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1748.18	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	142.7	(267)
Electricity for lighting	(232) x	0.519	=	213.24	(268)
Energy saving/generation technologies Item 1		0.519	=	-452.53	(269)
Total CO2, kg/year		sum of (265)…(271) =		1651.59	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.05	(273)
EI rating (section 14)				85	(274)

APPENDIX F. DFEE WORKSHEETS

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name: Panagiotis Dalapas **Stroma Number:** STRO030082
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.41

Property Address: Be Lean-First Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.18	(1a) x	2.5	(2a) =	125.45	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.18	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	125.45	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.16	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.31	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.22	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 3			2	x1/[1/(1.2)+ 0.04]		=	2.29			(27)
Windows Type 4			1.7	x1/[1/(1.2)+ 0.04]		=	1.95			(27)
Windows Type 5			2	x1/[1/(1.2)+ 0.04]		=	2.29			(27)
Floor			50.18	x	0.15	=	7.527			(28)
Walls Type1	53.68	12.22	41.46	x	0.18	=	7.46			(29)
Walls Type2	14.73	0	14.73	x	0.2	=	2.91			(29)
Walls Type3	3.34	2.15	1.19	x	0.22	=	0.26			(29)
Total area of elements, m²			121.93							(31)
Party wall			22.09	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.3 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10578.29 (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 16.37 (36)

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

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Total fabric heat loss (33) + (36) = 50.67 (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=	22.28	22.22	22.16	21.87	21.82	21.58	21.58	21.53	21.67	21.82	21.93	22.04	(38)

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

(39)m=	72.95	72.89	72.83	72.54	72.49	72.24	72.24	72.2	72.34	72.49	72.6	72.71	

Average = Sum(39)$_{1...12}$ /12= 72.54 (39)

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

(40)m=	1.45	1.45	1.45	1.45	1.44	1.44	1.44	1.44	1.44	1.44	1.45	1.45	

Average = Sum(40)$_{1...12}$ /12= 1.45 (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 1.7 (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 74.47 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	81.91	78.93	75.96	72.98	70	67.02	67.02	70	72.98	75.96	78.93	81.91	

Total = Sum(44)$_{1...12}$ = 893.59 (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=	121.47	106.24	109.63	95.58	91.71	79.14	73.33	84.15	85.16	99.24	108.33	117.64	

Total = Sum(45)$_{1...12}$ = 1171.64 (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)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

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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=	103.25	90.31	93.19	81.24	77.95	67.27	62.33	71.53	72.38	84.36	92.08	99.99	(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=	103.25	90.31	93.19	81.24	77.95	67.27	62.33	71.53	72.38	84.36	92.08	99.99	

Output from water heater (annual)$_{1...12}$ — 995.89 (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=	25.81	22.58	23.3	20.31	19.49	16.82	15.58	17.88	18.1	21.09	23.02	25	(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=	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	84.77	(66)

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

(67)m=	13.17	11.7	9.51	7.2	5.38	4.54	4.91	6.38	8.57	10.88	12.7	13.53	(67)

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

(68)m=	147.7	149.23	145.37	137.15	126.77	117.02	110.5	108.97	112.83	121.05	131.43	141.18	(68)

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

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(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=	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	-67.82	(71)

Water heating gains (Table 5)

(72)m=	34.7	33.6	31.31	28.21	26.19	23.36	20.95	24.04	25.13	28.35	31.97	33.6	(72)

