Energy & Sustainability Statement

Residential Development, Branch Hill House, Camden

Prepared for Almax Group

13th December 2019

envision

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EXECUTIVE SUMMARY

1. This Sustainability and Energy Statement has been prepared by Envision on behalf of Almax Group (The Applicant) and is submitted in support of a full planning application for the change of use of Branch Hill House from a care home (Use Class C2) to residential (Use Class C3) and associated external alterations, demolition of the 1960s extension and erection of replacement building, including basement, comprising residential accommodation (Use Class C3), ancillary plant, access and servicing and car parking.

2. The primary purpose of this document is to explain how the scheme can meet with London Borough of Camden energy and sustainability policies, along with those found within the London Plan, incorporating January 2019 updates.

3. Envision has undertaken a review of the relevant policies and worked with the design team to determine and agree the relevance and approach that should be taken to fulfil each policy.

Summary of Sustainability Strategy

4. The scheme will deliver a series of sustainability measures which are compatible with the GLA and the London Borough of Camden's requirements for sustainable design and construction:

- SuDs strategy to achieve a run-off rate of 2 l/s during all events up to and including the 1:100 AEP event, including a 40% allowance for climate change
- A comprehensive ecological strategy to deliver a net gain in biodiversity and the Protection, conservation and enhancement of the Site of Importance for Nature Conservation (SINC);
- Sustainable material selections with timber to be procured with Forest Stewardship Council accreditation;
- Incorporation of climate adaptation measures, including permeable paving, landscaping and passive building design including MVHR;
- Water conservation measures within the units to comply with 110 litres / bedspace per day and the provision of communal external rainwater harvesting tank for irrigation purposes;
- New play space and public realm.

Summary of Energy Strategy

5. This statement additionally illustrates how the scheme complies with the nationally recognised *Energy Hierarchy* and follows passive and efficiency improvements before the application of any Low or Zero Carbon (LZC) sources.

6. Envision has produced Part L1A compliant SAP calculations in order to determine the energy and CO_2 emissions for the proposed development. These have been calculated using SAP 10 figures, with detailed calculations provided in Appendix II.

7. To minimise energy consumption by the development and to ensure compliance with relevant energy policies, the following design measures are recommended and will need to be incorporated into the detailed design;

   - Building fabric construction U-values significantly improved compared with standard Building Regulations U-values;
   - Reduced Air Permeability, lower than standard Buildings Regulations, and in accordance with prospective development building occupiers;
   - High-efficiency ground-source heat pumps providing efficient space and water heating to each dwelling on site;
   - HVAC system controls ensure installed equipment will be operating efficiently and to include automatic monitoring and targeting with alarms for out of range values;
   - High efficiency LED lighting utilizing low-energy control systems such as daylight dimming and occupancy sensing;
   - Mechanical Ventilation Heat Recovery (MVHR), ensuring space heating loads are kept to a minimum;
   - Reduction in solar gain through the use of lower g-values.

8. The figures used as the basis for this assessment are discussed further in Section 5 of this report.

9. In line with the requirements of the October 2018 update to the 'GLA Guidance on preparing Energy Assessments', the predicted CO_2 emissions and energy demand presented in this report have been calculated using SAP 10 figures and presented in the 'Carbon Emission Reporting Spreadsheet', provided in Appendix II.

New-Build Residential - Carbon Savings Predicted

10. As seen in the table below, in total the new-build portion of the development reduces CO_2 emissions by **25.39 tonnes.CO_2.year**, equal to a **57.62%** saving beyond the Part L 2013 baseline (using SAP 10 emission factors), thereby complying with adopted and emerging London Borough of Camden and London Plan energy policies with regards to minimum CO_2 emission reductions for major residential developments.

11. In order to bring the residential carbon savings to 100%, the remaining residential carbon emissions are to be offset through a carbon offset payment. As detailed in the table below, the carbon offset payment, priced at £60 per tonne of CO_2 per year (over 30 years) to be paid via a S106 to LB Camden is **£33,606.69**

Table A.1 – Final New Build CO_2 reductions Chart

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	44.06	14.10
After energy demand reduction	39.49	14.10
After heat network / CHP	n/a	n/a
After renewable energy	18.67	14.10
	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Savings from energy demand reduction	4.56	10.36%
Savings from heat network / CHP	n/a	n/a
Savings from renewable energy	20.82	47.26%
Cumulative on-site savings	25.39	**57.62%**
Annual Savings from off-set payment	18.67	
Cumulative savings for off-set payment (over 30 Years)	560.11	
Carbon offset Payment (£60 per tonne)	**£ 33,606.69**	

Change-of-Use Apartments - Carbon Savings Predicted

12. As seen in the table below, in total the refurbished portion of the development reduces CO_2 emissions by **37.54 tonnes.CO_2.year**, equal to a **82.08%** saving beyond the existing building baseline (using SAP 10 emission factors), and is therefore deemed to have 'maximised CO2 reductions', as required by Policy CC1 of the Camden Local Plan.

Table A.2 – Final Refurbished CO_2 reductions Chart

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	45.73	14.10
After energy demand reduction	26.59	14.10
After heat network / CHP	n/a	n/a
After renewable energy	8.19	14.10
	Regulated domestic carbon dioxide savings	
	(Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	19.14	41.85%
Savings from heat network / CHP	n/a	n/a
Savings from renewable energy	18.40	40.23%
Cumulative on-site savings	37.54	**82.08%**

1 INTRODUCTION

1.1 Envision has been appointed by Almax Group (the Applicant) to produce a Sustainability and Energy Statement in support of a full planning application for the change of use of Branch Hill House from a care home (Use Class C2) to residential (Use Class C3) and associated external alterations, demolition of the 1960s extension and erection of replacement building, including basement, comprising residential accommodation (Use Class C3), ancillary plant, access and servicing and car parking.

Scope

1.2 The primary purpose of this statement is to explain how best practice sustainable design and construction measures would be incorporated in the proposed development to ensure alignment with local planning policy.

1.3 Section 5 (Energy Statement) sets the parameters of detailed design, but remains at a strategic level. The calculations in this document are an indication of system size and carbon emissions based on guidance documents, approved software and practical experience. They are not design calculations but establish the viability and feasibility of various technologies for the proposed development.

1.4 This statement is structured as follows:

- Section 2 provides a description of the site and the development proposals;
- Section 3 provides a description of the main energy and sustainability policies relevant to the application;
- Section 4 provides a summary of the sustainable design measures incorporated into the design;
- Section 5 provides an energy assessment, structured against the requirements of the policies examined in Section 3;
- Section 6 provides a concluding summary.

2 CONTEXT AND PROPOSALS

Site Location

2.1 Branch Hill House is an unlisted building located in the London Borough of Camden in the Hampstead Conservation Area.

2.2 The current site arrangement comprises a 3-storey (+1 storey basement) masonry residential manor house constructed circa 1870s, with an abutting 2-storey concrete frame residential block constructed circa 1960s. The site has formerly been used as a residential facility for senior-citizens but is currently occupied by building guardians. The site is set back from the main Branch Hill road, with access via a driveway (Spedan Close).

Fig 2.1 – Site Location

The Proposed Development

2.3 The general proposal is for the redevelopment of the site including the change of use of Branch Hill House from a care home (Use Class C2) to residential (Use Class C3) and associated external alterations, demolition of the 1960s extension and erection of replacement building, including basement, comprising residential accommodation (Use Class C3), ancillary plant, access and servicing and car parking.

2.4 The development will therefore create 34 new dwellings, with 29 new-build units in the 5 storey extension and 5 'change-of-use' apartments in the existing Branch Hill House.

3 SUSTAINABILITY & ENERGY POLICY CONTEXT

3.1 Many definitions of sustainable development exist, although the common objective for all is the integration of economic, social and environmental issues to ensure a better quality of life for people today, without compromising the needs of future generations. A key mechanism for delivering the principles of sustainable development lies within the UK planning system, which is implemented through national guidance and local planning policies. A review of all the relevant policy documents was undertaken in order to gain an understanding of the guiding policies for sustainability.

National Planning Policy Framework

3.1 The revised National Planning Policy Framework (NPPF) was published on 24th July 2018 and updated in February 2019. It sets the framework for all planning policy in England and how these are expected to be applied. The NPPF establishes a presumption in favour of sustainable development, and the need to support economic growth through the planning system.

- Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives: An economic role – to help build a strong, responsive and competitive economy, by ensuring that sufficient land if the right type is available in the right places and at the right time to support growth and innovation; and by identifying and coordinating development requirements, including the provision of infrastructure;
- A social role – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and
- An environmental role – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

3.2 Planning plays a key role in helping shape places to achieve radical reductions in greenhouse gas emissions, minimising vulnerability and providing resilience to the impacts of climate change, and supporting the delivery of renewable and low carbon energy and associated infrastructure. This is central to the economic, social and environmental dimensions of sustainable development. The NPPF does not include detailed measures on sustainable design codes and standards to apply, although expects that when setting any local requirement for a building's sustainability, local planning authorities should do so in a way consistent with the national technical standards.

London Plan

3.3 The London Plan (2016) sets out the Mayor's vision for London. In accord with the NPPF, it promotes economic development, and endorses the principles of sustainable development. It is the main vehicle for strategic decision-making on London's development, including development decisions. The Plan contains a number of policies directly related to a development's sustainable design and energy reduction, including:

- Policy 5.1 Climate change mitigation;
- Policy 5.2 Minimising carbon dioxide emissions;
- Policy 5.3 Sustainable design and construction;
- Policy 5.6 Decentralised energy in development proposals;
- Policy 5.7 Renewable energy;
- Policy 5.9 Overheating and cooling;
- Policy 5.10 Urban greening;
- Policy 5.11 Green roofs and development site environs;
- Policy 5.15 Water use and supplies, and
- Policy 7.2 An inclusive environment.

3.4 Of particular importance to the CO_2 and Energy reductions required for a development is *Policy 5.2: Minimising carbon dioxide emissions.*

3.5 Policy 5.2 requires that development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

- Be lean: use less energy;
- Be clean: supply energy efficiently;
- Be green: use renewable energy.

3.6 The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations.

CO_2 Reduction Targets for Major Residential Development (New-Build)

3.7 London Plan policy 5.2B sets a 'zero carbon' target for major residential development. The 'Zero Carbon Homes' requires the residential element of the application achieves at least a **35 per cent reduction** in regulated carbon dioxide emissions (beyond Part L1A 2013) on-site. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the London Borough of Camden to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

3.8 **Therefore, the CO_2 targets for the new-build residential portion of the development is a 35% reduction below Part L 2013.**

3.9 The remaining regulated carbon emissions, to 100%, are offset via the 'carbon offset fund'. The carbon off-set price has been determined at £60 per tonne of carbon dioxide for a period of 30 years, i.e. £1,800 per tonne of remaining carbon emissions.

Draft New London Plan

3.10 The Mayor of London has consulted on a Draft New London Plan which was published for consultation in December 2017. The consultation period ended on Friday 2 March 2018. The Draft New London Plan showing Minor Suggested Changes, which includes clarifications, corrections and factual updates to the Consultation Draft Plan, was published on 13th August 2018. The Examination in Public commenced in January 2019 and ran to the end of May 2019. Whilst the current 2016 London Plan is still the adopted Development Plan, the Draft London Plan may be a material consideration in planning decisions. The significance given to it is a matter for the decision maker, but it gains more weight as it moves through the process to adoption.

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

3.11 In October 2018 the GLA published their new guidance on preparing energy assessments for all planning applications submitted within London. The new guidance encourages the use of SAP 10 carbon dioxide emissions factors, which reflect the decarbonisation of the grid since the last update of Building Regulations Part L in April 2014. Some of the other key considerations include:

1. Domestic developments should achieve at least a 10% improvement on Building Regulations from energy efficiency (Be-Lean stage) alone;
2. Non-domestic developments should achieve at least a 15% improvement on Building Regulations from energy efficiency (Be-Lean stage) alone;
3. Site-wide heat networks should be embedded into development proposals from the beginning of the design process to avoid significant redesign at a later stage (e.g. by allowing sufficient space for an energy centre). Developments should commit to a single energy centre to supply the site wide heat network;

4. Demonstrate that connection to existing or planned district heating networks has been prioritised and provide evidence to support this;
5. Maximise on-site renewable energy generation, regardless of whether the 35% target has been met at the first 2 stages of the Energy Hierarchy (Be Lean, Be Clean) and; and
6. Carbon dioxide emissions reductions to be achieved as far as possible on-site. Cash in lieu contributions will only be considered acceptable in instances where it has been clearly demonstrated that no further savings can be achieved on-site.

3.12 The new guidance replaces the previous March 2016 version and should be used for any new applications, or where an application is at early enough stages to comply with the new guidance. The main change regarding the new carbon dioxide emission factors approach will apply from January 2019, and therefore these are stated in this report.

London Plan Supplementary Planning Guidance: Sustainable Design and Construction

3.13 The Mayor of London Published its Sustainable Designed Construction SPG in April 2014. The SPG provides guidance on the implementation of London Plan policy 5.3 - Sustainable Design and Construction, as well as a range of policies, primarily in Chapters 5 and 7 of the London Plan which address matters relating to environmental sustainability. As an SPG, the document does not set new policy, but explains how policies in the London Plan should be carried through into action.

London Borough of Camden Planning Policy

3.14 The most relevant policies which need to be considered when assessing the scheme's compliance to sustainability policy are those provided within local development documents.

3.15 The London Borough of Camden's adopted Local Plan (2016-2031) provides the planning framework for the Borough until 2031 and includes a suite of planning policies and strategic site allocations and supersedes the previous Core Strategy and Development Policies planning documents (adopted in 2010).

Camden Local Plan (2016 – 2031)

3.16 Policies relevant to the energy & sustainability of new development contained within the Camden Local Plan include:

1. **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.

Key additional targets under Policy CC1 include the requirement for development to achieve a 20% reduction in CO_2 emissions through the use of on-site renewable energy generation (which can include sources of site related decentralised renewable energy)

2. **Policy CC2 (a) – Adapting 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.

3. **Policy CC2 (b) – Sustainable design & construction measures**

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

(a) ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;

(b) encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;

(c) encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment.

4. **Policy CC3 – Water & Flooding**

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

Key additional targets under Policy CC3 include the requirement for new residential development to meet a requirement of 110 litres per person per day water use. Refurbishment will be required to meet BREEAM water efficiency credits. Major developments and high or intense water use developments, such as hotels, hostels and student housing, should include a grey water and rainwater harvesting system. Where such a system is not feasible or practical, developers must demonstrate to the Council's satisfaction that this is the case.

5. 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

6. Policy CC5 – Waste

This policy requires developments to include facilities for the storage and collection of waste and recycling.

Camden Planning Guidance – Energy Efficiency & Adaptation

3.17 The council prepared the Camden Planning Guidance (CPG) on Energy and resources to support the policies in the Camden Local Plan 2017. The guidance is consistent with the Local Plan and forms a Supplementary Planning Document (SPD) which is an additional "material consideration" in planning decisions.

3.18 The guidance provides information on key energy and resource issues within the borough and supports Local Plan Policies CC1 Climate change mitigation and CC2 Adapting to climate change with guidance provided on key areas including:

1. Information requirements for renewable energy installations;
2. Guidance on energy efficiency in existing buildings (i.e. flats in existing Branch Hill House);

3.19 This document is referred to within the sustainability statement and energy assessment.

Building Regulations Part L1b

3.20 The existing building at Branch Hill House comprises of a care home (Use Class C2) with the proposals including the change of use of Branch Hill House to residential (Use Class C3).

3.21 The five no. new flats in the existing Branch Hill House are therefore considered to be assessed against *Approved Document L1B: conservation of fuel and power in existing dwellings, 2010 edition (incorporating 2010, 2011, 2013, 2016 and 2018 amendments)* (ADL1B).

3.22 Clause 4.11 of ADL1B states; "Material changes of use covered by this document are where, after the change: a) the building is used as a dwelling where previously it was not, b) the building contains a flat, where previously it did not; or, c) the building, which contains at least one dwelling, contains a greater or lesser number of dwellings than it did previously.

4 SUSTAINABILITY STATEMENT

4.1 This section provides an account of the sustainability benefits of the proposed development, and how relevant policy will be addressed in the development proposals. The section is structured against the headline sustainability themes of the Mayor's SPG on Sustainable Design & Construction and applicable policies in the London Borough of Camden's Local Plan.

Sustainable Design Standards

4.2 Policy CC2 of the Local Plan "encourages" the application of BREEAM Domestic Refurbishment where 5 or more dwellings are to be created via change of use. There are impracticalities with applying BREEAM Domestic Refurbishment on a minor portion of a development, as the design team and contractor would be enacting specific design & construction measures on the existing building only, adding unnecessary cost and complexity.

4.3 Instead, it is proposed the refurbished apartments will implement many of the design principles from BREEAM Domestic Refurbishment, as outlined in the ensuing sections, including but not limited to:

1. 82.08% reduction in CO_2 emissions over the existing building baseline;
2. Water efficient fittings to achieve a 110 litres/person/day target;
3. Contractor to register with considerate constructors and monitor on-site utility consumption;
4. SuDs strategy to achieve a run-off rate of 2 l/s during all events up to and including the 1:100 AEP event, including a 40% allowance for climate change
5. A comprehensive ecological strategy to deliver a net gain in biodiversity and the Protection, conservation and enhancement of the Site of Importance for Nature Conservation (SINC)
6. Sustainable transport initiatives to include a 'car free scheme', save for disabled parking and the provision of extensive cycle parking.

Energy and CO_2 Reduction

4.4 An Energy Assessment has been prepared and is included in Section 5 which explains how the energy hierarchy identified above has been implemented.

4.5 The energy assessment has been undertaken using software recognised under the National Calculation Method (NCM) which have been applied by Envision to consider how the relevant targets can be met. Further details of the energy assessment are given in Section 5.

4.6 In total the new-build portion of the development reduces CO_2 emissions by 25.39 tonnes.CO_2.year, equal to a **57.62%** saving beyond the Part L 2013 baseline (using SAP 10 emission factors), thereby complying with adopted and emerging London Borough of Camden and London

Plan energy policies with regards to minimum CO_2 emission reductions for major residential developments.

4.7 In total the refurbished portion of the development reduces CO_2 emissions by 37.54 tonnes.CO_2.year, equal to a **82.08%** saving beyond the existing building baseline (using SAP 10 emission factors), and is therefore deemed to have 'maximised CO_2 reductions', as required by Policy CC1 of the Camden Local Plan.

4.8 The CO_2 reduction strategy for the development will follow the London Plan's 'Energy Hierarchy – Be Lean, Be Clean and Be Green' and the reductions proposed for the development are attributed to design features which reduce the consumption of energy. These outlined further in the appended Energy Statement, but include;

1. Optimised glazing;
2. Thermally efficient building fabrics;
3. Efficient lighting;
4. Low air permeability;
5. The use of Mechanical Ventilation Heat Recovery (MVHR); and
6. Use of a shared ground loop array providing efficient space and water heating.

Ecology & Green Infrastructure

4.9 Green spaces can contribute to the aesthetics and vitality of built-up urban areas. As Camden and the wider London area becomes more compact, dense and intensive in its built environment, the value of 'green' and 'amenity' space will increase. However, a balance must be struck between maximising the footprint of a site and providing an element of bio-diversity.

4.10 A Preliminary Ecological Appraisal (PEA) was undertaken in May 2018 by an experienced consultant ecologist, which determined that:

1. The woodland and notable tree specimens will need to be afforded suitable protection during the construction phase. All protective measures should accord with approved plans and BS 5837 (2012) Trees in Relation to Design, Demolition and Construction – Recommendations.
2. Branch Hill House was assigned 'high' bat roost potential due to the close proximity to Hampstead Heath, presence of loft voids and external crevices. Three dedicated emergence/re-entry surveys were recommended in the PEA, and subsequently undertaken. No roosts were identified. Spedan Close was identified as a commuting corridor for low numbers of common pipistrelle bats. Foraging activity is focused around groups of trees and the woodland edge. Lighting will be controlled to ensure this behaviour continues.
3. Trees on/bordering the site are likely to support breeding birds March-August inclusive. It is recommended that tree work avoids this period wherever practically possible. Where this is not possible, nest checks will be required immediately before work commences.

4. The grassland to the west of Branch Hill House has potential to attract transient reptiles if left unmanaged. Precautionary measures and habitat management recommendations are included in this report.
5. Japanese knotweed was identified in a localised position on the bank rear of Branch Hill House. This plant was subsequently remediated by a licensed contractor. It is recommended that contractors remain vigilant and any further Japanese knotweed is identified and treated appropriately.

4.11 In accordance with Local Plan Policy A3 and the NPPF Section 4.3.3, the following ecological enhancement measures are proposed for the scheme:

1. Protection, conservation and enhancement of the Site of Importance for Nature Conservation (SINC) to the north of the site;
2. Introduction of native species, bird nest boxes and bat boxes will be provided to the woodland to improve on-site biodiversity;
3. Development of a Residential Play strategy to include; play space, a woodland trail, a woodland glade and a Jekyll Gatden;
4. Softworks strategy to remainder of site to include a range of native & non-native species.

Flood Risk & SuDs

4.12 Policy CC3 of the Camden Local Plan requires developments to undertake a Flood Risk Assessment and to Incorporate sustainable drainage systems and avoid non-permeable hard standings with the aim of achieving greenfield runoff rates

4.13 As detailed in the Level 2Flood Risk Assessment prepared by Ridge for the development, the site is located within Flood Zone 1. This is defined as having a low chance of tidal or fluvial flooding (less than 1:1000 year probability). As the site falls into this zone, it is defined as suitable for all development classes. In addition, the risk of flooding from additional sources has been identified as follows:

- The risk of pluvial (surface water) flooding is considered to be very low;
- The risk of sewer flooding to be moderate;
- The risk of groundwater flooding is considered to be low;

4.14 The SuDs strategy prepared by Ridge confirms that in order to reduce the post-development surface water run-off rate to a maximum rate of 2 l/s during all events up to and including the 1:100 AEP event, including a 40% allowance for climate change, the following SuDs measures will be incorporated:

1. Reducing surface water run-off through the installation of permeable surfaces;
2. Installation of a shallow below ground geocellular attenuation tank(s) within the site curtilage. The tank(s) will be appropriately sized to accommodate the attenuated volume of surface water generated by the Application Site during the 1:100yr event plus the pre-determined allowance for climate change.

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Water Conservation

4.15 The Mayor of London has published his Water Strategy – Securing London's Water Future (2011), which sets out how water efficiency will be implemented across London. This guides development towards reducing demand for water. Policy CC3 includes the requirement for new residential development to meet a requirement of 110 litres per person per day water use. As part of this, the council requires the consideration of grey water, and rainwater harvesting systems. In accordance with Policy CC3, the following section examines the water efficiency within the development to meet the relevant targets.

Table 4.1 – Water consumption specifications

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Strategy, Code level	Fittings-based, Code level 3/4	Fittings-based, Code level 3/4	Fittings-based, Code level 3/4	Fittings-based, Code level 3/4	Fittings-based, Code level 5/6	Recycling-based, Code level 5/6
WC	4 (single flush)	4/2.6 (dual flush)	5/3 (dual flush)	6/4 (dual-flush toilet)	4/2.6 (dual flush)	6 (supplied by greywater)
Taps (excluding kitchen taps)	4	5	4	4	1.6	3
Bath	180	155	180	180	155	155
Shower	8	8	8	8	6	7
Kitchen sink taps	6	8	6	6	3	4
Washing machine	8.17 (not supplied)	8.17 (not supplied)	8.17 (not supplied)	6.14 (supplied)	6.14	8.17 (not supplied)
Dishwasher	1.25 (not supplied)	1.25 (not supplied)	1.25 (not supplied)	1.25 (not supplied)	0.67	1.25 (not supplied)
Water Recycling	0 (not supplied)	0 (not supplied)	0 (not supplied)	0 (not supplied)	0 (not supplied)	26.52 (greywater supplying toilet)
Predicted per capita consumption (Code)	104.65	99.81	103.28	103.43	79.99	79.84

4.16 Table 4.1 illustrates the various fittings-based water consumption levels to achieve scenarios. In this case, Scenario 1 specification demonstrate consumption of less than 110 litres/person/day.

4.17 The development will include a dedicated external communal rainwater harvesting tank, for use by residents (if desired), but primarily for irrigation use by the groundsman tending to the wider landscaped areas. The size and location of this tank will be agreed at the detail-design stage.

Pollution

4.18 Any new development can potentially lead to detrimental environmental effects; as is the nature of construction. These potential effects have been considered during the planning stages of this proposal. The development is not of the scale that would require an Environmental Impact Assessment (EIA), however the measures as outlined in this section, and subsequently implemented, will ensure that any potential impacts can be appropriately controlled in order to demonstrate compliance with Local Plan Policy A4 (Noise) and CC4 (Air Quality).

Noise

4.19 Hepworth Acoustics have prepared a Noise Impact Assessment that has been included with this application. The assessment measured background noise levels on site, and determined that no specific noise mitigation measures are required for the development. In addition, as no external plant is proposed, there is no mitigation required for plant.

Air Quality

4.20 With regards to air quality, the entire Borough of Camden was designated as an Air Quality Management Area in 2002, declared for exceedance of PM10 and NO2. Since then Camden have produced a number of Air Quality Action plans along with annual reports to Defra. Policy CC4 of the Camden Local Plan requires that "Air Quality Assessments (AQAs) are required where development is likely to expose residents to high levels of air pollution." The energy strategy at Branch Hill House is proposing no on-site fossil fuel combustion as all space and water heating will be provided by an electric-led ground-source heat pump, alongside electric cooking.

External Lighting

4.21 The development's lighting strategy will ensure that it does not have adverse effects at night-time. Although a detailed lighting scheme for the site that ensures it minimises light pollution has not yet been undertaken the following measure are expected to be incorporated:

1. External lighting will be designed in compliance with Table 1 and accompanying notes of ILE Guidance Note for reduction of obtrusive light.
2. All non-safety/security lighting will be automatically switched off between 2300hrs and 0700hrs.

Waste

4.22 This section has considered all the requirements set out under Camden Local Plan Policy CC5 which requires development proposals to; "make sure that developments include facilities for the storage and collection of waste and recycling.

4.23 Residential waste storage space would take account of the requirement of BS5906:2005. This requires that suitable refuse and recycling space provision is allocated for the residential apartments in a centralised waste store. The necessary provision is as follows:

- 100 litres for first bed/1 bed;
- 70 litres for each bedroom after that.

4.24 In accordance with storage requirements in BS5906:2005, 50% of this quantity of waste arisings should be for recyclable waste and 75% of the quantity should be for general municipal waste. This over provision of storage capacity will ensure that sufficient space is always allocated to cater for waste volumes.

4.25 For each portion of the development adequate storage for refuse and recycling has been provided in accessible locations and sufficient space will be provided in each collection location/area for refuse vehicles to manoeuvre so that they can enter and exit in forward gear. The development layout has been checked to ensure refuse and delivery vehicles can access the development as required.

Sustainable Transport

4.26 A Transport Assessment has been produced by RPS as part of the planning application, which demonstrates the measures to be incorporated into the development are in line with Local Plan policies T1 to T4 and Policy 6.13 of the London Plan. A summary of the measures is provided below.

4.27 The development site currently has a poor level of public transport with a PTAL rating of 1b, however the site is accessible by all modes of transport, with Hampstead Underground station and local bus services accessible within 650 metres of the site (8-minute walk). The site is therefore accessible to non-car modes of travel.

4.28 To encourage walking and cycling as sustainable modes of travel to/from the development, information will be provided to residents on the local facilities and amenities in the area including local pedestrian and cycle routes to and from the site.

Cycle Parking

4.29 The cycle parking for the two elements of the proposed scheme has been considered with regards to Camden Planning Guidance on Transport (March 2019) and the Emerging London Plan cycle parking minimum standards. The location of cycle parking has been considered for both short- and long-term use.

4.30 76 long-stay cycle parking spaces will be provided in accordance with the requirements of the Camden Planning Guidance (CPG) on Transport (March 2019). The provision represents a 20 percent increase on the minimum standards of the Draft New London Plan (July 2019). Furthermore, two short-stay cycle parking spaces for visitors will be provided close to the front entrance of the development, in accordance with the minimum standards of the Draft New London Plan (July 2019).

Car Parking

4.31 The development will be car-free with the exception of four disabled car parking spaces provided in the basement in accordance with the Draft New London Plan (July 2019). One disabled parking bay will be provided with an active Electric Vehicle Charging Point (ECVP), with the remaining three bays provided with passive provision in accordance with the Draft New London Plan (July 2019).

4.32 Deliveries and servicing, including refuse collection, and emergency vehicle access will be from Spedan Close, via Branch Hill

4.33 With regards to car sharing clubs, there are a number of clubs located in the vicinity of the site. The nearest car club is available on Lower Terrace circa 40 metres east of the site.

Sustainable Construction

4.34 The construction phase of the development can have a significant effect on the quality of the site and its surroundings, including the local environment, neighbouring residents, surrounding employees and the general public. Sustainable construction involves the prudent use of existing and new resources, the efficient management of the construction process, and consideration of potential adverse environmental impacts on local sensitive receptors.

4.35 It is not considered that the construction phase will yield an adverse level of disturbance, particularly given the surrounding land uses, although various measures adopted by the contractor will ensure that any potential disturbance is minimised. The principal contractor will be required to deliver high standards of sustainable construction, which will be achieved through the following:

- Registering the site against the Considerate Constructors Scheme;
- Managing the construction site to reduce environmental effects, this will include adopting best practice measures to protect water and air quality, monitoring water and energy use from construction activities;

Materials

4.36 Maximising the sustainability of all the materials used in the build will be an important factor from the outset. The re-use of a number of major existing building elements will add to the material environmental performance of the scheme.

4.37 The development will be designed and constructed as to maximise the sustainability of materials. The client will ensure the following standards are met in the development:

1. At least 50% of timber and timber products are to be sourced from accredited Forest Stewardship Council (FSC) or Programme for the Endorsement of Forestry Certification (PEFC) scheme.
2. No construction or insulation materials are to be used which will release toxins into the internal and external environment, including those that deplete stratospheric ozone.

5 ENERGY STATEMENT

5.1 In pursuing compliance with the Energy Policy in the London Borough of Camden, Envision has followed guidance from the Borough's Local Plan, namely Policy CC1 Energy & Carbon Reduction – which directs the user to seek guidance from the requirements of the London Plan for major development.

5.2 Policy CC1 refers to the requirements of the current London Plan 2016 and in particular Policy 5.2 which has a requirement that all new buildings should make the fullest contribution to minimising carbon dioxide (CO_2) emissions in accordance with the following energy hierarchy:

1. Step 1 – Reducing Energy Requirements;
2. Step 2 – Supplying the energy that is required more efficiently;
3. Step 3 – Meeting remaining energy requirements through renewable and low carbon energy.

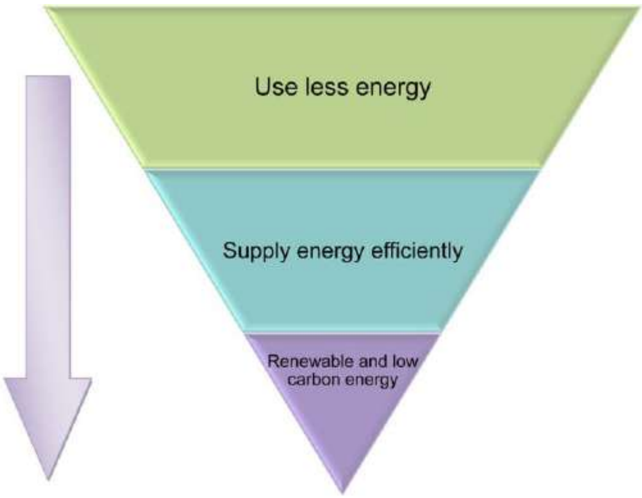

Fig 5.1 - 'Energy Hierarchy'

Methodology – New Build Residential

5.3 London Plan policy 5.2B sets a 'zero carbon' target for major residential development. The 'Zero Carbon Homes' requires the residential element of the application to achieve at least a **35 per cent reduction** in regulated carbon dioxide emissions (beyond Part L1A 2013) on-site. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the London Borough of Camden to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

5.4 In line with the requirements of the October 2018 update to the 'GLA Guidance on preparing Energy Assessments', the predicted CO_2 emissions and energy demand presented in this report have been calculated using **SAP 10 figures**. The GLA 'Carbon Emission Reporting Spreadsheet', to be provided with referable planning applications is set up for development proposing communal heating systems. As this development proposes a communal network connecting to individual heating systems (not compatible with the GLA Carbon Emission Reporting Spreadsheet) the consumption figures have been manually converted with SAP 10 emission factors and provided in Appendix II.

5.5 Compliance with Part L1a of Building Regulations is provided via the SAP worksheets in Appendix Vi to VIII.

5.6 In accordance with NCM guidance, the appropriate methodology for calculating the energy performance of the new-build apartments is "The Government's Standard Assessment Procedure for Energy Rating of Dwellings". This procedure was undertaken using Stroma FSAP 2012 version 1.0.4.16 which is a Department of Communities and Local Government (DCLG) approved methodology and software for undertaking SAP assessments.

5.7 For the purposes of this assessment, the following apartment typologies were selected for analysis;

Table 5.1 – Apartment Typologies

Apartment Type	Unit Reference
Ground Floor 2-Bed	**Flat 3**
Ground Floor – 3 or 4 Bed	**Flat 8**
Mid Floor 1-Bed	**Flat 10**
Mid Floor 2-Bed	**Flat 23**
Mid Floor 3 or 4 Bed	**Flat 15**
Top Floor 1-Bed	**Flat 33**
Top Floor 2-Bed	**Flat 32**
Top Floor 3 or 4 Bed	**Flat 31**
Gatehouse	**-**
Triplex	**-**

5.8 In order to provide a level of analysis reflecting the various orientations of the scheme, on each block, apartments were selected from each elevation.

Methodology – Refurbished (Change of Use) Residential

5.9 As detailed in Section 3, the five no. new flats in the existing Branch Hill House are to be assessed against *Approved Document L1B: conservation of fuel and power in existing dwellings, 2010 edition (incorporating 2010, 2011, 2013, 2016 and 2018 amendments)*.

5.10 Policy CC1 of the Camden Local Plan requires major residential refurbishment (>1,000m²) to meet the “greatest possible CO_2 reductions, alongside meeting Part L1B values for retained elements”

5.11 The applicant has followed best practice guidance in relation to major residential refurbishment, namely the ‘GLA Guidance on Preparing Energy Assessments’, alongside reference to the BRE Domestic Refurbishment ENE 01 methodology, which require:

1. Where major refurbishments are being carried out an estimate of the CO_2 savings from the refurbishment of the building will be expected. To provide this, developers are required to estimate the CO_2 emission baseline performance of the un-refurbished condition of the existing building using Building Regulations approved compliance software.
2. Where estimates of the existing performance of building elements or services have been made developers are required to outline the source of these assumptions, such as a building condition survey, Energy Performance Certificate (EPC) conventions, industry benchmarks etc.
3. The baseline for change of use applications should be estimated assuming the existing building is the same as the proposed end use.
4. All other assumptions (heating, hot water, infiltration, thermal bridging etc.) should be based on the details set out in SAP appendix S or using actual values where available.

5.12 Once the existing building baseline DER has been established the BER/DER of the refurbished building should be determined following improvements at each stage of the energy hierarchy using Building Regulations compliance software.

5.13 At each stage of the energy hierarchy, CO_2 emissions will be calculated and reported using SAP 10 emission factors.

5.14 As this refurbished portion proposes individual heating systems (not compatible with the GLA Carbon Emission Reporting Spreadsheet) the consumption figures have been manually converted with SAP 10 emission factors and provided in Appendix II.

Establishing the Target Emission Rate (TER) – New Build Residential

5.15 The total emissions savings calculated in this report for the new-build flats are expressed against a Building Regulation 2013 Target Emission Rate. This is the Baseline against which the measures implemented must show an improvement.

5.16 The Target Emission Rates for the development have been established using DCLG approved methodology and software.

5.17 The calculated carbon emissions and total energy demand for the Target Emission Rate are illustrated below. The calculated figure demonstrates a Part L1A Building Regulations 2013 compliant model – arrived at using SAP 10 carbon factors.

Table 5.2 – Target CO_2 emissions for New-Build Portion

Unit	Total Floor Area for Unit Type (m^2)	SAP 10 TER	Total Target CO_2 ($kg.CO_2.yr$)	Target Regulated Energy (kWh.yr)
GF-2 Bed	232.1	14.24	3,304.72	18,896.94
GF-3/4 Bed	391	13.57	5,306.35	28,283.90
MF-1 Bed	568.9	15.41	8,765.32	38,536.10
MF-2 Bed	212.6	12.79	2,719.22	11,751.46
MF-3/4 Bed	942.1	10.70	10,081.90	51,252.78
TF-1 Bed	109.4	18.65	2,040.35	10,547.22
TF-2 Bed	210.5	13.72	2,887.22	15,272.90
TF-3/4 Bed	191	13.24	2,528.69	12,054.00
Gatehouse	167	17.37	2,901.49	12,907.45
Triplex	263.3	13.38	3,522.68	16,955.69
		Total =	**44,057.93**	**216,458.44**

5.18 The figure of **44,057.93 $kg.CO_2.yr$** the targets that must be reached and improved upon by the proposals in this Energy Assessment in order to comply with Building Regulations Part L1a 2013. This will be achieved through the implementation of fabric efficiency, energy-reduction and carbon-saving measures as outlined in the ensuing sections.

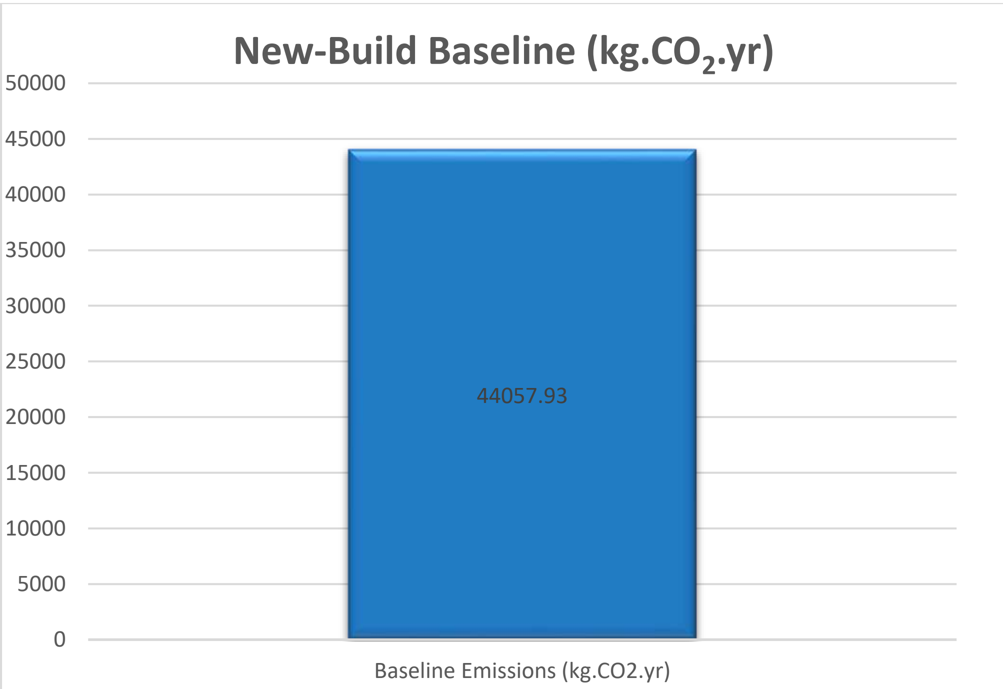

Fig 5.2 – Target CO_2 emissions for New-Build Portion

Establishing the Target Emission Rate (TER) – Refurbished Residential

5.19 As detailed in various reports submitted with this planning application, the existing building dates from the 1870s. Therefore, existing fabric performance figures were taken from SAP Appendix S (Reduced Data SAP for existing dwellings), with the age band assumed to be A, which applies to buildings built between before 1900 and up to 1919. Details on building services were provided by the client, and where not identified were also taken from SAP Appendix S.