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

(73)m=	244	242.96	234.63	220.99	206.78	193.35	184.79	187.81	194.96	208.7	224.53	236.75	(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)	
Northeast	0.9x	0.77	x	1.7	x	11.28	x	0.4	x	0.7	=	3.72	(75)
Northeast	0.9x	0.77	x	1.7	x	22.97	x	0.4	x	0.7	=	7.58	(75)
Northeast	0.9x	0.77	x	1.7	x	41.38	x	0.4	x	0.7	=	13.65	(75)
Northeast	0.9x	0.77	x	1.7	x	67.96	x	0.4	x	0.7	=	22.42	(75)
Northeast	0.9x	0.77	x	1.7	x	91.35	x	0.4	x	0.7	=	30.13	(75)
Northeast	0.9x	0.77	x	1.7	x	97.38	x	0.4	x	0.7	=	32.12	(75)
Northeast	0.9x	0.77	x	1.7	x	91.1	x	0.4	x	0.7	=	30.05	(75)
Northeast	0.9x	0.77	x	1.7	x	72.63	x	0.4	x	0.7	=	23.96	(75)
Northeast	0.9x	0.77	x	1.7	x	50.42	x	0.4	x	0.7	=	16.63	(75)
Northeast	0.9x	0.77	x	1.7	x	28.07	x	0.4	x	0.7	=	9.26	(75)
Northeast	0.9x	0.77	x	1.7	x	14.2	x	0.4	x	0.7	=	4.68	(75)
Northeast	0.9x	0.77	x	1.7	x	9.21	x	0.4	x	0.7	=	3.04	(75)
Southeast	0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast	0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast	0.9x	0.77	x	2	x	36.79	x	0.4	x	0.7	=	14.28	(77)
Southeast	0.9x	0.77	x	2	x	36.79	x	0.4	x	0.7	=	14.28	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	2	x	62.67	x	0.4	x	0.7	=	24.32	(77)
Southeast	0.9x	0.77	x	2	x	62.67	x	0.4	x	0.7	=	24.32	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	2	x	85.75	x	0.4	x	0.7	=	33.28	(77)
Southeast	0.9x	0.77	x	2	x	85.75	x	0.4	x	0.7	=	33.28	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	2	x	106.25	x	0.4	x	0.7	=	41.23	(77)
Southeast	0.9x	0.77	x	2	x	106.25	x	0.4	x	0.7	=	41.23	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	2	x	119.01	x	0.4	x	0.7	=	46.19	(77)
Southeast	0.9x	0.77	x	2	x	119.01	x	0.4	x	0.7	=	46.19	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	2	x	118.15	x	0.4	x	0.7	=	45.85	(77)
Southeast	0.9x	0.77	x	2	x	118.15	x	0.4	x	0.7	=	45.85	(77)
Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	2	x	113.91	x	0.4	x	0.7	=	44.21	(77)

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Southeast	0.9x	0.77	x	2	x	113.91	x	0.4	x	0.7	=	44.21	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	2	x	104.39	x	0.4	x	0.7	=	40.51	(77)
Southeast	0.9x	0.77	x	2	x	104.39	x	0.4	x	0.7	=	40.51	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	2	x	92.85	x	0.4	x	0.7	=	36.03	(77)
Southeast	0.9x	0.77	x	2	x	92.85	x	0.4	x	0.7	=	36.03	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	2	x	69.27	x	0.4	x	0.7	=	26.88	(77)
Southeast	0.9x	0.77	x	2	x	69.27	x	0.4	x	0.7	=	26.88	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	2	x	44.07	x	0.4	x	0.7	=	17.1	(77)
Southeast	0.9x	0.77	x	2	x	44.07	x	0.4	x	0.7	=	17.1	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast	0.9x	0.77	x	2	x	31.49	x	0.4	x	0.7	=	12.22	(77)
Southeast	0.9x	0.77	x	2	x	31.49	x	0.4	x	0.7	=	12.22	(77)

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

(83)m=	78.83	135.51	188.7	239.31	273.07	273.3	262.57	237.05	206.17	150.65	94.64	67.32	(83)

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

(84)m=	322.82	378.47	423.32	460.3	479.85	466.65	447.36	424.86	401.13	359.36	319.17	304.07	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.92	0.8	0.65	0.7	0.88	0.98	0.99	1	(86)

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

(87)m=	19.41	19.59	19.87	20.23	20.58	20.85	20.95	20.94	20.74	20.28	19.77	19.37	(87)

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

(88)m=	19.72	19.72	19.72	19.73	19.73	19.73	19.73	19.73	19.73	19.73	19.73	19.73	(88)

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

(89)m=	1	0.99	0.98	0.95	0.88	0.71	0.49	0.54	0.81	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=	18.3	18.47	18.75	19.11	19.44	19.66	19.72	19.72	19.59	19.17	18.66	18.26	(90)

fLA = Living area ÷ (4) = | 0.48 | (91)

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

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(92)m=	18.83	19.01	19.29	19.65	19.99	20.23	20.31	20.3	20.14	19.71	19.2	18.8	(92)

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

(93)m=	18.83	19.01	19.29	19.65	19.99	20.23	20.31	20.3	20.14	19.71	19.2	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	0.95	0.89	0.75	0.57	0.62	0.84	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	321.27	374.81	414.7	438.32	425.49	349.58	254.99	262.82	337.46	346.1	316.26	302.92	(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=	1060.18	1028.33	931.43	779.97	601.13	406.79	268.38	281.87	437.27	660.09	878.19	1061.19	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	549.75	439.17	384.45	245.99	130.68	0	0	0	0	233.61	404.59	564.16	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2952.38 (98)