Table 5.3 – Existing Building Inputs

Elements	Input	Comment
External Wall U-Value ($W/m^2 K$)	0.6	Taken from SAP Appendix S, assuming an unfilled cavity wall.
Ground Floor U-Value ($W/m^2 K$)	0.25	Calculated using guidance as provided in Table S9 of Appendix S from SAP for solid ground floors. (Nominal insulation assumed)
Roof (Flat & Pitched) U-Value ($W/m^2 K$)	0.68	Calculated using guidance as provided in Table S11 of Appendix S from SAP for solid ground floors
External Windows U-Value ($W/m^2 K$)	3.1	Assumed as double-glazed prior to 2002.
Party Walls U-Value ($W/m^2 K$)	0	Assumed as fully-filled cavity with effective edge sealing an insulation in line with layers in abutting elements.
Air Permeability	15 $m^3/h.m^2$	Default value.
Heating & Hot Water	Gas-fired system boiler.	Confirmed from client, assumed as regular condensing boiler (post-1998). DHW storage sized as 210 litres in line with Appendix S Table S17 with a nominal 50mm factory insulated jacket.
Lighting	Assumed as non-LED	-
Ventilation	Assumed as basic extract fans	-

5.20 Based on the inputs laid out in Table 5.3, the baseline for the refurbished portion of the development was calculated as follows (using SAP 10 emission factors):

Table 5.4 – Target CO_2 emissions for Refurbished Portion

Unit	Total Floor Area for Unit Type (m²)	SAP 10 TER	Total Target CO_2 (kg.CO_2.yr)	Target Regulated Energy (kWh.yr)
Flat 1	178	40.65	7,235.94	34,318.14
Flat 2	227.6	37.97	8,642.44	40,991.57
Flat 7	250.9	43.26	10,854.71	51,553.65
Flat 16	270	33.91	9,155.32	43,453.59
Flat 24	229	42.99	9,845.34	46,739.43
		Total =	**45,733.75**	**217,056.38**

5.21 The figure of **45,773.75 kg.CO_2.yr** is the target that must be reached and improved upon by the proposals in this Energy Assessment in order to comply with Camden Policy CC1, which requires major residential refurbishment (>1,000m²) to meet the "greatest possible CO_2 reductions, alongside meeting Part L1B values for retained elements. This will be achieved through the implementation of fabric efficiency, energy-reduction and carbon-saving measures as outlined in the ensuing sections.

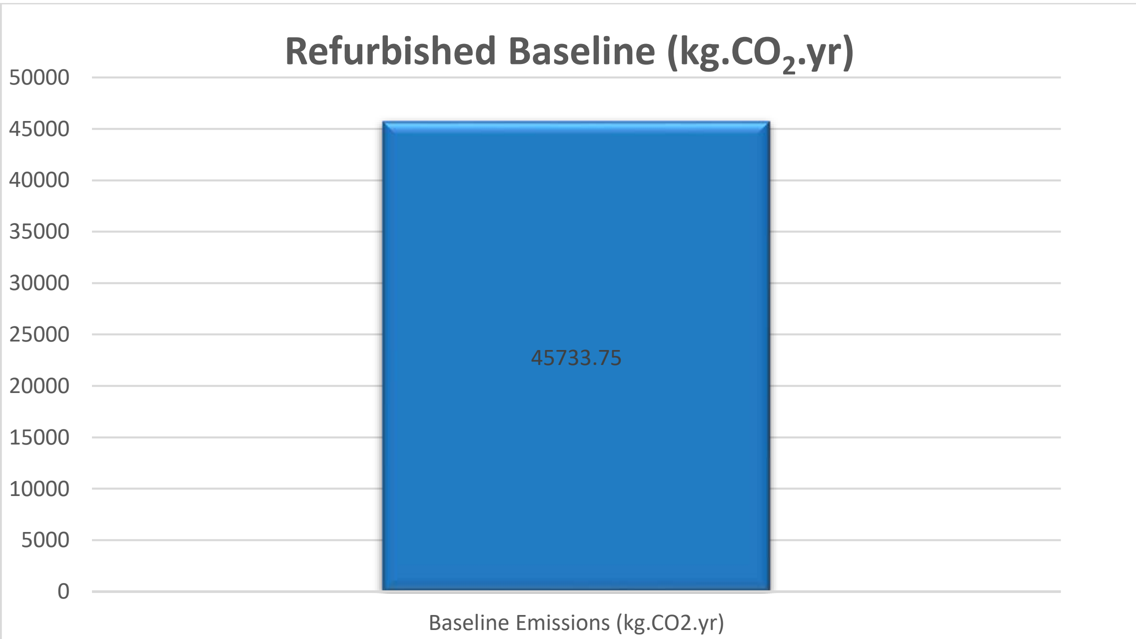

Fig 5.3 – Target CO_2 emissions for Refurbished Portion

Applying the London Plan Energy Hierarchy: Stage 1 – Be Lean

5.22 The Greater London Authority seeks a 'fabric first' approach to reducing the carbon footprint of London's built environment. This is achieved through buildings using less energy by improving u-values, air-tightness and lighting efficiency amongst others. This is the first step to consider in reducing a building's carbon emissions before the efficient delivery of power, heat or renewables are considered by a design-team.

Fabric Efficiency

5.23 U-Values, are used to measure how effective elements of a buildings fabric are as insulators. That is, how effective they are at preventing heat from transmitting between the inside and the outside of a building. Very broadly, the better (i.e. lower) the U-value of a buildings fabric, the less energy is required to maintain comfortable conditions inside the building. The following U-Values are proposed for the development;

Table 5.5 – Proposed U-Values

Elements	New Building Elements: U-Values – W/m² K	Refurbished Building Elements: U-Values – W/m²K[1]	Comment
External Wall	0.12	0.35	n/a
Wall to unheated corridor	0.15	0.35	
Ground Floor	0.11	0.25	n/a
Roof (Flat & Pitched)	0.13	0.16	n/a
External Windows	1.1 (G-Value 0.45)	1.8 (G-value 0.55)	Assumed as double-glazed
External Solid Doors	1.8	1.8	n/a
Party Walls	0	0	Assumed as fully-filled cavity with effective edge sealing

5.24 The main circulation areas and corridors are assumed to be unheated at this stage, and therefore walls adjoining each apartment to circulation zones are to be insulated.

Air Permeability

5.25 The designed Air Permeability Rate (APR) has been set at 3 $m^3/h.m^2$ @ 50Pa for the new-build portion of the development.

[1] The U-Values proposed in the refurbished portion will apply to new and upgraded elements.

5.26 The designed Air Permeability Rate (APR) has been retained at an assumed 15 $m^3/h.m^2$ @ 50Pa for the refurbished portion of the development. During detail-design, opportunities will be explored to improve this figure.

Lighting

5.27 The SAP calculation software used for assessing the development does not allow for the specification of lighting elements. However, it is assumed that the light fittings will be specified as LED, low-energy with local manual switching and if appropriate, occupancy sensing.

Ventilation Strategy: New-Build Portion

5.28 The ventilation strategy has been designed to meet with occupant and client requirements across the varied activity zones in the development, whilst maintaining the energy efficiency needed to lower carbon emissions. A balanced whole-house mechanical ventilation system with heat recovery is proposed for every new-build dwelling as follows;

1. 1-Bed Flats: *Nuaire MRXBOX95AB-WM1* (or similar);
2. 2-Bed Flats: *Nuaire MRXBOX95-WM2* (or similar);
3. 3 & 4-Bed Flats: *Nuaire MRXBOX95-WH1*

Ventilation Strategy: Refurbished Portion

5.29 In order to reduce the impact of the ventilation strategy on the internal aesthetics of the existing building, basic extract fans have been assumed for all WCs and kitchen hoods.

Space & Water Heating

5.30 In line with the 'GLA guidance on preparing Energy Assessments', the heating system for each dwelling (new build & refurbished) assumed at 'Be-Lean' stage is an individual gas-fired heating system, with the efficiency in line with the notional building boiler efficiency (91%).

5.31 Each dwelling will be provided with domestic hot water storage as follows:

1. 1-Bed Flats: *150 litre cylinder with 0.99 kwh/day heat loss*
2. 2-Bed Flats: *250 litre cylinder with 1.49 kwh/day heat loss*
3. 3 & 4-Bed Flats: *305 litre cylinder with 1.63 kwh/day heat loss*

5.32 The SAP assessment assumes the pipework will be fully insulated and the water heating will be timed separately.

New-Build Residential - Be Lean Stage CO_2 Reductions

5.33 The following tables and graphs represent the Be-Lean improvements for the new-build apartments over the Target Emission Rate (TER) baseline emissions;

Table 5.6 – New-Build Be-Lean Emissions

Unit	Total Floor Area for Unit Type (m^2)	SAP 10 DER	Total CO_2 (kg.CO_2.yr)	Regulated Energy (kWh.yr)
GF-2 Bed	232.1	13.54	3,142.20	17,884.12
GF-3/4 Bed	391	12.98	5,073.65	26,897.52
MF-1 Bed	568.9	13.24	7,533.55	32,903.40
MF-2 Bed	212.6	11.30	2,401.40	10,316.06
MF-3/4 Bed	942.1	8.52	8,024.65	40,391.88
TF-1 Bed	109.4	18.19	1,989.72	10,248.86
TF-2 Bed	210.5	13.07	2,752.14	14,496.46
TF-3/4 Bed	191	12.88	2,459.66	11,676.21
Gatehouse	167	17.28	2,885.19	12,778.03
Triplex	263.3	12.28	3,232.16	15,453.74
		Total =	**39,494.31**	**193,046.28**
		Difference over Baseline	4563.62	23412.16
		% Difference	**10.36%**	**10.82%**

5.34 As detailed above, the measures as taken at 'Be-Lean' stage would result in a **10.36%** reduction in new-build regulated CO_2 emissions over the Part L 2013 Target Emission Rate, calculated using SAP 10 emission factors.

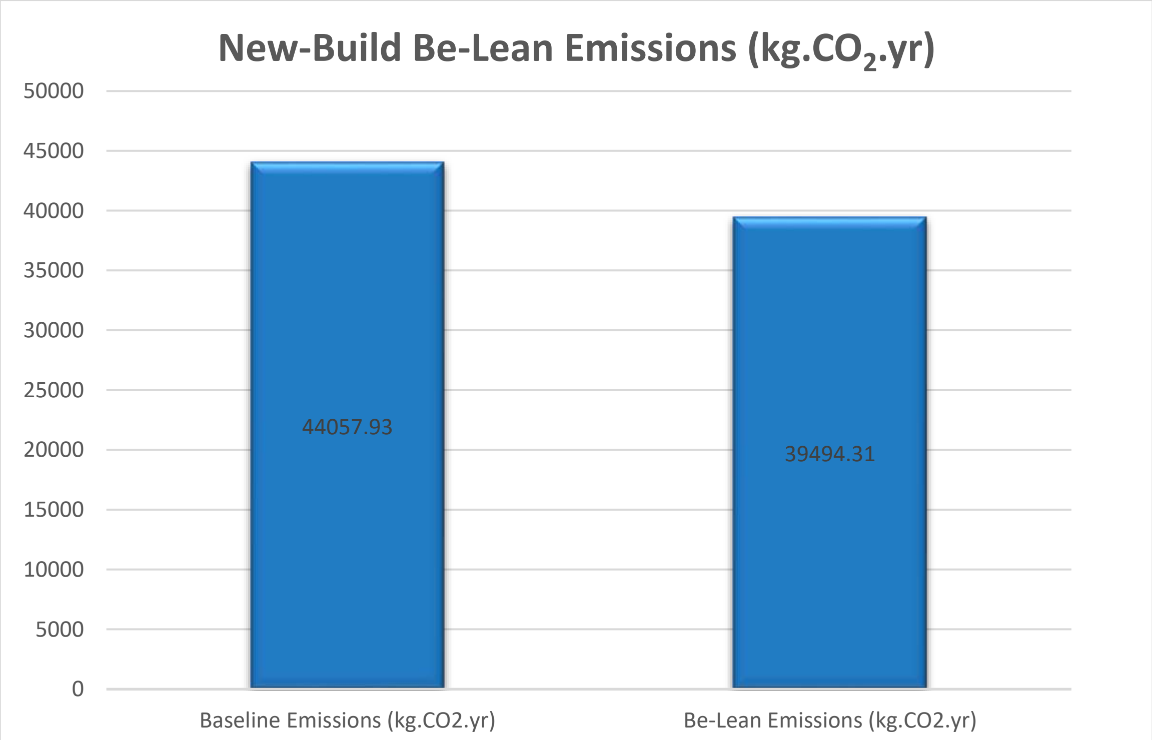

Fig 5.4 – New Build Be-Lean Stage Reductions

Refurbished Residential - Be Lean Stage CO_2 Reductions

5.35 The following tables and graphs represent the Be-Lean improvements for the refurbished apartments over the existing building baseline:

Table 5.7 – Refurbished Be-Lean Emissions

Unit	Total Floor Area for Unit Type (m^2)	SAP 10 DER	Total CO_2 ($kg.CO_2.yr$)	Regulated Energy (kWh.yr)
Flat 1	178	34.26	6,099.16	28,954.96
Flat 2	227.6	31.40	7,146.64	33,930.39
Flat 7	250.9	36.54	9,168.12	43,572.63
Flat 16	270	28.43	7,676.91	36,467.10
Flat 24	229	31.20	7,144.35	33,931.13
		Total =	**37,235.18**	**176,856.21**
		Difference over Baseline	8498.56	40200.17
		% Difference	**18.58%**	**18.52%**

5.36 As detailed above, the measures as taken at 'Be-Lean' stage would result in a **18.58%** reduction in refurbished element's regulated CO_2 emissions over the existing building baseline DER, calculated using SAP 10 emission factors.

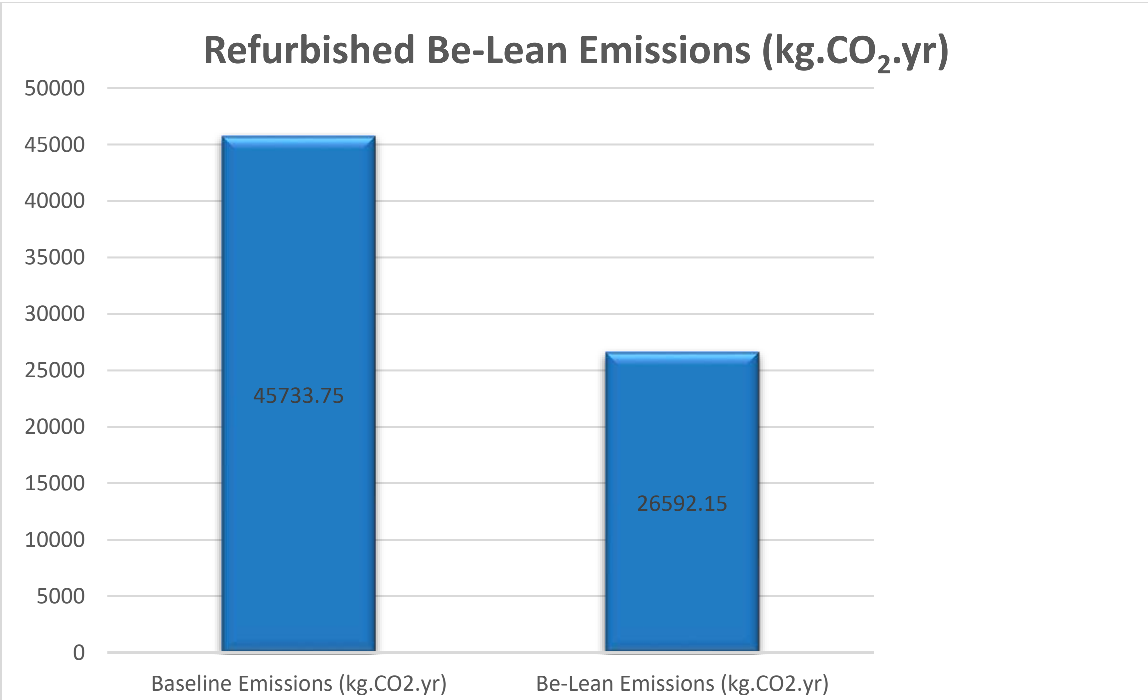

Fig 5.5 – Refurbished Be-Lean Stage Reductions

Cooling & Overheating

5.37 Policy 5.9 of the London Plan (2016) seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

5.38 Applicants should apply the cooling hierarchy as detailed in Policy 5.9 with the development at Branch Hill House to incorporate the following measures;

Table 5.8 – Cooling Methods

Cooling Method	Measures Employed
Minimising internal heat generation through energy efficient design	• Where present, lateral pipework will run through all residential corridors to ensure internal heat gains are minimised. Corridors will be ventilated to prevent heat build up in summer operation. • The g-value of all installed glazing will be as low as feasible possible (currently assumed as 0.45 in new build apartments) in order to reduce internal solar gain. • Mechanical service risers to be ventilated at low level and at roof level to ensure risers do not create nuisance heat load in summer operation.
Reducing the amount of heat entering the building in summer	• The building form for all new-build apartments is on a beneficial east-west axis, reducing the risk of overheating from low lying morning and evening sun. To the direct south of the new-build portion are a large number of large trees which will offer a significant level of shading. • Internal blinds will be provided to all bedrooms to reduce evening sun, although it is acknowledged very few bedrooms have a western orientation which are most at risk from evening overheating.
Use of thermal mass and high ceilings to manage the heat within the building	• All floor-to-ceiling heights are maintained at a minimum 2500mm, with the majority at 2700mm. This relative increase in exposed surface will help to lower indoor air temperatures.
Passive ventilation	• The majority of dwellings (which comprise the majority of floor area in the development) have been designed with, a shallow floor plate, openable windows and a number allow for cross-ventilation.
Mechanical ventilation	• The refurbished apartments will utilise natural ventilation via openable windows and extract fans to all WCs and kitchen hoods. • An MVHR system is proposed for each new-build apartment. These will facilitate a sufficient amount of air changes per hour to ensure there is no stagnant air and will help in lowering the overall indoor air temperature.

CIBSE TM59 Assessment

5.39 The latest criteria for the assessment of overheating risk have been specified by the Chartered Institute of Building Services Engineers (CIBSE) in CIBSE TM59: Design methodology for the assessment of overheating risk in homes (2017). CIBSE TM59 is based on CIBSE TM52 and CIBSE Guide A guidance documents, and provides a standardised approach to predicting overheating risk for both naturally and mechanically ventilated residential buildings.

5.40 The new CIBSE TM59 guidance requires that the following two criteria must be met in order to demonstrate compliance:

1. For living rooms, kitchens and bedrooms: the number of hours during which the operative temperature exceeds the comfort threshold temperature is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance);

2. For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (CIBSE Guide A Fixed temperature threshold).

   (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32.85 hours, so 33 or more hours above 26 °C will be recorded as a fail).

Modelling Methodology

5.41 The performance of the units has been assessed under CIBSE TM59 adaptive comfort model for a primarily natural ventilated scenario through the EnergyPlus engine using DesignBuilder v.6.1.0.006.

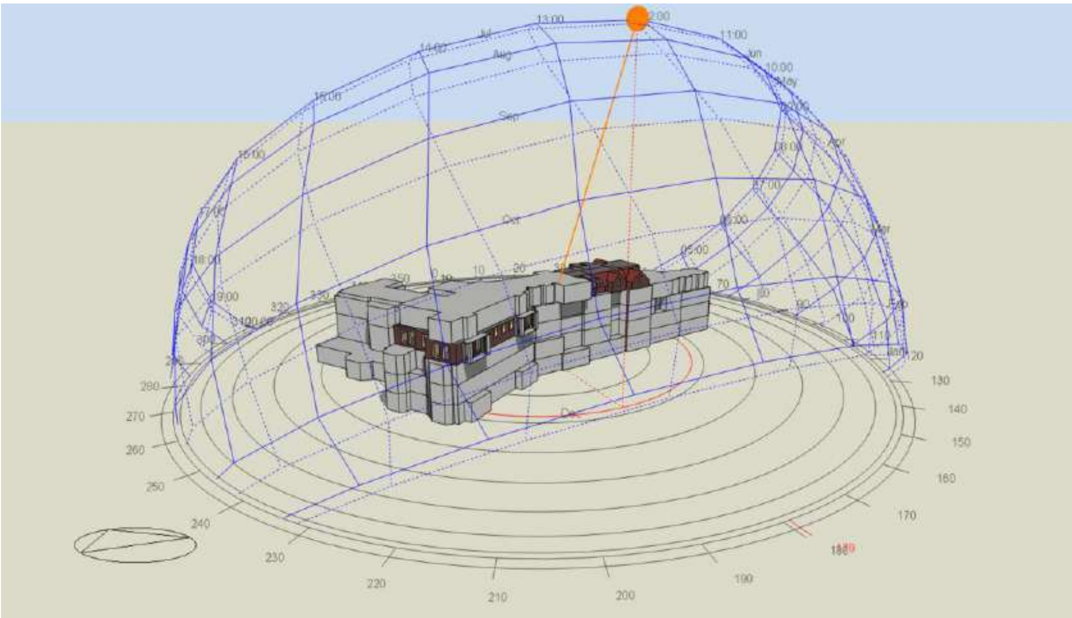

Fig 5.6 – Image of overheating model

5.42 For the purposes of the assessment, a number of the worst-case apartments in the development were chosen for analysis:

1. Flat 25: 2-Bed Apartment on south west corner (mid floor apartment);
2. Flat 26 & 27: 1-Bed apartments with single aspect living areas/bedrooms on south elevation (mid floor apartment);
3. Flat 34: 1-Bed apartment with single aspect living areas/bedrooms on south elevation (top floor flat)

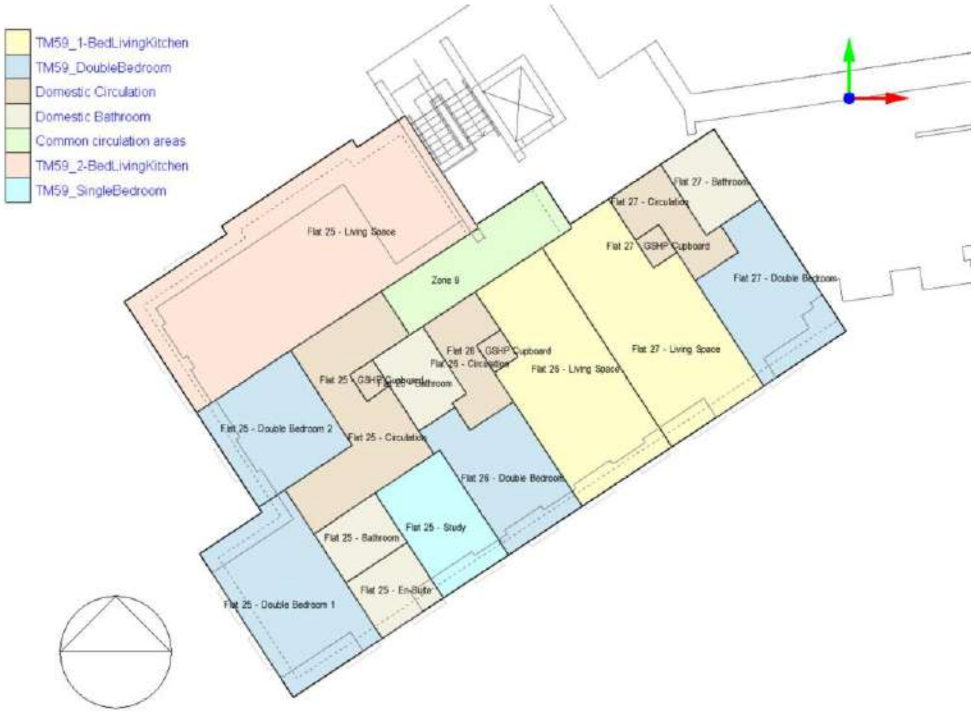

Fig 5.7 – Image of mid floor apartments

Site External Weather Conditions

5.43 The effects of external conditions are vital in an overheating assessment as, in particular, they influence:

1. Solar heat gains (a function of incident direct & diffuse solar radiation and solar altitude);
2. Calculated natural ventilation rates (a function of external temperature, wind directions and speeds).

5.44 CIBSE Design Summer Year weather data for London Heathrow (representative of urban areas outside the Central Activity Zone) has been used for the 2020s, high emissions, 50% percentile scenario as required by CIBSE TM59 guidance and as the most relevant to the location of the proposed development site.

DesignBuilder EnergyPlus Model Inputs

5.45 All fabric and M&E inputs to the EnergyPlus model are in line with the measures outlined in this report. Design Inputs specific to the TM59 analysis have been detailed below;

Table 5.9 – DesignBuilder Inputs

Input	Parameters	Comment
Building Fabric & Construction	As per inputs detailed in 'Be-Lean' section	-
Window & Balcony Doors	Glazing g-value to be specified at 0.45 as per 'Be-Lean' section.	-
External Shading	-All balcony windows benefit from overhang of balcony above; - All windows benefit from 200mm reveal of surrounding wall. - External trees are present on southern elevation	Trees have been modelled with 20% transparency, i.e. 80% of sunlight is let through.
Internal Shading	High-reflectance internal blinds have been assumed and to be included in the design, operating in accordance with TM59 schedules. The slats are assumed to close fully to block beam solar in high summer months and this will be reported in a Home User Guide.	TM59 methodology prescribes that internal blinds can be included for the analysis only if specifically included in the design, provided in the base build and explained within the associated home user guide. In addition, blinds should not be used if they clash with the opening of windows. The architect will need to include for these in design.
Natural Ventilation	Windows to have effective free area of between 50%-70% depending on window typology All windows to operate in accordance with TM59 schedules	
Mechanical Ventilation	MVHR assumed for all dwellings, to achieve minimum 0.7-1 ach/hr dependant on apartment type and zone.	Assumptions on the dwelling ventilation are based on a MVHR system achieving minimum Part F requirements.

Internal Gains

5.46 The following internal gains assumptions (Table 5.9) have been made in the DesignBuilder EnergyPlus model, in line with the CIBSE TM59 guidance and calculations of the Energetik heat gains;

Table 5.10 – Internal Gains Assumptions

Unit/Room Type	Occupancy	Equipment Load
1 Bed Apartment: Living/Kitchen	1 person from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
2 Bed Apartment: Living/Kitchen	2 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
3+ Bed Apartment: Living/Kitchen	3 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day
Double Bedroom	2 people at 70% gains from 11 pm to 8 am 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm 1 person at full gain in the bedroom from 9 am to 10 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours
Single Bedroom	1 person at 70% gains from 11 pm to 8 am 1 person at full gains from 8 am to 11 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours
All Rooms – Lighting	n/a	Lighting assumed 2 W/m² from 6pm to 11pm
Internal DHW	n/a	A standing loss of 20 W for the hot water cylinder has been assumed in each dwelling.

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TM59 Results - Dwellings

5.47 The table below summarises the results given by running dynamic thermal simulations for the buildings under the current design summer year (1989) for the 2020s high emission, 50% percentile scenario, as required by CIBSE TM59.

Table 5.8 – EnergyPlus TM59 Output

Naturally ventilated

Criteria for predominantly naturally ventilated homes

Block	Zone	Criterion A (%)	Criterion B (hr)	Pass/Fail
Level3SWApartments	Flat25XLivingSpace	0.49	N/A	Pass
Level3SWApartments	Flat25XStudy	0.00	23.67	Pass
Level3SWApartments	Flat26XDoubleBedroom	0.00	30.33	Pass
Level3SWApartments	Flat26XLivingSpace	0.09	N/A	Pass
Level3SWApartments	Flat27XDoubleBedroom	0.00	13.50	Pass
Level3SWApartments	Flat27XLivingSpace	0.02	N/A	Pass
Level3SWApartments	Flt25XDblBdrm1	0.00	8.00	Pass
Level3SWApartments	Flt25XDblBdrm2	0.00	17.17	Pass
UpperFloor	Flat32DoubleBedroom	0.07	46.17	Fail
UpperFloor	Flat34DoubleBedroom	0.28	59.33	Fail
UpperFloor	Flat34KitchenXLiving	2.04	N/A	Pass

5.48 Results presented above demonstrate that, based on the design and internal gain assumptions, all rooms meet the TM59 Criterion A. Under Criterion B, the following room types shows a non-compliance under Criterion B:

1. Top Floor South Facing Bedrooms (single-aspect).

5.49 Top-floor dwellings typically present a greater degree of overheating risk due to additional solar radiation absorption through the roof build-up. Typically, this can be mitigated through large window openings, which allow a sufficient volume of fresh air into a space.

5.50 The south-facing roof top apartments at Branch Hill House have been designed in line with comments received by the conservation officer, namely to complement the aesthetics of the existing Branch Hill House. This has resulted in small window openings to the south-facing bedrooms. As a result of this the model shows a moderately increased overheating risk.

5.51 Criterion B of TM59 has a requirement that during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (CIBSE Guide A Fixed temperature threshold). 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32.85 hours, so 33 or more hours above 26 °C will be recorded as a fail.

5.52 As detailed above the hours of exceedance for the 2 bedrooms are 46 and 59 hours respectively, meaning a moderate increase over the 33 hour threshold.

5.53 It is therefore proposed that the development demonstrates an acceptable level of overheating risk generally.

Unregulated CO_2 Emissions

5.54 Unregulated loads (plug-in and specialist process equipment) can contribute to a significant quantum of the overall CO_2 emissions of any development.

5.55 The unregulated loads for the residential portion of the development have been calculated using guidance as laid out in Appendix L of SAP 2012 Manual and are presented below:

Table 5.10 – Unregulated load for entire development

Unregulated Load	Unregulated Emissions (tonnes.CO_2.annum)[2]
Electrical Appliances	26.8

5.56 Unregulated CO_2 emissions associated with landlord areas of the development have not been reported, therefore the following measures and opportunities will be explored and included in a residents/tenant user guide where appropriate;

Table 5.11 – Unregulated load opportunities

Unregulated load opportunity	Measures Employed
Energy Efficient Lifts	- LED lights in lift cars; - Variable voltage drives; - Regenerative lift motors to be considered.
External Lighting	- Energy efficient lamps (>65 lamp lumens/circuit watt); - Photocell dimming/time clock controls to avoid unnecessary use.
White Goods (if developer specified)	- All white goods will be minimum A rated.

[2] Calculated using SAP 10 emission factor for electricity

Applying the London Plan Energy Hierarchy: Stage 2 – Be Clean

5.57 Policy CC1 of the Camden Local Plan (2017) requires development to follow the steps below, in the order listed, to ensure that energy from an efficient source is used where possible:

1. Connect immediately: where feasible, development will be required to connect immediately to existing networks;
2. Connect in immediate future: where networks do not currently exist, developments will be required to assess feasibility of connecting to identified future decentralised energy network opportunities in the vicinity of the site, having regard to Energy Networks identified in the plan and on the London Heat Map specific feasibility studies, energy plans and site allocations.
3. Provide a site wide low carbon network: all major developments that cannot immediately connect to an existing or planned network should evaluate the feasibility of a site wide network using low carbon energy sources such as CHP or other low carbon technologies and examine the feasibility of extending the system beyond the site boundary to other sites within a 500m radius, prioritising communally heated Council buildings.

Connection to existing heating or cooling networks

5.58 As seen on the map adjacent, there are no existing or planned heat networks in the vicinity of Branch Hill House.

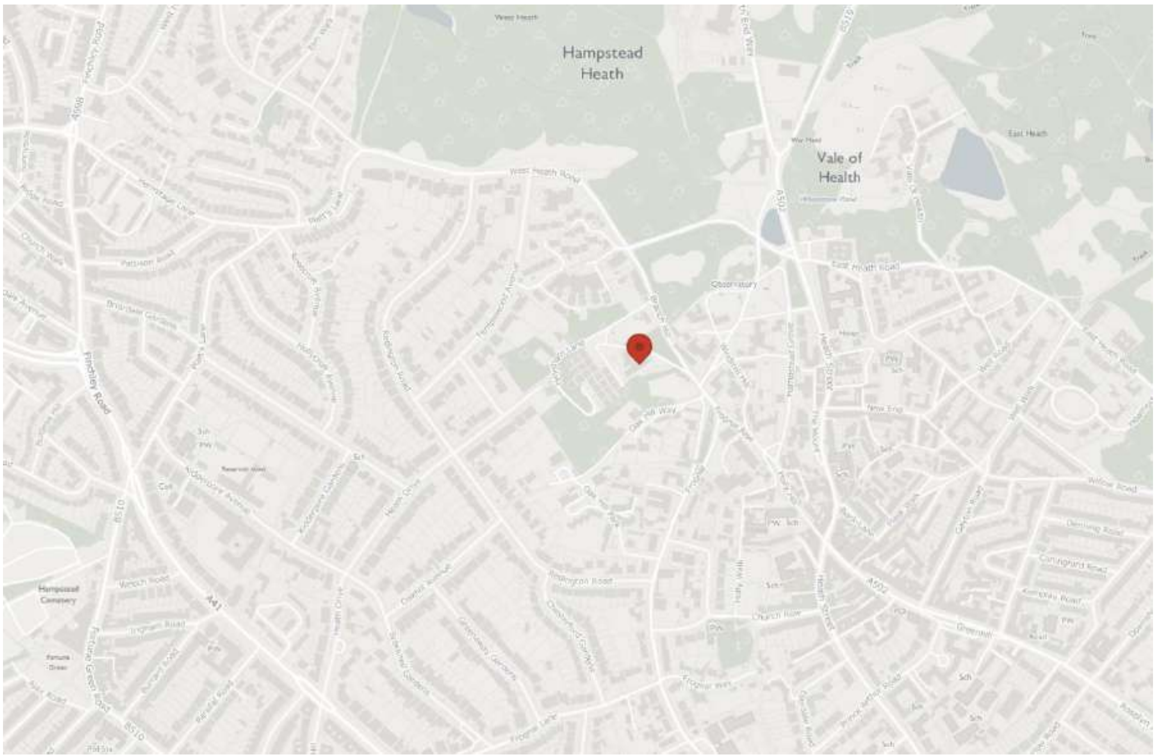

Fig 5.9 - Local Heat Map

Future Connection to District Heating

5.59 As detailed in the 'Be-Green' section, the development proposals include the installation of a shared ground loop array which will deliver low-carbon space and water heating to each dwelling, effectively meeting with the objective of "energy from an efficient source" as required by Policy CC1.

5.60 In this instance, given that no DH networks are available within the vicinity of the site, and given the reasons outlined above, it is suggested that a capped connection at boundary or other similar infrastructure is unnecessary and impractical.

5.61 In addition, it is noted that by pursuing an all-electric scheme the development is future-proofed for falling CO_2 emissions as the National Grid continues to decarbonise and therefore a future connection to a DH network would not necessarily result in the scheme having lower CO_2 emissions than an all-electric scheme.

Applying the London Plan Energy Hierarchy: Stage 3 – Be Green

5.62 An analysis of low carbon/renewable technologies was undertaken to determine which would be suitable for application in a development of this size and nature. This analysis has been appended to this document in Appendix I.

5.63 During the design-development period for this scheme, multiple low carbon/renewable systems were examined for both their feasibility and ability to lower carbon emissions insofar as possible. As per the analysis contained in Appendix I, the renewable systems deemed to be the most viable for the development is the installation of a shared ground loop array (SGLA) closed system connecting to individual ground-source heat pumps in each dwelling, providing efficient space and water heating to each dwelling.

Renewable Energy / Low Carbon Technology – Shared Ground Loop Array

5.64 The development at Branch Hill House is intending to make use of a shared ground loop array (SGLA) as its primary source of space and water heating.

Overview of System

5.65 Mimicking a traditional gas framework, a series of ground boreholes (120 – 240 meters deep) are linked together to form a shared ground loop array acting as a heat energy source to each dwelling at Branch Hill House. The shared ground loop system transfers ambient temperature low grade heat energy from the ground (-5°C to 20°C) to individual ground source heat pumps (GSHP) located inside each individual dwelling. Each GSHP then upgrades the ground's heat energy to provide independently controllable heat and hot water to the property.

Fig 5.10 – Typical Image of Shared Ground Loop Array

External Design Requirements

5.66 The typical diameter of each borehole is approximately 150mm. Within the finished borehole there are flow and return pipes for the ground array (40mm diameter each) and a sacrificial pipe that is used to install the grout in the borehole (also 40mm diameter). The top of the borehole is terminated approximately 1m below ground level.

5.67 The number of boreholes is dependent on how dwellings are grouped within different ground arrays, which will occur at the detail-design stage. The design assumption at present is 20 boreholes (average depth around 170 metres). with 10 to 12 metres of separation between boreholes.

5.68 During detailed design, boreholes will be located exactly within the modelling software to understand how they interact with each other.

5.69 The boreholes themselves are fully covered by ground and do not need to be accessed. There will be a flow and return pipe running at about 1m below ground level from the top of each borehole back to a subterranean manifold, which has a manhole cover to enable access in future.[3] From this manifold, each individual borehole can be isolated and flushed/purged/filled. The ground array does not require any annual maintenance. Approximately every 20 years or so, the antifreeze will need to be changed from the manifold.

Internal Design Requirements

5.70 The exact dimensions of the risers are subject to detailed design and an agreement on how many apartments will be connected to each array. Riser space has been designed to a 'worst-case' scenario, with 2no. 108mm diameter pipes with 25mm insulation as main risers, branching down to 40mm or 28mm or potentially 22mm when running to each GSHP.

5.71 All 1 to 2 bed dwellings will make use of a Shoebox Ground Source Heat Pump (GSHP) with DHW cylinder capacity in line with the details in the 'Be-Lean' section.

5.72 Larger dwellings will require the larger EVO GSHP, with DHW cylinder capacity in line with the details in the 'Be-Lean' section.

5.73 Datasheets for the GSHP units and cylinders have been provided in Appendix IV.

5.74 Although there is a shared ground loop array, as each dwelling has an individual heat pump, enabling occupants to manage their own electricity supply and therefore have a choice of energy supplier. This is typically not possible in a traditional District Heating (DH) network as metering and billing is managed by one ESCO/management company.

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[3] Note – this can also be located in a plant room.

Environmental & Geological Considerations

5.75 The proposed shared ground loop array is a 'closed-loop' system, in which a mixture of water and antifreeze flows through a closed network of pipes (known as the ground loop). In one part of the circuit, it exchanges heat with the ground. In the other part, it exchanges that heat with the evaporator of the heat pump. There is no contact between the working fluid and the ground and between the working fluid and the fluid of the heat pump at any point.

5.76 This as opposed to an 'open-loop' system which extract heat from ground water, usually abstracted from an aquifer via a borehole.

5.77 Section 3.1 of the Environment Agency's 'Ground Source Heat Pump – Good Practice Guide' confirms; "Closed loop ground source heating and cooling systems do not currently require any form of permission from us".

5.78 This is further confirmed in an email in Appendix V from Kensa Engineering (the proposed manufacturer), which confirms:

1. When drilling closed loop boreholes, no permission is required from the EA;

2. With regards to the local geological suitability for a SGLA, Kensa's Certified Geoexchange Designer has confirmed they are confident the ground will be suitable for installation and will likely consist of:
   (a) Sand and gravel for approximately 20 metres
   (b) Clay and gravel for approximately a further 30 metres
   (c) Chalk with flints to depth from point onwards

New-Build Residential: Be-Green CO_2 Reductions

5.79 The following tables and graphs represent the Be-Green improvements for the new-build portion over the Target Emission Rate (TER) baseline emissions;

Table 5.12 – New Build Be-Green Improvement over TER

Unit	Total Floor Area for Unit Type (m²)	SAP 10 DER	Total CO2 (kg.CO2.yr)	Regulated Energy (kWh.yr)
GF-2 Bed	232.1	5.25	1,218.16	6,320.62
GF-3/4 Bed	391	4.45	1,740.03	8,403.80
MF-1 Bed	568.9	7.85	4,465.36	17,854.20
MF-2 Bed	212.6	5.47	1,162.61	4,568.20
MF-3/4 Bed	942.1	4.58	4,314.70	19,931.28
TF-1 Bed	109.4	10.77	1,178.55	5,537.14
TF-2 Bed	210.5	6.20	1,304.95	6,279.12
TF-3/4 Bed	191	4.73	904.30	3,909.56
Gatehouse	167	6.07	1,014.05	4,087.91
Triplex	263.3	5.19	1,367.68	5,966.20
		Total =	**18,670.38**	**82,858.03**
		Difference over Be-Lean	20823.93	110188.25
		% Difference	**52.73%**	**57.08%**
		Difference over Baseline	25387.55	133600.41
		% Difference	**57.62%**	**61.72%**

5.80 As detailed above, the measures as taken at this stage would result in a **57.62%** reduction in the new-build regulated CO_2 emissions over the Building Regulations Part L 2013 Target Emission Rate, calculated using SAP 10 emission factors.

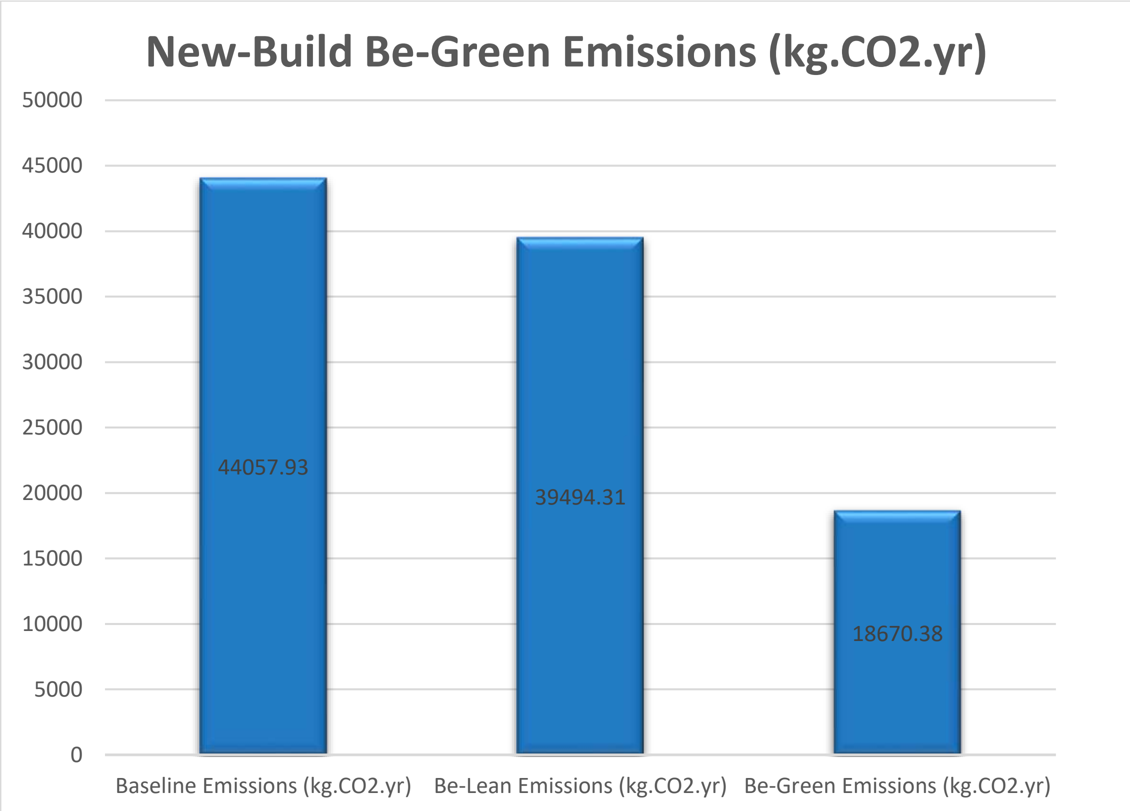


Fig 5.11 – New Build Be-Green Reductions

Refurbished Residential: Be-Green CO_2 Reductions

5.81 The following tables and graphs represent the Be-Green improvements for the new-build portion over the Target Emission Rate (TER) baseline emissions;

Table 5.13– Refurbished Be-Green Improvement over TER

Unit	Total Floor Area for Unit Type (m^2)	SAP 10 DER	Total CO2 (kg.CO2.yr)	Regulated Energy (kWh.yr)
Flat 1	178	7.16	1,275.16	5,472.81
Flat 2	227.6	6.95	1,582.21	6,790.59
Flat 7	250.9	8.46	2,123.59	9,114.12
Flat 16	270	6.18	1,669.78	7,166.45
Flat 24	229	6.74	1,543.80	6,625.76
		Total =	**8,194.55**	**35,169.73**
		Difference over Be-Lean	18397.60	91058.59
		% Difference	**69.18%**	**72.14%**
		Difference over Baseline	37539.20	181886.65
		% Difference	**82.08%**	**83.80%**

5.82 As detailed above, the measures as taken at this stage would result in a **82.08%** reduction in the refurbished regulated CO_2 emissions over the existing building baseline, calculated using SAP 10 emission factors.

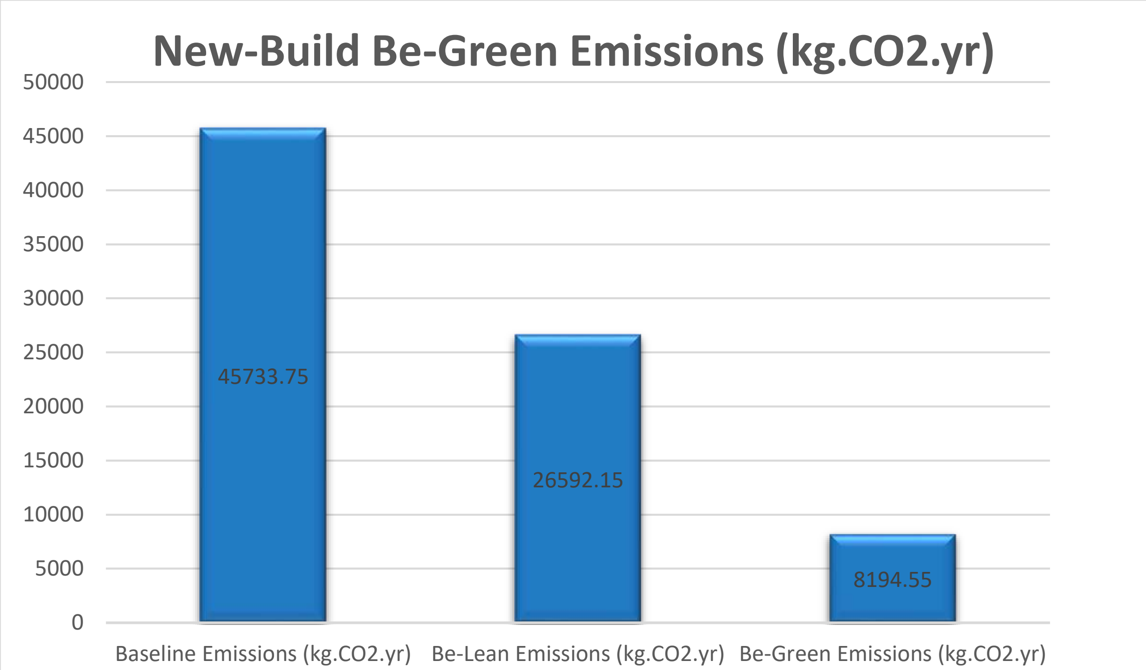


Fig 5.12 – Be-Green Reductions

Final New-Build Residential CO_2 Reduction Charts & Carbon Offset Payment

5.83 In accordance with the 'GLA guidance on preparing energy assessments', the final carbon emissions and predicted savings are presented below for the entire development. Also included is the predicted carbon offset payment for the development. The final table represents the site wide regulated carbon dioxide emissions and savings.

Table 5.14 – Final New-Build Residential CO_2 reductions

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	44.06	14.10
After energy demand reduction	39.49	14.10
After heat network / CHP	n/a	n/a
After renewable energy	18.67	14.10
	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Savings from energy demand reduction	4.56	10.36%
Savings from heat network / CHP	n/a	n/a
Savings from renewable energy	20.82	47.26%
Cumulative on-site savings	25.39	57.62%
Annual Savings from off-set payment	18.67	
Cumulative savings for off-set payment (over 30 Years)	560.11	
Carbon offset Payment (£60 per tonne)	**£ 33,606.69**	

5.84 In order to bring the residential carbon savings up to 100%, the remaining residential carbon emissions are to be offset through a carbon offset payment. As detailed above, the carbon offset payment, priced at £60 per tonne of CO_2 per year (over 30 years) to be paid via a S106 to LB Camden is **£33,606.69.**

Final Refurbished Residential CO_2 Reduction Charts

5.85 In accordance with the 'GLA guidance on preparing energy assessments', the final carbon emissions and predicted savings are presented below for the refurbished portion of the development. The final table represents the site wide regulated carbon dioxide emissions and savings.

Table 5.15 – Final Refurbished Residential CO_2 reductions

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	45.73	14.10
After energy demand reduction	26.59	14.10
After heat network / CHP	n/a	n/a
After renewable energy	8.19	14.10
	Regulated domestic carbon dioxide savings	
	(Tonnes CO2 per annum)	**(%)**
Savings from energy demand reduction	19.14	41.85%
Savings from heat network / CHP	n/a	n/a
Savings from renewable energy	18.40	40.23%
Cumulative on-site savings	37.54	**82.08%**

6 CONCLUSION

6.1 This Sustainability and Energy Statement has been prepared by Envision on behalf of Almax Group (The Applicant) and is submitted in support of a full planning application for the change of use of Branch Hill House from a care home (Use Class C2) to residential (Use Class C3) and associated external alterations, demolition of the 1960s extension and erection of replacement building, including basement, comprising residential accommodation (Use Class C3), ancillary plant, access and servicing and car parking.

6.2 The scheme will deliver a series of sustainability measures which are compatible with the GLA and London Borough of Camden's requirements for sustainable design and construction, including:

- SuDs strategy to achieve a run-off rate of 2 l/s during all events up to and including the 1:100 AEP event, including a 40% allowance for climate change
- A comprehensive ecological strategy to deliver a net gain in biodiversity and the Protection, conservation and enhancement of the Site of Importance for Nature Conservation (SINC);
- Sustainable material selections with timber to be procured with Forest Stewardship Council accreditation;
- Incorporation of climate adaptation measures, including permeable paving, landscaping and passive building design including MVHR;
- Water conservation measures within the units to comply with 110 litres / bedspace per day and the provision of communal external rainwater harvesting tank for irrigation purposes;
- New play space and public realm.

6.3 To minimise energy consumption by the development and to ensure compliance with relevant energy policies, the following design measures are proposed:

- Building fabric construction U-values significantly improved compared with standard Building Regulations U-values;
- Reduced Air Permeability, lower than standard Buildings Regulations, and in accordance with prospective development building occupiers;
- High-efficiency ground-source seat pumps providing efficient space and water heating to each dwelling on site;
- HVAC system controls ensure installed equipment will be operating efficiently and to include automatic monitoring and targeting with alarms for out of range values;
- High efficiency LED lighting utilizing low-energy control systems such as daylight dimming and occupancy sensing;
- Mechanical Ventilation Heat Recovery (MVHR), ensuring space heating loads are kept to a minimum;
- Reduction in solar gain through the use of lower g-values.

6.4 The strategy proposed follows the three-step 'Energy Hierarchy' and meets all policies as outlined in Section 3 of the report, with the development expected to perform as follows:

1. The new-build portions (comprising 29 apartments) overall reduction in carbon emissions over the Part L 2013 (using SAP 10 emission figures) baseline is **57.62%** therefore complying with LB Camden & GLA policy on CO_2 reductions in major residential developments;

2. The 5-dwelling created by change-of-use in the existing Branch Hill House are expected to reduce CO_2 emissions by **82.08%,** when compared to the existing building baseline, - and have therefore have maximised CO_2 emission reductions as required by LB Camden Policy CC1.

6.5 Further optimising of the ground source heat pump installation will be assessed at the detail-design phase. For this Energy Report, the solutions have been optimised to suit the predicted energy consumption and carbon emissions as per Envision's calculations.

6.6 The development is therefore considered to comply with the sustainability & energy requirements outlined by Camden and GLA sustainability and energy policies.

APPENDIX I – RENEWABLE TECHNOLOGY ANALYSIS

Renewable Technology	Rating (out of 5)	Comment
Photovoltaics	***	The roof layout is not optimal for the inclusion of PV given the many ridge and gable end roofs. In addition, given the CO_2 reductions already achieved on-site their inclusion is deemed extraneous. In addition, the CO_2 offset offered by PV using SAP 10 emission factors is halved when compared to previous Part L emission factors, meaning a significant quantum is required to lower CO_2 emissions meaningfully.
Solar Thermal	*	The proposed DHW system (on-site Ground Source Heat Pump) will already provide hot water – the use of a solar thermal system would be an over-design, especially given the limited roof space already allocated for the PV array. They also have a shorter lifespan than PV systems.
Wind Turbine	*	The restricted nature of the site, coupled with the noise, aesthetic (planning) and building vibrations arising from their installation means this system is impractical.
Ground Source Heat Pump	*****	A shared ground loop array has been identified as a viable renewable technology for providing space & water heating to the development as; • The site has been identified as suitable for the installation of the boreholes required for this system; • Depending on apartment size, the system offers high COPs • As each apartment has its own individual heat pump, tenants can manage their own metering and billing
Air Source Heat Pump	***	ASHPs are potentially viable for the development and are capable of providing a significant portion of the building's energy from effectively a renewable source, as for each kW of electricity in excess of 3kW of heating will be extracted. Two ASHP solutions were examined for inclusion in the design but were rejected for the following reasons; • **Individual ASHP** – these offer high COPs but each ASHP would need to be located on the roof (no space) as a condenser farm at ground level would not be suitable. • **Communal ASHP** – these offer lower COPs than individual ASHPs which would require a larger amount of PV than currently specified**. Also space considerations are an issue.**
Biomass Communal Boiler	*	The significant plant and in particular, storage space required for a biomass boiler is unsuitable for a development of this size.

APPENDIX II – ENVISION SAP 10 CALCULATIONS

Table 1. CARBON (CO2) FACTORS		
Fuel type	Fuel Carbon Factor (kgCO2/kWh)	
	SAP 2012	SAP 10
Natural Gas	0.216	0.210
Grid Electricity	0.519	0.233

STEP 1 - BASELINE (TER) CALCULATIONS				REGULATED ENERGY CONSUMPTION PER UNIT (kWh.p.a)							SAP 2012 CO2 PERFORMANCE (Regulated CO2 Emissions)						SAP 10 CO2 PERFORMANCE (Regulated CO2 Emissions)					
Unit	Area (m²)	SAP 10 TER	SAP 2012 TER	Space Heating	Fuel Type	Domestic Hot Water	Fuel Type	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	Total	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	Total
GF-2 Bed	140.3	14.24	15.81	6192.83	Natural Gas	2670.35	Natural Gas	510.29	75	n/a	1337.6513	576.7956	264.84051	38.925	n/a	2218.2124	1300.4943	560.7735	118.89757	17.475	n/a	1997.6404
GF-3/4 Bed	220	13.57	14.83	10696.44	Natural Gas	2755.89	Natural Gas	614.62	75	n/a	2310.431	595.27224	318.98778	38.925	n/a	3263.6161	2246.2524	578.7369	143.20646	17.475	n/a	2985.6708
MF-1 Bed	53	15.41	17.53	1425.18	Natural Gas	2109.37	Natural Gas	244.06	75	n/a	307.83888	455.62392	126.66714	38.925	n/a	929.05494	299.2878	442.9677	56.86598	17.475	n/a	816.59648
MF-2 Bed	97.32	12.79	14.51	2772.38	Natural Gas	2631.72	Natural Gas	396.63	75	n/a	598.83408	568.45152	205.85097	38.925	n/a	1412.0616	582.1998	552.6612	92.41479	17.475	n/a	1244.7508
MF-3/4 Bed	169	10.70	12.06	5142.93	Natural Gas	2759.68	Natural Gas	564.52	75	n/a	1110.8729	596.09088	292.98588	38.925	n/a	2038.8746	1080.0153	579.5328	131.53316	17.475	n/a	1808.5563
TF-1 Bed	59.88	18.65	21.08	2703.37	Natural Gas	2164.68	Natural Gas	330.56	75	n/a	583.92792	467.57088	171.56064	38.925	n/a	1261.9844	567.7077	454.5828	77.02048	17.475	n/a	1116.786
TF-2 Bed	118	13.72	15.64	4334.93	Natural Gas	2656.44	Natural Gas	570.08	75	n/a	936.34488	573.79104	295.87152	38.925	n/a	1844.9324	910.3353	557.8524	132.82864	17.475	n/a	1618.4913
TF-3/4 Bed	192.4	13.24	14.62	8616.41	Natural Gas	2747.07	Natural Gas	615.52	75	n/a	1861.1446	593.36712	319.45488	38.925	n/a	2812.8916	1809.4461	576.8847	143.41616	17.475	n/a	2547.222
Gatehouse	156.86	17.37	19.01	9545.99	Natural Gas	2720.16	Natural Gas	566.3	75	n/a	2061.9338	587.55456	293.9097	38.925	n/a	2982.3231	2004.6579	571.2336	131.9479	17.475	n/a	2725.3144
Triplex	267.62	13.38	14.66	13322.32	Natural Gas	2773.41	Natural Gas	784.96	75	n/a	2877.6211	599.05656	407.39424	38.925	n/a	3922.9969	2797.6872	582.4161	182.89568	17.475	n/a	3580.474

STEP 2 - BE-LEAN DER CALCULATIONS				REGULATED ENERGY CONSUMPTION PER UNIT (kWh.p.a)							SAP 2012 CO2 PERFORMANCE (Regulated CO2 Emissions)						SAP 10 CO2 PERFORMANCE (Regulated CO2 Emissions)					
Unit	Area (m²)	SAP 10 DER	SAP 2012 DER	Space Heating	Fuel Type	Domestic Hot Water	Fuel Type	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	Total	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	Total
GF-2 Bed	140.3	13.54	15.79	5474.06	Natural Gas	2530.28	Natural Gas	514.89	422.83	n/a	1182.397	546.54048	267.22791	219.44877	n/a	2215.6141	1149.5526	531.3588	119.96937	98.51939	n/a	1899.4002
GF-3/4 Bed	220	12.98	15.03	9531.73	Natural Gas	2590.99	Natural Gas	616.65	709.39	n/a	2058.8537	559.65384	320.04135	368.17341	n/a	3306.7223	2001.6633	544.1079	143.67945	165.28787	n/a	2854.7385
MF-1 Bed	53	13.24	16.11	827.96	Natural Gas	1989.73	Natural Gas	244.06	228.59	n/a	178.83936	429.78168	126.66714	118.63821	n/a	853.92639	173.8716	417.8433	56.86598	53.26147	n/a	701.84235
MF-2 Bed	97.32	11.30	13.62	1963.06	Natural Gas	2495.85	Natural Gas	396.63	302.49	n/a	424.02096	539.1036	205.85097	156.99231	n/a	1325.9678	412.2426	524.1285	92.41479	70.48017	n/a	1099.2661
MF-3/4 Bed	169	8.52	10.62	2993.44	Natural Gas	2616.92	Natural Gas	569.73	551.89	n/a	646.58304	565.25472	295.68987	286.43091	n/a	1793.9585	628.6224	549.5532	132.74709	128.59037	n/a	1439.5131
TF-1 Bed	59.88	18.19	21.33	2532.78	Natural Gas	2029.05	Natural Gas	333.16	229.44	n/a	547.08048	438.2748	172.91004	119.07936	n/a	1277.3447	531.8838	426.1005	77.62628	53.45952	n/a	1089.0701
TF-2 Bed	118	13.07	15.57	3834.91	Natural Gas	2516.07	Natural Gas	573.57	323.68	n/a	828.34056	543.47112	297.68283	167.98992	n/a	1837.4844	805.3311	528.3747	133.64181	75.41744	n/a	1542.7651
TF-3/4 Bed	192.4	12.88	14.87	7978.92	Natural Gas	2580.47	Natural Gas	621.47	495.35	n/a	1723.4467	557.38152	322.54293	257.08665	n/a	2860.4578	1675.5732	541.8987	144.80251	115.41655	n/a	2477.691
Gatehouse	156.86	17.28	19.83	9066.58	Natural Gas	2554.14	Natural Gas	571.83	585.48	n/a	1958.3813	551.69424	296.77977	303.86412	n/a	3110.7194	1903.9818	536.3694	133.23639	136.41684	n/a	2710.0044
Triplex	267.62	12.28	14.44	11107.58	Natural Gas	2611.06	Natural Gas	791.38	943.72	n/a	2399.2373	563.98896	410.72622	489.79068	n/a	3863.7431	2332.5918	548.3226	184.39154	219.88676	n/a	3285.1927

STEP 3 - BE-GREEN DER CALCULATIONS				REGULATED ENERGY CONSUMPTION PER UNIT (kWh.p.a)							SAP 2012 CO2 PERFORMANCE (Regulated CO2 Emissions)						SAP 10 CO2 PERFORMANCE (Regulated CO2 Emissions)					
Unit	Area (m²)	SAP 10 DER	SAP 2012 DER	Space Heating	Fuel Type	Domestic Hot Water	Fuel Type	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	Total	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	Total
GF-2 Bed	140.3	5.25	11.69	1533.16	Electricity	719.43	Electricity	514.89	392.83	n/a	795.71004	373.38417	267.22791	203.87877	n/a	1640.2009	357.22628	167.62719	119.96937	91.52939	n/a	736.35223
GF-3/4 Bed	220	4.45	9.91	2151.93	Electricity	753.93	Electricity	616.65	679.39	n/a	1116.8517	391.28967	320.04135	352.60341	n/a	2180.7861	501.39969	175.66569	143.67945	158.29787	n/a	979.0427
MF-1 Bed	53	7.85	17.48	795.08	Electricity	547.69	Electricity	244.06	198.59	n/a	412.64652	284.25111	126.66714	103.06821	n/a	926.63298	185.25364	127.61177	56.86598	46.27147	n/a	416.00286
MF-2 Bed	97.32	5.47	12.18	920.57	Electricity	694.41	Electricity	396.63	272.49	n/a	477.77583	360.39879	205.85097	141.42231	n/a	1185.4479	214.49281	161.79753	92.41479	63.49017	n/a	532.1953
MF-3/4 Bed	169	4.58	10.20	1484.62	Electricity	745.64	Electricity	569.73	521.89	n/a	770.51778	386.98716	295.68987	270.86091	n/a	1724.0557	345.91646	173.73412	132.74709	121.60037	n/a	773.99804
TF-1 Bed	59.88	10.77	24.00	1663.84	Electricity	572.13	Electricity	333.16	199.44	n/a	863.53296	296.93547	172.91004	103.50936	n/a	1436.8878	387.67472	133.30629	77.62628	46.46952	n/a	645.07681
TF-2 Bed	118	6.20	13.81	1560.52	Electricity	711.79	Electricity	573.57	293.68	n/a	809.90988	369.41901	297.68283	152.41992	n/a	1629.4316	363.60116	165.84707	133.64181	68.42744	n/a	731.51748
TF-3/4 Bed	192.4	4.73	10.55	2073.27	Electricity	749.47	Electricity	621.47	465.35	n/a	1076.0271	388.97493	322.54293	241.51665	n/a	2029.0616	483.07191	174.62651	144.80251	108.42655	n/a	910.92748
Gatehouse	156.86	6.07	13.53	2217.05	Electricity	743.55	Electricity	571.83	555.48	n/a	1150.649	385.90245	296.77977	288.29412	n/a	2121.6253	516.57265	173.24715	133.23639	129.42684	n/a	952.48303
Triplex	267.62	5.19	11.57	3475.1	Electricity	786	Electricity	791.38	913.72	n/a	1803.5769	407.934	410.72622	474.22068	n/a	3096.4578	809.6983	183.138	184.39154	212.89676	n/a	1390.1246

Table 1. CARBON (CO_2) FACTORS		
Fuel type	Fuel Carbon Factor (kgCO2/kWh)	
	SAP 2012	SAP 10
Natural Gas	0.216	0.210
Grid Electricity	0.519	0.233

TEP 1 - BASELINE EXISTING BUILDING (DER) CALCULATION				REGULATED ENERGY CONSUMPTION PER UNIT (kWh.p.a)							SAP 2012 CO2 PERFORMANCE (Regulated CO2 Emissions)						SAP 10 CO2 PERFORMANCE (Regulated CO2 Emissions)					
Unit	Area (m²)	SAP 10 TER	SAP 2012 TER	Space Heating	Fuel Type	Domestic Hot Water	Fuel Type	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	Total	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	Total
Flat 1	178	40.65	43.80	29114.86	Natural Gas	3936.65	Natural Gas	1110.63	156	n/a	6288.81	850.3164	576.417	80.964	n/a	7796.507	6114.121	826.6965	258.7768	36.348	n/a	7235.942
Flat 2	227.6	37.97	40.88	35539.75	Natural Gas	3964.51	Natural Gas	1367.31	120	n/a	7676.586	856.3342	709.6339	62.28	n/a	9304.834	7463.348	832.5471	318.5832	27.96	n/a	8642.438
Flat 7	250.9	43.26	45.88	46342.08	Natural Gas	3975.01	Natural Gas	1116.56	120	n/a	10009.89	858.6022	579.4946	62.28	n/a	11510.27	9731.837	834.7521	260.1585	27.96	n/a	10854.71
Flat 16	270	33.91	36.23	38153.36	Natural Gas	3992.99	Natural Gas	1187.24	120	n/a	8241.126	862.4858	616.1776	62.28	n/a	9782.069	8012.206	838.5279	276.6269	27.96	n/a	9155.32
Flat 24	229	42.99	45.82	41470.89	Natural Gas	3961.7	Natural Gas	1186.84	120	n/a	8957.712	855.7272	615.97	62.28	n/a	10491.69	8708.887	831.957	276.5337	27.96	n/a	9845.338

STEP 2 - BE-LEAN DER CALCULATIONS				REGULATED ENERGY CONSUMPTION PER UNIT (kWh.p.a)							SAP 2012 CO2 PERFORMANCE (Regulated CO2 Emissions)						SAP 10 CO2 PERFORMANCE (Regulated CO2 Emissions)					
Unit	Area (m²)	SAP 10 DER	SAP 2012 DER	Space Heating	Fuel Type	Domestic Hot Water	Fuel Type	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	Total	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	Total
Flat 1	178	23.83	25.59	16508.52	Natural Gas	2933.6	Natural Gas	653.31	30	n/a	3565.84	633.6576	339.0679	15.57	n/a	4554.136	3466.789	616.056	152.2212	6.99	n/a	4242.056
Flat 2	227.6	22.99	24.67	21038.67	Natural Gas	2955.25	Natural Gas	804.3	30	n/a	4544.353	638.334	417.4317	15.57	n/a	5615.688	4418.121	620.6025	187.4019	6.99	n/a	5233.115
Flat 7	250.9	25.63	27.13	26900.06	Natural Gas	2964.49	Natural Gas	656.8	30	n/a	5810.413	640.3298	340.8792	15.57	n/a	6807.192	5649.013	622.5429	153.0344	6.99	n/a	6431.58
Flat 16	270	20.52	21.86	22600.8	Natural Gas	2978.39	Natural Gas	698.38	30	n/a	4881.773	643.3322	362.4592	15.57	n/a	5903.134	4746.168	625.4619	162.7225	6.99	n/a	5541.342
Flat 24	229	22.46	23.99	20730.78	Natural Gas	2956.83	Natural Gas	698.14	30	n/a	4477.848	638.6753	362.3347	15.57	n/a	5494.428	4353.464	620.9343	162.6666	6.99	n/a	5144.055

STEP 3 - BE-GREEN DER CALCULATIONS				REGULATED ENERGY CONSUMPTION PER UNIT (kWh.p.a)							SAP 2012 CO2 PERFORMANCE (Regulated CO2 Emissions)						SAP 10 CO2 PERFORMANCE (Regulated CO2 Emissions)					
Unit	Area (m²)	SAP 10 DER	SAP 2012 DER	Space Heating	Fuel Type	Domestic Hot Water	Fuel Type	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	Total	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	Total
Flat 1	178	7.16	15.96	4017.36	Electricity	802.14	Electricity	653.31	0	n/a	2085.01	416.3107	339.0679	0	n/a	2840.388	936.0449	186.8986	152.2212	0	n/a	1275.165
Flat 2	227.6	6.95	15.48	5176.11	Electricity	810.18	Electricity	804.3	0	n/a	2686.401	420.4834	417.4317	0	n/a	3524.316	1206.034	188.7719	187.4019	0	n/a	1582.207
Flat 7	250.9	8.46	18.85	7643.37	Electricity	813.95	Electricity	656.8	0	n/a	3966.909	422.4401	340.8792	0	n/a	4730.228	1780.905	189.6504	153.0344	0	n/a	2123.59
Flat 16	270	6.18	13.78	5651.03	Electricity	817.04	Electricity	698.38	0	n/a	2932.885	424.0438	362.4592	0	n/a	3719.388	1316.69	190.3703	162.7225	0	n/a	1669.783
Flat 24	229	6.74	15.02	5117.22	Electricity	810.4	Electricity	698.14	0	n/a	2655.837	420.5976	362.3347	0	n/a	3438.769	1192.312	188.8232	162.6666	0	n/a	1543.802

APPENDIX III – SAP SUMMARY SHEETS (NEW-BUILD & REFURB)

Block Compliance WorkSheet: Be-Lean (New Build)

User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP

Software Version: Version: 1.0.4.23

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
Flat 3 - 2B4P - GF (Be Lean)	15.79	15.81	53.4	53.7	140.3
Flat 8 - 4B8P - GF (Be Lean)	15.03	14.83	56.4	58	220
Flat 10 - 1B2P - MF (Be Lean)	16.11	17.53	38.3	38.4	53
Flat 23 - 2B4P - MF (Be Lean)	13.62	14.51	37.5	39	97.32
Flat 15 - 3B6P - MF (Be Lean)	10.62	12.06	34.2	38	169
Flat 33 - 1B2P -TF (Be Lean)	21.33	21.08	58.4	56.8	59.88
Flat 32 - 2B4P - TF (Be Lean)	15.57	15.64	46.6	45.3	118
Flat 31 - 3B6P - TF (Be Lean)	14.87	14.62	54	53.6	192.4
Gate House (Be Lean)	19.83	19.01	71.5	72.3	156.86
Triplex (Be Lean)	14.44	14.66	55.6	57.8	267.62

Calculation Summary

Total Floor Area	1474.38
Average TER	15.39
Average DER	15.22
Average DFEE	52.12
Average TFEE	53.19
Compliance % Improvement DER|TER % Improvement DFEE|TFEE	Pass 1.1 2.01

Block Compliance WorkSheet: Be-Green (New Build)

User Details

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP
Software Version: Version: 1.0.4.23

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
Flat 3 - 2B4P - GF (Be Green)	11.69	23.32	53.4	53.7	140.3
Flat 8 - 4B8P - GF (Be Green)	9.91	22.1	56.4	58	220
Flat 10 - 1B2P - MF (Be Green)	17.48	25.45	38.3	38.4	53
Flat 23 - 2B4P - MF (Be Green)	12.18	21.11	37.5	39	97.32
Flat 15 - 3B6P - MF (Be Green)	10.2	17.62	34.2	38	169
Flat 33 - 1B2P -TF (Be Green)	24	30.73	58.4	56.8	59.88
Flat 32 - 2B4P - TF (Be Green)	13.81	22.67	46.6	45.3	118
Flat 31 - 3B6P - TF (Be Green)	10.55	21.64	54	53.6	192.4
Gate House (Be Green)	13.53	28.3	71.5	72.3	156.86
Triplex (Be Green)	11.57	21.8	55.6	57.8	267.62

Calculation Summary

Total Floor Area	1474.38
Average TER	22.70
Average DER	12.19
Average DFEE	52.12
Average TFEE	53.19
Compliance % Improvement DER|TER % Improvement DFEE|TFEE	Pass 46.3 2.01

Block Compliance WorkSheet: Existing Building Baseline

User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP

Software Version: Version: 1.0.4.23

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
Flat 1 - Existing - 3B6P - GF	43.8	15.92	114.7	57.9	178
Flat 2 - Existing - 4B8P - GF	40.88	15.86	114.5	61.1	227.6
Flat 7 - Existing - 3B6P - MF	45.88	17.12	133.8	73.2	250.9
Flat 16 - Existing - 3B4P - MF	36.23	13.68	103.8	55.2	270
Flat 24 Existing - 3B4P - TF	45.82	15.24	131.3	59.9	229

Calculation Summary

Total Floor Area	1155.50
Average TER	15.51
Average DER	42.31
Average DFEE	119.55
Average TFEE	61.62
Compliance	Fail
% Improvement DER|TER	N/A
% Improvement DFEE|TFEE	N/A

Block Compliance WorkSheet: Be-Lean (Refurb)

User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP

Software Version: Version: 1.0.4.23

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
Flat 1 - Existing Be Lean - 3B6P - GF	25.59	15.99	96.4	57.9	178
Flat 2 - Existing Be Lean - 4B8P - GF	24.67	15.91	94.1	61.1	227.6
Flat 7 - Existing Be Lean- 3B6P - MF	27.13	17.18	112.5	73.2	250.9
Flat 16 - Existing Be Lean - 3B4P - MF	21.86	13.73	86.9	55.2	270
Flat 24Existing Be Lean - 3B4P - TF	23.99	15.3	93.8	59.9	229

Calculation Summary

Total Floor Area	1155.50
Average TER	15.57
Average DER	24.55
Average DFEE	96.71
Average TFEE	61.62
Compliance % Improvement DER|TER % Improvement DFEE|TFEE	Fail N/A N/A

Block Compliance WorkSheet: Be-Green (Refurb)

User Details

Assessor Name:
Software Name: Stroma FSAP

Stroma Number:
Software Version: Version: 1.0.4.23

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
Flat 1 - Existing Be-Green - 3B6P - GF	15.96	23.64	96.4	57.9	178
Flat 2 - Existing Be-Green - 4B8P - GF	15.48	23.57	94.1	61.1	227.6
Flat 7 - Existing Be-Green - 3B6P - MF	18.85	25.79	112.5	73.2	250.9
Flat 16 - Existing Be-Green - 3B4P - MF	13.78	20.47	86.9	55.2	270
Flat 24 Existing Be-Green - 3B4P - TF	15.02	22.76	93.8	59.9	229

Calculation Summary

Total Floor Area	1155.50
Average TER	23.18
Average DER	15.80
Average DFEE	96.71
Average TFEE	61.62
Compliance	Fail
% Improvement DER|TER	N/A
% Improvement DFEE|TFEE	N/A

APPENDIX IV – GROUND SOURCE HEAT PUMP DATA

Kensa Evo Heat Pump Series

Features & Benefits

- Available in 7kW, 9kW, 13kW,15kW and 17kW
- 15% gain in efficiency*
- Increases RHI income*
- ERP A++ rated series
- Increased SCOP performance*
- 60°C domestic hot water
- Significantly reduced noise outputs*
- Custom built control panel
- Designed for easy installation

Product Description

The ERP A++ rated Evo series delivers heating and hot water efficiencies of SCOPs up to 4.7 at 35°C along with significantly reduced noise outputs, packaged in a contemporary contoured gunmetal and gloss-white finish, punctuated by a custom built control panel unique to the Kensa series.

Performance: Each model in the Kensa Evo series has optimised sized stainless steel heat exchangers, which allows the compressor to respond more efficiently, increasing SCOP performance and delivering up to 60°C domestic hot water.

Appearance: The ergonomic steel casing has been designed with a focus on ease of access, whilst providing sturdy yet stylish protection from ageing and wear and tear.

Installation: The Evo has been designed to be easy to handle and install. With cross head screws in its unique bevelled front panel, the Evo's electrical component and wiring terminals are easily accessible.

The heat pump has four rear water connections, two for the ground collectors and two for the property's heating distribution system. The connections consist of four 28mm straight brass fittings designed with tight tolerances, ensuring compatibility with easy to install push fittings.

The external side panels feature a curved cut-out offering the installer an extra level of flexibility to install the Evo according to the demands of the site, with vertical and horizontal pipework exit points from the sides and top of the unit.

Controls: Kensa has developed its own control board which is the brain of the new Evo heat pump. The customer interface is an intuitive touch screen that facilitates commissioning and parameter settings, and provides live status readings supported by LED light indicators.

The custom built software also permits the control board to pre-empt system irregularities using warning safety levels, which may previously have resulted in a fault if left unchecked. This pro-active system will ultimately reduce costs and call outs and enable better diagnostics and system resolution, aided by Kensa's technical support and UK wide installation network.

* against equivalent Kensa compact units

Single Phase					
Nominal thermal kW rating	**7**	**9**	**13**	**17**	**15**
Part No.	K070-S1H	K090-S1H	K130-S1H	K170-S1H	K150-S3H
MCS Approved	BBA0055/41	BBA0055/42	BBA0055/43	BBA0055/44	BBA0055/39
Performance data—rated heating output at B0/W35 BS EN14511					
Power consumption	1.7	2.16	3.2	4.6	3.8
Coefficient of performance*	4.42	4.35	4.13	3.81	4.18
Immersion heater output	Kensa heat pumps do not feature back-up electric immersion heaters**				
Brine (primary) based on 0°C in, -4°C out					
Design flow rate kg/min	29.1	28.4	39.2	50.6	42.8
Pressure drop kPa at design flow rate	12	11	17	29.2	20.6
Max inlet temperature °C	15				
Min temperature °C (Outlet)	-5 (at standard settings)				
Heating water (secondary) based on 30°C in, 35°C out					
Design flow rate l/min	22.4	28.5	37.9	51.3	45.9
Pressure drop kPa at design flow rate	4	5.7	10.1	28.3	13.6
Max flow temperature °C***	62			55	63
Electrical Values @B0/W35					
Rated Voltage	220 – 240 V / 50-60 Hz				380-420V / 50-60 Hz
Power supply rating amps	25	25	40	50	16
Rated current (max) amps	17.4	21.8	32.7	37	12
Typical running current @ B0/W35 amps	8.8	12.7	16.4	22	7.3
Starting current amps****	18.2	28.7	41.3	45	74

Single Phase					
Nominal thermal kW rating	**7**	**9**	**13**	**17**	**15**
Refrigerant circuit					
Process medium	R407C				
Fill volume kg	1.9	1.9	2	2.1	2
Compressor type	Scroll				
Dimensions					
H x W x L (mm)	1145 x 600 x 575				
Dry weight kg (Approx)	153	154	167	167	170
Operating pressure					
Brine circuit min (primary) bar g	Settable at commissioning				
Heating water circuit min (secondary) bar g	Settable at commissioning				
Low pressure reset bar g	Settable at commissioning				
Connection sizes					
Primary IN and OUT (brass stubs) mm	28				
Heating flow and return (brass stubs) mm	28				
Performance (based on Average Climate) at 35°C					
ErP rating	A++	A++	A++	A++	A++
SCOP	4.72	4.64	4.40	4.06	4.47
Seasonal space heating energy efficiency	180%	178%	168%	155%	171%
Performance (based on Average Climate) at 55°C					
ErP rating	A++	A++	A++	A+	A++
SCOP	3.67	3.62	3.48	3.16	3.58
Seasonal space heating energy efficiency	139%	137%	131%	118%	135%
Sound Power Level					
Sound Power Level (dB)	49.4	56.1	49.7	56.2	49.2

* The COP figure quoted is calculated as per EN14511.
** In-built immersion heaters will increase running costs and CO_2 emissions as they use direct electricity, because of this Kensa heat pumps do not include them.
*** By increasing the flow temperature from the heat pump the efficiency of the unit will drop and the COP decreases.
**** Kensa Evo heat pumps incorporate smart starts as standard to limit the starting current of the compressors. For full details on how the starting currents are calculated please contact Kensa.
Note: Design flowrates are for a ground temperature of 0 and –4°C and a load temperature of 30°C and 35°C

The 17kW is sold complete with a hot water cylinder immersion control box to ensure a higher than 60C DHW temperature

Shoebox Heat Pumps

Features and Benefits

- Quiet operation
- Low running costs
- Low carbon emissions
- Ease of installation inside a dwelling
- Available in 3kW and 6kW
- Single phase
- UK manufactured
- Access to industry grants

Product Description

The Kensa Shoebox range of heat pumps are designed to provide space heating and domestic hot water (optional extra) for well insulated buildings with multiple accommodation. By using a communal ground array this avoids the high heat losses associated with running high temperature pipe throughout buildings improving the overall efficiency of the system.