Space heating requirement in kWh/m²/year 58.84 (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	679.1	534.61	548.71	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.76	0.84	0.82	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	517.68	450.85	448.2	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	609.59	585.82	560.47	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	66.18	100.42	83.53	0	0	0	0

Total = Sum(104)$_{6...8}$ = 250.13 (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	16.54	25.1	20.88	0	0	0	0

Total = Sum(107)$_{6...8}$ = 62.53 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.25 (108)

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

Fabric Energy Efficiency (99) + (108) = 60.08 (109)

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Lean-Second Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	61.28	(1a)	x	2.5	(2a)	=	153.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.28	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			153.2	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(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		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.28	(18)

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

Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

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=	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.53	(24d)

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

(25)m=	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.53	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 2			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 3			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 4			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 5			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 6			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 7			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 8			1.76	x1/[1/(1.2)+ 0.04]		=	2.02			(27)
Walls Type1	59.88	18.18	41.7	x	0.18	=	7.51			(29)
Walls Type2	5.48	0	5.48	x	0.2	=	1.08			(29)
Walls Type3	16.37	2.15	14.22	x	0.22	=	3.09			(29)
Total area of elements, m²			81.73							(31)
Party wall			24.18	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.65 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7043.88 (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		11.59	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	46.24	(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=	26.86	26.8	26.74	26.46	26.4	26.16	26.16	26.11	26.25	26.4	26.51	26.62		(38)
Heat transfer coefficient, W/K									(39)m = (37) + (38)m					
(39)m=	73.1	73.04	72.98	72.7	72.64	72.4	72.4	72.35	72.49	72.64	72.75	72.86		
										Average = Sum(39)$_{1…12}$ /12=			72.7	(39)
Heat loss parameter (HLP), W/m²K									(40)m = (39)m ÷ (4)					
(40)m=	1.19	1.19	1.19	1.19	1.19	1.18	1.18	1.18	1.18	1.19	1.19	1.19		
										Average = Sum(40)$_{1…12}$ /12=			1.19	(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 — 2.02 (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 — 82.12 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)														
(44)m=	90.33	87.04	83.76	80.48	77.19	73.91	73.91	77.19	80.48	83.76	87.04	90.33		
										Total = Sum(44)$_{1…12}$ =			985.41	(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=	133.96	117.16	120.9	105.4	101.13	87.27	80.87	92.8	93.91	109.44	119.46	129.73		
										Total = Sum(45)$_{1…12}$ =			1292.03	(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=	113.86	99.58	102.76	89.59	85.96	74.18	68.74	78.88	79.82	93.02	101.54	110.27	(62)

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

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

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

Output from water heater

(64)m=	113.86	99.58	102.76	89.59	85.96	74.18	68.74	78.88	79.82	93.02	101.54	110.27	

Output from water heater (annual)$_{1...12}$ — 1098.23 (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=	28.47	24.9	25.69	22.4	21.49	18.55	17.18	19.72	19.96	23.26	25.39	27.57	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	100.88	(66)

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

(67)m=	15.71	13.95	11.34	8.59	6.42	5.42	5.86	7.61	10.22	12.97	15.14	16.14	(67)

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

(68)m=	176.16	177.99	173.38	163.58	151.2	139.56	131.79	129.96	134.57	144.38	156.76	168.39	(68)

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

(69)m=	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	33.09	(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=	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	-80.7	(71)

Water heating gains (Table 5)

(72)m=	38.26	37.05	34.53	31.11	28.89	25.76	23.1	26.51	27.72	31.26	35.26	37.05	(72)