The Shoebox heat pump is designed specifically to operate with low noise levels enabling easy installation in places such as an apartment's kitchen.

The unit has been specifically designed to provide a renewable alternative for heating multiple apartment blocks. When combined with a District Vertical Array (D-VA) communal ground array, Shoebox units are eligible for the Renewable Heat Incentive (RHI) commercial tariff.

The Shoebox heat pump is available in two sizes; a 3kW version and 6kW version. Both units come complete with the ground side water pump internal to the unit reducing the complexity of installation.

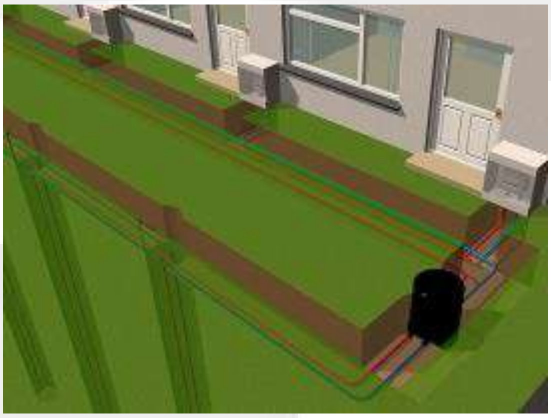
Kensa Shoebox heat pumps use low grade renewable energy from a communal borehole field and each individual apartment's heat pump concentrates this to a higher temperature to provide heat into the apartment's heating system.

As a UK manufacturer, Kensa offers a high quality product which is supported by leading industry technical support to ensure the application engineering is performed to the highest standard.

Shoebox Heat Pumps

	Single Phase	
Nominal thermal kW rating	**3.0**	**6.0**
Part No	S3-P0K	S6-P0K
MCS Approved	BBA0055/31	BBA0055/35
Performance data—rated heating output at B0/W35 BS EN14511		
Power consumption	0.8kW	1.6kW
Coefficient of performance*	4.05	3.84
Immersion heater output	Kensa heat pumps do not feature back-up electric immersion heaters**	
Brine (primary) based on 0°C in, -4°C out		
Design flow rate kg/min	9.2	18.4
Pressure drop kPa at design flow rate	5	16
Max inlet temperature °C	25	
Min temperature °C (Outlet)	-5 (at standard settings)	
Heating water (secondary) based on 30°C in, 35°C out		
Design flow rate l/min	8.62	16.88
Pressure drop kPa at design flow rate	1.0	0.64
Max flow temperature °C***	65 (RHI applications 64C)	65 (RHI applications 60C)
Electrical Values @B0/W35		
Rated Voltage	220 – 240 V / 50-60 Hz	
Power supply rating amps	13	25
Rated current (max) amps	7	14
Typical running current @ B0/W35 amps	4	8
Starting current amps	30	34
Acoustic Performance		
Sound Power Level	47dBA	52dBA

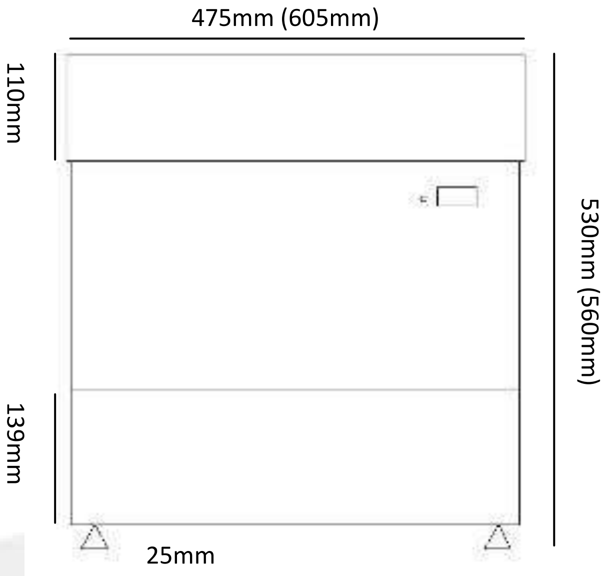
Apartment Development with a DV-A Communal ground array

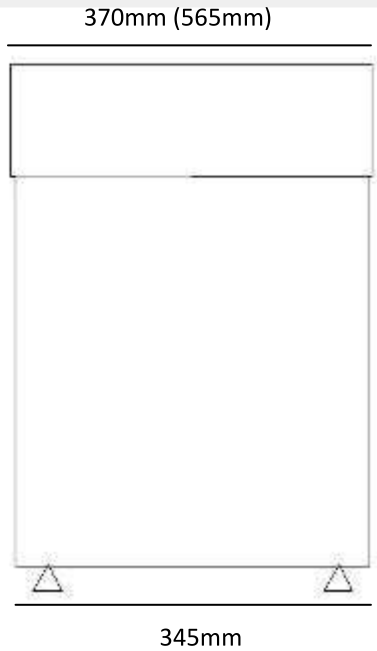


Terraced House Communal Ground Array

Shoebox Heat Pumps

	Single Phase	
Nominal thermal kW rating	**3.0**	**6.0**
Refrigerant circuit		
Process medium	R134a	
Fill volume kg	0.7	1.6
Compressor type	Reciprocal	
Dimensions		
H x W x D (mm)	530 (H) X 475 (W) X 370 (D)	560 (H) X 605(W)X 565(D)
Nominal weight kg	60	100
Operating pressure		
Brine circuit min (primary) bar g	0.3	
Heating water circuit min (secondary) bar g	0.6	
Low pressure reset bar g	1.8	
Connection sizes		
Primary IN and OUT	3/4" BSP Parallel with 22mm Adaptor valves	
Heating flow and return		
Performance (based on Average Climate) @35°C		
ErP rating	A+	A+
SCOP	3.68	3.45
Seasonal space heating energy efficiency	139%	130%
Performance (based on Average Climate) @55°C		
ErP rating	A+	A+
SCOP	2.99	2.97
Seasonal space heating energy efficiency	112%	111%





Dimensions in brackets are for the twin compressor 6kW version.

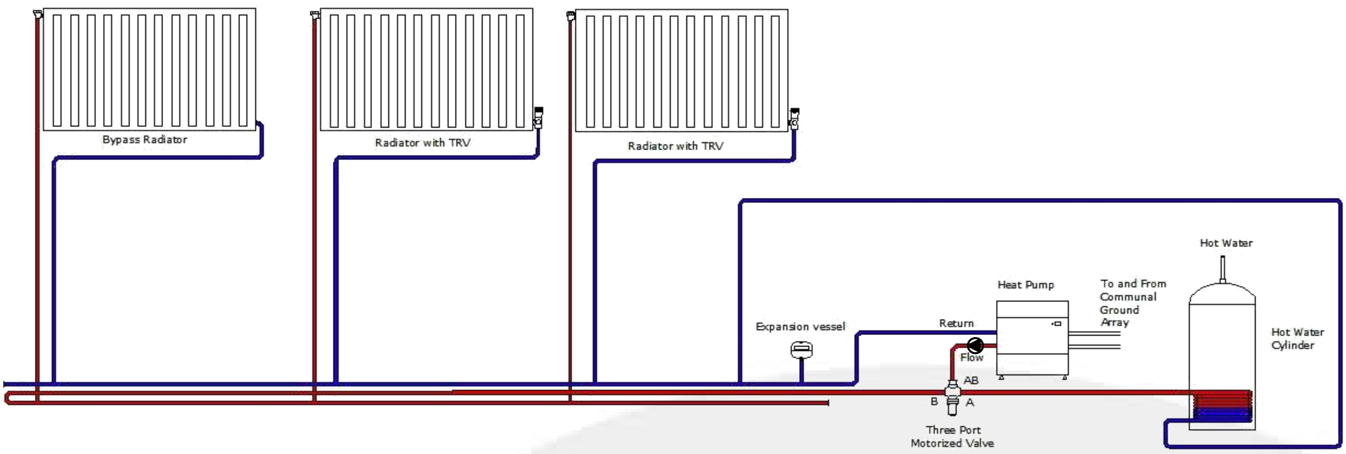
* The COP figure quoted is calculated as per EN14511

** In-built immersion heaters will increase running costs and CO2 emissions as they use direct electricity, because of this Kensa heat pumps do not include them.

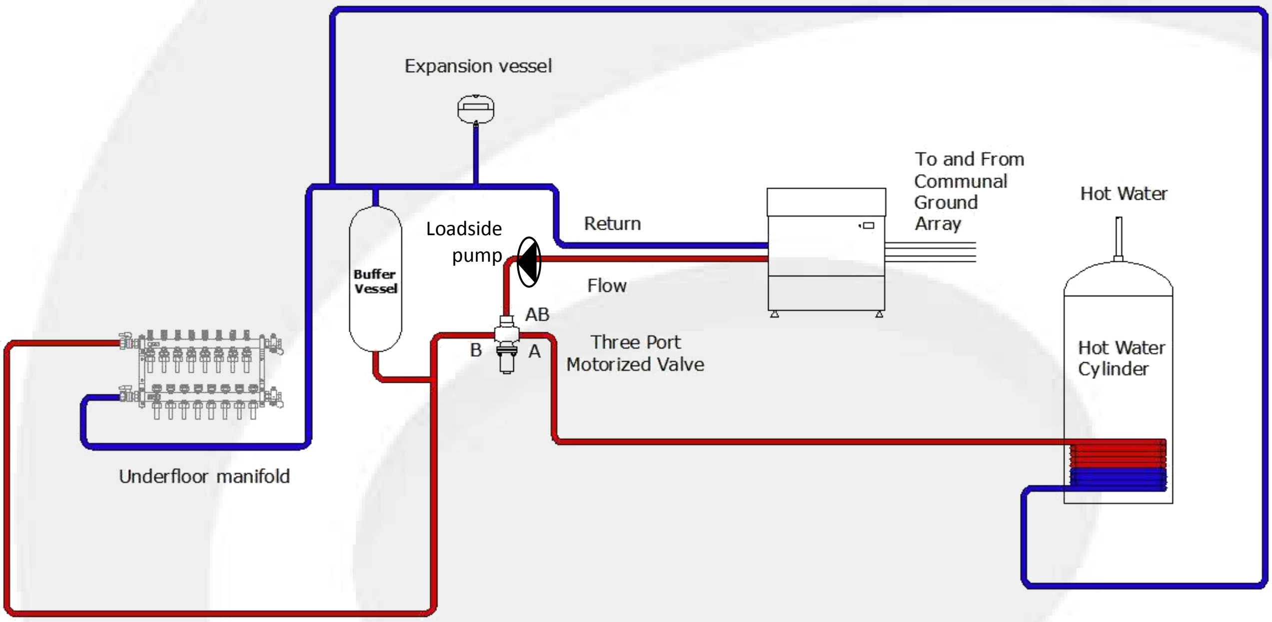
*** By increasing the flow temperature from the heat pump the efficiency of the unit will drop and the COP decreases.

Note: Design flowrates are for a ground temperature of 0 and –4°C and a load temperature of 30 and 35°C

Shoebox Heat Pumps



Shoebox Installation Schematic—Radiators



Shoebox Installation Schematic—Underfloor

Single Coil Domestic Hot Water Cylinder

Features and Benefits

- Designed for heat pump applications
- Large coil to improve heat transfer
- Ease of installation
- Manufactured from Duplex stainless steel
- UK manufactured
- 25 year guarantee for the shell

Product Description

Kensa has partnered with a leading cylinder manufacturer (Advance Appliances) to design and produce an indirect hot water cylinder designed for use with heat pumps.

The cylinder has a coil specifically designed with a larger surface area to provide a better heat transfer from the heat pump into the cylinder. This improves the actual temperature reached by the domestic hot water and the time taken to reach this temperature.

The vessels are manufactured from corrosion resistant Duplex stainless steel which enables an industry leading 25 year guarantee for the shell of the cylinder.

Tanks installed on private water supplies are sold without a warranty.

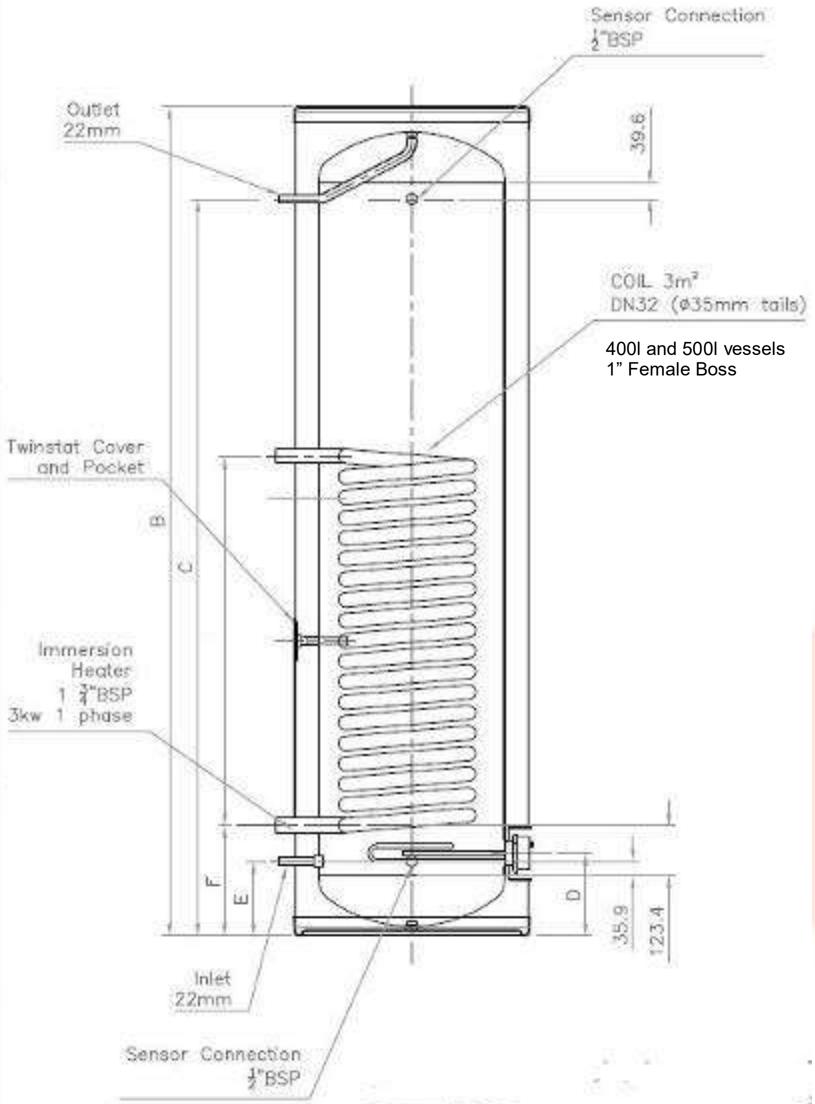
The cylinder is designed using the heat pump as the sole heat source and will provide at least 50°C domestic hot water from the cylinder.

The units meet current Building Regulations, are manufactured in the UK and guaranteed for 25 years (components 2 years).

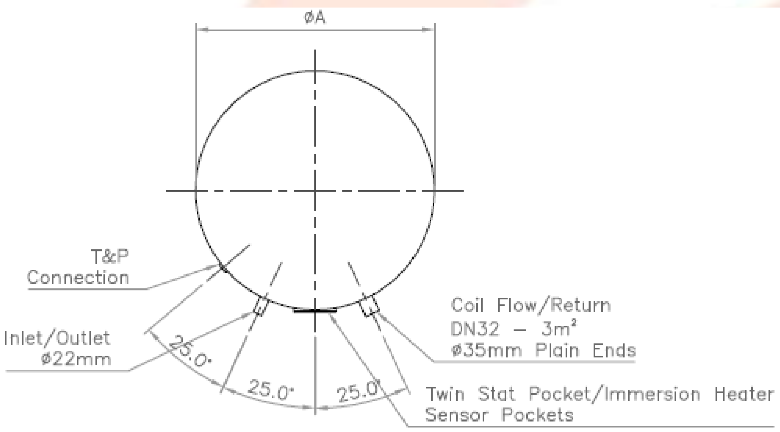
Also supplied: One 3kW immersion heater and G3 kit.

Single Coil Domestic Hot Water Cylinder (DN32 Coil)

Kensa Model No.	95-069A	95-070A	95-071A	95-072A
Volume (l)	255	305	400	500
Expansion Vessel capacity (l)	24	24	50	50
Heat Loss kWh/24hrs@55°C	1.49	1.63	2.25	2.38
ErP Rating	C	C	C	C



Material	Duplex Stainless Steel
Operating Pressure Tank and Coils	3 Bar—95°C
P & T Valve Rating	7 Bar—90°C
Pressure Reducing Valve	Max Pressure 12 Bar/ Control Pressure 3 Bar
Safety Relief Valve	6 Bar
Expansion Vessel Charge	3 Bar
Expansion Relief Valve	6 Bar
Flexible Hose for Expansion Vessel	Supplied Loose
Bracket for Expansion Vessel	Supplied Loose
Immersion Heater	13/4—240V-3kW
Tundish	1/2" x 22mm



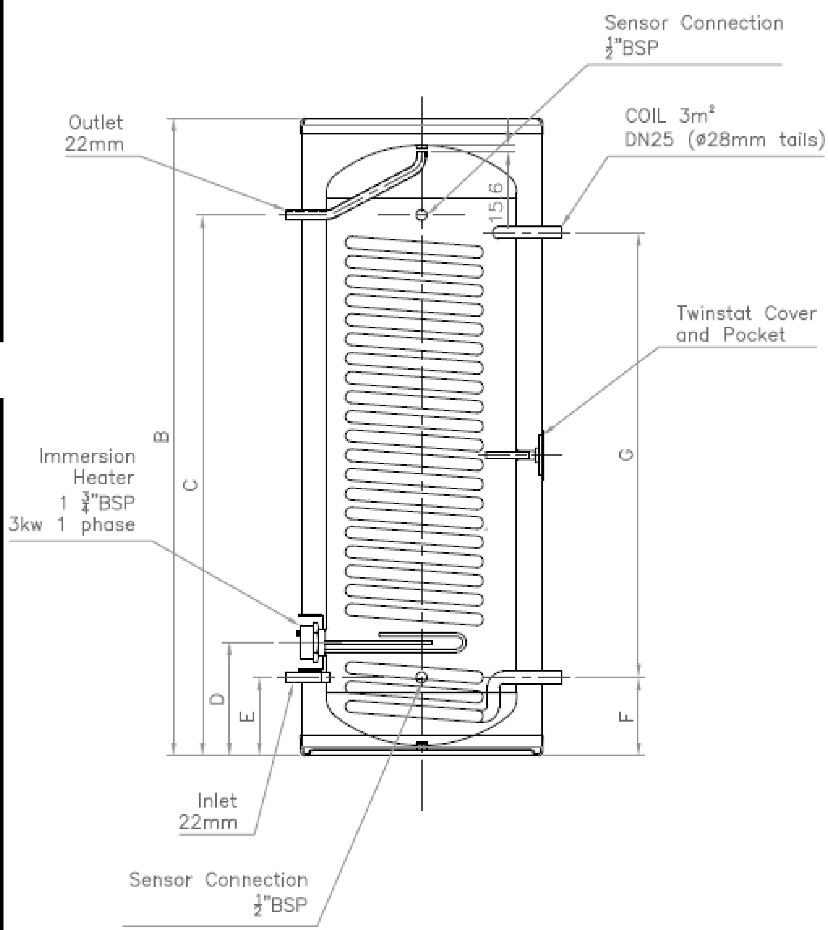
	A	B	C	D	E	F	G	Coil Size	Weight Full (kg)
255 ($3m^2$)	575	1750	1527	202	182	270	900	DN32	315
305 ($3m^2$)	575	2023	1800	202	182	270	900	DN32	365
400 ($3m^2$)	580	2190	1830	300	200	375	1080	DN32	485
500 ($3m^2$)	750	1999	1740	330	250	440	1080	DN32	605

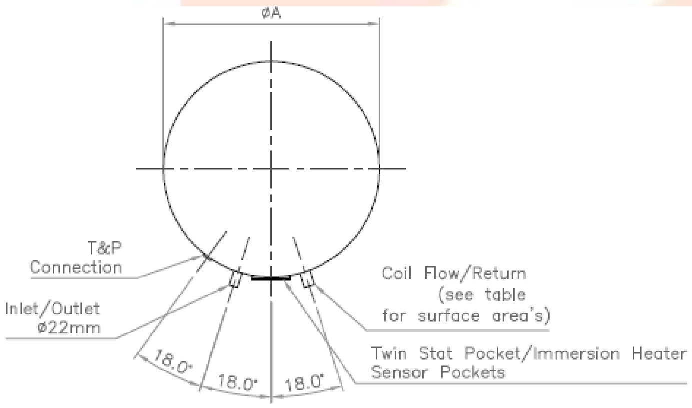
All Dimensions are nominal and in mm

Single Coil Domestic Hot Water Cylinder (DN25 Coil)

Kensa Model No.	95-060A	95-061A	95-062A	95-063A
Volume (l)	150	215	255	305
Expansion Vessel capacity (l)	12	18	24	24
Heat Loss kWh/24hrs@55°C	0.99	1.41	1.49	1.63
ErP Rating	B	C	C	C

Material	Duplex Stainless Steel
Operating Pressure Tank and Coils	3 Bar—95°C
P & T Valve Rating	7 Bar—90°C
Pressure Reducing Valve	Max Pressure 12 Bar/ Control Pressure 3 Bar
Safety Relief Valve	6 Bar
Expansion Vessel Charge	3 Bar
Expansion Relief Valve	6 Bar
Flexible Hose for Expansion Vessel	Supplied Loose
Bracket for Expansion Vessel	Supplied Loose
Immersion Heater	13/4—240V-3kW
Tundish	1/2” x 22mm





	A	B	C	D	E	F	G	Coil Size	Weight Full (kg)
150 (2m²)	575	1083	860	264	182	182	675	DN25	195
215 (3m²)	575	1485	1259	264	182	182	1035	DN25	270
255 (3m²)	575	1750	1527	202	182	272	1035	DN25	310
305 (3m²)	575	2023	1800	202	182	272	1035	DN25	370

All Dimensions are nominal and in mm

APPENDIX V – CORRESPONDENCE WITH MANUFACTURER

Sam Wallis | Envision

From: Stuart Gadsden <stuart.gadsden@kensaengineering.com>
Sent: 13 September 2019 12:38
To: Sam Wallis | Envision
Cc: Ciaran Dorrity | Envision
Subject: Re: 190325: Branch Hill House - GSHP Information

Hi Sam,

Good to hear from you and great to hear the project is back on track.

Point 1: I can confirm that when drilling closed loop boreholes, no permission is required from the EA.

Point 2: I have discussed this site with our ground array designer (who is a Certified Geoexchange Designer - one of only 5 in the UK) to get his initial thoughts on underlying geology and suitability for closed loop drilling. The expected geology is very similar to a previous project we carried out for Enfield Council (which required 96 boreholes) and so we are very confident that the ground is suitable. We expect the geology to be approximately:

Sand and gravel for approximately 20 metres
Clay and gravel for approximately a further 30 metres
Chalk with flints to depth from point onwards

At this stage, no detailed assessments are available for peak heat loss, annual heating demand and annual hot water demand. However, based on some rules of thumb we estimated peak heat loss as 157kW, annual space heating demand as 168,369 kWh/year and annual DHW demand as 72,772 kWh/year. With the expected geology, the estimated borehole requirement is 3,357 metres. From looking at site plans, it appears there would be sufficient space on site for this borehole depth.

Of course, no detailed design has been carried out at this stage and everything is subject to change. However, our initial desktop study does show that we are very confident that a shared ground loop GSHP system can be installed at this site.

Point 3: No permit will be required as per Point 1.

Point 4: All manuals etc will be provided to householders. Kensa also operate a phone line that can be contacted at any time by householders. On-going maintenance would need to be agreed with each householder for their GSHP but it is possible to enter into service agreements with M&E contractors for this (Kensa does not do this). Long-term maintenance of the ground array would also be discussed with the owner of the site and Kensa can enter into an agreement to maintain this.

In terms of the householders, there is no real difference in control and operation to a standard gas boiler system and so not expecting any undue problems with this.

Hope this helps. Let me know if you need anything else.

As an interesting aside, I'm directly speaking to some of Camden Council's asset management team about retrofitting our solution into some of their own social housing. So hopefully the planning department will be keen to support a solution that may well end up in their own buildings!

Cheers
Stuart

On Thu, 12 Sep 2019 at 11:51, Sam Wallis | Envision <swallis@envisioneco.com> wrote:

APPENDIX VI – TER WORKSHEETS (NEW-BUILD)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 3 - 2B4P - GF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	140.3	(1a) x	2.7	(2a) =	378.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	140.3	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	378.81	(5)

2. Ventilation rate:

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

DRAFT

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

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

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

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

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

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

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

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			2.85	x1/[1/(1.4)+ 0.04]		=	3.78			(27)
Windows Type 2			2.85	x1/[1/(1.4)+ 0.04]		=	3.78			(27)
Windows Type 3			8.88	x1/[1/(1.4)+ 0.04]		=	11.77			(27)
Windows Type 4			2.67	x1/[1/(1.4)+ 0.04]		=	3.54			(27)
Windows Type 5			1.78	x1/[1/(1.4)+ 0.04]		=	2.36			(27)
Floor			139.42	x	0.13	=	18.1246			(28)
Walls Type1	99.06	27.4	71.66	x	0.18	=	12.9			(29)
Walls Type2	30.1	0	30.1	x	0.18	=	5.42			(29)
Total area of elements, m²			268.59							(31)
Party wall			25.35	x	0	=	0			(32)
Party ceiling			139.42							(32b)

** 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) = 72.77 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27783.44 (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 13.43 (36)

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

Total fabric heat loss (33) + (36) = 86.2 (37)

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TER WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	73.5	73.07	72.65	70.69	70.32	68.61	68.61	68.29	69.27	70.32	71.06	71.84	(38)

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

(39)m=	159.69	159.27	158.85	156.88	156.52	154.8	154.8	154.49	155.46	156.52	157.26	158.04	

Average = $Sum(39)_{1...12}$ /12= 156.88 (39)

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

(40)m=	1.14	1.14	1.13	1.12	1.12	1.1	1.1	1.1	1.11	1.12	1.12	1.13

Average = $Sum(40)_{1...12}$ /12= 1.12 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.92 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 103.49 (43)

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

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

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

(44)m=	113.84	109.7	105.56	101.42	97.28	93.14	93.14	97.28	101.42	105.56	109.7	113.84

Total = $Sum(44)_{1...12}$ = 1241.93 (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=	168.83	147.66	152.37	132.84	127.46	109.99	101.92	116.96	118.35	137.93	150.56	163.5

Total = $Sum(45)_{1...12}$ = 1628.37 (45)

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

(46)m=	25.32	22.15	22.86	19.93	19.12	16.5	15.29	17.54	17.75	20.69	22.58	24.52	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.89 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.02 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 1.02 (55)

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

(56)m=	31.64	28.58	31.64	30.62	31.64	30.62	31.64	31.64	30.62	31.64	30.62	31.64	(56)

TER WorkSheet: New dwelling design stage

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=	31.64	28.58	31.64	30.62	31.64	30.62	31.64	31.64	30.62	31.64	30.62	31.64	(57)

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

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

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

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

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

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

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

(62)m=	223.73	197.25	207.28	185.97	182.37	163.13	156.83	171.86	171.49	192.84	203.7	218.41	(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=	223.73	197.25	207.28	185.97	182.37	163.13	156.83	171.86	171.49	192.84	203.7	218.41

Output from water heater (annual)$_{1...12}$ | 2274.85 | (64)

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

(65)m=	100.06	88.77	94.59	86.68	86.31	79.08	77.81	82.81	81.86	89.79	92.57	98.29	(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=	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	(66)

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

(67)m=	28.89	25.66	20.87	15.8	11.81	9.97	10.77	14.01	18.8	23.87	27.86	29.7	(67)

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

(68)m=	309.75	312.97	304.87	287.62	265.86	245.4	231.73	228.52	236.62	253.86	275.63	296.09	(68)

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

(69)m=	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

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

(71)m=	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	(71)

Water heating gains (Table 5)

(72)m=	134.49	132.1	127.13	120.39	116	109.83	104.59	111.31	113.7	120.68	128.57	132.11	(72)

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

(73)m=	542.9	540.5	522.64	493.57	463.44	434.97	416.86	423.6	438.88	468.18	501.82	527.66	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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Southeast	0.9x	0.54	x	8.88	x	36.79	x	0.63	x	0.7	=	70.03	(77)
Southeast	0.9x	0.54	x	1.78	x	36.79	x	0.63	x	0.7	=	14.04	(77)
Southeast	0.9x	0.54	x	8.88	x	62.67	x	0.63	x	0.7	=	119.28	(77)
Southeast	0.9x	0.54	x	1.78	x	62.67	x	0.63	x	0.7	=	23.91	(77)
Southeast	0.9x	0.54	x	8.88	x	85.75	x	0.63	x	0.7	=	163.21	(77)
Southeast	0.9x	0.54	x	1.78	x	85.75	x	0.63	x	0.7	=	32.71	(77)
Southeast	0.9x	0.54	x	8.88	x	106.25	x	0.63	x	0.7	=	202.22	(77)
Southeast	0.9x	0.54	x	1.78	x	106.25	x	0.63	x	0.7	=	40.54	(77)
Southeast	0.9x	0.54	x	8.88	x	119.01	x	0.63	x	0.7	=	226.5	(77)
Southeast	0.9x	0.54	x	1.78	x	119.01	x	0.63	x	0.7	=	45.4	(77)
Southeast	0.9x	0.54	x	8.88	x	118.15	x	0.63	x	0.7	=	224.86	(77)
Southeast	0.9x	0.54	x	1.78	x	118.15	x	0.63	x	0.7	=	45.07	(77)
Southeast	0.9x	0.54	x	8.88	x	113.91	x	0.63	x	0.7	=	216.79	(77)
Southeast	0.9x	0.54	x	1.78	x	113.91	x	0.63	x	0.7	=	43.46	(77)
Southeast	0.9x	0.54	x	8.88	x	104.39	x	0.63	x	0.7	=	198.68	(77)
Southeast	0.9x	0.54	x	1.78	x	104.39	x	0.63	x	0.7	=	39.82	(77)
Southeast	0.9x	0.54	x	8.88	x	92.85	x	0.63	x	0.7	=	176.72	(77)
Southeast	0.9x	0.54	x	1.78	x	92.85	x	0.63	x	0.7	=	35.42	(77)
Southeast	0.9x	0.54	x	8.88	x	69.27	x	0.63	x	0.7	=	131.83	(77)
Southeast	0.9x	0.54	x	1.78	x	69.27	x	0.63	x	0.7	=	26.43	(77)
Southeast	0.9x	0.54	x	8.88	x	44.07	x	0.63	x	0.7	=	83.88	(77)
Southeast	0.9x	0.54	x	1.78	x	44.07	x	0.63	x	0.7	=	16.81	(77)
Southeast	0.9x	0.54	x	8.88	x	31.49	x	0.63	x	0.7	=	59.93	(77)
Southeast	0.9x	0.54	x	1.78	x	31.49	x	0.63	x	0.7	=	12.01	(77)
South	0.9x	0.54	x	2.85	x	46.75	x	0.63	x	0.7	=	57.12	(78)
South	0.9x	0.54	x	2.85	x	46.75	x	0.63	x	0.7	=	57.12	(78)
South	0.9x	0.54	x	2.85	x	76.57	x	0.63	x	0.7	=	93.54	(78)
South	0.9x	0.54	x	2.85	x	76.57	x	0.63	x	0.7	=	93.54	(78)
South	0.9x	0.54	x	2.85	x	97.53	x	0.63	x	0.7	=	119.15	(78)
South	0.9x	0.54	x	2.85	x	97.53	x	0.63	x	0.7	=	119.15	(78)
South	0.9x	0.54	x	2.85	x	110.23	x	0.63	x	0.7	=	134.67	(78)
South	0.9x	0.54	x	2.85	x	110.23	x	0.63	x	0.7	=	134.67	(78)
South	0.9x	0.54	x	2.85	x	114.87	x	0.63	x	0.7	=	140.33	(78)
South	0.9x	0.54	x	2.85	x	114.87	x	0.63	x	0.7	=	140.33	(78)
South	0.9x	0.54	x	2.85	x	110.55	x	0.63	x	0.7	=	135.05	(78)
South	0.9x	0.54	x	2.85	x	110.55	x	0.63	x	0.7	=	135.05	(78)
South	0.9x	0.54	x	2.85	x	108.01	x	0.63	x	0.7	=	131.95	(78)
South	0.9x	0.54	x	2.85	x	108.01	x	0.63	x	0.7	=	131.95	(78)
South	0.9x	0.54	x	2.85	x	104.89	x	0.63	x	0.7	=	128.15	(78)
South	0.9x	0.54	x	2.85	x	104.89	x	0.63	x	0.7	=	128.15	(78)
South	0.9x	0.54	x	2.85	x	101.89	x	0.63	x	0.7	=	124.47	(78)

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South	0.9x	0.54	x	2.85	x	101.89	x	0.63	x	0.7	=	124.47	(78)
South	0.9x	0.54	x	2.85	x	82.59	x	0.63	x	0.7	=	100.89	(78)
South	0.9x	0.54	x	2.85	x	82.59	x	0.63	x	0.7	=	100.89	(78)
South	0.9x	0.54	x	2.85	x	55.42	x	0.63	x	0.7	=	67.7	(78)
South	0.9x	0.54	x	2.85	x	55.42	x	0.63	x	0.7	=	67.7	(78)
South	0.9x	0.54	x	2.85	x	40.4	x	0.63	x	0.7	=	49.35	(78)
South	0.9x	0.54	x	2.85	x	40.4	x	0.63	x	0.7	=	49.35	(78)
Southwest	0.9x	0.54	x	2.67	x	36.79		0.63	x	0.7	=	42.11	(79)
Southwest	0.9x	0.54	x	2.67	x	62.67		0.63	x	0.7	=	71.73	(79)
Southwest	0.9x	0.54	x	2.67	x	85.75		0.63	x	0.7	=	98.14	(79)
Southwest	0.9x	0.54	x	2.67	x	106.25		0.63	x	0.7	=	121.61	(79)
Southwest	0.9x	0.54	x	2.67	x	119.01		0.63	x	0.7	=	136.21	(79)
Southwest	0.9x	0.54	x	2.67	x	118.15		0.63	x	0.7	=	135.22	(79)
Southwest	0.9x	0.54	x	2.67	x	113.91		0.63	x	0.7	=	130.37	(79)
Southwest	0.9x	0.54	x	2.67	x	104.39		0.63	x	0.7	=	119.47	(79)
Southwest	0.9x	0.54	x	2.67	x	92.85		0.63	x	0.7	=	106.27	(79)
Southwest	0.9x	0.54	x	2.67	x	69.27		0.63	x	0.7	=	79.28	(79)
Southwest	0.9x	0.54	x	2.67	x	44.07		0.63	x	0.7	=	50.44	(79)
Southwest	0.9x	0.54	x	2.67	x	31.49		0.63	x	0.7	=	36.04	(79)

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

(83)m=	240.4	402	532.37	633.7	688.78	675.27	654.53	614.27	567.35	439.32	286.53	206.68	(83)

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

(84)m=	783.31	942.5	1055.01	1127.27	1152.22	1110.23	1071.39	1037.86	1006.22	907.49	788.35	734.34	(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	0.92	0.79	0.61	0.65	0.86	0.98	1	1	(86)

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

(87)m=	19.74	19.91	20.15	20.46	20.73	20.92	20.98	20.98	20.86	20.5	20.06	19.71	(87)

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

(88)m=	19.97	19.97	19.97	19.99	19.99	20	20	20	19.99	19.99	19.98	19.98	(88)

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

(89)m=	1	0.99	0.99	0.96	0.88	0.7	0.48	0.53	0.8	0.97	1	1	(89)

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

(90)m=	18.28	18.53	18.89	19.34	19.71	19.94	19.99	19.99	19.88	19.4	18.76	18.25	(90)

fLA = Living area ÷ (4) = 0.32 (91)

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

(92)m=	18.74	18.97	19.3	19.7	20.04	20.25	20.31	20.3	20.19	19.75	19.17	18.71	(92)

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

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(93)m=	18.74	18.97	19.3	19.7	20.04	20.25	20.31	20.3	20.19	19.75	19.17	18.71	(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	0.88	0.73	0.53	0.57	0.81	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	781.13	935.75	1036.64	1076.6	1019.42	805.46	563.39	587.72	816.95	873.79	783.25	732.86	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	2306.68	2241.38	2032.54	1693.63	1304.96	875.34	574.03	603.26	947.44	1432.75	1898.82	2293.58	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1135.01	877.38	740.95	444.26	212.44	0	0	0	0	415.87	803.21	1161.18	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5790.3 (98)

Space heating requirement in kWh/m²/year 41.27 (99)

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

Space heating:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	1135.01	877.38	740.95	444.26	212.44	0	0	0	0	415.87	803.21	1161.18		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	1213.91	938.38	792.46	475.14	227.21	0	0	0	0	444.78	859.05	1241.9		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													6192.83	(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)														
	223.73	197.25	207.28	185.97	182.37	163.13	156.83	171.86	171.49	192.84	203.7	218.41		
Efficiency of water heater													79.8	(216)
(217)m=	88.55	88.33	87.92	87.06	85.22	79.8	79.8	79.8	79.8	86.81	88.11	88.62		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	252.68	223.32	235.75	213.63	213.99	204.42	196.53	215.37	214.9	222.13	231.18	246.46		
Total = Sum(219a)$_{1...12}$ =													2670.35	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		6192.83

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Water heating fuel used			2670.35	
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			510.29	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1337.65	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	576.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1914.45	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	264.84	(268)
Total CO2, kg/year		sum of (265)…(271) =		2218.21	(272)

TER = 15.81 (273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 8 - 4B8P - GF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	220	(1a) x	2.7	(2a) =	594	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	220	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		594	(5)

2. Ventilation rate:

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

DRAFT

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.07	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.32	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(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	0.34	0.33	0.3	0.29	0.26	0.26	0.25	0.27	0.29	0.3	0.32

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	0.55	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	0.55	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	
Windows Type 1			6.74	x1/[1/(1.4)+ 0.04]	=	8.94			(27)
Windows Type 2			0.88	x1/[1/(1.4)+ 0.04]	=	1.17			(27)
Windows Type 3			0.88	x1/[1/(1.4)+ 0.04]	=	1.17			(27)
Windows Type 4			11.41	x1/[1/(1.4)+ 0.04]	=	15.13			(27)
Windows Type 5			0.88	x1/[1/(1.4)+ 0.04]	=	1.17			(27)
Windows Type 6			4.1	x1/[1/(1.4)+ 0.04]	=	5.44			(27)
Windows Type 7			1.54	x1/[1/(1.4)+ 0.04]	=	2.04			(27)
Windows Type 8			2.68	x1/[1/(1.4)+ 0.04]	=	3.55			(27)
Floor			220	x 0.13	=	28.6			(28)
Walls Type1	115.69	49.54	66.16	x 0.18	=	11.91			(29)
Walls Type2	57.78	0	57.78	x 0.18	=	10.4			(29)
Total area of elements, m²			393.47						(31)
Party wall			35.24	x 0	=	0			(32)
Party ceiling			220						(32b)

** 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) = 116.59 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 41061.02 (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 | 19.67 | (36)

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

Total fabric heat loss (33) + (36) = | 136.26 | (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=	109.6	109.15	108.71	106.64	106.25	104.45	104.45	104.11	105.14	106.25	107.04	107.86	(38)

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

(39)m=	245.86	245.41	244.97	242.9	242.51	240.71	240.71	240.37	241.4	242.51	243.3	244.12	

Average = Sum(39)$_{1…12}$ /12= | 242.9 | (39)

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

(40)m=	1.12	1.12	1.11	1.1	1.1	1.09	1.09	1.09	1.1	1.1	1.11	1.11	

Average = Sum(40)$_{1…12}$ /12= | 1.1 | (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 3.03 | (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 106.11 | (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=	116.72	112.48	108.24	103.99	99.75	95.5	95.5	99.75	103.99	108.24	112.48	116.72	

Total = Sum(44)$_{1…12}$ = | 1273.36 | (44)

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

(45)m=	173.1	151.39	156.22	136.2	130.69	112.77	104.5	119.92	121.35	141.42	154.37	167.64	

Total = Sum(45)$_{1…12}$ = | 1669.58 | (45)

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

(46)m=	25.96	22.71	23.43	20.43	19.6	16.92	15.68	17.99	18.2	21.21	23.16	25.15	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 2.13 | (48)

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

Energy lost from water storage, kWh/year (48) x (49) = | 1.15 | (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)		1.15	(55)

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

(56)m=	35.73	32.27	35.73	34.57	35.73	34.57	35.73	35.73	34.57	35.73	34.57	35.73	(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=	35.73	32.27	35.73	34.57	35.73	34.57	35.73	35.73	34.57	35.73	34.57	35.73	(57)

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

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

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

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

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

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

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

(62)m=	232.09	204.67	215.21	193.29	189.68	169.86	163.49	178.91	178.44	200.41	211.46	226.63	(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=	232.09	204.67	215.21	193.29	189.68	169.86	163.49	178.91	178.44	200.41	211.46	226.63	

Output from water heater (annual)$_{1...12}$ | 2364.13 | (64)

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

(65)m=	104.75	92.96	99.14	90.96	90.64	83.17	81.94	87.06	86.02	94.21	97	102.93	(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=	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	(66)

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

(67)m=	34.8	30.91	25.14	19.03	14.23	12.01	12.98	16.87	22.64	28.75	33.55	35.77	(67)

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

(68)m=	389.68	393.72	383.53	361.84	334.46	308.72	291.52	287.48	297.67	319.36	346.75	372.48	(68)

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

(69)m=	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	(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=	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	(71)

Water heating gains (Table 5)

(72)m=	140.79	138.34	133.25	126.33	121.83	115.51	110.13	117.02	119.47	126.63	134.72	138.35	(72)

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

(73)m=	636.69	634.39	613.34	578.62	541.94	507.66	486.05	492.79	511.2	546.16	586.44	618.02	(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)	
North	0.9x	0.77	x	6.74	x	10.63	x	0.63	x	0.7	=	21.9	(74)
North	0.9x	0.77	x	11.41	x	10.63	x	0.63	x	0.7	=	74.16	(74)
North	0.9x	0.77	x	2.68	x	10.63	x	0.63	x	0.7	=	8.71	(74)
North	0.9x	0.77	x	6.74	x	20.32	x	0.63	x	0.7	=	41.86	(74)
North	0.9x	0.77	x	11.41	x	20.32	x	0.63	x	0.7	=	141.72	(74)
North	0.9x	0.77	x	2.68	x	20.32	x	0.63	x	0.7	=	16.64	(74)
North	0.9x	0.77	x	6.74	x	34.53	x	0.63	x	0.7	=	71.13	(74)
North	0.9x	0.77	x	11.41	x	34.53	x	0.63	x	0.7	=	240.82	(74)
North	0.9x	0.77	x	2.68	x	34.53	x	0.63	x	0.7	=	28.28	(74)
North	0.9x	0.77	x	6.74	x	55.46	x	0.63	x	0.7	=	114.25	(74)
North	0.9x	0.77	x	11.41	x	55.46	x	0.63	x	0.7	=	386.81	(74)
North	0.9x	0.77	x	2.68	x	55.46	x	0.63	x	0.7	=	45.43	(74)
North	0.9x	0.77	x	6.74	x	74.72	x	0.63	x	0.7	=	153.9	(74)
North	0.9x	0.77	x	11.41	x	74.72	x	0.63	x	0.7	=	521.07	(74)
North	0.9x	0.77	x	2.68	x	74.72	x	0.63	x	0.7	=	61.2	(74)
North	0.9x	0.77	x	6.74	x	79.99	x	0.63	x	0.7	=	164.76	(74)
North	0.9x	0.77	x	11.41	x	79.99	x	0.63	x	0.7	=	557.82	(74)
North	0.9x	0.77	x	2.68	x	79.99	x	0.63	x	0.7	=	65.51	(74)
North	0.9x	0.77	x	6.74	x	74.68	x	0.63	x	0.7	=	153.82	(74)
North	0.9x	0.77	x	11.41	x	74.68	x	0.63	x	0.7	=	520.8	(74)
North	0.9x	0.77	x	2.68	x	74.68	x	0.63	x	0.7	=	61.16	(74)
North	0.9x	0.77	x	6.74	x	59.25	x	0.63	x	0.7	=	122.04	(74)
North	0.9x	0.77	x	11.41	x	59.25	x	0.63	x	0.7	=	413.19	(74)
North	0.9x	0.77	x	2.68	x	59.25	x	0.63	x	0.7	=	48.53	(74)
North	0.9x	0.77	x	6.74	x	41.52	x	0.63	x	0.7	=	85.52	(74)
North	0.9x	0.77	x	11.41	x	41.52	x	0.63	x	0.7	=	289.54	(74)
North	0.9x	0.77	x	2.68	x	41.52	x	0.63	x	0.7	=	34	(74)
North	0.9x	0.77	x	6.74	x	24.19	x	0.63	x	0.7	=	49.83	(74)
North	0.9x	0.77	x	11.41	x	24.19	x	0.63	x	0.7	=	168.7	(74)
North	0.9x	0.77	x	2.68	x	24.19	x	0.63	x	0.7	=	19.81	(74)
North	0.9x	0.77	x	6.74	x	13.12	x	0.63	x	0.7	=	27.02	(74)
North	0.9x	0.77	x	11.41	x	13.12	x	0.63	x	0.7	=	91.48	(74)
North	0.9x	0.77	x	2.68	x	13.12	x	0.63	x	0.7	=	10.74	(74)
North	0.9x	0.77	x	6.74	x	8.86	x	0.63	x	0.7	=	18.26	(74)
North	0.9x	0.77	x	11.41	x	8.86	x	0.63	x	0.7	=	61.82	(74)
North	0.9x	0.77	x	2.68	x	8.86	x	0.63	x	0.7	=	7.26	(74)
Northeast	0.9x	0.77	x	0.88	x	11.28	x	0.63	x	0.7	=	6.07	(75)
Northeast	0.9x	0.77	x	0.88	x	22.97	x	0.63	x	0.7	=	12.35	(75)
Northeast	0.9x	0.77	x	0.88	x	41.38	x	0.63	x	0.7	=	22.26	(75)

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Northeast	0.9x	0.77	x	0.88	x	67.96	x	0.63	x	0.7	=	36.55	(75)
Northeast	0.9x	0.77	x	0.88	x	91.35	x	0.63	x	0.7	=	49.13	(75)
Northeast	0.9x	0.77	x	0.88	x	97.38	x	0.63	x	0.7	=	52.38	(75)
Northeast	0.9x	0.77	x	0.88	x	91.1	x	0.63	x	0.7	=	49	(75)
Northeast	0.9x	0.77	x	0.88	x	72.63	x	0.63	x	0.7	=	39.06	(75)
Northeast	0.9x	0.77	x	0.88	x	50.42	x	0.63	x	0.7	=	27.12	(75)
Northeast	0.9x	0.77	x	0.88	x	28.07	x	0.63	x	0.7	=	15.1	(75)
Northeast	0.9x	0.77	x	0.88	x	14.2	x	0.63	x	0.7	=	7.64	(75)
Northeast	0.9x	0.77	x	0.88	x	9.21	x	0.63	x	0.7	=	4.96	(75)
South	0.9x	0.54	x	0.88	x	46.75	x	0.63	x	0.7	=	35.27	(78)
South	0.9x	0.54	x	4.1	x	46.75	x	0.63	x	0.7	=	41.08	(78)
South	0.9x	0.54	x	1.54	x	46.75	x	0.63	x	0.7	=	61.72	(78)
South	0.9x	0.54	x	0.88	x	76.57	x	0.63	x	0.7	=	57.76	(78)
South	0.9x	0.54	x	4.1	x	76.57	x	0.63	x	0.7	=	67.28	(78)
South	0.9x	0.54	x	1.54	x	76.57	x	0.63	x	0.7	=	101.09	(78)
South	0.9x	0.54	x	0.88	x	97.53	x	0.63	x	0.7	=	73.58	(78)
South	0.9x	0.54	x	4.1	x	97.53	x	0.63	x	0.7	=	85.71	(78)
South	0.9x	0.54	x	1.54	x	97.53	x	0.63	x	0.7	=	128.77	(78)
South	0.9x	0.54	x	0.88	x	110.23	x	0.63	x	0.7	=	83.16	(78)
South	0.9x	0.54	x	4.1	x	110.23	x	0.63	x	0.7	=	96.87	(78)
South	0.9x	0.54	x	1.54	x	110.23	x	0.63	x	0.7	=	145.54	(78)
South	0.9x	0.54	x	0.88	x	114.87	x	0.63	x	0.7	=	86.66	(78)
South	0.9x	0.54	x	4.1	x	114.87	x	0.63	x	0.7	=	100.94	(78)
South	0.9x	0.54	x	1.54	x	114.87	x	0.63	x	0.7	=	151.66	(78)
South	0.9x	0.54	x	0.88	x	110.55	x	0.63	x	0.7	=	83.4	(78)
South	0.9x	0.54	x	4.1	x	110.55	x	0.63	x	0.7	=	97.14	(78)
South	0.9x	0.54	x	1.54	x	110.55	x	0.63	x	0.7	=	145.95	(78)
South	0.9x	0.54	x	0.88	x	108.01	x	0.63	x	0.7	=	81.49	(78)
South	0.9x	0.54	x	4.1	x	108.01	x	0.63	x	0.7	=	94.91	(78)
South	0.9x	0.54	x	1.54	x	108.01	x	0.63	x	0.7	=	142.6	(78)
South	0.9x	0.54	x	0.88	x	104.89	x	0.63	x	0.7	=	79.14	(78)
South	0.9x	0.54	x	4.1	x	104.89	x	0.63	x	0.7	=	92.17	(78)
South	0.9x	0.54	x	1.54	x	104.89	x	0.63	x	0.7	=	138.49	(78)
South	0.9x	0.54	x	0.88	x	101.89	x	0.63	x	0.7	=	76.87	(78)
South	0.9x	0.54	x	4.1	x	101.89	x	0.63	x	0.7	=	89.53	(78)
South	0.9x	0.54	x	1.54	x	101.89	x	0.63	x	0.7	=	134.51	(78)
South	0.9x	0.54	x	0.88	x	82.59	x	0.63	x	0.7	=	62.3	(78)
South	0.9x	0.54	x	4.1	x	82.59	x	0.63	x	0.7	=	72.57	(78)
South	0.9x	0.54	x	1.54	x	82.59	x	0.63	x	0.7	=	109.03	(78)
South	0.9x	0.54	x	0.88	x	55.42	x	0.63	x	0.7	=	41.81	(78)
South	0.9x	0.54	x	4.1	x	55.42	x	0.63	x	0.7	=	48.7	(78)

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South	0.9x	0.54	x	1.54	x	55.42	x	0.63	x	0.7	=	73.16	(78)
South	0.9x	0.54	x	0.88	x	40.4	x	0.63	x	0.7	=	30.48	(78)
South	0.9x	0.54	x	4.1	x	40.4	x	0.63	x	0.7	=	35.5	(78)
South	0.9x	0.54	x	1.54	x	40.4	x	0.63	x	0.7	=	53.34	(78)
Northwest	0.9x	0.77	x	0.88	x	11.28	x	0.63	x	0.7	=	6.07	(81)
Northwest	0.9x	0.77	x	0.88	x	22.97	x	0.63	x	0.7	=	12.35	(81)
Northwest	0.9x	0.77	x	0.88	x	41.38	x	0.63	x	0.7	=	22.26	(81)
Northwest	0.9x	0.77	x	0.88	x	67.96	x	0.63	x	0.7	=	36.55	(81)
Northwest	0.9x	0.77	x	0.88	x	91.35	x	0.63	x	0.7	=	49.13	(81)
Northwest	0.9x	0.77	x	0.88	x	97.38	x	0.63	x	0.7	=	52.38	(81)
Northwest	0.9x	0.77	x	0.88	x	91.1	x	0.63	x	0.7	=	49	(81)
Northwest	0.9x	0.77	x	0.88	x	72.63	x	0.63	x	0.7	=	39.06	(81)
Northwest	0.9x	0.77	x	0.88	x	50.42	x	0.63	x	0.7	=	27.12	(81)
Northwest	0.9x	0.77	x	0.88	x	28.07	x	0.63	x	0.7	=	15.1	(81)
Northwest	0.9x	0.77	x	0.88	x	14.2	x	0.63	x	0.7	=	7.64	(81)
Northwest	0.9x	0.77	x	0.88	x	9.21	x	0.63	x	0.7	=	4.96	(81)

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

(83)m=	254.99	451.06	672.8	945.16	1173.7	1219.35	1152.79	971.68	764.21	512.44	308.19	216.57	(83)

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

(84)m=	891.67	1085.45	1286.13	1523.78	1715.63	1727	1638.85	1464.47	1275.41	1058.6	894.63	834.59	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.98	0.93	0.79	0.62	0.7	0.93	0.99	1	1	(86)

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

(87)m=	19.62	19.77	20.02	20.38	20.72	20.92	20.98	20.97	20.79	20.37	19.93	19.6	(87)

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

(88)m=	19.99	19.99	19.99	20	20	20.01	20.01	20.01	20	20	20	19.99	(88)

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

(89)m=	1	1	1	0.98	0.9	0.7	0.49	0.58	0.88	0.99	1	1	(89)

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

(90)m=	18.12	18.34	18.72	19.24	19.7	19.95	20	19.99	19.81	19.22	18.58	18.09	(90)

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

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

(92)m=	18.34	18.55	18.91	19.41	19.85	20.09	20.14	20.14	19.96	19.39	18.78	18.31	(92)

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

(93)m=	18.34	18.55	18.91	19.41	19.85	20.09	20.14	20.14	19.96	19.39	18.78	18.31	(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	1	0.99	0.97	0.89	0.71	0.51	0.59	0.88	0.99	1	1	(94)

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

(95)m=	891.05	1083.24	1277.31	1479.8	1530.08	1227.94	839.6	870.09	1121.45	1044.44	893.1	834.17	(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=	3452.95	3350.58	3040.13	2552.02	1976.89	1322.6	853.29	898.28	1414.39	2132.28	2842.21	3445.44	(97)

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

(98)m=	1906.05	1523.65	1311.54	772	332.43	0	0	0	0	809.36	1403.36	1942.78

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 10001.17 (98)

Space heating requirement in kWh/m²/year 45.46 (99)

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

Space heating:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	1906.05	1523.65	1311.54	772	332.43	0	0	0	0	809.36	1403.36	1942.78	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	2038.56	1629.58	1402.72	825.67	355.54	0	0	0	0	865.62	1500.92	2077.84	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 10696.44 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)

232.09	204.67	215.21	193.29	189.68	169.86	163.49	178.91	178.44	200.41	211.46	226.63

Efficiency of water heater 79.8 (216)

(217)m=	89.2	89.09	88.82	88.13	86.3	79.8	79.8	79.8	79.8	88.15	88.94	89.25	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	260.18	229.75	242.3	219.31	219.8	212.86	204.88	224.19	223.6	227.34	237.76	253.92

Total = Sum(219a)$_{1...12}$ = 2755.89 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		10696.44
Water heating fuel used		2755.89
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		614.62	(232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	2310.43	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	595.27	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2905.7	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	318.99	(268)
Total CO2, kg/year			sum of (265)…(271) =		3263.62	(272)

TER = 14.83 (273)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 10 - 1B2P - MF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53	(1a) x	2.7	(2a) =	143.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	143.1	(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) =	0.14	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

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

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

Infiltration rate modified for monthly wind speed

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

0.42	0.41	0.41	0.36	0.36	0.31	0.31	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55	0.56	0.57	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	
Windows Type 1			1.39	x1/[1/(1.4)+ 0.04]		=	1.84			(27)
Windows Type 2			1.39	x1/[1/(1.4)+ 0.04]		=	1.84			(27)
Windows Type 3			5.52	x1/[1/(1.4)+ 0.04]		=	7.32			(27)
Windows Type 4			2.79	x1/[1/(1.4)+ 0.04]		=	3.7			(27)
Windows Type 5			2.16	x1/[1/(1.4)+ 0.04]		=	2.86			(27)
Walls Type1	47.55	13.25	34.3	x	0.18	=	6.17			(29)
Walls Type2	3.78	0	3.78	x	0.18	=	0.68			(29)
Total area of elements, m²			51.33							(31)
Party wall			39.56	x	0	=	0			(32)
Party floor			53.93							(32a)
Party ceiling			53.93							(32b)

** 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) = 24.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8220.47 (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 2.57 (36)

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

Total fabric heat loss (33) + (36) = 26.99 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.82	27.66	27.5	26.75	26.61	25.95	25.95	25.83	26.2	26.61	26.89	27.19	(38)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(39)m=	54.81	54.65	54.49	53.73	53.59	52.94	52.94	52.82	53.19	53.59	53.88	54.18

Average = Sum(39)$_{1\ldots12}$ /12= 53.73 (39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(40)m=	1.03	1.03	1.03	1.01	1.01	1	1	1	1	1.01	1.02	1.02

Average = Sum(40)$_{1\ldots12}$ /12= 1.01 (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 1.78 (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 76.44 (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=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08

Total = Sum(44)$_{1\ldots12}$ = 917.29 (44)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76

Total = Sum(45)$_{1\ldots12}$ = 1202.71 (45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.75 (55)

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

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

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

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

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

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

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

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

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

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

(62)m=	171.29	151.15	159.13	143.21	140.74	126.33	121.87	132.98	132.51	148.47	156.3	167.36	(62)

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

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

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

Output from water heater

(64)m=	171.29	151.15	159.13	143.21	140.74	126.33	121.87	132.98	132.51	148.47	156.3	167.36

Output from water heater (annual)$_{1...12}$ — 1751.33 (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=	78.74	69.93	74.7	68.7	68.58	63.09	62.31	66	65.14	71.15	73.05	77.43	(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=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

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

(67)m=	13.82	12.27	9.98	7.56	5.65	4.77	5.15	6.7	8.99	11.42	13.32	14.2	(67)

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

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)

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

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(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=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)

Water heating gains (Table 5)

(72)m=	105.83	104.06	100.4	95.41	92.18	87.62	83.75	88.71	90.47	95.63	101.46	104.07	(72)

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

(73)m=	327.35	325.64	315.63	299.59	283.55	267.88	257.55	262.45	270.56	286.77	305.4	319.13	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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Southeast	0.9x	0.54	x	5.52	x	36.79	x	0.63	x	0.7	=	43.53	(77)
Southeast	0.9x	0.77	x	2.16	x	36.79	x	0.63	x	0.7	=	24.29	(77)
Southeast	0.9x	0.54	x	5.52	x	62.67	x	0.63	x	0.7	=	74.15	(77)
Southeast	0.9x	0.77	x	2.16	x	62.67	x	0.63	x	0.7	=	41.37	(77)
Southeast	0.9x	0.54	x	5.52	x	85.75	x	0.63	x	0.7	=	101.45	(77)
Southeast	0.9x	0.77	x	2.16	x	85.75	x	0.63	x	0.7	=	56.61	(77)
Southeast	0.9x	0.54	x	5.52	x	106.25	x	0.63	x	0.7	=	125.7	(77)
Southeast	0.9x	0.77	x	2.16	x	106.25	x	0.63	x	0.7	=	70.14	(77)
Southeast	0.9x	0.54	x	5.52	x	119.01	x	0.63	x	0.7	=	140.8	(77)
Southeast	0.9x	0.77	x	2.16	x	119.01	x	0.63	x	0.7	=	78.56	(77)
Southeast	0.9x	0.54	x	5.52	x	118.15	x	0.63	x	0.7	=	139.78	(77)
Southeast	0.9x	0.77	x	2.16	x	118.15	x	0.63	x	0.7	=	77.99	(77)
Southeast	0.9x	0.54	x	5.52	x	113.91	x	0.63	x	0.7	=	134.76	(77)
Southeast	0.9x	0.77	x	2.16	x	113.91	x	0.63	x	0.7	=	75.19	(77)
Southeast	0.9x	0.54	x	5.52	x	104.39	x	0.63	x	0.7	=	123.5	(77)
Southeast	0.9x	0.77	x	2.16	x	104.39	x	0.63	x	0.7	=	68.91	(77)
Southeast	0.9x	0.54	x	5.52	x	92.85	x	0.63	x	0.7	=	109.85	(77)
Southeast	0.9x	0.77	x	2.16	x	92.85	x	0.63	x	0.7	=	61.29	(77)
Southeast	0.9x	0.54	x	5.52	x	69.27	x	0.63	x	0.7	=	81.95	(77)
Southeast	0.9x	0.77	x	2.16	x	69.27	x	0.63	x	0.7	=	45.73	(77)
Southeast	0.9x	0.54	x	5.52	x	44.07	x	0.63	x	0.7	=	52.14	(77)
Southeast	0.9x	0.77	x	2.16	x	44.07	x	0.63	x	0.7	=	29.09	(77)
Southeast	0.9x	0.54	x	5.52	x	31.49	x	0.63	x	0.7	=	37.25	(77)
Southeast	0.9x	0.77	x	2.16	x	31.49	x	0.63	x	0.7	=	20.79	(77)
South	0.9x	0.77	x	1.39	x	46.75	x	0.63	x	0.7	=	19.86	(78)
South	0.9x	0.77	x	1.39	x	76.57	x	0.63	x	0.7	=	32.53	(78)
South	0.9x	0.77	x	1.39	x	97.53	x	0.63	x	0.7	=	41.43	(78)
South	0.9x	0.77	x	1.39	x	110.23	x	0.63	x	0.7	=	46.83	(78)
South	0.9x	0.77	x	1.39	x	114.87	x	0.63	x	0.7	=	48.8	(78)
South	0.9x	0.77	x	1.39	x	110.55	x	0.63	x	0.7	=	46.96	(78)
South	0.9x	0.77	x	1.39	x	108.01	x	0.63	x	0.7	=	45.88	(78)
South	0.9x	0.77	x	1.39	x	104.89	x	0.63	x	0.7	=	44.56	(78)
South	0.9x	0.77	x	1.39	x	101.89	x	0.63	x	0.7	=	43.28	(78)
South	0.9x	0.77	x	1.39	x	82.59	x	0.63	x	0.7	=	35.08	(78)
South	0.9x	0.77	x	1.39	x	55.42	x	0.63	x	0.7	=	23.54	(78)
South	0.9x	0.77	x	1.39	x	40.4	x	0.63	x	0.7	=	17.16	(78)
Southwest	0.9x	0.77	x	2.79	x	36.79		0.63	x	0.7	=	31.37	(79)
Southwest	0.9x	0.77	x	2.79	x	62.67		0.63	x	0.7	=	53.44	(79)
Southwest	0.9x	0.77	x	2.79	x	85.75		0.63	x	0.7	=	73.12	(79)
Southwest	0.9x	0.77	x	2.79	x	106.25		0.63	x	0.7	=	90.6	(79)
Southwest	0.9x	0.77	x	2.79	x	119.01		0.63	x	0.7	=	101.48	(79)

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Southwest	0.9x	0.77	x	2.79	x	118.15		0.63	x	0.7	=	100.74	(79)
Southwest	0.9x	0.77	x	2.79	x	113.91		0.63	x	0.7	=	97.13	(79)
Southwest	0.9x	0.77	x	2.79	x	104.39		0.63	x	0.7	=	89.01	(79)
Southwest	0.9x	0.77	x	2.79	x	92.85		0.63	x	0.7	=	79.17	(79)
Southwest	0.9x	0.77	x	2.79	x	69.27		0.63	x	0.7	=	59.06	(79)
Southwest	0.9x	0.77	x	2.79	x	44.07		0.63	x	0.7	=	37.58	(79)
Southwest	0.9x	0.77	x	2.79	x	31.49		0.63	x	0.7	=	26.85	(79)
West	0.9x	0.77	x	1.39	x	19.64	x	0.63	x	0.7	=	8.34	(80)
West	0.9x	0.77	x	1.39	x	38.42	x	0.63	x	0.7	=	16.32	(80)
West	0.9x	0.77	x	1.39	x	63.27	x	0.63	x	0.7	=	26.88	(80)
West	0.9x	0.77	x	1.39	x	92.28	x	0.63	x	0.7	=	39.2	(80)
West	0.9x	0.77	x	1.39	x	113.09	x	0.63	x	0.7	=	48.04	(80)
West	0.9x	0.77	x	1.39	x	115.77	x	0.63	x	0.7	=	49.18	(80)
West	0.9x	0.77	x	1.39	x	110.22	x	0.63	x	0.7	=	46.82	(80)
West	0.9x	0.77	x	1.39	x	94.68	x	0.63	x	0.7	=	40.22	(80)
West	0.9x	0.77	x	1.39	x	73.59	x	0.63	x	0.7	=	31.26	(80)
West	0.9x	0.77	x	1.39	x	45.59	x	0.63	x	0.7	=	19.37	(80)
West	0.9x	0.77	x	1.39	x	24.49	x	0.63	x	0.7	=	10.4	(80)
West	0.9x	0.77	x	1.39	x	16.15	x	0.63	x	0.7	=	6.86	(80)

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

(83)m=	127.39	217.81	299.49	372.47	417.68	414.66	399.79	366.2	324.86	241.18	152.75	108.91	(83)

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

(84)m=	454.74	543.45	615.12	672.06	701.23	682.53	657.34	628.65	595.42	527.96	458.15	428.04	(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	0.97	0.93	0.83	0.68	0.49	0.35	0.39	0.6	0.87	0.97	0.99	(86)

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

(87)m=	20.16	20.36	20.61	20.84	20.96	20.99	21	21	20.98	20.82	20.45	20.12	(87)

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

(88)m=	20.48	20.48	20.49	20.49	20.49	20.5	20.5	20.5	20.5	20.49	20.49	20.49	(88)

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

(89)m=	0.99	0.97	0.92	0.81	0.65	0.45	0.31	0.34	0.56	0.85	0.97	0.99	(89)

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

(90)m=	19.69	19.89	20.13	20.35	20.46	20.5	20.5	20.5	20.49	20.35	19.99	19.66	(90)

fLA = Living area ÷ (4) = 0.85 (91)

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

(92)m=	20.08	20.29	20.53	20.76	20.88	20.92	20.92	20.92	20.91	20.75	20.38	20.05	(92)

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

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(93)m=	20.08	20.29	20.53	20.76	20.88	20.92	20.92	20.92	20.91	20.75	20.38	20.05	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.92	0.82	0.67	0.49	0.35	0.38	0.59	0.86	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	448.27	524.87	567.13	554.03	469.45	331.32	228.4	238.19	352.96	454.19	443.5	423.42	(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=	865.18	841.04	764.57	637.38	491.97	334.4	228.79	238.82	361.99	543.87	715.42	858.55	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	310.18	212.47	146.9	60.01	16.75	0	0	0	0	66.72	195.78	323.74	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1332.54 (98)

Space heating requirement in kWh/m²/year 25.14 (99)

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

Space heating:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	310.18	212.47	146.9	60.01	16.75	0	0	0	0	66.72	195.78	323.74		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	331.75	227.24	157.11	64.18	17.92	0	0	0	0	71.36	209.39	346.25		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1425.18	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	171.29	151.15	159.13	143.21	140.74	126.33	121.87	132.98	132.51	148.47	156.3	167.36		
Efficiency of water heater													79.8	(216)
(217)m=	86.38	85.72	84.6	82.69	80.82	79.8	79.8	79.8	79.8	82.84	85.42	86.55		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	198.3	176.32	188.1	173.19	174.15	158.31	152.72	166.64	166.05	179.23	182.98	193.37		
Total = Sum(219a)$_{1...12}$ =													2109.37	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1425.18

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Water heating fuel used		2109.37	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		244.06	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	307.84	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	455.62	(264)
Space and water heating	(261) + (262) + (263) + (264) =				763.46	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	126.67	(268)
Total CO2, kg/year			sum of (265)…(271) =		929.06	(272)

TER = 17.53 (273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 15 - 3B6P - MF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	169	(1a) x	2.7	(2a) =	456.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	169	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	456.3	(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) =	0.09	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.34	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

	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	
Windows Type 1			3.6	x1/[1/(1.4)+ 0.04]	=	4.77			(27)
Windows Type 2			2.4	x1/[1/(1.4)+ 0.04]	=	3.18			(27)
Windows Type 3			9.36	x1/[1/(1.4)+ 0.04]	=	12.41			(27)
Windows Type 4			2.4	x1/[1/(1.4)+ 0.04]	=	3.18			(27)
Windows Type 5			1.78	x1/[1/(1.4)+ 0.04]	=	2.36			(27)
Windows Type 6			1.05	x1/[1/(1.4)+ 0.04]	=	1.39			(27)
Windows Type 7			1.05	x1/[1/(1.4)+ 0.04]	=	1.39			(27)
Windows Type 8			3.6	x1/[1/(1.4)+ 0.04]	=	4.77			(27)
Walls Type1	86.43	27.64	58.79	x 0.18	=	10.58			(29)
Walls Type2	27.27	0	27.27	x 0.18	=	4.91			(29)
Total area of elements, m²			113.7						(31)
Party wall			52.38	x 0	=	0			(32)
Party floor			175.4						(32a)
Party ceiling			175.8						(32b)

** 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) =	52.13	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	20671.09	(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 — 5.68 (36)

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

Total fabric heat loss — (33) + (36) = 57.82 (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=	85.37	84.98	84.6	82.79	82.46	80.89	80.89	80.6	81.49	82.46	83.14	83.85	(38)

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

(39)m=	143.19	142.8	142.42	140.61	140.28	138.71	138.71	138.42	139.31	140.28	140.96	141.67	

Average = Sum(39)1…12 /12= 140.61 (39)

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

(40)m=	0.85	0.84	0.84	0.83	0.83	0.82	0.82	0.82	0.82	0.83	0.83	0.84	

Average = Sum(40)1…12 /12= 0.83 (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 — 2.96 (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 — 104.53 (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=	114.98	110.8	106.62	102.44	98.26	94.08	94.08	98.26	102.44	106.62	110.8	114.98	

Total = Sum(44)1…12 = 1254.35 (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=	170.52	149.13	153.89	134.17	128.74	111.09	102.94	118.13	119.54	139.31	152.07	165.13	

Total = Sum(45)1…12 = 1644.65 (45)

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

(46)m=	25.58	22.37	23.08	20.13	19.31	16.66	15.44	17.72	17.93	20.9	22.81	24.77	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 2.13 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 1.15 (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)		1.15	(55)

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

(56)m=	35.73	32.27	35.73	34.57	35.73	34.57	35.73	35.73	34.57	35.73	34.57	35.73	(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=	35.73	32.27	35.73	34.57	35.73	34.57	35.73	35.73	34.57	35.73	34.57	35.73	(57)

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

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

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

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

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

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

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

(62)m=	229.5	202.41	212.88	191.25	187.73	168.18	161.93	177.12	176.62	198.3	209.15	224.12	(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=	229.5	202.41	212.88	191.25	187.73	168.18	161.93	177.12	176.62	198.3	209.15	224.12	

Output from water heater (annual)$_{1…12}$ | 2339.2 | (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=	103.89	92.21	98.36	90.28	90	82.61	81.42	86.47	85.42	93.51	96.23	102.1	(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=	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	(66)

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

(67)m=	31.97	28.39	23.09	17.48	13.07	11.03	11.92	15.49	20.8	26.4	30.82	32.85	(67)

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

(68)m=	340.53	344.06	335.16	316.2	292.27	269.78	254.76	251.22	260.13	279.08	303.01	325.5	(68)

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

(69)m=	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	(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=	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	(71)

Water heating gains (Table 5)

(72)m=	139.63	137.22	132.21	125.39	120.96	114.73	109.43	116.22	118.63	125.69	133.65	137.23	(72)

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

(73)m=	582.55	580.09	560.87	529.49	496.72	465.96	446.53	453.36	469.97	501.59	537.9	566.01	(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)	
North	0.9x	0.77	x	3.6	x	10.63	x	0.63	x	0.7	=	11.7	(74)
North	0.9x	0.77	x	2.4	x	10.63	x	0.63	x	0.7	=	7.8	(74)
North	0.9x	0.77	x	3.6	x	10.63	x	0.63	x	0.7	=	11.7	(74)
North	0.9x	0.77	x	3.6	x	20.32	x	0.63	x	0.7	=	22.36	(74)
North	0.9x	0.77	x	2.4	x	20.32	x	0.63	x	0.7	=	14.9	(74)
North	0.9x	0.77	x	3.6	x	20.32	x	0.63	x	0.7	=	22.36	(74)
North	0.9x	0.77	x	3.6	x	34.53	x	0.63	x	0.7	=	37.99	(74)
North	0.9x	0.77	x	2.4	x	34.53	x	0.63	x	0.7	=	25.33	(74)
North	0.9x	0.77	x	3.6	x	34.53	x	0.63	x	0.7	=	37.99	(74)
North	0.9x	0.77	x	3.6	x	55.46	x	0.63	x	0.7	=	61.02	(74)
North	0.9x	0.77	x	2.4	x	55.46	x	0.63	x	0.7	=	40.68	(74)
North	0.9x	0.77	x	3.6	x	55.46	x	0.63	x	0.7	=	61.02	(74)
North	0.9x	0.77	x	3.6	x	74.72	x	0.63	x	0.7	=	82.2	(74)
North	0.9x	0.77	x	2.4	x	74.72	x	0.63	x	0.7	=	54.8	(74)
North	0.9x	0.77	x	3.6	x	74.72	x	0.63	x	0.7	=	82.2	(74)
North	0.9x	0.77	x	3.6	x	79.99	x	0.63	x	0.7	=	88	(74)
North	0.9x	0.77	x	2.4	x	79.99	x	0.63	x	0.7	=	58.67	(74)
North	0.9x	0.77	x	3.6	x	79.99	x	0.63	x	0.7	=	88	(74)
North	0.9x	0.77	x	3.6	x	74.68	x	0.63	x	0.7	=	82.16	(74)
North	0.9x	0.77	x	2.4	x	74.68	x	0.63	x	0.7	=	54.77	(74)
North	0.9x	0.77	x	3.6	x	74.68	x	0.63	x	0.7	=	82.16	(74)
North	0.9x	0.77	x	3.6	x	59.25	x	0.63	x	0.7	=	65.18	(74)
North	0.9x	0.77	x	2.4	x	59.25	x	0.63	x	0.7	=	43.46	(74)
North	0.9x	0.77	x	3.6	x	59.25	x	0.63	x	0.7	=	65.18	(74)
North	0.9x	0.77	x	3.6	x	41.52	x	0.63	x	0.7	=	45.68	(74)
North	0.9x	0.77	x	2.4	x	41.52	x	0.63	x	0.7	=	30.45	(74)
North	0.9x	0.77	x	3.6	x	41.52	x	0.63	x	0.7	=	45.68	(74)
North	0.9x	0.77	x	3.6	x	24.19	x	0.63	x	0.7	=	26.61	(74)
North	0.9x	0.77	x	2.4	x	24.19	x	0.63	x	0.7	=	17.74	(74)
North	0.9x	0.77	x	3.6	x	24.19	x	0.63	x	0.7	=	26.61	(74)
North	0.9x	0.77	x	3.6	x	13.12	x	0.63	x	0.7	=	14.43	(74)
North	0.9x	0.77	x	2.4	x	13.12	x	0.63	x	0.7	=	9.62	(74)
North	0.9x	0.77	x	3.6	x	13.12	x	0.63	x	0.7	=	14.43	(74)
North	0.9x	0.77	x	3.6	x	8.86	x	0.63	x	0.7	=	9.75	(74)
North	0.9x	0.77	x	2.4	x	8.86	x	0.63	x	0.7	=	6.5	(74)
North	0.9x	0.77	x	3.6	x	8.86	x	0.63	x	0.7	=	9.75	(74)
Northeast	0.9x	0.77	x	1.05	x	11.28	x	0.63	x	0.7	=	3.62	(75)
Northeast	0.9x	0.77	x	1.05	x	22.97	x	0.63	x	0.7	=	7.37	(75)
Northeast	0.9x	0.77	x	1.05	x	41.38	x	0.63	x	0.7	=	13.28	(75)