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

(73)m=	283.39	282.25	272.52	256.54	239.77	224	214.01	217.34	225.77	241.87	260.42	274.85	(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)	
Northeast 0.9x	0.77	x	1.76	x	11.28	x	0.4	x	0.7	=	3.85	(75)
Northeast 0.9x	0.77	x	1.76	x	22.97	x	0.4	x	0.7	=	7.84	(75)
Northeast 0.9x	0.77	x	1.76	x	41.38	x	0.4	x	0.7	=	14.13	(75)
Northeast 0.9x	0.77	x	1.76	x	67.96	x	0.4	x	0.7	=	23.21	(75)
Northeast 0.9x	0.77	x	1.76	x	91.35	x	0.4	x	0.7	=	31.2	(75)
Northeast 0.9x	0.77	x	1.76	x	97.38	x	0.4	x	0.7	=	33.26	(75)
Northeast 0.9x	0.77	x	1.76	x	91.1	x	0.4	x	0.7	=	31.11	(75)
Northeast 0.9x	0.77	x	1.76	x	72.63	x	0.4	x	0.7	=	24.8	(75)
Northeast 0.9x	0.77	x	1.76	x	50.42	x	0.4	x	0.7	=	17.22	(75)
Northeast 0.9x	0.77	x	1.76	x	28.07	x	0.4	x	0.7	=	9.59	(75)
Northeast 0.9x	0.77	x	1.76	x	14.2	x	0.4	x	0.7	=	4.85	(75)
Northeast 0.9x	0.77	x	1.76	x	9.21	x	0.4	x	0.7	=	3.15	(75)
Southeast 0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast 0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast 0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast 0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast 0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast 0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast 0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast 0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast 0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast 0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast 0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast 0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast 0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast 0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast 0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast 0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast 0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast 0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast 0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast 0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast 0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast 0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast 0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast 0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast 0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast 0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast 0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)

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Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25		0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25		0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25		0.4	x	0.7	=	40.82	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01		0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01		0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01		0.4	x	0.7	=	45.72	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15		0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15		0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15		0.4	x	0.7	=	45.39	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91		0.4	x	0.7	=	43.76	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91		0.4	x	0.7	=	43.76	(79)

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Southwest	0.9x	0.77	x	1.98	x	113.91	0.4	x	0.7	=	43.76	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.4	x	0.7	=	40.11	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.4	x	0.7	=	35.67	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.4	x	0.7	=	26.61	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.4	x	0.7	=	16.93	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49	0.4	x	0.7	=	12.1	(79)

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

(83)m=	121.08	207.53	287.35	361.74	410.38	409.7	394.04	357.41	313.06	230.28	145.26	103.47	(83)

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

(84)m=	404.48	489.78	559.87	618.28	650.15	633.7	608.05	574.75	538.82	472.15	405.68	378.32	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.85	0.68	0.51	0.56	0.8	0.96	0.99	1	(86)

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

(87)m=	19.76	19.95	20.22	20.55	20.81	20.95	20.99	20.98	20.89	20.54	20.07	19.71	(87)

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

(88)m=	19.93	19.93	19.93	19.93	19.93	19.93	19.93	19.94	19.93	19.93	19.93	19.93	(88)

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

(89)m=	1	0.99	0.97	0.92	0.79	0.59	0.39	0.44	0.72	0.94	0.99	1	(89)

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

(90)m=	18.8	18.99	19.26	19.57	19.81	19.91	19.93	19.93	19.88	19.58	19.12	18.76	(90)

fLA = Living area ÷ (4) = 0.45 (91)

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

(92)m=	19.23	19.42	19.69	20.01	20.25	20.38	20.4	20.4	20.33	20.01	19.55	19.18	(92)

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

(93)m=	19.23	19.42	19.69	20.01	20.25	20.38	20.4	20.4	20.33	20.01	19.55	19.18	(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

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Utilisation factor for gains, hm:

(94)m=	1	0.99	0.97	0.92	0.81	0.63	0.45	0.5	0.75	0.94	0.99	1	(94)

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

(95)m=	402.47	483.66	542.6	568.94	527.5	398.08	272.33	284.5	404.3	445.33	401.26	376.93	(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=	1091.23	1060.59	962.75	807.49	621.41	418.22	275.43	289.51	451.71	683.3	905.47	1091.77	(97)

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

(98)m=	512.44	387.7	312.59	171.75	69.87	0	0	0	0	177.05	363.03	531.84

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2526.27 (98)

Space heating requirement in kWh/m²/year 41.22 (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	680.53	535.74	549.87	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.9	0.95	0.93	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	610.27	506.67	511.44	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	815.96	784.49	746.73	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	148.09	206.7	175.06	0	0	0	0

Total = Sum(104)$_{6...8}$ = 529.84 (104)

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

Intermittency factor (Table 10b)

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

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

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

(107)m=	0	0	0	0	0	37.02	51.67	43.76	0	0	0	0

Total = Sum(107)$_{6...8}$ = 132.46 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 2.16 (108)

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

Fabric Energy Efficiency (99) + (108) = 43.39 (109)

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Be Lean-Top Floor Flat

Address : 238 KILBURN HIGH ROAD, LONDON, NW6 2BS

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	102.92	(1a)	x	2.45	(2a)	=	252.15	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	102.92	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	252.15	(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) =	0.16	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.31	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.26	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.33	0.33	0.32	0.29	0.28	0.25	0.25	0.24	0.26	0.28	0.3	0.31

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

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

(25)m=	0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 2			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 3			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 4			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 5			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 6			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 7			1.98	x1/[1/(1.2)+ 0.04]		=	2.27			(27)
Windows Type 8			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 9			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 10			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 11			1.87	x1/[1/(1.2)+ 0.04]		=	2.14			(27)
Windows Type 12			1.2	x1/[1/(1.2)+ 0.04]		=	1.37			(27)
Walls Type1	128.4	26.71	101.69	x	0.18	=	18.3			(29)
Walls Type2	22.83	0	22.83	x	0.2	=	4.51			(29)
Walls Type3	19.21	2.15	17.06	x	0.22	=	3.71			(29)
Roof	102.92	0	102.92	x	0.13	=	13.38			(30)
Total area of elements, m²			273.36							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 72.64 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	16692.33	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		39.78	(36)

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

Total fabric heat loss	(33) + (36) =	112.41	(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=	46.26	46.08	45.9	45.07	44.91	44.19	44.19	44.06	44.47	44.91	45.23	45.56	(38)

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

(39)m=	158.67	158.49	158.32	157.48	157.33	156.6	156.6	156.47	156.88	157.33	157.64	157.97	

Average = Sum(39)$_{1…12}$ /12= 157.48 (39)

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

(40)m=	1.54	1.54	1.54	1.53	1.53	1.52	1.52	1.52	1.52	1.53	1.53	1.53	

Average = Sum(40)$_{1…12}$ /12= 1.53 (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 2.76 (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 99.87 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	109.85	105.86	101.87	97.87	93.88	89.88	89.88	93.88	97.87	101.87	105.86	109.85	

Total = Sum(44)$_{1…12}$ = 1198.41 (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=	162.91	142.48	147.03	128.18	123	106.14	98.35	112.86	114.21	133.1	145.29	157.77	

Total = Sum(45)$_{1…12}$ = 1571.31 (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:

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Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

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

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

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

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

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

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

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

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

(61)m=	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=	138.47	121.11	124.98	108.96	104.55	90.22	83.6	95.93	97.08	113.13	123.49	134.11	(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=	138.47	121.11	124.98	108.96	104.55	90.22	83.6	95.93	97.08	113.13	123.49	134.11	

Output from water heater (annual)$_{1\ldots12}$ — 1335.61 (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=	34.62	30.28	31.24	27.24	26.14	22.55	20.9	23.98	24.27	28.28	30.87	33.53	(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=	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	138.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	23.27	20.66	16.8	12.72	9.51	8.03	8.68	11.28	15.14	19.22	22.43	23.91	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	260.96	263.67	256.85	242.32	223.98	206.75	195.23	192.52	199.35	213.88	232.21	249.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	36.82	(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=	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	-110.6	(71)
Water heating gains (Table 5)													
(72)m=	46.53	45.06	41.99	37.83	35.13	31.32	28.09	32.23	33.71	38.01	42.88	45.06	(72)