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Northeast	0.9x	0.77	x	1.05	x	67.96	x	0.63	x	0.7	=	21.81	(75)
Northeast	0.9x	0.77	x	1.05	x	91.35	x	0.63	x	0.7	=	29.31	(75)
Northeast	0.9x	0.77	x	1.05	x	97.38	x	0.63	x	0.7	=	31.25	(75)
Northeast	0.9x	0.77	x	1.05	x	91.1	x	0.63	x	0.7	=	29.23	(75)
Northeast	0.9x	0.77	x	1.05	x	72.63	x	0.63	x	0.7	=	23.31	(75)
Northeast	0.9x	0.77	x	1.05	x	50.42	x	0.63	x	0.7	=	16.18	(75)
Northeast	0.9x	0.77	x	1.05	x	28.07	x	0.63	x	0.7	=	9.01	(75)
Northeast	0.9x	0.77	x	1.05	x	14.2	x	0.63	x	0.7	=	4.56	(75)
Northeast	0.9x	0.77	x	1.05	x	9.21	x	0.63	x	0.7	=	2.96	(75)
Southeast	0.9x	0.77	x	1.78	x	36.79	x	0.63	x	0.7	=	20.02	(77)
Southeast	0.9x	0.77	x	1.78	x	62.67	x	0.63	x	0.7	=	34.09	(77)
Southeast	0.9x	0.77	x	1.78	x	85.75	x	0.63	x	0.7	=	46.65	(77)
Southeast	0.9x	0.77	x	1.78	x	106.25	x	0.63	x	0.7	=	57.8	(77)
Southeast	0.9x	0.77	x	1.78	x	119.01	x	0.63	x	0.7	=	64.74	(77)
Southeast	0.9x	0.77	x	1.78	x	118.15	x	0.63	x	0.7	=	64.27	(77)
Southeast	0.9x	0.77	x	1.78	x	113.91	x	0.63	x	0.7	=	61.97	(77)
Southeast	0.9x	0.77	x	1.78	x	104.39	x	0.63	x	0.7	=	56.79	(77)
Southeast	0.9x	0.77	x	1.78	x	92.85	x	0.63	x	0.7	=	50.51	(77)
Southeast	0.9x	0.77	x	1.78	x	69.27	x	0.63	x	0.7	=	37.68	(77)
Southeast	0.9x	0.77	x	1.78	x	44.07	x	0.63	x	0.7	=	23.97	(77)
Southeast	0.9x	0.77	x	1.78	x	31.49	x	0.63	x	0.7	=	17.13	(77)
South	0.9x	0.54	x	9.36	x	46.75	x	0.63	x	0.7	=	93.79	(78)
South	0.9x	0.77	x	2.4	x	46.75	x	0.63	x	0.7	=	68.58	(78)
South	0.9x	0.54	x	9.36	x	76.57	x	0.63	x	0.7	=	153.6	(78)
South	0.9x	0.77	x	2.4	x	76.57	x	0.63	x	0.7	=	112.32	(78)
South	0.9x	0.54	x	9.36	x	97.53	x	0.63	x	0.7	=	195.66	(78)
South	0.9x	0.77	x	2.4	x	97.53	x	0.63	x	0.7	=	143.08	(78)
South	0.9x	0.54	x	9.36	x	110.23	x	0.63	x	0.7	=	221.14	(78)
South	0.9x	0.77	x	2.4	x	110.23	x	0.63	x	0.7	=	161.71	(78)
South	0.9x	0.54	x	9.36	x	114.87	x	0.63	x	0.7	=	230.44	(78)
South	0.9x	0.77	x	2.4	x	114.87	x	0.63	x	0.7	=	168.51	(78)
South	0.9x	0.54	x	9.36	x	110.55	x	0.63	x	0.7	=	221.77	(78)
South	0.9x	0.77	x	2.4	x	110.55	x	0.63	x	0.7	=	162.17	(78)
South	0.9x	0.54	x	9.36	x	108.01	x	0.63	x	0.7	=	216.68	(78)
South	0.9x	0.77	x	2.4	x	108.01	x	0.63	x	0.7	=	158.45	(78)
South	0.9x	0.54	x	9.36	x	104.89	x	0.63	x	0.7	=	210.43	(78)
South	0.9x	0.77	x	2.4	x	104.89	x	0.63	x	0.7	=	153.87	(78)
South	0.9x	0.54	x	9.36	x	101.89	x	0.63	x	0.7	=	204.39	(78)
South	0.9x	0.77	x	2.4	x	101.89	x	0.63	x	0.7	=	149.46	(78)
South	0.9x	0.54	x	9.36	x	82.59	x	0.63	x	0.7	=	165.67	(78)
South	0.9x	0.77	x	2.4	x	82.59	x	0.63	x	0.7	=	121.15	(78)

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South	0.9x	0.54	x	9.36	x	55.42	x	0.63	x	0.7	=	111.17	(78)
South	0.9x	0.77	x	2.4	x	55.42	x	0.63	x	0.7	=	81.29	(78)
South	0.9x	0.54	x	9.36	x	40.4	x	0.63	x	0.7	=	81.04	(78)
South	0.9x	0.77	x	2.4	x	40.4	x	0.63	x	0.7	=	59.26	(78)
Northwest	0.9x	0.77	x	1.05	x	11.28	x	0.63	x	0.7	=	3.62	(81)
Northwest	0.9x	0.77	x	1.05	x	22.97	x	0.63	x	0.7	=	7.37	(81)
Northwest	0.9x	0.77	x	1.05	x	41.38	x	0.63	x	0.7	=	13.28	(81)
Northwest	0.9x	0.77	x	1.05	x	67.96	x	0.63	x	0.7	=	21.81	(81)
Northwest	0.9x	0.77	x	1.05	x	91.35	x	0.63	x	0.7	=	29.31	(81)
Northwest	0.9x	0.77	x	1.05	x	97.38	x	0.63	x	0.7	=	31.25	(81)
Northwest	0.9x	0.77	x	1.05	x	91.1	x	0.63	x	0.7	=	29.23	(81)
Northwest	0.9x	0.77	x	1.05	x	72.63	x	0.63	x	0.7	=	23.31	(81)
Northwest	0.9x	0.77	x	1.05	x	50.42	x	0.63	x	0.7	=	16.18	(81)
Northwest	0.9x	0.77	x	1.05	x	28.07	x	0.63	x	0.7	=	9.01	(81)
Northwest	0.9x	0.77	x	1.05	x	14.2	x	0.63	x	0.7	=	4.56	(81)
Northwest	0.9x	0.77	x	1.05	x	9.21	x	0.63	x	0.7	=	2.96	(81)

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

(83)m=	220.83	374.38	513.25	646.99	741.52	745.38	714.65	641.52	558.53	413.49	264.04	189.35	(83)

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

(84)m=	803.37	954.47	1074.12	1176.47	1238.24	1211.34	1161.18	1094.88	1028.5	915.08	801.94	755.36	(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	0.89	0.71	0.52	0.57	0.84	0.98	1	1	(86)

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

(87)m=	20.07	20.21	20.41	20.67	20.88	20.98	21	21	20.94	20.67	20.32	20.04	(87)

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

(88)m=	20.21	20.21	20.22	20.23	20.23	20.24	20.24	20.24	20.23	20.23	20.22	20.22	(88)

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

(89)m=	1	1	0.99	0.96	0.85	0.63	0.43	0.48	0.78	0.97	1	1	(89)

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

(90)m=	18.94	19.15	19.45	19.83	20.11	20.22	20.23	20.23	20.18	19.83	19.32	18.91	(90)

fLA = Living area ÷ (4) = | 0.24 | (91)

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

(92)m=	19.22	19.41	19.69	20.03	20.3	20.41	20.42	20.42	20.37	20.04	19.56	19.19	(92)

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

(93)m=	19.22	19.41	19.69	20.03	20.3	20.41	20.42	20.42	20.37	20.04	19.56	19.19	(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	1	0.99	0.96	0.86	0.65	0.46	0.51	0.79	0.97	1	1	(94)

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

(95)m=	802.47	951.06	1061.71	1125.8	1060.2	786.75	528.47	553.55	810.67	888.54	799.37	754.78	(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=	2135.94	2071.92	1877.82	1565.38	1205.75	805.55	530.05	556.61	873.38	1323.62	1756.63	2123.64	(97)

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

(98)m=	992.1	753.21	607.18	316.5	108.29	0	0	0	0	323.7	689.22	1018.43

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4808.64 (98)

Space heating requirement in kWh/m²/year 28.45 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 93.5 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	992.1	753.21	607.18	316.5	108.29	0	0	0	0	323.7	689.22	1018.43	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1061.07	805.58	649.39	338.5	115.82	0	0	0	0	346.2	737.14	1089.23	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 5142.93 (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)

	229.5	202.41	212.88	191.25	187.73	168.18	161.93	177.12	176.62	198.3	209.15	224.12

Efficiency of water heater 79.8 (216)

(217)m=	88.28	88	87.46	86.15	83.41	79.8	79.8	79.8	79.8	86.11	87.76	88.36	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	259.98	230.01	243.42	222	225.07	210.75	202.92	221.95	221.33	230.28	238.32	253.64

Total = Sum(219a)$_{1...12}$ = 2759.68 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		5142.93
Water heating fuel used		2759.68
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			564.52	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	1110.87	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	596.09	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1706.96	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	292.98	(268)
Total CO2, kg/year			sum of (265)…(271) =		2038.87	(272)

TER = 12.06 (273)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 23 - 2B4P - MF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	97.32	(1a) x	2.7	(2a) =	262.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	97.32	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	262.76	(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							3	x 10 =	30	(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) =	30	÷ (5) =	0.11	(8)

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

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

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

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

Infiltration rate modified for monthly wind speed

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

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

Calculate effective air change rate for the applicable case

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.58	0.57	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			2.53		x1/[1/(1.4)+ 0.04]	=	3.35			(27)
Windows Type 2			2.53		x1/[1/(1.4)+ 0.04]	=	3.35			(27)
Windows Type 3			7.89		x1/[1/(1.4)+ 0.04]	=	10.46			(27)
Windows Type 4			2.37		x1/[1/(1.4)+ 0.04]	=	3.14			(27)
Windows Type 5			1.58		x1/[1/(1.4)+ 0.04]	=	2.09			(27)
Walls Type1	92.42	24.33	68.09	x	0.18	=	12.26			(29)
Walls Type2	29.89	0	29.89	x	0.18	=	5.38			(29)
Total area of elements, m²			122.31							(31)
Party wall			23.22	x	0	=	0			(32)
Party floor			97.32							(32a)
Party ceiling			97.32							(32b)

** 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) =	49.89	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14715.9	(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		6.12	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	56.01	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	50.11	49.85	49.59	48.38	48.16	47.11	47.11	46.91	47.51	48.16	48.61	49.09	(38)

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

(39)m=	106.12	105.85	105.6	104.39	104.16	103.11	103.11	102.92	103.52	104.16	104.62	105.1	

Average = $\text{Sum}(39)_{1\ldots12}$ /12= 104.39 (39)

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

(40)m=	1.09	1.09	1.09	1.07	1.07	1.06	1.06	1.06	1.06	1.07	1.08	1.08	

Average = $\text{Sum}(40)_{1\ldots12}$ /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 2.71 (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 98.64 (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=	108.5	104.56	100.61	96.67	92.72	88.78	88.78	92.72	96.67	100.61	104.56	108.5	

Total = $\text{Sum}(44)_{1\ldots12}$ = 1183.69 (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=	160.91	140.73	145.22	126.61	121.48	104.83	97.14	111.47	112.8	131.46	143.5	155.83	

Total = $\text{Sum}(45)_{1\ldots12}$ = 1552 (45)

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

(46)m=	24.14	21.11	21.78	18.99	18.22	15.72	14.57	16.72	16.92	19.72	21.53	23.37	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.91 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.03 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.03	28.93	32.03	30.99	32.03	30.99	32.03	32.03	30.99	32.03	30.99	32.03	(56)

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

(57)m=	32.03	28.93	32.03	30.99	32.03	30.99	32.03	32.03	30.99	32.03	30.99	32.03	(57)

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

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

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

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

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

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

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

(62)m=	216.2	190.67	200.51	180.12	176.77	158.34	152.43	166.76	166.31	186.75	197.01	211.12	(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=	216.2	190.67	200.51	180.12	176.77	158.34	152.43	166.76	166.31	186.75	197.01	211.12

Output from water heater (annual)$_{1\ldots12}$ | 2202.99 | (64)

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

(65)m=	97.73	86.74	92.52	84.9	84.63	77.66	76.53	81.3	80.31	87.94	90.52	96.05	(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=	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	22.46	19.95	16.22	12.28	9.18	7.75	8.37	10.89	14.61	18.55	21.65	23.08	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	251.92	254.54	247.95	233.92	216.22	199.58	188.47	185.85	192.44	206.46	224.17	240.81	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	(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=	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	(71)
Water heating gains (Table 5)													
(72)m=	131.36	129.08	124.35	117.92	113.74	107.86	102.86	109.27	111.54	118.2	125.72	129.09	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	472.44	470.27	455.22	430.82	405.84	381.9	366.41	372.71	385.29	409.92	438.24	459.68	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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Southeast	0.9x	0.77	x	7.89	x	36.79	x	0.63	x	0.7	=	88.72	(77)
Southeast	0.9x	0.77	x	1.58	x	36.79	x	0.63	x	0.7	=	17.77	(77)
Southeast	0.9x	0.77	x	7.89	x	62.67	x	0.63	x	0.7	=	151.12	(77)
Southeast	0.9x	0.77	x	1.58	x	62.67	x	0.63	x	0.7	=	30.26	(77)
Southeast	0.9x	0.77	x	7.89	x	85.75	x	0.63	x	0.7	=	206.77	(77)
Southeast	0.9x	0.77	x	1.58	x	85.75	x	0.63	x	0.7	=	41.41	(77)
Southeast	0.9x	0.77	x	7.89	x	106.25	x	0.63	x	0.7	=	256.2	(77)
Southeast	0.9x	0.77	x	1.58	x	106.25	x	0.63	x	0.7	=	51.31	(77)
Southeast	0.9x	0.77	x	7.89	x	119.01	x	0.63	x	0.7	=	286.97	(77)
Southeast	0.9x	0.77	x	1.58	x	119.01	x	0.63	x	0.7	=	57.47	(77)
Southeast	0.9x	0.77	x	7.89	x	118.15	x	0.63	x	0.7	=	284.89	(77)
Southeast	0.9x	0.77	x	1.58	x	118.15	x	0.63	x	0.7	=	57.05	(77)
Southeast	0.9x	0.77	x	7.89	x	113.91	x	0.63	x	0.7	=	274.67	(77)
Southeast	0.9x	0.77	x	1.58	x	113.91	x	0.63	x	0.7	=	55	(77)
Southeast	0.9x	0.77	x	7.89	x	104.39	x	0.63	x	0.7	=	251.72	(77)
Southeast	0.9x	0.77	x	1.58	x	104.39	x	0.63	x	0.7	=	50.41	(77)
Southeast	0.9x	0.77	x	7.89	x	92.85	x	0.63	x	0.7	=	223.89	(77)
Southeast	0.9x	0.77	x	1.58	x	92.85	x	0.63	x	0.7	=	44.84	(77)
Southeast	0.9x	0.77	x	7.89	x	69.27	x	0.63	x	0.7	=	167.02	(77)
Southeast	0.9x	0.77	x	1.58	x	69.27	x	0.63	x	0.7	=	33.45	(77)
Southeast	0.9x	0.77	x	7.89	x	44.07	x	0.63	x	0.7	=	106.27	(77)
Southeast	0.9x	0.77	x	1.58	x	44.07	x	0.63	x	0.7	=	21.28	(77)
Southeast	0.9x	0.77	x	7.89	x	31.49	x	0.63	x	0.7	=	75.93	(77)
Southeast	0.9x	0.77	x	1.58	x	31.49	x	0.63	x	0.7	=	15.2	(77)
South	0.9x	0.77	x	2.53	x	46.75	x	0.63	x	0.7	=	72.3	(78)
South	0.9x	0.77	x	2.53	x	46.75	x	0.63	x	0.7	=	72.3	(78)
South	0.9x	0.77	x	2.53	x	76.57	x	0.63	x	0.7	=	118.4	(78)
South	0.9x	0.77	x	2.53	x	76.57	x	0.63	x	0.7	=	118.4	(78)
South	0.9x	0.77	x	2.53	x	97.53	x	0.63	x	0.7	=	150.83	(78)
South	0.9x	0.77	x	2.53	x	97.53	x	0.63	x	0.7	=	150.83	(78)
South	0.9x	0.77	x	2.53	x	110.23	x	0.63	x	0.7	=	170.47	(78)
South	0.9x	0.77	x	2.53	x	110.23	x	0.63	x	0.7	=	170.47	(78)
South	0.9x	0.77	x	2.53	x	114.87	x	0.63	x	0.7	=	177.64	(78)
South	0.9x	0.77	x	2.53	x	114.87	x	0.63	x	0.7	=	177.64	(78)
South	0.9x	0.77	x	2.53	x	110.55	x	0.63	x	0.7	=	170.95	(78)
South	0.9x	0.77	x	2.53	x	110.55	x	0.63	x	0.7	=	170.95	(78)
South	0.9x	0.77	x	2.53	x	108.01	x	0.63	x	0.7	=	167.03	(78)
South	0.9x	0.77	x	2.53	x	108.01	x	0.63	x	0.7	=	167.03	(78)
South	0.9x	0.77	x	2.53	x	104.89	x	0.63	x	0.7	=	162.21	(78)
South	0.9x	0.77	x	2.53	x	104.89	x	0.63	x	0.7	=	162.21	(78)
South	0.9x	0.77	x	2.53	x	101.89	x	0.63	x	0.7	=	157.56	(78)

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South	0.9x	0.77	x	2.53	x	101.89	x	0.63	x	0.7	=	157.56	(78)
South	0.9x	0.77	x	2.53	x	82.59	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	2.53	x	82.59	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	2.53	x	55.42	x	0.63	x	0.7	=	85.7	(78)
South	0.9x	0.77	x	2.53	x	55.42	x	0.63	x	0.7	=	85.7	(78)
South	0.9x	0.77	x	2.53	x	40.4	x	0.63	x	0.7	=	62.47	(78)
South	0.9x	0.77	x	2.53	x	40.4	x	0.63	x	0.7	=	62.47	(78)
Southwest	0.9x	0.77	x	2.37	x	36.79		0.63	x	0.7	=	53.3	(79)
Southwest	0.9x	0.77	x	2.37	x	62.67		0.63	x	0.7	=	90.79	(79)
Southwest	0.9x	0.77	x	2.37	x	85.75		0.63	x	0.7	=	124.22	(79)
Southwest	0.9x	0.77	x	2.37	x	106.25		0.63	x	0.7	=	153.92	(79)
Southwest	0.9x	0.77	x	2.37	x	119.01		0.63	x	0.7	=	172.4	(79)
Southwest	0.9x	0.77	x	2.37	x	118.15		0.63	x	0.7	=	171.15	(79)
Southwest	0.9x	0.77	x	2.37	x	113.91		0.63	x	0.7	=	165.01	(79)
Southwest	0.9x	0.77	x	2.37	x	104.39		0.63	x	0.7	=	151.22	(79)
Southwest	0.9x	0.77	x	2.37	x	92.85		0.63	x	0.7	=	134.51	(79)
Southwest	0.9x	0.77	x	2.37	x	69.27		0.63	x	0.7	=	100.34	(79)
Southwest	0.9x	0.77	x	2.37	x	44.07		0.63	x	0.7	=	63.84	(79)
Southwest	0.9x	0.77	x	2.37	x	31.49		0.63	x	0.7	=	45.61	(79)

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

(83)m=	304.38	508.99	674.06	802.36	872.11	855	828.74	777.76	718.35	556.23	362.78	261.69	(83)

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

(84)m=	776.82	979.25	1129.28	1233.18	1277.95	1236.9	1195.15	1150.47	1103.64	966.15	801.02	721.37	(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	0.94	0.85	0.71	0.52	0.38	0.41	0.62	0.89	0.98	0.99	(86)

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

(87)m=	20.02	20.27	20.54	20.79	20.94	20.99	21	21	20.97	20.78	20.35	19.98	(87)

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

(88)m=	20.01	20.01	20.01	20.02	20.03	20.03	20.03	20.04	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	0.97	0.92	0.82	0.65	0.45	0.3	0.32	0.55	0.85	0.97	0.99	(89)

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

(90)m=	18.73	19.08	19.46	19.8	19.97	20.03	20.03	20.03	20.01	19.79	19.2	18.66	(90)

fLA = Living area ÷ (4) = | 0.38 | (91)

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

(92)m=	19.21	19.53	19.87	20.17	20.33	20.39	20.4	20.4	20.37	20.16	19.63	19.16	(92)

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

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(93)m=	19.21	19.53	19.87	20.17	20.33	20.39	20.4	20.4	20.37	20.16	19.63	19.16	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.96	0.92	0.82	0.67	0.48	0.33	0.36	0.57	0.85	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	767.25	944.92	1036.62	1012.85	853.29	590.72	390.8	410.31	633.33	825.56	777.15	714.97	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1582.61	1548.43	1411.37	1176.78	899.28	596.96	391.46	411.36	649.54	996.14	1311.11	1571.92	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	606.62	405.56	278.81	118.03	34.22	0	0	0	0	126.91	384.45	637.57	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2592.18	(98)
Space heating requirement in kWh/m²/year	26.64	(99)

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

Space heating:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	606.62	405.56	278.81	118.03	34.22	0	0	0	0	126.91	384.45	637.57		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	648.8	433.75	298.19	126.24	36.59	0	0	0	0	135.73	411.18	681.9		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2772.38	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	216.2	190.67	200.51	180.12	176.77	158.34	152.43	166.76	166.31	186.75	197.01	211.12		
Efficiency of water heater													79.8	(216)
(217)m=	87.42	86.78	85.69	83.72	81.36	79.8	79.8	79.8	79.8	83.81	86.57	87.58		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	247.31	219.72	233.99	215.14	217.27	198.42	191.02	208.97	208.41	222.83	227.58	241.06		
Total = Sum(219a)$_{1...12}$ =													2631.72	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2772.38

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Water heating fuel used			2631.72	
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			396.63	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	598.84	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	568.45	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1167.29	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	205.85	(268)
Total CO2, kg/year		sum of (265)…(271) =		1412.06	(272)

TER = 14.51 (273)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 31 - 3B6P - TF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	192.4	(1a) x	2.6	(2a) =	500.24	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	192.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	500.24	(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) =	0.08	(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)	0.33	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(21)

Infiltration rate modified for monthly wind speed

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

envision

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

0.39	0.38	0.37	0.34	0.33	0.29	0.29	0.28	0.31	0.33	0.34	0.36

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	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	
Windows Type 1			10.34		x1/[1/(1.4)+ 0.04]	=	13.71			(27)
Windows Type 2			9.9		x1/[1/(1.4)+ 0.04]	=	13.12			(27)
Windows Type 3			5.25		x1/[1/(1.4)+ 0.04]	=	6.96			(27)
Windows Type 4			5.5		x1/[1/(1.4)+ 0.04]	=	7.29			(27)
Walls Type1	146.45	30.99	115.46	x	0.18	=	20.78			(29)
Walls Type2	26.73	0	26.73	x	0.18	=	4.81			(29)
Roof	191	0	191	x	0.13	=	24.83			(30)
Total area of elements, m²			364.18							(31)
Party floor			191							(32a)

** 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) = 91.51 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 19312.16 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.21 (36)

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

Total fabric heat loss (33) + (36) = 109.72 (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=	95.04	94.55	94.08	91.84	91.43	89.48	89.48	89.12	90.23	91.43	92.27	93.16	(38)

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

(39)m=	204.76	204.27	203.8	201.56	201.14	199.2	199.2	198.84	199.95	201.14	201.99	202.87	

Average = Sum(39)$_{1…12}$ /12= 201.56 (39)

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

(40)m=	1.06	1.06	1.06	1.05	1.05	1.04	1.04	1.03	1.04	1.05	1.05	1.05

Average = Sum(40)$_{1\ldots12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.99 (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) + 36 105.26 (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=	115.79	111.58	107.37	103.16	98.94	94.73	94.73	98.94	103.16	107.37	111.58	115.79	
										Total = Sum(44)$_{1\ldots12}$ =		1263.13	(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=	171.71	150.18	154.97	135.11	129.64	111.87	103.66	118.95	120.37	140.28	153.13	166.29	
										Total = Sum(45)$_{1\ldots12}$ =		1656.16	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	25.76	22.53	23.25	20.27	19.45	16.78	15.55	17.84	18.06	21.04	22.97	24.94	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 2.13 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.15 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 1.15 (55)

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

(56)m=	35.73	32.27	35.73	34.57	35.73	34.57	35.73	35.73	34.57	35.73	34.57	35.73	(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=	35.73	32.27	35.73	34.57	35.73	34.57	35.73	35.73	34.57	35.73	34.57	35.73	(57)

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

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

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

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

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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=	230.7	203.46	213.96	192.19	188.63	168.95	162.65	177.94	177.46	199.27	210.22	225.28	(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=	230.7	203.46	213.96	192.19	188.63	168.95	162.65	177.94	177.46	199.27	210.22	225.28	

Output from water heater (annual)1…12 2350.71 (64)

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

(65)m=	104.28	92.56	98.72	90.59	90.3	82.86	81.66	86.74	85.69	93.84	96.59	102.48	(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=	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	(66)

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

(67)m=	34.85	30.96	25.18	19.06	14.25	12.03	13	16.89	22.67	28.79	33.6	35.82	(67)

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

(68)m=	363.76	367.54	358.03	337.78	312.21	288.19	272.14	268.36	277.88	298.13	323.69	347.71	(68)

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

(69)m=	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	(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=	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	(71)

Water heating gains (Table 5)

(72)m=	140.17	137.74	132.69	125.82	121.37	115.09	109.76	116.59	119.02	126.12	134.15	137.75	(72)

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

(73)m=	609.66	607.11	586.77	553.54	518.71	486.19	465.77	472.73	490.45	523.92	562.32	592.16	(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	0.3	x	5.5	x	11.28	x	0.63	x	0.7	=	7.39	(75)
Northeast 0.9x	0.3	x	5.5	x	22.97	x	0.63	x	0.7	=	15.04	(75)
Northeast 0.9x	0.3	x	5.5	x	41.38	x	0.63	x	0.7	=	27.1	(75)
Northeast 0.9x	0.3	x	5.5	x	67.96	x	0.63	x	0.7	=	44.5	(75)
Northeast 0.9x	0.3	x	5.5	x	91.35	x	0.63	x	0.7	=	59.82	(75)

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Northeast	0.9x	0.3	x	5.5	x	97.38	x	0.63	x	0.7	=	63.78	(75)
Northeast	0.9x	0.3	x	5.5	x	91.1	x	0.63	x	0.7	=	59.66	(75)
Northeast	0.9x	0.3	x	5.5	x	72.63	x	0.63	x	0.7	=	47.56	(75)
Northeast	0.9x	0.3	x	5.5	x	50.42	x	0.63	x	0.7	=	33.02	(75)
Northeast	0.9x	0.3	x	5.5	x	28.07	x	0.63	x	0.7	=	18.38	(75)
Northeast	0.9x	0.3	x	5.5	x	14.2	x	0.63	x	0.7	=	9.3	(75)
Northeast	0.9x	0.3	x	5.5	x	9.21	x	0.63	x	0.7	=	6.03	(75)
Southeast	0.9x	0.77	x	9.9	x	36.79	x	0.63	x	0.7	=	111.32	(77)
Southeast	0.9x	0.77	x	9.9	x	62.67	x	0.63	x	0.7	=	189.62	(77)
Southeast	0.9x	0.77	x	9.9	x	85.75	x	0.63	x	0.7	=	259.45	(77)
Southeast	0.9x	0.77	x	9.9	x	106.25	x	0.63	x	0.7	=	321.47	(77)
Southeast	0.9x	0.77	x	9.9	x	119.01	x	0.63	x	0.7	=	360.07	(77)
Southeast	0.9x	0.77	x	9.9	x	118.15	x	0.63	x	0.7	=	357.47	(77)
Southeast	0.9x	0.77	x	9.9	x	113.91	x	0.63	x	0.7	=	344.64	(77)
Southeast	0.9x	0.77	x	9.9	x	104.39	x	0.63	x	0.7	=	315.84	(77)
Southeast	0.9x	0.77	x	9.9	x	92.85	x	0.63	x	0.7	=	280.93	(77)
Southeast	0.9x	0.77	x	9.9	x	69.27	x	0.63	x	0.7	=	209.57	(77)
Southeast	0.9x	0.77	x	9.9	x	44.07	x	0.63	x	0.7	=	133.34	(77)
Southeast	0.9x	0.77	x	9.9	x	31.49	x	0.63	x	0.7	=	95.27	(77)
Southwest	0.9x	0.77	x	10.34	x	36.79		0.63	x	0.7	=	116.27	(79)
Southwest	0.9x	0.77	x	10.34	x	62.67		0.63	x	0.7	=	198.05	(79)
Southwest	0.9x	0.77	x	10.34	x	85.75		0.63	x	0.7	=	270.98	(79)
Southwest	0.9x	0.77	x	10.34	x	106.25		0.63	x	0.7	=	335.76	(79)
Southwest	0.9x	0.77	x	10.34	x	119.01		0.63	x	0.7	=	376.08	(79)
Southwest	0.9x	0.77	x	10.34	x	118.15		0.63	x	0.7	=	373.36	(79)
Southwest	0.9x	0.77	x	10.34	x	113.91		0.63	x	0.7	=	359.96	(79)
Southwest	0.9x	0.77	x	10.34	x	104.39		0.63	x	0.7	=	329.88	(79)
Southwest	0.9x	0.77	x	10.34	x	92.85		0.63	x	0.7	=	293.42	(79)
Southwest	0.9x	0.77	x	10.34	x	69.27		0.63	x	0.7	=	218.89	(79)
Southwest	0.9x	0.77	x	10.34	x	44.07		0.63	x	0.7	=	139.26	(79)
Southwest	0.9x	0.77	x	10.34	x	31.49		0.63	x	0.7	=	99.5	(79)
Northwest	0.9x	0.3	x	5.25	x	11.28	x	0.63	x	0.7	=	7.05	(81)
Northwest	0.9x	0.3	x	5.25	x	22.97	x	0.63	x	0.7	=	14.36	(81)
Northwest	0.9x	0.3	x	5.25	x	41.38	x	0.63	x	0.7	=	25.87	(81)
Northwest	0.9x	0.3	x	5.25	x	67.96	x	0.63	x	0.7	=	42.48	(81)
Northwest	0.9x	0.3	x	5.25	x	91.35	x	0.63	x	0.7	=	57.1	(81)
Northwest	0.9x	0.3	x	5.25	x	97.38	x	0.63	x	0.7	=	60.88	(81)
Northwest	0.9x	0.3	x	5.25	x	91.1	x	0.63	x	0.7	=	56.95	(81)
Northwest	0.9x	0.3	x	5.25	x	72.63	x	0.63	x	0.7	=	45.4	(81)
Northwest	0.9x	0.3	x	5.25	x	50.42	x	0.63	x	0.7	=	31.52	(81)
Northwest	0.9x	0.3	x	5.25	x	28.07	x	0.63	x	0.7	=	17.55	(81)

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Northwest	0.9x	0.3	x	5.25	x	14.2	x	0.63	x	0.7	=	8.87	(81)
Northwest	0.9x	0.3	x	5.25	x	9.21	x	0.63	x	0.7	=	5.76	(81)

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

(83)m=	242.03	417.07	583.4	744.21	853.08	855.48	821.21	738.68	638.88	464.39	290.77	206.57	(83)

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

(84)m=	851.7	1024.18	1170.17	1297.75	1371.78	1341.67	1286.98	1211.41	1129.33	988.31	853.09	798.73	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.98	0.94	0.82	0.65	0.71	0.92	0.99	1	1	(86)

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

(87)m=	19.73	19.88	20.11	20.42	20.71	20.91	20.98	20.97	20.83	20.45	20.03	19.7	(87)

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

(88)m=	20.03	20.03	20.03	20.04	20.05	20.05	20.05	20.06	20.05	20.05	20.04	20.04	(88)

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

(89)m=	1	1	0.99	0.98	0.92	0.74	0.53	0.58	0.87	0.99	1	1	(89)

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

(90)m=	18.31	18.53	18.87	19.33	19.74	19.99	20.05	20.04	19.9	19.37	18.76	18.28	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	18.58	18.79	19.11	19.54	19.92	20.17	20.22	20.22	20.07	19.58	19	18.55	(92)

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

(93)m=	18.58	18.79	19.11	19.54	19.92	20.17	20.22	20.22	20.07	19.58	19	18.55	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.91	0.76	0.55	0.61	0.87	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	850.88	1021.4	1160.78	1262.66	1250.62	1013.09	708.19	736.31	979.96	970.96	851.06	798.18	(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=	2923.67	2836.36	2569.9	2144.47	1654.07	1108.74	721.92	759.34	1194.41	1805.4	2403.67	2911.6	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1542.16	1219.66	1048.38	634.9	300.17	0	0	0	0	620.82	1117.88	1572.38	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 8056.34 (98)

Space heating requirement in kWh/m²/year 41.87 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	1542.16	1219.66	1048.38	634.9	300.17	0	0	0	0	620.82	1117.88	1572.38		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1649.37	1304.45	1121.27	679.04	321.03	0	0	0	0	663.98	1195.59	1681.69		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													8616.41	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	230.7	203.46	213.96	192.19	188.63	168.95	162.65	177.94	177.46	199.27	210.22	225.28		
Efficiency of water heater													79.8	(216)
(217)m=	88.95	88.8	88.49	87.77	86.05	79.8	79.8	79.8	79.8	87.64	88.62	89		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	259.36	229.12	241.79	218.98	219.21	211.72	203.82	222.99	222.38	227.37	237.21	253.11		
Total = Sum(219a)$_{1...12}$ =													2747.07	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			8616.41	
Water heating fuel used			2747.07	
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			615.52	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	1861.14	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	593.37	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2454.51	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	319.46	(268)

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Total CO2, kg/year	sum of (265)…(271) =	2812.89	(272)
TER =		14.62	(273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 32 - 2B4P - TF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	118	(1a) x	2.4	(2a) =	283.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	118	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	283.2	(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							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.14	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

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

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

Infiltration rate modified for monthly wind speed

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

0.42	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	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	
Windows Type 1			6.2	x1/[1/(1.4)+ 0.04]		=	8.22			(27)
Windows Type 2			0.36	x1/[1/(1.4)+ 0.04]		=	0.48			(27)
Walls Type1	103.96	6.56	97.4	x	0.18	=	17.53			(29)
Walls Type2	4.93	0	4.93	x	0.18	=	0.89			(29)
Roof	118	0	118	x	0.13	=	15.34			(30)
Total area of elements, m²			226.89							(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) = 42.46 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8224.82 (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 11.34 (36)

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

Total fabric heat loss (33) + (36) = 53.8 (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=	55.13	54.8	54.48	52.98	52.7	51.39	51.39	51.15	51.9	52.7	53.27	53.86	(38)

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

(39)m=	108.93	108.6	108.28	106.78	106.5	105.19	105.19	104.95	105.7	106.5	107.07	107.66	

Average = $Sum(39)_{1…12}$ /12= 106.78 (39)

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

(40)m=	0.92	0.92	0.92	0.9	0.9	0.89	0.89	0.89	0.9	0.9	0.91	0.91

Average = $\text{Sum}(40)_{1\ldots12}$ /12= 0.9 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.86 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.01 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	112.21	108.13	104.05	99.97	95.89	91.81	91.81	95.89	99.97	104.05	108.13	112.21	
										Total = $\text{Sum}(44)_{1\ldots12}$ =		1224.14	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	166.41	145.54	150.19	130.94	125.64	108.41	100.46	115.28	116.66	135.95	148.41	161.16	
										Total = $\text{Sum}(45)_{1\ldots12}$ =		1605.05	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	24.96	21.83	22.53	19.64	18.85	16.26	15.07	17.29	17.5	20.39	22.26	24.17	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.89 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.02 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 1.02 (55)

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

(56)m=	31.64	28.58	31.64	30.62	31.64	30.62	31.64	31.64	30.62	31.64	30.62	31.64	(56)

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

(57)m=	31.64	28.58	31.64	30.62	31.64	30.62	31.64	31.64	30.62	31.64	30.62	31.64	(57)

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

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

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

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

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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=	221.32	195.14	205.09	184.07	180.54	161.55	155.37	170.19	169.79	190.86	201.54	216.07	(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=	221.32	195.14	205.09	184.07	180.54	161.55	155.37	170.19	169.79	190.86	201.54	216.07	

Output from water heater (annual)1…12 | 2251.53 | (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=	99.26	88.07	93.86	86.04	85.7	78.56	77.33	82.26	81.3	89.13	91.85	97.51	(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=	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	(66)

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

(67)m=	32.28	28.67	23.32	17.65	13.2	11.14	12.04	15.65	21	26.66	31.12	33.18	(67)

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

(68)m=	282.59	285.52	278.13	262.4	242.54	223.88	211.41	208.48	215.86	231.6	251.45	270.12	(68)

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

(69)m=	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

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

(71)m=	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	(71)

Water heating gains (Table 5)

(72)m=	133.41	131.05	126.16	119.51	115.19	109.11	103.94	110.56	112.91	119.8	127.57	131.06	(72)

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

(73)m=	517.1	514.07	496.43	468.39	439.75	412.95	396.21	403.51	418.61	446.89	478.98	503.19	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	0.36	x	10.63	x	0.63	x	0.7	=	1.17	(74)
North	0.9x	0.77	x	0.36	x	20.32	x	0.63	x	0.7	=	2.24	(74)
North	0.9x	0.77	x	0.36	x	34.53	x	0.63	x	0.7	=	3.8	(74)
North	0.9x	0.77	x	0.36	x	55.46	x	0.63	x	0.7	=	6.1	(74)
North	0.9x	0.77	x	0.36	x	74.72	x	0.63	x	0.7	=	8.22	(74)

North	0.9x	0.77	x	0.36	x	79.99	x	0.63	x	0.7	=	8.8	(74)
North	0.9x	0.77	x	0.36	x	74.68	x	0.63	x	0.7	=	8.22	(74)
North	0.9x	0.77	x	0.36	x	59.25	x	0.63	x	0.7	=	6.52	(74)
North	0.9x	0.77	x	0.36	x	41.52	x	0.63	x	0.7	=	4.57	(74)
North	0.9x	0.77	x	0.36	x	24.19	x	0.63	x	0.7	=	2.66	(74)
North	0.9x	0.77	x	0.36	x	13.12	x	0.63	x	0.7	=	1.44	(74)
North	0.9x	0.77	x	0.36	x	8.86	x	0.63	x	0.7	=	0.98	(74)
South	0.9x	0.77	x	6.2	x	46.75	x	0.63	x	0.7	=	88.59	(78)
South	0.9x	0.77	x	6.2	x	76.57	x	0.63	x	0.7	=	145.08	(78)
South	0.9x	0.77	x	6.2	x	97.53	x	0.63	x	0.7	=	184.81	(78)
South	0.9x	0.77	x	6.2	x	110.23	x	0.63	x	0.7	=	208.87	(78)
South	0.9x	0.77	x	6.2	x	114.87	x	0.63	x	0.7	=	217.66	(78)
South	0.9x	0.77	x	6.2	x	110.55	x	0.63	x	0.7	=	209.47	(78)
South	0.9x	0.77	x	6.2	x	108.01	x	0.63	x	0.7	=	204.66	(78)
South	0.9x	0.77	x	6.2	x	104.89	x	0.63	x	0.7	=	198.75	(78)
South	0.9x	0.77	x	6.2	x	101.89	x	0.63	x	0.7	=	193.05	(78)
South	0.9x	0.77	x	6.2	x	82.59	x	0.63	x	0.7	=	156.48	(78)
South	0.9x	0.77	x	6.2	x	55.42	x	0.63	x	0.7	=	105	(78)
South	0.9x	0.77	x	6.2	x	40.4	x	0.63	x	0.7	=	76.55	(78)

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

(83)m=	89.76	147.32	188.61	214.97	225.88	218.27	212.88	205.27	197.62	159.14	106.45	77.52	(83)

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

(84)m=	606.86	661.39	685.04	683.36	665.63	631.22	609.09	608.78	616.23	606.03	585.43	580.71	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.97	0.89	0.72	0.75	0.92	0.99	1	1	(86)

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

(87)m=	19.99	20.1	20.26	20.49	20.71	20.91	20.98	20.98	20.87	20.58	20.25	19.98	(87)

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

(88)m=	20.15	20.15	20.15	20.16	20.17	20.17	20.17	20.18	20.17	20.17	20.16	20.16	(88)

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

(89)m=	1	1	0.99	0.99	0.95	0.83	0.61	0.63	0.88	0.98	1	1	(89)

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

(90)m=	18.79	18.94	19.18	19.52	19.84	20.1	20.17	20.16	20.05	19.65	19.17	18.77	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

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

(92)m=	19.16	19.3	19.52	19.82	20.11	20.35	20.42	20.42	20.3	19.94	19.5	19.15	(92)

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

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(93)m=	19.16	19.3	19.52	19.82	20.11	20.35	20.42	20.42	20.3	19.94	19.5	19.15	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.95	0.84	0.64	0.67	0.89	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	605.82	659.25	680.52	672.34	634.13	531.32	390.73	407.22	545.73	594.31	583.21	579.95	(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=	1618.71	1563.57	1409.57	1165.91	895.72	604.56	401.65	421.46	655.45	994.34	1327.92	1609.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	753.59	607.7	542.41	355.37	194.63	0	0	0	0	297.62	536.19	765.64	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4053.16 (98)

Space heating requirement in kWh/m²/year 34.35 (99)