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

(73)m=	395.23	393.87	380.12	357.35	333.1	310.57	296.47	300.51	312.66	335.58	362	382.9	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	1.87	x	11.28	x	0.4	x	0.7	=	4.09	(75)
Northeast	0.9x	0.77	x	1.2	x	11.28	x	0.4	x	0.7	=	2.63	(75)
Northeast	0.9x	0.77	x	1.87	x	22.97	x	0.4	x	0.7	=	8.33	(75)
Northeast	0.9x	0.77	x	1.2	x	22.97	x	0.4	x	0.7	=	5.35	(75)
Northeast	0.9x	0.77	x	1.87	x	41.38	x	0.4	x	0.7	=	15.01	(75)
Northeast	0.9x	0.77	x	1.2	x	41.38	x	0.4	x	0.7	=	9.63	(75)
Northeast	0.9x	0.77	x	1.87	x	67.96	x	0.4	x	0.7	=	24.66	(75)
Northeast	0.9x	0.77	x	1.2	x	67.96	x	0.4	x	0.7	=	15.82	(75)
Northeast	0.9x	0.77	x	1.87	x	91.35	x	0.4	x	0.7	=	33.15	(75)
Northeast	0.9x	0.77	x	1.2	x	91.35	x	0.4	x	0.7	=	21.27	(75)
Northeast	0.9x	0.77	x	1.87	x	97.38	x	0.4	x	0.7	=	35.34	(75)
Northeast	0.9x	0.77	x	1.2	x	97.38	x	0.4	x	0.7	=	22.68	(75)
Northeast	0.9x	0.77	x	1.87	x	91.1	x	0.4	x	0.7	=	33.06	(75)
Northeast	0.9x	0.77	x	1.2	x	91.1	x	0.4	x	0.7	=	21.21	(75)
Northeast	0.9x	0.77	x	1.87	x	72.63	x	0.4	x	0.7	=	26.35	(75)
Northeast	0.9x	0.77	x	1.2	x	72.63	x	0.4	x	0.7	=	16.91	(75)
Northeast	0.9x	0.77	x	1.87	x	50.42	x	0.4	x	0.7	=	18.3	(75)
Northeast	0.9x	0.77	x	1.2	x	50.42	x	0.4	x	0.7	=	11.74	(75)
Northeast	0.9x	0.77	x	1.87	x	28.07	x	0.4	x	0.7	=	10.18	(75)
Northeast	0.9x	0.77	x	1.2	x	28.07	x	0.4	x	0.7	=	6.54	(75)
Northeast	0.9x	0.77	x	1.87	x	14.2	x	0.4	x	0.7	=	5.15	(75)
Northeast	0.9x	0.77	x	1.2	x	14.2	x	0.4	x	0.7	=	3.31	(75)
Northeast	0.9x	0.77	x	1.87	x	9.21	x	0.4	x	0.7	=	3.34	(75)
Northeast	0.9x	0.77	x	1.2	x	9.21	x	0.4	x	0.7	=	2.15	(75)
Southeast	0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast	0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast	0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast	0.9x	0.77	x	1.98	x	36.79	x	0.4	x	0.7	=	14.14	(77)
Southeast	0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast	0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast	0.9x	0.77	x	3.26	x	36.79	x	0.4	x	0.7	=	23.27	(77)
Southeast	0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast	0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast	0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)

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Southeast	0.9x	0.77	x	1.98	x	62.67	x	0.4	x	0.7	=	24.08	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	3.26	x	62.67	x	0.4	x	0.7	=	39.65	(77)
Southeast	0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast	0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast	0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast	0.9x	0.77	x	1.98	x	85.75	x	0.4	x	0.7	=	32.95	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	3.26	x	85.75	x	0.4	x	0.7	=	54.24	(77)
Southeast	0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast	0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast	0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast	0.9x	0.77	x	1.98	x	106.25	x	0.4	x	0.7	=	40.82	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	3.26	x	106.25	x	0.4	x	0.7	=	67.21	(77)
Southeast	0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast	0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast	0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast	0.9x	0.77	x	1.98	x	119.01	x	0.4	x	0.7	=	45.72	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	3.26	x	119.01	x	0.4	x	0.7	=	75.28	(77)
Southeast	0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast	0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast	0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast	0.9x	0.77	x	1.98	x	118.15	x	0.4	x	0.7	=	45.39	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	3.26	x	118.15	x	0.4	x	0.7	=	74.74	(77)
Southeast	0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast	0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast	0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast	0.9x	0.77	x	1.98	x	113.91	x	0.4	x	0.7	=	43.76	(77)
Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	3.26	x	113.91	x	0.4	x	0.7	=	72.06	(77)
Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)

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Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast	0.9x	0.77	x	1.98	x	104.39	x	0.4	x	0.7	=	40.11	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	3.26	x	104.39	x	0.4	x	0.7	=	66.03	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	1.98	x	92.85	x	0.4	x	0.7	=	35.67	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	3.26	x	92.85	x	0.4	x	0.7	=	58.74	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	1.98	x	69.27	x	0.4	x	0.7	=	26.61	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	3.26	x	69.27	x	0.4	x	0.7	=	43.82	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	1.98	x	44.07	x	0.4	x	0.7	=	16.93	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	3.26	x	44.07	x	0.4	x	0.7	=	27.88	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	1.98	x	31.49	x	0.4	x	0.7	=	12.1	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southeast	0.9x	0.77	x	3.26	x	31.49	x	0.4	x	0.7	=	19.92	(77)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.4	x	0.7	=	14.14	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67		0.4	x	0.7	=	24.08	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)

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Southwest0.9x	0.77	x	1.98	x	85.75		0.4	x	0.7	=	32.95	(79)
Southwest0.9x	0.77	x	1.98	x	106.25		0.4	x	0.7	=	40.82	(79)
Southwest0.9x	0.77	x	1.98	x	106.25		0.4	x	0.7	=	40.82	(79)
Southwest0.9x	0.77	x	1.98	x	106.25		0.4	x	0.7	=	40.82	(79)
Southwest0.9x	0.77	x	1.98	x	119.01		0.4	x	0.7	=	45.72	(79)
Southwest0.9x	0.77	x	1.98	x	119.01		0.4	x	0.7	=	45.72	(79)
Southwest0.9x	0.77	x	1.98	x	119.01		0.4	x	0.7	=	45.72	(79)
Southwest0.9x	0.77	x	1.98	x	118.15		0.4	x	0.7	=	45.39	(79)
Southwest0.9x	0.77	x	1.98	x	118.15		0.4	x	0.7	=	45.39	(79)
Southwest0.9x	0.77	x	1.98	x	118.15		0.4	x	0.7	=	45.39	(79)
Southwest0.9x	0.77	x	1.98	x	113.91		0.4	x	0.7	=	43.76	(79)
Southwest0.9x	0.77	x	1.98	x	113.91		0.4	x	0.7	=	43.76	(79)
Southwest0.9x	0.77	x	1.98	x	113.91		0.4	x	0.7	=	43.76	(79)
Southwest0.9x	0.77	x	1.98	x	104.39		0.4	x	0.7	=	40.11	(79)
Southwest0.9x	0.77	x	1.98	x	104.39		0.4	x	0.7	=	40.11	(79)
Southwest0.9x	0.77	x	1.98	x	104.39		0.4	x	0.7	=	40.11	(79)
Southwest0.9x	0.77	x	1.98	x	92.85		0.4	x	0.7	=	35.67	(79)
Southwest0.9x	0.77	x	1.98	x	92.85		0.4	x	0.7	=	35.67	(79)
Southwest0.9x	0.77	x	1.98	x	92.85		0.4	x	0.7	=	35.67	(79)
Southwest0.9x	0.77	x	1.98	x	69.27		0.4	x	0.7	=	26.61	(79)
Southwest0.9x	0.77	x	1.98	x	69.27		0.4	x	0.7	=	26.61	(79)
Southwest0.9x	0.77	x	1.98	x	69.27		0.4	x	0.7	=	26.61	(79)
Southwest0.9x	0.77	x	1.98	x	44.07		0.4	x	0.7	=	16.93	(79)
Southwest0.9x	0.77	x	1.98	x	44.07		0.4	x	0.7	=	16.93	(79)
Southwest0.9x	0.77	x	1.98	x	44.07		0.4	x	0.7	=	16.93	(79)
Southwest0.9x	0.77	x	1.98	x	31.49		0.4	x	0.7	=	12.1	(79)
Southwest0.9x	0.77	x	1.98	x	31.49		0.4	x	0.7	=	12.1	(79)
Southwest0.9x	0.77	x	1.98	x	31.49		0.4	x	0.7	=	12.1	(79)

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

(83)m=	175.5	301.17	418.01	527.87	600.33	599.98	576.78	522.11	455.96	334.46	210.61	149.93	(83)

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

(84)m=	570.73	695.04	798.13	885.22	933.43	910.55	873.26	822.62	768.62	670.04	572.61	532.82	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.84	0.7	0.74	0.91	0.98	1	1	(86)

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

(87)m=	19.23	19.42	19.72	20.11	20.5	20.8	20.93	20.91	20.67	20.17	19.62	19.19	(87)

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

(88)m=	19.66	19.66	19.66	19.66	19.67	19.67	19.67	19.67	19.67	19.67	19.66	19.66	(88)

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

(89)m=	1	0.99	0.99	0.96	0.9	0.74	0.53	0.58	0.85	0.97	1	1	(89)

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

(90)m=	18.07	18.25	18.55	18.95	19.31	19.57	19.65	19.65	19.48	19.01	18.46	18.03	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	18.45	18.64	18.94	19.33	19.71	19.98	20.08	20.07	19.88	19.39	18.84	18.42	(92)

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

(93)m=	18.45	18.64	18.94	19.33	19.71	19.98	20.08	20.07	19.88	19.39	18.84	18.42	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.96	0.9	0.77	0.59	0.64	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	568.96	690.15	785.3	849.77	840.57	700.44	511.23	525.33	662.17	650.9	569.08	531.57	(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=	2245.58	2177.68	1969.61	1643.03	1259.51	842.22	544.74	573.5	906.32	1383.1	1851.47	2245.92	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1247.41	999.62	881.13	571.15	311.7	0	0	0	0	544.76	923.32	1275.48	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6754.55 (98)