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

Space heating:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	753.59	607.7	542.41	355.37	194.63	0	0	0	0	297.62	536.19	765.64		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	805.98	649.95	580.12	380.08	208.16	0	0	0	0	318.31	573.46	818.87		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													4334.93	(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)														
	221.32	195.14	205.09	184.07	180.54	161.55	155.37	170.19	169.79	190.86	201.54	216.07		
Efficiency of water heater													79.8	(216)
(217)m=	87.83	87.64	87.29	86.54	85.01	79.8	79.8	79.8	79.8	85.99	87.3	87.91		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	251.99	222.65	234.96	212.7	212.37	202.44	194.7	213.27	212.77	221.95	230.85	245.79		
Total = Sum(219a)$_{1...12}$ =													2656.44	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		4334.93

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Water heating fuel used			2656.44	
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			570.08	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	936.35	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	573.79	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1510.14	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	295.87	(268)
Total CO2, kg/year		sum of (265)…(271) =		1844.93	(272)

TER = 15.64 (273)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 33 - 1B2P -TF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	59.88	(1a) x	2.4	(2a) =	143.71	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.88	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	143.71	(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)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(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

0.38	0.38	0.37	0.33	0.32	0.29	0.29	0.28	0.3	0.32	0.34	0.35

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

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

(25)m=	0.57	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	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	
Windows			4.6	x1/[1/(1.4)+ 0.04]		=	6.1			(27)
Walls Type1	72.9	4.6	68.3	x	0.18	=	12.29			(29)
Walls Type2	26.57	0	26.57	x	0.18	=	4.78			(29)
Roof	55	0	55	x	0.13	=	7.15			(30)
Total area of elements, m²			154.47							(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) = 30.32 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7135.62 (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 7.72 (36)

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

Total fabric heat loss (33) + (36) = 38.05 (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=	27.22	27.08	26.95	26.32	26.21	25.66	25.66	25.56	25.87	26.21	26.44	26.69	(38)

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

(39)m=	65.27	65.13	65	64.37	64.25	63.71	63.71	63.61	63.92	64.25	64.49	64.74	

Average = $Sum(39)_{1…12}$ /12= 64.37 (39)

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

(40)m=	1.09	1.09	1.09	1.07	1.07	1.06	1.06	1.06	1.07	1.07	1.08	1.08

Average = $Sum(40)_{1…12}$ /12= 1.07 (40)

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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 — 1.98 (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 — 81.18 (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=	89.3	86.05	82.81	79.56	76.31	73.06	73.06	76.31	79.56	82.81	86.05	89.3	

Total = Sum(44)1…12 = 974.2 (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=	132.43	115.83	119.52	104.2	99.98	86.28	79.95	91.74	92.84	108.2	118.1	128.25	

Total = Sum(45)1…12 = 1277.33 (45)

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

(46)m=	19.86	17.37	17.93	15.63	15	12.94	11.99	13.76	13.93	16.23	17.72	19.24	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.39 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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

Enter (50) or (54) in (55) — 0.75 (55)

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

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

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

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

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

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

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

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

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

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

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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=	179.03	157.91	166.12	149.29	146.58	131.37	126.54	138.34	137.93	154.79	163.2	174.85	(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=	179.03	157.91	166.12	149.29	146.58	131.37	126.54	138.34	137.93	154.79	163.2	174.85

Output from water heater (annual)$_{1\ldots12}$ | 1825.95 | (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=	81.31	72.18	77.02	70.72	70.52	64.76	63.86	67.78	66.94	73.25	75.34	79.92	(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=	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	(66)

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

(67)m=	18.72	16.62	13.52	10.24	7.65	6.46	6.98	9.07	12.18	15.46	18.05	19.24	(67)

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

(68)m=	172.64	174.44	169.92	160.31	148.18	136.78	129.16	127.37	131.88	141.49	153.62	165.03	(68)

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

(69)m=	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	(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=	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	(71)

Water heating gains (Table 5)

(72)m=	109.29	107.41	103.52	98.22	94.79	89.95	85.83	91.1	92.98	98.46	104.64	107.42	(72)

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

(73)m=	356.32	354.15	342.63	324.44	306.29	288.85	277.64	283.22	292.71	311.08	331.99	347.36	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.6	x	10.63	x	0.63	x	0.7	=	14.95	(74)
North	0.9x	0.77	x	4.6	x	20.32	x	0.63	x	0.7	=	28.57	(74)
North	0.9x	0.77	x	4.6	x	34.53	x	0.63	x	0.7	=	48.54	(74)
North	0.9x	0.77	x	4.6	x	55.46	x	0.63	x	0.7	=	77.97	(74)
North	0.9x	0.77	x	4.6	x	74.72	x	0.63	x	0.7	=	105.04	(74)
North	0.9x	0.77	x	4.6	x	79.99	x	0.63	x	0.7	=	112.44	(74)
North	0.9x	0.77	x	4.6	x	74.68	x	0.63	x	0.7	=	104.98	(74)
North	0.9x	0.77	x	4.6	x	59.25	x	0.63	x	0.7	=	83.29	(74)

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North	0.9x	0.77	x	4.6	x	41.52	x	0.63	x	0.7	=	58.36	(74)
North	0.9x	0.77	x	4.6	x	24.19	x	0.63	x	0.7	=	34.01	(74)
North	0.9x	0.77	x	4.6	x	13.12	x	0.63	x	0.7	=	18.44	(74)
North	0.9x	0.77	x	4.6	x	8.86	x	0.63	x	0.7	=	12.46	(74)

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

(83)m=	14.95	28.57	48.54	77.97	105.04	112.44	104.98	83.29	58.36	34.01	18.44	12.46	(83)

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

(84)m=	371.27	382.71	391.18	402.42	411.33	401.3	382.63	366.51	351.07	345.09	350.43	359.82	(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	0.99	0.95	0.85	0.69	0.74	0.92	0.99	1	1	(86)

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

(87)m=	19.86	19.94	20.12	20.39	20.67	20.89	20.97	20.96	20.81	20.48	20.13	19.84	(87)

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

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

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

(89)m=	1	1	0.99	0.98	0.93	0.77	0.56	0.61	0.87	0.98	0.99	1	(89)

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

(90)m=	18.49	18.61	18.87	19.27	19.67	19.95	20.02	20.01	19.86	19.4	18.89	18.47	(90)

fLA = Living area ÷ (4) = 0.61 (91)

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

(92)m=	19.33	19.42	19.64	19.96	20.28	20.53	20.6	20.59	20.44	20.06	19.65	19.31	(92)

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

(93)m=	19.33	19.42	19.64	19.96	20.28	20.53	20.6	20.59	20.44	20.06	19.65	19.31	(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	0.99	0.98	0.94	0.82	0.64	0.69	0.9	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	369.86	380.75	387.67	393.69	385.21	327.35	244.5	251.51	314.56	337.51	348.06	358.66	(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=	980.68	945.94	853.82	711.7	551.42	377.51	255	266.77	405.34	607.72	809.23	978.12	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	454.45	379.81	346.81	228.96	123.66	0	0	0	0	201.04	332.04	460.88	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2527.65 (98)

Space heating requirement in kWh/m²/year 42.21 (99)

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

Space heating:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	454.45	379.81	346.81	228.96	123.66	0	0	0	0	201.04	332.04	460.88		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	486.05	406.21	370.92	244.88	132.25	0	0	0	0	215.01	355.13	492.92		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2703.37	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	179.03	157.91	166.12	149.29	146.58	131.37	126.54	138.34	137.93	154.79	163.2	174.85		
Efficiency of water heater													79.8	(216)
(217)m=	87.2	87.07	86.73	85.95	84.36	79.8	79.8	79.8	79.8	85.51	86.67	87.28		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	205.32	181.36	191.52	173.7	173.75	164.62	158.58	173.36	172.85	181.02	188.29	200.33		
Total = Sum(219a)$_{1...12}$ =													2164.68	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2703.37	
Water heating fuel used			2164.68	
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			330.56	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	583.93	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	467.57	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1051.5	(265)

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Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	171.56	(268)
Total CO2, kg/year		sum of (265)…(271) =		1261.99	(272)

TER =	21.08	(273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Gate House (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	36.22	(1a)	x	3.2	(2a)	=	115.9	(3a)
Ground floor	47.4	(1b)	x	3.2	(2b)	=	151.68	(3b)
First floor	36.22	(1c)	x	3.2	(2c)	=	115.9	(3c)
Second floor	37.02	(1d)	x	2.76	(2d)	=	102.18	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	156.86	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	485.66	(5)

2. Ventilation rate:

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

DRAFT

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.08	(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)	0.33	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(21)

Infiltration rate modified for monthly wind speed

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

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Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.39	0.38	0.38	0.34	0.33	0.29	0.29	0.28	0.31	0.33	0.35	0.36

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			4.08	x	1	=	4.08			(26)
Doors Type 2			2.43	x	1	=	2.43			(26)
Doors Type 3			2.43	x	1	=	2.43			(26)
Windows Type 1			0.408		x1/[1/(1.4)+ 0.04]	=	0.54			(27)
Windows Type 2			1.84		x1/[1/(1.4)+ 0.04]	=	2.44			(27)
Windows Type 3			0.408		x1/[1/(1.4)+ 0.04]	=	0.54			(27)
Windows Type 4			1.84		x1/[1/(1.4)+ 0.04]	=	2.44			(27)
Windows Type 5			0.907		x1/[1/(1.4)+ 0.04]	=	1.2			(27)
Windows Type 6			0.907		x1/[1/(1.4)+ 0.04]	=	1.2			(27)
Windows Type 7			1.34		x1/[1/(1.4)+ 0.04]	=	1.78			(27)
Windows Type 8			2.72		x1/[1/(1.4)+ 0.04]	=	3.61			(27)
Windows Type 9			1.82		x1/[1/(1.4)+ 0.04]	=	2.41			(27)
Windows Type 10			2.72		x1/[1/(1.4)+ 0.04]	=	3.61			(27)
Windows Type 11			1.45		x1/[1/(1.4)+ 0.04]	=	1.92			(27)

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Windows Type 12			2.91	x1/[1/(1.4)+ 0.04] =		3.86			(27)
Windows Type 13			0.58	x1/[1/(1.4)+ 0.04] =		0.77			(27)
Floor Type 1			36.22	x	0.13	= 4.7086			(28)
Floor Type 2			47.41	x	0.13	= 6.1633			(28)
Walls Type1	66.24	4.08	62.16	x	0.18	= 11.19			(29)
Walls Type2	76.51	11.17	65.34	x	0.18	= 11.76			(29)
Walls Type3	66.24	8.6	57.64	x	0.18	= 10.38			(29)
Walls Type4	75.9	4.94	70.96	x	0.18	= 12.77			(29)
Roof	45	0	45	x	0.13	= 5.85			(30)
Total area of elements, m²			413.52						(31)
Party wall			14.08	x	0	= 0			(32)
Party wall			14.08	x	0	= 0			(32)
Party wall			14.08	x	0	= 0			(32)
Party wall			9.91	x	0	= 0			(32)
Party floor			36.22						(32a)
Party floor			37.02						(32a)
Party ceiling			36.22						(32b)
Party ceiling			47.4						(32b)
Party ceiling			36.22						(32b)

** 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) = 98.08 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 37002.6 (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 20.68 (36)

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

Total fabric heat loss (33) + (36) = 118.75 (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=	92.45	91.97	91.5	89.3	88.89	86.97	86.97	86.61	87.71	88.89	89.72	90.59	(38)

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

(39)m=	211.2	210.72	210.25	208.05	207.64	205.72	205.72	205.37	206.46	207.64	208.47	209.34	

Average = Sum(39)1…12 /12= 208.05 (39)

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

(40)m=	1.35	1.34	1.34	1.33	1.32	1.31	1.31	1.31	1.32	1.32	1.33	1.33

Average = Sum(40)1…12 /12= 1.33 (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 2.94 (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) + 36 104.13 (43)

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

(45)m=	169.86	148.56	153.31	133.66	128.25	110.67	102.55	117.68	119.08	138.78	151.49	164.5

Total = Sum(45)1...12 = 1638.38 (45)

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

(46)m=	25.48	22.28	23	20.05	19.24	16.6	15.38	17.65	17.86	20.82	22.72	24.68	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 2.13 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 1.15 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 1.15 (55)

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

(56)m=	35.73	32.27	35.73	34.57	35.73	34.57	35.73	35.73	34.57	35.73	34.57	35.73	(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=	35.73	32.27	35.73	34.57	35.73	34.57	35.73	35.73	34.57	35.73	34.57	35.73	(57)

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

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

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

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

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

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

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

(62)m=	228.85	201.85	212.29	190.74	187.23	167.75	161.54	176.67	176.17	197.77	208.57	223.49	(62)

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

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

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

Output from water heater

(64)m=	228.85	201.85	212.29	190.74	187.23	167.75	161.54	176.67	176.17	197.77	208.57	223.49

Output from water heater (annual)1...12 2332.93 (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=	103.67	92.02	98.17	90.11	89.83	82.47	81.29	86.32	85.26	93.33	96.04	101.89	(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

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(66)m=	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	(66)

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

(67)m=	32.07	28.48	23.16	17.54	13.11	11.07	11.96	15.54	20.86	26.49	30.92	32.96	(67)

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

(68)m=	327.89	331.29	322.72	304.46	281.42	259.77	245.3	241.9	250.47	268.73	291.77	313.42	(68)

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

(69)m=	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	(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=	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	(71)

Water heating gains (Table 5)

(72)m=	139.34	136.94	131.94	125.15	120.74	114.54	109.26	116.02	118.42	125.45	133.39	136.95	(72)

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

(73)m=	569.47	566.88	547.99	517.32	485.44	455.54	436.68	443.63	459.92	490.83	526.24	553.49	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	0.41	x	10.63	x	0.63	x	0.7	=	1.33	(74)
North	0.9x	0.77	x	1.84	x	10.63	x	0.63	x	0.7	=	5.98	(74)
North	0.9x	0.77	x	1.34	x	10.63	x	0.63	x	0.7	=	4.35	(74)
North	0.9x	0.77	x	2.72	x	10.63	x	0.63	x	0.7	=	8.84	(74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	4.71	(74)
North	0.9x	0.77	x	0.58	x	10.63	x	0.63	x	0.7	=	1.88	(74)
North	0.9x	0.77	x	0.41	x	20.32	x	0.63	x	0.7	=	2.53	(74)
North	0.9x	0.77	x	1.84	x	20.32	x	0.63	x	0.7	=	11.43	(74)
North	0.9x	0.77	x	1.34	x	20.32	x	0.63	x	0.7	=	8.32	(74)
North	0.9x	0.77	x	2.72	x	20.32	x	0.63	x	0.7	=	16.89	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	9.01	(74)
North	0.9x	0.77	x	0.58	x	20.32	x	0.63	x	0.7	=	3.6	(74)
North	0.9x	0.77	x	0.41	x	34.53	x	0.63	x	0.7	=	4.31	(74)
North	0.9x	0.77	x	1.84	x	34.53	x	0.63	x	0.7	=	19.42	(74)
North	0.9x	0.77	x	1.34	x	34.53	x	0.63	x	0.7	=	14.14	(74)
North	0.9x	0.77	x	2.72	x	34.53	x	0.63	x	0.7	=	28.7	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	15.3	(74)
North	0.9x	0.77	x	0.58	x	34.53	x	0.63	x	0.7	=	6.12	(74)
North	0.9x	0.77	x	0.41	x	55.46	x	0.63	x	0.7	=	6.92	(74)
North	0.9x	0.77	x	1.84	x	55.46	x	0.63	x	0.7	=	31.19	(74)
North	0.9x	0.77	x	1.34	x	55.46	x	0.63	x	0.7	=	22.71	(74)

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North	0.9x	0.77	x	2.72	x	55.46	x	0.63	x	0.7	=	46.11	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	24.58	(74)
North	0.9x	0.77	x	0.58	x	55.46	x	0.63	x	0.7	=	9.83	(74)
North	0.9x	0.77	x	0.41	x	74.72	x	0.63	x	0.7	=	9.32	(74)
North	0.9x	0.77	x	1.84	x	74.72	x	0.63	x	0.7	=	42.01	(74)
North	0.9x	0.77	x	1.34	x	74.72	x	0.63	x	0.7	=	30.6	(74)
North	0.9x	0.77	x	2.72	x	74.72	x	0.63	x	0.7	=	62.11	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	33.11	(74)
North	0.9x	0.77	x	0.58	x	74.72	x	0.63	x	0.7	=	13.24	(74)
North	0.9x	0.77	x	0.41	x	79.99	x	0.63	x	0.7	=	9.97	(74)
North	0.9x	0.77	x	1.84	x	79.99	x	0.63	x	0.7	=	44.98	(74)
North	0.9x	0.77	x	1.34	x	79.99	x	0.63	x	0.7	=	32.76	(74)
North	0.9x	0.77	x	2.72	x	79.99	x	0.63	x	0.7	=	66.49	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	35.44	(74)
North	0.9x	0.77	x	0.58	x	79.99	x	0.63	x	0.7	=	14.18	(74)
North	0.9x	0.77	x	0.41	x	74.68	x	0.63	x	0.7	=	9.31	(74)
North	0.9x	0.77	x	1.84	x	74.68	x	0.63	x	0.7	=	41.99	(74)
North	0.9x	0.77	x	1.34	x	74.68	x	0.63	x	0.7	=	30.58	(74)
North	0.9x	0.77	x	2.72	x	74.68	x	0.63	x	0.7	=	62.08	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	33.09	(74)
North	0.9x	0.77	x	0.58	x	74.68	x	0.63	x	0.7	=	13.24	(74)
North	0.9x	0.77	x	0.41	x	59.25	x	0.63	x	0.7	=	7.39	(74)
North	0.9x	0.77	x	1.84	x	59.25	x	0.63	x	0.7	=	33.32	(74)
North	0.9x	0.77	x	1.34	x	59.25	x	0.63	x	0.7	=	24.26	(74)
North	0.9x	0.77	x	2.72	x	59.25	x	0.63	x	0.7	=	49.25	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	0.58	x	59.25	x	0.63	x	0.7	=	10.5	(74)
North	0.9x	0.77	x	0.41	x	41.52	x	0.63	x	0.7	=	5.18	(74)
North	0.9x	0.77	x	1.84	x	41.52	x	0.63	x	0.7	=	23.35	(74)
North	0.9x	0.77	x	1.34	x	41.52	x	0.63	x	0.7	=	17	(74)
North	0.9x	0.77	x	2.72	x	41.52	x	0.63	x	0.7	=	34.51	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	0.58	x	41.52	x	0.63	x	0.7	=	7.36	(74)
North	0.9x	0.77	x	0.41	x	24.19	x	0.63	x	0.7	=	3.02	(74)
North	0.9x	0.77	x	1.84	x	24.19	x	0.63	x	0.7	=	13.6	(74)
North	0.9x	0.77	x	1.34	x	24.19	x	0.63	x	0.7	=	9.91	(74)
North	0.9x	0.77	x	2.72	x	24.19	x	0.63	x	0.7	=	20.11	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	10.72	(74)
North	0.9x	0.77	x	0.58	x	24.19	x	0.63	x	0.7	=	4.29	(74)
North	0.9x	0.77	x	0.41	x	13.12	x	0.63	x	0.7	=	1.64	(74)
North	0.9x	0.77	x	1.84	x	13.12	x	0.63	x	0.7	=	7.38	(74)

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North	0.9x	0.77	x	1.34	x	13.12	x	0.63	x	0.7	=	5.37	(74)
North	0.9x	0.77	x	2.72	x	13.12	x	0.63	x	0.7	=	10.9	(74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)
North	0.9x	0.77	x	0.58	x	13.12	x	0.63	x	0.7	=	2.33	(74)
North	0.9x	0.77	x	0.41	x	8.86	x	0.63	x	0.7	=	1.11	(74)
North	0.9x	0.77	x	1.84	x	8.86	x	0.63	x	0.7	=	4.98	(74)
North	0.9x	0.77	x	1.34	x	8.86	x	0.63	x	0.7	=	3.63	(74)
North	0.9x	0.77	x	2.72	x	8.86	x	0.63	x	0.7	=	7.37	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	0.58	x	8.86	x	0.63	x	0.7	=	1.57	(74)
Northeast	0.9x	0.77	x	0.91	x	11.28	x	0.63	x	0.7	=	3.13	(75)
Northeast	0.9x	0.77	x	0.91	x	22.97	x	0.63	x	0.7	=	6.37	(75)
Northeast	0.9x	0.77	x	0.91	x	41.38	x	0.63	x	0.7	=	11.47	(75)
Northeast	0.9x	0.77	x	0.91	x	67.96	x	0.63	x	0.7	=	18.84	(75)
Northeast	0.9x	0.77	x	0.91	x	91.35	x	0.63	x	0.7	=	25.32	(75)
Northeast	0.9x	0.77	x	0.91	x	97.38	x	0.63	x	0.7	=	26.99	(75)
Northeast	0.9x	0.77	x	0.91	x	91.1	x	0.63	x	0.7	=	25.25	(75)
Northeast	0.9x	0.77	x	0.91	x	72.63	x	0.63	x	0.7	=	20.13	(75)
Northeast	0.9x	0.77	x	0.91	x	50.42	x	0.63	x	0.7	=	13.98	(75)
Northeast	0.9x	0.77	x	0.91	x	28.07	x	0.63	x	0.7	=	7.78	(75)
Northeast	0.9x	0.77	x	0.91	x	14.2	x	0.63	x	0.7	=	3.94	(75)
Northeast	0.9x	0.77	x	0.91	x	9.21	x	0.63	x	0.7	=	2.55	(75)
South	0.9x	0.77	x	0.41	x	46.75	x	0.63	x	0.7	=	5.83	(78)
South	0.9x	0.77	x	1.84	x	46.75	x	0.63	x	0.7	=	26.29	(78)
South	0.9x	0.77	x	1.82	x	46.75	x	0.63	x	0.7	=	26	(78)
South	0.9x	0.77	x	2.72	x	46.75	x	0.63	x	0.7	=	38.86	(78)
South	0.9x	0.77	x	2.91	x	46.75	x	0.63	x	0.7	=	41.58	(78)
South	0.9x	0.77	x	0.41	x	76.57	x	0.63	x	0.7	=	9.55	(78)
South	0.9x	0.77	x	1.84	x	76.57	x	0.63	x	0.7	=	43.06	(78)
South	0.9x	0.77	x	1.82	x	76.57	x	0.63	x	0.7	=	42.59	(78)
South	0.9x	0.77	x	2.72	x	76.57	x	0.63	x	0.7	=	63.65	(78)
South	0.9x	0.77	x	2.91	x	76.57	x	0.63	x	0.7	=	68.09	(78)
South	0.9x	0.77	x	0.41	x	97.53	x	0.63	x	0.7	=	12.16	(78)
South	0.9x	0.77	x	1.84	x	97.53	x	0.63	x	0.7	=	54.85	(78)
South	0.9x	0.77	x	1.82	x	97.53	x	0.63	x	0.7	=	54.25	(78)
South	0.9x	0.77	x	2.72	x	97.53	x	0.63	x	0.7	=	81.08	(78)
South	0.9x	0.77	x	2.91	x	97.53	x	0.63	x	0.7	=	86.74	(78)
South	0.9x	0.77	x	0.41	x	110.23	x	0.63	x	0.7	=	13.75	(78)
South	0.9x	0.77	x	1.84	x	110.23	x	0.63	x	0.7	=	61.99	(78)
South	0.9x	0.77	x	1.82	x	110.23	x	0.63	x	0.7	=	61.31	(78)
South	0.9x	0.77	x	2.72	x	110.23	x	0.63	x	0.7	=	91.63	(78)

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South	0.9x	0.77	x	2.91	x	110.23	x	0.63	x	0.7	=	98.04 (78)
South	0.9x	0.77	x	0.41	x	114.87	x	0.63	x	0.7	=	14.32 (78)
South	0.9x	0.77	x	1.84	x	114.87	x	0.63	x	0.7	=	64.6 (78)
South	0.9x	0.77	x	1.82	x	114.87	x	0.63	x	0.7	=	63.89 (78)
South	0.9x	0.77	x	2.72	x	114.87	x	0.63	x	0.7	=	95.49 (78)
South	0.9x	0.77	x	2.91	x	114.87	x	0.63	x	0.7	=	102.16 (78)
South	0.9x	0.77	x	0.41	x	110.55	x	0.63	x	0.7	=	13.78 (78)
South	0.9x	0.77	x	1.84	x	110.55	x	0.63	x	0.7	=	62.16 (78)
South	0.9x	0.77	x	1.82	x	110.55	x	0.63	x	0.7	=	61.49 (78)
South	0.9x	0.77	x	2.72	x	110.55	x	0.63	x	0.7	=	91.89 (78)
South	0.9x	0.77	x	2.91	x	110.55	x	0.63	x	0.7	=	98.31 (78)
South	0.9x	0.77	x	0.41	x	108.01	x	0.63	x	0.7	=	13.47 (78)
South	0.9x	0.77	x	1.84	x	108.01	x	0.63	x	0.7	=	60.74 (78)
South	0.9x	0.77	x	1.82	x	108.01	x	0.63	x	0.7	=	60.08 (78)
South	0.9x	0.77	x	2.72	x	108.01	x	0.63	x	0.7	=	89.79 (78)
South	0.9x	0.77	x	2.91	x	108.01	x	0.63	x	0.7	=	96.06 (78)
South	0.9x	0.77	x	0.41	x	104.89	x	0.63	x	0.7	=	13.08 (78)
South	0.9x	0.77	x	1.84	x	104.89	x	0.63	x	0.7	=	58.99 (78)
South	0.9x	0.77	x	1.82	x	104.89	x	0.63	x	0.7	=	58.34 (78)
South	0.9x	0.77	x	2.72	x	104.89	x	0.63	x	0.7	=	87.2 (78)
South	0.9x	0.77	x	2.91	x	104.89	x	0.63	x	0.7	=	93.29 (78)
South	0.9x	0.77	x	0.41	x	101.89	x	0.63	x	0.7	=	12.7 (78)
South	0.9x	0.77	x	1.84	x	101.89	x	0.63	x	0.7	=	57.29 (78)
South	0.9x	0.77	x	1.82	x	101.89	x	0.63	x	0.7	=	56.67 (78)
South	0.9x	0.77	x	2.72	x	101.89	x	0.63	x	0.7	=	84.69 (78)
South	0.9x	0.77	x	2.91	x	101.89	x	0.63	x	0.7	=	90.61 (78)
South	0.9x	0.77	x	0.41	x	82.59	x	0.63	x	0.7	=	10.3 (78)
South	0.9x	0.77	x	1.84	x	82.59	x	0.63	x	0.7	=	46.44 (78)
South	0.9x	0.77	x	1.82	x	82.59	x	0.63	x	0.7	=	45.94 (78)
South	0.9x	0.77	x	2.72	x	82.59	x	0.63	x	0.7	=	68.65 (78)
South	0.9x	0.77	x	2.91	x	82.59	x	0.63	x	0.7	=	73.45 (78)
South	0.9x	0.77	x	0.41	x	55.42	x	0.63	x	0.7	=	6.91 (78)
South	0.9x	0.77	x	1.84	x	55.42	x	0.63	x	0.7	=	31.16 (78)
South	0.9x	0.77	x	1.82	x	55.42	x	0.63	x	0.7	=	30.82 (78)
South	0.9x	0.77	x	2.72	x	55.42	x	0.63	x	0.7	=	46.07 (78)
South	0.9x	0.77	x	2.91	x	55.42	x	0.63	x	0.7	=	49.28 (78)
South	0.9x	0.77	x	0.41	x	40.4	x	0.63	x	0.7	=	5.04 (78)
South	0.9x	0.77	x	1.84	x	40.4	x	0.63	x	0.7	=	22.72 (78)
South	0.9x	0.77	x	1.82	x	40.4	x	0.63	x	0.7	=	22.47 (78)
South	0.9x	0.77	x	2.72	x	40.4	x	0.63	x	0.7	=	33.58 (78)
South	0.9x	0.77	x	2.91	x	40.4	x	0.63	x	0.7	=	35.93 (78)

Northwest	0.9x	0.77	x	0.91	x	11.28	x	0.63	x	0.7	=	3.13	(81)
Northwest	0.9x	0.77	x	0.91	x	22.97	x	0.63	x	0.7	=	6.37	(81)
Northwest	0.9x	0.77	x	0.91	x	41.38	x	0.63	x	0.7	=	11.47	(81)
Northwest	0.9x	0.77	x	0.91	x	67.96	x	0.63	x	0.7	=	18.84	(81)
Northwest	0.9x	0.77	x	0.91	x	91.35	x	0.63	x	0.7	=	25.32	(81)
Northwest	0.9x	0.77	x	0.91	x	97.38	x	0.63	x	0.7	=	26.99	(81)
Northwest	0.9x	0.77	x	0.91	x	91.1	x	0.63	x	0.7	=	25.25	(81)
Northwest	0.9x	0.77	x	0.91	x	72.63	x	0.63	x	0.7	=	20.13	(81)
Northwest	0.9x	0.77	x	0.91	x	50.42	x	0.63	x	0.7	=	13.98	(81)
Northwest	0.9x	0.77	x	0.91	x	28.07	x	0.63	x	0.7	=	7.78	(81)
Northwest	0.9x	0.77	x	0.91	x	14.2	x	0.63	x	0.7	=	3.94	(81)
Northwest	0.9x	0.77	x	0.91	x	9.21	x	0.63	x	0.7	=	2.55	(81)

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

(83)m=	171.92	291.45	400	505.72	581.49	585.45	560.93	502.12	435.72	321.97	205.54	147.43	(83)

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

(84)m=	741.38	858.33	947.99	1023.04	1066.93	1040.99	997.61	945.75	895.64	812.8	731.78	700.92	(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=	1	1	1	0.99	0.97	0.9	0.78	0.82	0.95	0.99	1	1	(86)

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

(87)m=	19.39	19.53	19.78	20.13	20.48	20.78	20.92	20.9	20.67	20.21	19.74	19.37	(87)

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

(88)m=	19.8	19.81	19.81	19.82	19.82	19.83	19.83	19.83	19.83	19.82	19.82	19.81	(88)

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

(89)m=	1	1	0.99	0.98	0.95	0.83	0.63	0.68	0.91	0.99	1	1	(89)

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

(90)m=	17.66	17.87	18.24	18.75	19.25	19.65	19.8	19.78	19.52	18.88	18.19	17.63	(90)

fLA = Living area ÷ (4) = 0.22 (91)

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

(92)m=	18.04	18.24	18.58	19.05	19.52	19.9	20.05	20.03	19.77	19.17	18.53	18.02	(92)

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

(93)m=	18.04	18.24	18.58	19.05	19.52	19.9	20.05	20.03	19.77	19.17	18.53	18.02	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.94	0.84	0.66	0.71	0.91	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	740.09	855.27	940.59	1002.32	1005.55	872.22	657.89	672.46	814.42	799.63	729.23	699.98	(95)

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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=	2902.75	2811.28	2539.98	2112.33	1624.32	1091.11	709.48	745.88	1171.15	1780.42	2383.44	2893.24	(97)

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

(98)m=	1609.02	1314.44	1189.95	799.21	460.37	0	0	0	0	729.7	1191.03	1631.78	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 8925.5 (98)

Space heating requirement in kWh/m²/year 56.9 (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		93.5	(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)	1609.02	1314.44	1189.95	799.21	460.37	0	0	0	0	729.7	1191.03	1631.78		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1720.88	1405.82	1272.67	854.77	492.37	0	0	0	0	780.43	1273.83	1745.22		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													9545.99	(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)	228.85	201.85	212.29	190.74	187.23	167.75	161.54	176.67	176.17	197.77	208.57	223.49		
Efficiency of water heater													79.8	(216)
(217)m=	89.01	88.91	88.7	88.22	87.12	79.8	79.8	79.8	79.8	87.98	88.73	89.06		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	257.1	227.01	239.34	216.21	214.91	210.22	202.43	221.38	220.76	224.78	235.07	250.94		
Total = Sum(219a)$_{1...12}$ =													2720.16	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			9545.99	
Water heating fuel used			2720.16	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)

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Electricity for lighting				566.3	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	2061.93	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	587.55	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2649.49	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	293.91	(268)
Total CO2, kg/year		sum of (265)…(271) =		2982.32	(272)

TER =	19.01	(273)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.4.23

Property Address: Triplex (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	70.32	(1a)	x	3.2	(2a)	=	225.02	(3a)
Ground floor	82.3	(1b)	x	3.2	(2b)	=	263.36	(3b)
First floor	115	(1c)	x	2.7	(2c)	=	310.5	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	267.62	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	798.88	(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) =	0.05	(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)	0.3	(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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.33	0.32	0.31	0.28	0.27	0.24	0.24	0.24	0.26	0.27	0.29	0.3

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			3.36	x	1	=	3.36			(26)
Doors Type 2			2.8	x	1.2	=	3.36			(26)
Windows Type 1			2.72		x1/[1/(1.4)+ 0.04]	=	3.61			(27)
Windows Type 2			6.18		x1/[1/(1.4)+ 0.04]	=	8.19			(27)
Windows Type 3			5.44		x1/[1/(1.4)+ 0.04]	=	7.21			(27)
Windows Type 4			1.81		x1/[1/(1.4)+ 0.04]	=	2.4			(27)
Windows Type 5			4.55		x1/[1/(1.4)+ 0.04]	=	6.03			(27)
Windows Type 6			4.37		x1/[1/(1.4)+ 0.04]	=	5.79			(27)
Floor Type 1			70.32	x	0.13	=	9.1416			(28)
Floor Type 2			11.98	x	0.13	=	1.5574			(28)
Walls Type1	69.25	6.16	63.09	x	0.18	=	11.36			(29)
Walls Type2	38.21	0	38.21	x	0.18	=	6.88			(29)
Walls Type3	73.6	8.9	64.7	x	0.18	=	11.65			(29)
Walls Type4	28.32	0	28.32	x	0.18	=	5.1			(29)
Walls Type5	90.99	16.17	74.82	x	0.18	=	13.47			(29)
Walls Type6	28.89	0	28.89	x	0.18	=	5.2			(29)
Roof	9.61	0	9.61	x	0.13	=	1.25			(30)

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Total area of elements, m²	421.17						(31)
Party wall	25.35	x	0	=	0		(32)
Party floor	70.32						(32a)
Party floor	105.39						(32a)
Party ceiling	70.32						(32b)
Party ceiling	70.32						(32b)

** 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) =	105.55	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	51368.19	(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		21.06	(36)

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

Total fabric heat loss	(33) + (36) =	126.61	(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=	145.76	145.21	144.68	142.19	141.73	139.56	139.56	139.15	140.39	141.73	142.67	143.66	(38)

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

(39)m=	272.36	271.82	271.29	268.8	268.33	266.16	266.16	265.76	267	268.33	269.28	270.26	

Average = Sum(39)$_{1\ldots12}$ /12= 268.8 (39)

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

(40)m=	1.02	1.02	1.01	1	1	0.99	0.99	0.99	1	1	1.01	1.01	

Average = Sum(40)$_{1\ldots12}$ /12= 1 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 3.09 (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 — 107.58 (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=	118.34	114.04	109.74	105.43	101.13	96.83	96.83	101.13	105.43	109.74	114.04	118.34	

Total = Sum(44)$_{1\ldots12}$ = 1291 (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=	175.5	153.49	158.39	138.09	132.5	114.34	105.95	121.58	123.03	143.38	156.51	169.96	

Total = Sum(45)$_{1\ldots12}$ = 1692.71 (45)

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

(46)m=	26.32	23.02	23.76	20.71	19.87	17.15	15.89	18.24	18.45	21.51	23.48	25.49	(46)

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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		150	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)			
Water storage loss:			
a) If manufacturer's declared loss factor is known (kWh/day):		2.13	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	1.15	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		1.15	(55)

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

(56)m=	35.73	32.27	35.73	34.57	35.73	34.57	35.73	35.73	34.57	35.73	34.57	35.73	(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=	35.73	32.27	35.73	34.57	35.73	34.57	35.73	35.73	34.57	35.73	34.57	35.73	(57)

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

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

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

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

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

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

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

(62)m=	234.49	206.77	217.38	195.17	191.49	171.42	164.94	180.57	180.12	202.37	213.6	228.95	(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=	234.49	206.77	217.38	195.17	191.49	171.42	164.94	180.57	180.12	202.37	213.6	228.95

Output from water heater (annual)1…12 — 2387.26 (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=	105.54	93.66	99.86	91.58	91.25	83.69	82.42	87.62	86.58	94.87	97.71	103.7	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	(66)

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

(67)m=	44.45	39.48	32.11	24.31	18.17	15.34	16.57	21.54	28.92	36.72	42.85	45.68	(67)

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

(68)m=	431.48	435.96	424.68	400.66	370.34	341.84	322.8	318.32	329.61	353.63	383.95	412.44	(68)

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

(69)m=	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	(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=	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	(71)

Water heating gains (Table 5)

(72)m=	141.86	139.38	134.21	127.2	122.64	116.23	110.78	117.76	120.25	127.51	135.71	139.39	(72)

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

(73)m=	690.14	687.16	663.35	624.51	583.5	545.76	522.5	529.98	551.11	590.2	634.85	669.86	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.54	x	6.18	x	10.63	x	0.63	x	0.7	=	14.08	(74)
North	0.9x	0.77	x	5.44	x	10.63	x	0.63	x	0.7	=	17.68	(74)
North	0.9x	0.54	x	6.18	x	20.32	x	0.63	x	0.7	=	26.92	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.63	x	0.7	=	33.78	(74)
North	0.9x	0.54	x	6.18	x	34.53	x	0.63	x	0.7	=	45.74	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.63	x	0.7	=	57.41	(74)
North	0.9x	0.54	x	6.18	x	55.46	x	0.63	x	0.7	=	73.46	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.63	x	0.7	=	92.21	(74)
North	0.9x	0.54	x	6.18	x	74.72	x	0.63	x	0.7	=	98.96	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.63	x	0.7	=	124.22	(74)
North	0.9x	0.54	x	6.18	x	79.99	x	0.63	x	0.7	=	105.94	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.63	x	0.7	=	132.98	(74)
North	0.9x	0.54	x	6.18	x	74.68	x	0.63	x	0.7	=	98.91	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.63	x	0.7	=	124.15	(74)
North	0.9x	0.54	x	6.18	x	59.25	x	0.63	x	0.7	=	78.47	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.63	x	0.7	=	98.5	(74)
North	0.9x	0.54	x	6.18	x	41.52	x	0.63	x	0.7	=	54.99	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.63	x	0.7	=	69.02	(74)
North	0.9x	0.54	x	6.18	x	24.19	x	0.63	x	0.7	=	32.04	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.63	x	0.7	=	40.22	(74)
North	0.9x	0.54	x	6.18	x	13.12	x	0.63	x	0.7	=	17.37	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.63	x	0.7	=	21.81	(74)
North	0.9x	0.54	x	6.18	x	8.86	x	0.63	x	0.7	=	11.74	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.63	x	0.7	=	14.74	(74)
South	0.9x	0.77	x	2.72	x	46.75	x	0.63	x	0.7	=	38.86	(78)
South	0.9x	0.77	x	1.81	x	46.75	x	0.63	x	0.7	=	25.86	(78)