Space heating requirement in kWh/m²/year 65.63 (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	1472.07	1158.86	1189.16	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.7	0.79	0.76	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	1032.21	915.06	899.51	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1170.9	1124.99	1067.69	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	99.85	156.18	125.13	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 381.17 (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)

DFEE WorkSheet: New dwelling design stage

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

(107)m=	0	0	0	0	0	24.96	39.05	31.28	0	0	0	0

Total = Sum(107)$_{6...8}$ = 95.29 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.93 (108)

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

Fabric Energy Efficiency (99) + (108) = 66.55 (109)

APPENDIX G. CLASS E UNIT (BRUKL OUTPUT DOCUMENTS)

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

238 Kilburn High Road (Be Lean)

As designed

Date: Thu Jul 22 17:19:13 2021

Administrative information

Building Details

Address: 238 Kilburn High Road, London, NW6 2BS

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

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	38.4
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	38.4
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	35.9
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	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	GF000000:Surf[2]
Floor	0.25	0.15	0.15	GF000000:Surf[0]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	-	-	No windows or rooflights in building
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-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	5

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- VRF

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4	0	0	0.75
Standard value	0.91*	2.6	N/A	N/A	0.5
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.					

"No HWS in project, or hot water is provided by HVAC system"

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
GF.Class E unit	-	-	-	1.6	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
GF.Class E unit	-	80	22	923

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?
GF.Class E unit	NO (-9.1%)	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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	76.5	76.5
External area [m²]	144.8	144.8
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	5
Average conductance [W/K]	80.1	69.75
Average U-value [W/m²K]	0.55	0.48
Alpha value* [%]	10	10

* 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	16.56	10.49
Cooling	16.09	14.7
Auxiliary	7.51	3.06
Lighting	38.54	52.52
Hot water	1.7	1.87
Equipment*	20.26	20.26
TOTAL**	**80.39**	**82.64**

* 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]	215.03	233.16
Primary energy* [kWh/m²]	211.27	225.22
Total emissions [kg/m²]	35.9	38.4

* 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] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	50.6	164.5	16.6	16.1	7.5	0.85	2.84	0.91	4
	Notional	32.6	200.6	10.5	14.7	3.1	0.86	3.79	----	----

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	0.18	GF000000:Surf[2]
Floor	0.2	0.15	GF000000:Surf[0]
Roof	0.15	-	UNKNOWN
Windows, roof windows, and rooflights	1.5	-	No windows or rooflights in building
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = 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	5

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

238 Kilburn High Road (Be Lean)

As designed

Date: Thu Jul 22 17:21:20 2021

Administrative information

Building Details

Address: 238 Kilburn High Road, London, NW6 2BS

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

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	37.9
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	37.9
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	34.8
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	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	GF000000:Surf[2]
Floor	0.25	0.15	0.15	GF000000:Surf[0]
Roof	0.25	-	-	UNKNOWN
Windows***, roof windows, and rooflights	2.2	-	-	No windows or rooflights in building
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

U_{i-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	5

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	NO
Whole building electric power factor achieved by power factor correction	>0.95

1- VRF

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3	4	0	0	0.75
Standard value	2.5*	2.6	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

"No HWS in project, or hot water is provided by HVAC system"

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**
GF.Class E unit	-	-	-	1.6	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
GF.Class E unit	-	80	22	923

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?
GF.Class E unit	NO (-9.1%)	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?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	76.5	76.5
External area [m²]	144.8	144.8
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	5
Average conductance [W/K]	80.1	69.75
Average U-value [W/m²K]	0.55	0.48
Alpha value* [%]	10	10

* 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	5.02	3.54
Cooling	16.09	14.7
Auxiliary	7.51	3.06
Lighting	38.54	52.52
Hot water	1.7	1.87
Equipment*	20.26	20.26
TOTAL**	**68.86**	**75.68**

* 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]	215.03	233.16
Primary energy* [kWh/m²]	206.1	223.01
Total emissions [kg/m²]	34.8	37.9

* 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] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	50.6	164.5	5	16.1	7.5	2.8	2.84	3	4
	Notional	32.6	200.6	3.5	14.7	3.1	2.56	3.79	----	----

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	0.18	GF000000:Surf[2]
Floor	0.2	0.15	GF000000:Surf[0]
Roof	0.15	-	UNKNOWN
Windows, roof windows, and rooflights	1.5	-	No windows or rooflights in building
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = 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	5