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South	0.9x	0.77	x	4.55	x	46.75	x	0.63	x	0.7	=	65.01	(78)
South	0.9x	0.77	x	4.37	x	46.75	x	0.63	x	0.7	=	62.44	(78)
South	0.9x	0.77	x	2.72	x	76.57	x	0.63	x	0.7	=	63.65	(78)
South	0.9x	0.77	x	1.81	x	76.57	x	0.63	x	0.7	=	42.35	(78)
South	0.9x	0.77	x	4.55	x	76.57	x	0.63	x	0.7	=	106.47	(78)
South	0.9x	0.77	x	4.37	x	76.57	x	0.63	x	0.7	=	102.26	(78)
South	0.9x	0.77	x	2.72	x	97.53	x	0.63	x	0.7	=	81.08	(78)
South	0.9x	0.77	x	1.81	x	97.53	x	0.63	x	0.7	=	53.95	(78)
South	0.9x	0.77	x	4.55	x	97.53	x	0.63	x	0.7	=	135.62	(78)
South	0.9x	0.77	x	4.37	x	97.53	x	0.63	x	0.7	=	130.26	(78)
South	0.9x	0.77	x	2.72	x	110.23	x	0.63	x	0.7	=	91.63	(78)
South	0.9x	0.77	x	1.81	x	110.23	x	0.63	x	0.7	=	60.98	(78)
South	0.9x	0.77	x	4.55	x	110.23	x	0.63	x	0.7	=	153.29	(78)
South	0.9x	0.77	x	4.37	x	110.23	x	0.63	x	0.7	=	147.22	(78)
South	0.9x	0.77	x	2.72	x	114.87	x	0.63	x	0.7	=	95.49	(78)
South	0.9x	0.77	x	1.81	x	114.87	x	0.63	x	0.7	=	63.54	(78)
South	0.9x	0.77	x	4.55	x	114.87	x	0.63	x	0.7	=	159.73	(78)
South	0.9x	0.77	x	4.37	x	114.87	x	0.63	x	0.7	=	153.41	(78)
South	0.9x	0.77	x	2.72	x	110.55	x	0.63	x	0.7	=	91.89	(78)
South	0.9x	0.77	x	1.81	x	110.55	x	0.63	x	0.7	=	61.15	(78)
South	0.9x	0.77	x	4.55	x	110.55	x	0.63	x	0.7	=	153.72	(78)
South	0.9x	0.77	x	4.37	x	110.55	x	0.63	x	0.7	=	147.64	(78)
South	0.9x	0.77	x	2.72	x	108.01	x	0.63	x	0.7	=	89.79	(78)
South	0.9x	0.77	x	1.81	x	108.01	x	0.63	x	0.7	=	59.75	(78)
South	0.9x	0.77	x	4.55	x	108.01	x	0.63	x	0.7	=	150.19	(78)
South	0.9x	0.77	x	4.37	x	108.01	x	0.63	x	0.7	=	144.25	(78)
South	0.9x	0.77	x	2.72	x	104.89	x	0.63	x	0.7	=	87.2	(78)
South	0.9x	0.77	x	1.81	x	104.89	x	0.63	x	0.7	=	58.02	(78)
South	0.9x	0.77	x	4.55	x	104.89	x	0.63	x	0.7	=	145.86	(78)
South	0.9x	0.77	x	4.37	x	104.89	x	0.63	x	0.7	=	140.09	(78)
South	0.9x	0.77	x	2.72	x	101.89	x	0.63	x	0.7	=	84.69	(78)
South	0.9x	0.77	x	1.81	x	101.89	x	0.63	x	0.7	=	56.36	(78)
South	0.9x	0.77	x	4.55	x	101.89	x	0.63	x	0.7	=	141.68	(78)
South	0.9x	0.77	x	4.37	x	101.89	x	0.63	x	0.7	=	136.07	(78)
South	0.9x	0.77	x	2.72	x	82.59	x	0.63	x	0.7	=	68.65	(78)
South	0.9x	0.77	x	1.81	x	82.59	x	0.63	x	0.7	=	45.68	(78)
South	0.9x	0.77	x	4.55	x	82.59	x	0.63	x	0.7	=	114.84	(78)
South	0.9x	0.77	x	4.37	x	82.59	x	0.63	x	0.7	=	110.3	(78)
South	0.9x	0.77	x	2.72	x	55.42	x	0.63	x	0.7	=	46.07	(78)
South	0.9x	0.77	x	1.81	x	55.42	x	0.63	x	0.7	=	30.65	(78)
South	0.9x	0.77	x	4.55	x	55.42	x	0.63	x	0.7	=	77.06	(78)

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South	0.9x	0.77	x	4.37	x	55.42	x	0.63	x	0.7	=	74.01	(78)
South	0.9x	0.77	x	2.72	x	40.4	x	0.63	x	0.7	=	33.58	(78)
South	0.9x	0.77	x	1.81	x	40.4	x	0.63	x	0.7	=	22.35	(78)
South	0.9x	0.77	x	4.55	x	40.4	x	0.63	x	0.7	=	56.18	(78)
South	0.9x	0.77	x	4.37	x	40.4	x	0.63	x	0.7	=	53.95	(78)

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

(83)m=	223.94	375.43	504.06	618.79	695.36	693.33	667.05	608.14	542.81	411.72	266.98	192.54	(83)

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

(84)m=	914.08	1062.59	1167.4	1243.3	1278.85	1239.08	1189.55	1138.12	1093.93	1001.92	901.83	862.4	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	1	0.99	0.95	0.84	0.88	0.98	1	1	1	(86)

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

(87)m=	19.69	19.81	20	20.27	20.56	20.81	20.94	20.92	20.72	20.35	19.98	19.68	(87)

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

(88)m=	20.07	20.07	20.07	20.08	20.08	20.09	20.09	20.09	20.09	20.08	20.08	20.08	(88)

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

(89)m=	1	1	1	1	0.98	0.91	0.73	0.78	0.96	1	1	1	(89)

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

(90)m=	18.29	18.46	18.75	19.15	19.56	19.91	20.06	20.04	19.8	19.26	18.71	18.27	(90)

fLA = Living area ÷ (4) = 0.22 (91)

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

(92)m=	18.6	18.75	19.02	19.39	19.78	20.11	20.25	20.23	20	19.5	18.99	18.58	(92)

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

(93)m=	18.6	18.75	19.02	19.39	19.78	20.11	20.25	20.23	20	19.5	18.99	18.58	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.98	0.91	0.75	0.8	0.96	1	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	913.85	1061.92	1165.4	1236.25	1250.9	1129.07	894.7	909.35	1046.96	997.49	901.29	862.25	(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=	3893.62	3765.56	3396.95	2820.7	2166.83	1466.1	971.13	1018.57	1574.78	2389.08	3200.84	3885.13	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	2216.95	1816.85	1660.28	1140.8	681.45	0	0	0	0	1035.34	1655.67	2249.02	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 12456.37 (98)

Space heating requirement in kWh/m²/year 46.54 (99)

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

Space heating:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	2216.95	1816.85	1660.28	1140.8	681.45	0	0	0	0	1035.34	1655.67	2249.02		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	2371.07	1943.15	1775.7	1220.11	728.83	0	0	0	0	1107.32	1770.77	2405.37		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													13322.32	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	234.49	206.77	217.38	195.17	191.49	171.42	164.94	180.57	180.12	202.37	213.6	228.95		
Efficiency of water heater													79.8	(216)
(217)m=	89.35	89.28	89.12	88.76	87.91	79.8	79.8	79.8	79.8	88.56	89.13	89.39		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	262.42	231.61	243.93	219.89	217.81	214.82	206.69	226.27	225.71	228.51	239.63	256.12		
Total = Sum(219a)$_{1...12}$ =													2773.41	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			13322.32	
Water heating fuel used			2773.41	
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			784.96	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	2877.62	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	599.06	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3476.68	(265)

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Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	407.4	(268)
Total CO2, kg/year		sum of (265)…(271) =		3923	(272)

TER = 14.66 (273)

APPENDIX VII – BE-LEAN DER WORKSHEETS (NEW-BUILD)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 3 - 2B4P - GF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	140.3	(1a) x	2.7	(2a) =	378.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	140.3	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	378.81	(5)

2. Ventilation rate:

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

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration		0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate		(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.14	(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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

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

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.95 (23c)

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

(24a)m=	0.31	0.3	0.3	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.29	0.29	(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=	0.31	0.3	0.3	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.29	0.29	(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	
Windows Type 1			2.85	x1/[1/(1.1)+ 0.04]		=	3			(27)
Windows Type 2			2.85	x1/[1/(1.1)+ 0.04]		=	3			(27)
Windows Type 3			8.88	x1/[1/(1.1)+ 0.04]		=	9.36			(27)
Windows Type 4			2.67	x1/[1/(1.1)+ 0.04]		=	2.81			(27)
Windows Type 5			1.78	x1/[1/(1.1)+ 0.04]		=	1.88			(27)
Floor			139.42	x	0.11	=	15.3362			(28)
Walls Type1	99.06	27.4	71.66	x	0.12	=	8.6			(29)
Walls Type2	30.1	0	30.1	x	0.14	=	4.26			(29)
Total area of elements, m²			268.59							(31)
Party wall			25.35	x	0	=	0			(32)
Party ceiling			139.42							(32b)

** 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) = 57.07 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27783.44 (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 40.29 (36)

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

Total fabric heat loss (33) + (36) = 97.35 (37)

DER WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	38.4	37.96	37.53	35.36	34.93	32.76	32.76	32.33	33.63	34.93	35.8	36.66	(38)

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

(39)m=	135.75	135.32	134.88	132.72	132.28	130.11	130.11	129.68	130.98	132.28	133.15	134.02	

Average = Sum(39)$_{1\ldots12}$ /12= 132.61 (39)

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

(40)m=	0.97	0.96	0.96	0.95	0.94	0.93	0.93	0.92	0.93	0.94	0.95	0.96

Average = Sum(40)$_{1\ldots12}$ /12= 0.95 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.92 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 103.49 (43)

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

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

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

(44)m=	113.84	109.7	105.56	101.42	97.28	93.14	93.14	97.28	101.42	105.56	109.7	113.84

Total = Sum(44)$_{1\ldots12}$ = 1241.93 (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=	168.83	147.66	152.37	132.84	127.46	109.99	101.92	116.96	118.35	137.93	150.56	163.5

Total = Sum(45)$_{1\ldots12}$ = 1628.37 (45)

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

(46)m=	25.32	22.15	22.86	19.93	19.12	16.5	15.29	17.54	17.75	20.69	22.58	24.52	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.49 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.8 (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) 0.8 (55)

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

(56)m=	24.94	22.53	24.94	24.14	24.94	24.14	24.94	24.94	24.14	24.94	24.14	24.94	(56)

DER WorkSheet: New dwelling design stage

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=	24.94	22.53	24.94	24.14	24.94	24.14	24.94	24.94	24.14	24.94	24.14	24.94	(57)

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

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

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

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

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

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

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

(62)m=	217.03	191.2	200.57	179.49	175.67	156.64	150.13	165.16	165	186.13	197.21	211.7	(62)

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

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

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

Output from water heater

(64)m=	217.03	191.2	200.57	179.49	175.67	156.64	150.13	165.16	165	186.13	197.21	211.7

Output from water heater (annual)$_{1...12}$ — 2195.94 (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=	94.7	83.93	89.23	81.49	80.95	73.89	72.45	77.45	76.67	84.43	87.38	92.93	(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=	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	(66)

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

(67)m=	29.16	25.9	21.06	15.94	11.92	10.06	10.87	14.13	18.97	24.08	28.11	29.97	(67)

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

(68)m=	309.75	312.97	304.87	287.62	265.86	245.4	231.73	228.52	236.62	253.86	275.63	296.09	(68)

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

(69)m=	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

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

(71)m=	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	(71)

Water heating gains (Table 5)

(72)m=	127.28	124.89	119.93	113.18	108.8	102.63	97.38	104.1	106.49	113.48	121.36	124.9	(72)

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

(73)m=	535.96	533.52	515.62	486.51	456.34	427.85	409.75	416.52	431.84	461.18	494.87	520.72	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

DER WorkSheet: New dwelling design stage

Southeast	0.9x	0.54	x	8.88	x	36.79	x	0.45	x	0.67	=	47.88	(77)
Southeast	0.9x	0.54	x	1.78	x	36.79	x	0.45	x	0.67	=	9.6	(77)
Southeast	0.9x	0.54	x	8.88	x	62.67	x	0.45	x	0.67	=	81.55	(77)
Southeast	0.9x	0.54	x	1.78	x	62.67	x	0.45	x	0.67	=	16.35	(77)
Southeast	0.9x	0.54	x	8.88	x	85.75	x	0.45	x	0.67	=	111.58	(77)
Southeast	0.9x	0.54	x	1.78	x	85.75	x	0.45	x	0.67	=	22.37	(77)
Southeast	0.9x	0.54	x	8.88	x	106.25	x	0.45	x	0.67	=	138.25	(77)
Southeast	0.9x	0.54	x	1.78	x	106.25	x	0.45	x	0.67	=	27.71	(77)
Southeast	0.9x	0.54	x	8.88	x	119.01	x	0.45	x	0.67	=	154.85	(77)
Southeast	0.9x	0.54	x	1.78	x	119.01	x	0.45	x	0.67	=	31.04	(77)
Southeast	0.9x	0.54	x	8.88	x	118.15	x	0.45	x	0.67	=	153.73	(77)
Southeast	0.9x	0.54	x	1.78	x	118.15	x	0.45	x	0.67	=	30.82	(77)
Southeast	0.9x	0.54	x	8.88	x	113.91	x	0.45	x	0.67	=	148.22	(77)
Southeast	0.9x	0.54	x	1.78	x	113.91	x	0.45	x	0.67	=	29.71	(77)
Southeast	0.9x	0.54	x	8.88	x	104.39	x	0.45	x	0.67	=	135.83	(77)
Southeast	0.9x	0.54	x	1.78	x	104.39	x	0.45	x	0.67	=	27.23	(77)
Southeast	0.9x	0.54	x	8.88	x	92.85	x	0.45	x	0.67	=	120.82	(77)
Southeast	0.9x	0.54	x	1.78	x	92.85	x	0.45	x	0.67	=	24.22	(77)
Southeast	0.9x	0.54	x	8.88	x	69.27	x	0.45	x	0.67	=	90.13	(77)
Southeast	0.9x	0.54	x	1.78	x	69.27	x	0.45	x	0.67	=	18.07	(77)
Southeast	0.9x	0.54	x	8.88	x	44.07	x	0.45	x	0.67	=	57.34	(77)
Southeast	0.9x	0.54	x	1.78	x	44.07	x	0.45	x	0.67	=	11.49	(77)
Southeast	0.9x	0.54	x	8.88	x	31.49	x	0.45	x	0.67	=	40.97	(77)
Southeast	0.9x	0.54	x	1.78	x	31.49	x	0.45	x	0.67	=	8.21	(77)
South	0.9x	0.54	x	2.85	x	46.75	x	0.45	x	0.67	=	39.05	(78)
South	0.9x	0.54	x	2.85	x	46.75	x	0.45	x	0.67	=	39.05	(78)
South	0.9x	0.54	x	2.85	x	76.57	x	0.45	x	0.67	=	63.95	(78)
South	0.9x	0.54	x	2.85	x	76.57	x	0.45	x	0.67	=	63.95	(78)
South	0.9x	0.54	x	2.85	x	97.53	x	0.45	x	0.67	=	81.46	(78)
South	0.9x	0.54	x	2.85	x	97.53	x	0.45	x	0.67	=	81.46	(78)
South	0.9x	0.54	x	2.85	x	110.23	x	0.45	x	0.67	=	92.07	(78)
South	0.9x	0.54	x	2.85	x	110.23	x	0.45	x	0.67	=	92.07	(78)
South	0.9x	0.54	x	2.85	x	114.87	x	0.45	x	0.67	=	95.94	(78)
South	0.9x	0.54	x	2.85	x	114.87	x	0.45	x	0.67	=	95.94	(78)
South	0.9x	0.54	x	2.85	x	110.55	x	0.45	x	0.67	=	92.33	(78)
South	0.9x	0.54	x	2.85	x	110.55	x	0.45	x	0.67	=	92.33	(78)
South	0.9x	0.54	x	2.85	x	108.01	x	0.45	x	0.67	=	90.21	(78)
South	0.9x	0.54	x	2.85	x	108.01	x	0.45	x	0.67	=	90.21	(78)
South	0.9x	0.54	x	2.85	x	104.89	x	0.45	x	0.67	=	87.61	(78)
South	0.9x	0.54	x	2.85	x	104.89	x	0.45	x	0.67	=	87.61	(78)
South	0.9x	0.54	x	2.85	x	101.89	x	0.45	x	0.67	=	85.1	(78)

South	0.9x	0.54	x	2.85	x	101.89	x	0.45	x	0.67	=	85.1	(78)
South	0.9x	0.54	x	2.85	x	82.59	x	0.45	x	0.67	=	68.98	(78)
South	0.9x	0.54	x	2.85	x	82.59	x	0.45	x	0.67	=	68.98	(78)
South	0.9x	0.54	x	2.85	x	55.42	x	0.45	x	0.67	=	46.29	(78)
South	0.9x	0.54	x	2.85	x	55.42	x	0.45	x	0.67	=	46.29	(78)
South	0.9x	0.54	x	2.85	x	40.4	x	0.45	x	0.67	=	33.74	(78)
South	0.9x	0.54	x	2.85	x	40.4	x	0.45	x	0.67	=	33.74	(78)
Southwest	0.9x	0.54	x	2.67	x	36.79		0.45	x	0.67	=	28.79	(79)
Southwest	0.9x	0.54	x	2.67	x	62.67		0.45	x	0.67	=	49.04	(79)
Southwest	0.9x	0.54	x	2.67	x	85.75		0.45	x	0.67	=	67.1	(79)
Southwest	0.9x	0.54	x	2.67	x	106.25		0.45	x	0.67	=	83.14	(79)
Southwest	0.9x	0.54	x	2.67	x	119.01		0.45	x	0.67	=	93.12	(79)
Southwest	0.9x	0.54	x	2.67	x	118.15		0.45	x	0.67	=	92.45	(79)
Southwest	0.9x	0.54	x	2.67	x	113.91		0.45	x	0.67	=	89.13	(79)
Southwest	0.9x	0.54	x	2.67	x	104.39		0.45	x	0.67	=	81.68	(79)
Southwest	0.9x	0.54	x	2.67	x	92.85		0.45	x	0.67	=	72.65	(79)
Southwest	0.9x	0.54	x	2.67	x	69.27		0.45	x	0.67	=	54.2	(79)
Southwest	0.9x	0.54	x	2.67	x	44.07		0.45	x	0.67	=	34.48	(79)
Southwest	0.9x	0.54	x	2.67	x	31.49		0.45	x	0.67	=	24.64	(79)

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

(83)m=	164.36	274.84	363.97	433.24	470.9	461.66	447.48	419.96	387.88	300.35	195.89	141.3	(83)

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

(84)m=	700.31	808.36	879.59	919.75	927.24	889.51	857.23	836.48	819.72	761.53	690.76	662.02	(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	0.95	0.83	0.65	0.68	0.89	0.99	1	1	(86)

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

(87)m=	20.14	20.24	20.39	20.59	20.77	20.9	20.95	20.94	20.87	20.63	20.35	20.13	(87)

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

(88)m=	20.11	20.11	20.12	20.13	20.13	20.14	20.14	20.15	20.14	20.13	20.13	20.12	(88)

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

(89)m=	1	1	0.99	0.98	0.92	0.75	0.53	0.57	0.84	0.98	1	1	(89)

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

(90)m=	18.94	19.09	19.31	19.61	19.86	20.04	20.07	20.07	19.99	19.67	19.26	18.93	(90)

fLA = Living area ÷ (4) = 0.32 (91)

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

(92)m=	19.32	19.46	19.66	19.92	20.15	20.32	20.35	20.35	20.27	19.98	19.61	19.31	(92)

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

(93)m=	19.17	19.31	19.51	19.77	20	20.17	20.2	20.2	20.12	19.83	19.46	19.16	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.92	0.76	0.54	0.58	0.84	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	699.31	805.48	871.61	895.19	850.28	672.65	462.89	484.31	688.02	743.2	688.31	661.34	(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=	2019.12	1949.67	1754.53	1442.86	1098.41	724.11	468.67	492.97	788.81	1220.44	1645.43	2005.17	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	981.94	768.89	656.89	394.32	184.61	0	0	0	0	355.07	689.12	999.81	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5030.66 (98)

Space heating requirement in kWh/m²/year 35.86 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)														
	981.94	768.89	656.89	394.32	184.61	0	0	0	0	355.07	689.12	999.81		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	1068.49	836.66	714.79	429.08	200.88	0	0	0	0	386.37	749.86	1087.93		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													5474.06	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	217.03	191.2	200.57	179.49	175.67	156.64	150.13	165.16	165	186.13	197.21	211.7		
Efficiency of water heater													81.8	(216)
(217)m=	89.89	89.69	89.32	88.48	86.68	81.8	81.8	81.8	81.8	88.16	89.44	89.96		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	241.44	213.16	224.56	202.85	202.66	191.49	183.53	201.91	201.72	211.14	220.49	235.33		
Total = Sum(219a)$_{1...12}$ =													2530.28	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		5474.06

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Water heating fuel used			2530.28	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		392.83		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		422.83	(231)
Electricity for lighting			514.89	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1182.4	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	546.54	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1728.94	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	219.45	(267)
Electricity for lighting	(232) x	0.519	=	267.23	(268)
Total CO2, kg/year		sum of (265)…(271) =		2215.61	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.79	(273)
EI rating (section 14)				84	(274)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 8 - 4B8P - GF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	220	(1a) x	2.7	(2a) =	594	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	220	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	594	(5)

2. Ventilation rate:

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

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

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

(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) = 74.8 (23c)

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

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			6.74	x1/[1/(1.1)+ 0.04] =	7.1			(27)
Windows Type 2			0.88	x1/[1/(1.1)+ 0.04] =	0.93			(27)
Windows Type 3			0.88	x1/[1/(1.1)+ 0.04] =	0.93			(27)
Windows Type 4			11.41	x1/[1/(1.1)+ 0.04] =	12.02			(27)
Windows Type 5			0.88	x1/[1/(1.1)+ 0.04] =	0.93			(27)
Windows Type 6			4.1	x1/[1/(1.1)+ 0.04] =	4.32			(27)
Windows Type 7			1.54	x1/[1/(1.1)+ 0.04] =	1.62			(27)
Windows Type 8			2.68	x1/[1/(1.1)+ 0.04] =	2.82			(27)
Floor			220	x 0.11 =	24.2			(28)
Walls Type1	115.69	49.54	66.16	x 0.12 =	7.94			(29)
Walls Type2	57.78	0	57.78	x 0.14 =	8.18			(29)
Total area of elements, m²			393.47					(31)
Party wall			35.24	x 0 =	0			(32)
Party ceiling			220					(32b)

** 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) = 92.51 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 41061.02 (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 | 59.02 | (36)

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

Total fabric heat loss (33) + (36) = | 151.53 | (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=	56.56	55.94	55.31	52.19	51.57	48.44	48.44	47.82	49.69	51.57	52.82	54.06	(38)

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

(39)m=	208.1	207.47	206.85	203.72	203.1	199.98	199.98	199.35	201.22	203.1	204.35	205.6	

Average = Sum(39)$_{1…12}$ /12= | 203.57 | (39)

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

(40)m=	0.95	0.94	0.94	0.93	0.92	0.91	0.91	0.91	0.91	0.92	0.93	0.93

Average = Sum(40)$_{1…12}$ /12= | 0.93 | (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 3.03 | (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 106.11 | (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=	116.72	112.48	108.24	103.99	99.75	95.5	95.5	99.75	103.99	108.24	112.48	116.72

Total = Sum(44)$_{1…12}$ = | 1273.36 | (44)

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

(45)m=	173.1	151.39	156.22	136.2	130.69	112.77	104.5	119.92	121.35	141.42	154.37	167.64

Total = Sum(45)$_{1…12}$ = | 1669.58 | (45)

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

(46)m=	25.96	22.71	23.43	20.43	19.6	16.92	15.68	17.99	18.2	21.21	23.16	25.15	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 305 | (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 1.63 | (48)

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

Energy lost from water storage, kWh/year (48) x (49) = | 0.88 | (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)		0.88	(55)

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

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(57)

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

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

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

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

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

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

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

(62)m=	223.65	197.05	206.77	185.12	181.24	161.69	155.05	170.47	170.27	191.97	203.29	218.19	(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=	223.65	197.05	206.77	185.12	181.24	161.69	155.05	170.47	170.27	191.97	203.29	218.19	

Output from water heater (annual)$_{1...12}$ — 2264.74 (64)

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

(65)m=	97.99	86.86	92.38	84.42	83.89	76.63	75.19	80.31	79.48	87.46	90.46	96.18	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	(66)

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

(67)m=	34.92	31.01	25.22	19.09	14.27	12.05	13.02	16.92	22.72	28.84	33.66	35.89	(67)

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

(68)m=	389.68	393.72	383.53	361.84	334.46	308.72	291.52	287.48	297.67	319.36	346.75	372.48	(68)

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

(69)m=	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	(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=	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	(71)

Water heating gains (Table 5)

(72)m=	131.71	129.26	124.17	117.25	112.76	106.43	101.06	107.95	110.39	117.56	125.64	129.27	(72)

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

(73)m=	627.73	625.42	604.34	569.6	532.91	498.62	477.02	483.77	502.2	537.18	577.47	609.06	(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)	
North	0.9x	0.77	x	6.74	x	10.63	x	0.45	x	0.67	=	14.97	(74)
North	0.9x	0.77	x	11.41	x	10.63	x	0.45	x	0.67	=	50.7	(74)
North	0.9x	0.77	x	2.68	x	10.63	x	0.45	x	0.67	=	5.95	(74)
North	0.9x	0.77	x	6.74	x	20.32	x	0.45	x	0.67	=	28.62	(74)
North	0.9x	0.77	x	11.41	x	20.32	x	0.45	x	0.67	=	96.89	(74)
North	0.9x	0.77	x	2.68	x	20.32	x	0.45	x	0.67	=	11.38	(74)
North	0.9x	0.77	x	6.74	x	34.53	x	0.45	x	0.67	=	48.63	(74)
North	0.9x	0.77	x	11.41	x	34.53	x	0.45	x	0.67	=	164.64	(74)
North	0.9x	0.77	x	2.68	x	34.53	x	0.45	x	0.67	=	19.34	(74)
North	0.9x	0.77	x	6.74	x	55.46	x	0.45	x	0.67	=	78.11	(74)
North	0.9x	0.77	x	11.41	x	55.46	x	0.45	x	0.67	=	264.45	(74)
North	0.9x	0.77	x	2.68	x	55.46	x	0.45	x	0.67	=	31.06	(74)
North	0.9x	0.77	x	6.74	x	74.72	x	0.45	x	0.67	=	105.22	(74)
North	0.9x	0.77	x	11.41	x	74.72	x	0.45	x	0.67	=	356.24	(74)
North	0.9x	0.77	x	2.68	x	74.72	x	0.45	x	0.67	=	41.84	(74)
North	0.9x	0.77	x	6.74	x	79.99	x	0.45	x	0.67	=	112.64	(74)
North	0.9x	0.77	x	11.41	x	79.99	x	0.45	x	0.67	=	381.37	(74)
North	0.9x	0.77	x	2.68	x	79.99	x	0.45	x	0.67	=	44.79	(74)
North	0.9x	0.77	x	6.74	x	74.68	x	0.45	x	0.67	=	105.16	(74)
North	0.9x	0.77	x	11.41	x	74.68	x	0.45	x	0.67	=	356.06	(74)
North	0.9x	0.77	x	2.68	x	74.68	x	0.45	x	0.67	=	41.82	(74)
North	0.9x	0.77	x	6.74	x	59.25	x	0.45	x	0.67	=	83.43	(74)
North	0.9x	0.77	x	11.41	x	59.25	x	0.45	x	0.67	=	282.49	(74)
North	0.9x	0.77	x	2.68	x	59.25	x	0.45	x	0.67	=	33.18	(74)
North	0.9x	0.77	x	6.74	x	41.52	x	0.45	x	0.67	=	58.47	(74)
North	0.9x	0.77	x	11.41	x	41.52	x	0.45	x	0.67	=	197.95	(74)
North	0.9x	0.77	x	2.68	x	41.52	x	0.45	x	0.67	=	23.25	(74)
North	0.9x	0.77	x	6.74	x	24.19	x	0.45	x	0.67	=	34.06	(74)
North	0.9x	0.77	x	11.41	x	24.19	x	0.45	x	0.67	=	115.34	(74)
North	0.9x	0.77	x	2.68	x	24.19	x	0.45	x	0.67	=	13.55	(74)
North	0.9x	0.77	x	6.74	x	13.12	x	0.45	x	0.67	=	18.47	(74)
North	0.9x	0.77	x	11.41	x	13.12	x	0.45	x	0.67	=	62.54	(74)
North	0.9x	0.77	x	2.68	x	13.12	x	0.45	x	0.67	=	7.35	(74)
North	0.9x	0.77	x	6.74	x	8.86	x	0.45	x	0.67	=	12.48	(74)
North	0.9x	0.77	x	11.41	x	8.86	x	0.45	x	0.67	=	42.27	(74)
North	0.9x	0.77	x	2.68	x	8.86	x	0.45	x	0.67	=	4.96	(74)
Northeast	0.9x	0.77	x	0.88	x	11.28	x	0.45	x	0.67	=	4.15	(75)
Northeast	0.9x	0.77	x	0.88	x	22.97	x	0.45	x	0.67	=	8.45	(75)
Northeast	0.9x	0.77	x	0.88	x	41.38	x	0.45	x	0.67	=	15.22	(75)

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Northeast	0.9x	0.77	x	0.88	x	67.96	x	0.45	x	0.67	=	24.99	(75)
Northeast	0.9x	0.77	x	0.88	x	91.35	x	0.45	x	0.67	=	33.59	(75)
Northeast	0.9x	0.77	x	0.88	x	97.38	x	0.45	x	0.67	=	35.81	(75)
Northeast	0.9x	0.77	x	0.88	x	91.1	x	0.45	x	0.67	=	33.5	(75)
Northeast	0.9x	0.77	x	0.88	x	72.63	x	0.45	x	0.67	=	26.71	(75)
Northeast	0.9x	0.77	x	0.88	x	50.42	x	0.45	x	0.67	=	18.54	(75)
Northeast	0.9x	0.77	x	0.88	x	28.07	x	0.45	x	0.67	=	10.32	(75)
Northeast	0.9x	0.77	x	0.88	x	14.2	x	0.45	x	0.67	=	5.22	(75)
Northeast	0.9x	0.77	x	0.88	x	9.21	x	0.45	x	0.67	=	3.39	(75)
South	0.9x	0.54	x	0.88	x	46.75	x	0.45	x	0.67	=	24.11	(78)
South	0.9x	0.54	x	4.1	x	46.75	x	0.45	x	0.67	=	28.09	(78)
South	0.9x	0.54	x	1.54	x	46.75	x	0.45	x	0.67	=	42.2	(78)
South	0.9x	0.54	x	0.88	x	76.57	x	0.45	x	0.67	=	39.49	(78)
South	0.9x	0.54	x	4.1	x	76.57	x	0.45	x	0.67	=	46	(78)
South	0.9x	0.54	x	1.54	x	76.57	x	0.45	x	0.67	=	69.11	(78)
South	0.9x	0.54	x	0.88	x	97.53	x	0.45	x	0.67	=	50.31	(78)
South	0.9x	0.54	x	4.1	x	97.53	x	0.45	x	0.67	=	58.6	(78)
South	0.9x	0.54	x	1.54	x	97.53	x	0.45	x	0.67	=	88.04	(78)
South	0.9x	0.54	x	0.88	x	110.23	x	0.45	x	0.67	=	56.86	(78)
South	0.9x	0.54	x	4.1	x	110.23	x	0.45	x	0.67	=	66.23	(78)
South	0.9x	0.54	x	1.54	x	110.23	x	0.45	x	0.67	=	99.5	(78)
South	0.9x	0.54	x	0.88	x	114.87	x	0.45	x	0.67	=	59.25	(78)
South	0.9x	0.54	x	4.1	x	114.87	x	0.45	x	0.67	=	69.01	(78)
South	0.9x	0.54	x	1.54	x	114.87	x	0.45	x	0.67	=	103.68	(78)
South	0.9x	0.54	x	0.88	x	110.55	x	0.45	x	0.67	=	57.02	(78)
South	0.9x	0.54	x	4.1	x	110.55	x	0.45	x	0.67	=	66.41	(78)
South	0.9x	0.54	x	1.54	x	110.55	x	0.45	x	0.67	=	99.78	(78)
South	0.9x	0.54	x	0.88	x	108.01	x	0.45	x	0.67	=	55.71	(78)
South	0.9x	0.54	x	4.1	x	108.01	x	0.45	x	0.67	=	64.89	(78)
South	0.9x	0.54	x	1.54	x	108.01	x	0.45	x	0.67	=	97.49	(78)
South	0.9x	0.54	x	0.88	x	104.89	x	0.45	x	0.67	=	54.1	(78)
South	0.9x	0.54	x	4.1	x	104.89	x	0.45	x	0.67	=	63.02	(78)
South	0.9x	0.54	x	1.54	x	104.89	x	0.45	x	0.67	=	94.68	(78)
South	0.9x	0.54	x	0.88	x	101.89	x	0.45	x	0.67	=	52.55	(78)
South	0.9x	0.54	x	4.1	x	101.89	x	0.45	x	0.67	=	61.21	(78)
South	0.9x	0.54	x	1.54	x	101.89	x	0.45	x	0.67	=	91.96	(78)
South	0.9x	0.54	x	0.88	x	82.59	x	0.45	x	0.67	=	42.6	(78)
South	0.9x	0.54	x	4.1	x	82.59	x	0.45	x	0.67	=	49.61	(78)
South	0.9x	0.54	x	1.54	x	82.59	x	0.45	x	0.67	=	74.54	(78)
South	0.9x	0.54	x	0.88	x	55.42	x	0.45	x	0.67	=	28.58	(78)
South	0.9x	0.54	x	4.1	x	55.42	x	0.45	x	0.67	=	33.29	(78)

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South	0.9x	0.54	x	1.54	x	55.42	x	0.45	x	0.67	=	50.02	(78)
South	0.9x	0.54	x	0.88	x	40.4	x	0.45	x	0.67	=	20.84	(78)
South	0.9x	0.54	x	4.1	x	40.4	x	0.45	x	0.67	=	24.27	(78)
South	0.9x	0.54	x	1.54	x	40.4	x	0.45	x	0.67	=	36.46	(78)
Northwest	0.9x	0.77	x	0.88	x	11.28	x	0.45	x	0.67	=	4.15	(81)
Northwest	0.9x	0.77	x	0.88	x	22.97	x	0.45	x	0.67	=	8.45	(81)
Northwest	0.9x	0.77	x	0.88	x	41.38	x	0.45	x	0.67	=	15.22	(81)
Northwest	0.9x	0.77	x	0.88	x	67.96	x	0.45	x	0.67	=	24.99	(81)
Northwest	0.9x	0.77	x	0.88	x	91.35	x	0.45	x	0.67	=	33.59	(81)
Northwest	0.9x	0.77	x	0.88	x	97.38	x	0.45	x	0.67	=	35.81	(81)
Northwest	0.9x	0.77	x	0.88	x	91.1	x	0.45	x	0.67	=	33.5	(81)
Northwest	0.9x	0.77	x	0.88	x	72.63	x	0.45	x	0.67	=	26.71	(81)
Northwest	0.9x	0.77	x	0.88	x	50.42	x	0.45	x	0.67	=	18.54	(81)
Northwest	0.9x	0.77	x	0.88	x	28.07	x	0.45	x	0.67	=	10.32	(81)
Northwest	0.9x	0.77	x	0.88	x	14.2	x	0.45	x	0.67	=	5.22	(81)
Northwest	0.9x	0.77	x	0.88	x	9.21	x	0.45	x	0.67	=	3.39	(81)

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

(83)m=	174.33	308.38	459.97	646.18	802.43	833.64	788.13	664.31	522.47	350.34	210.7	148.06	(83)

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

(84)m=	802.05	933.8	1064.32	1215.78	1335.33	1332.26	1265.15	1148.08	1024.67	887.52	788.18	757.12	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.84	0.67	0.75	0.95	1	1	1	(86)

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

(87)m=	20.06	20.15	20.31	20.53	20.75	20.9	20.94	20.94	20.82	20.54	20.27	20.06	(87)

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

(88)m=	20.13	20.13	20.13	20.15	20.15	20.16	20.16	20.16	20.16	20.15	20.14	20.14	(88)

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

(89)m=	1	1	1	0.99	0.94	0.77	0.56	0.64	0.92	1	1	1	(89)

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

(90)m=	18.85	18.98	19.21	19.55	19.86	20.05	20.09	20.09	19.95	19.57	19.16	18.84	(90)

fLA = Living area ÷ (4) = 0.15 (91)

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

(92)m=	19.03	19.15	19.37	19.69	19.99	20.18	20.22	20.21	20.08	19.71	19.32	19.02	(92)

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

(93)m=	18.88	19	19.22	19.54	19.84	20.03	20.07	20.06	19.93	19.56	19.17	18.87	(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	1	1	0.99	0.93	0.76	0.54	0.62	0.91	0.99	1	1	(94)

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

(95)m=	801.82	933.05	1061.34	1198.89	1243.79	1010.32	685.17	712.83	932.05	881.43	787.59	756.97	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

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

(97)m=	3033.75	2926.04	2631.69	2168.43	1653.22	1085.72	693.31	730.29	1173.76	1819.93	2467.36	3016.54	(97)

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

(98)m=	1660.55	1339.29	1168.34	698.07	304.61	0	0	0	0	698.24	1209.43	1681.12

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 8759.66 (98)

Space heating requirement in kWh/m²/year 39.82 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)	1660.55	1339.29	1168.34	698.07	304.61	0	0	0	0	698.24	1209.43	1681.12	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1806.91	1457.34	1271.32	759.6	331.46	0	0	0	0	759.78	1316.03	1829.29	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 9531.73 (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)

	223.65	197.05	206.77	185.12	181.24	161.69	155.05	170.47	170.27	191.97	203.29	218.19	

Efficiency of water heater 81.8 (216)

(217)m=	90.57	90.47	90.22	89.58	87.85	81.8	81.8	81.8	81.8	89.52	90.3	90.61	(217)

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

(219)m=	246.93	217.81	229.18	206.65	206.29	197.67	189.55	208.39	208.15	214.45	225.14	240.78

Total = Sum(219a)$_{1...12}$ = 2590.99 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		9531.73
Water heating fuel used		2590.99
Electricity for pumps, fans and electric keep-hot		

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mechanical ventilation - balanced, extract or positive input from outside		679.39		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		709.39	(231)
Electricity for lighting			616.65	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	2058.85	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	559.65	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2618.51	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	368.17	(267)
Electricity for lighting	(232)	x	0.519	=	320.04	(268)
Total CO2, kg/year			sum of (265)…(271) =		3306.72	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		15.03	(273)
EI rating (section 14)					83	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 10 - 1B2P - MF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53	(1a) x	2.7	(2a) =	143.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	143.1	(5)

2. Ventilation rate:

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

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration		0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate		(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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) = 73.1 (23c)

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			1.68	x1/[1/(1.1)+ 0.04]	=	1.77			(27)
Windows Type 2			1.68	x1/[1/(1.1)+ 0.04]	=	1.77			(27)
Windows Type 3			6.66	x1/[1/(1.1)+ 0.04]	=	7.02			(27)
Windows Type 4			3.36	x1/[1/(1.1)+ 0.04]	=	3.54			(27)
Windows Type 5			2.6	x1/[1/(1.1)+ 0.04]	=	2.74			(27)
Walls Type1	47.55	15.98	31.57	x 0.12	=	3.79			(29)
Walls Type2	3.78	0	3.78	x 0.14	=	0.53			(29)
Total area of elements, m²			51.33						(31)
Party wall			39.56	x 0	=	0			(32)
Party floor			53.93						(32a)
Party ceiling			53.93						(32b)

** 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) = 21.16 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8029.37 (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 7.7 (36)

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

Total fabric heat loss (33) + (36) = 28.86 (37)

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DER WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	14.03	13.88	13.73	12.97	12.82	12.07	12.07	11.92	12.37	12.82	13.13	13.43	(38)

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

(39)m=	42.89	42.74	42.59	41.83	41.68	40.93	40.93	40.78	41.23	41.68	41.98	42.29	

Average = $Sum(39)_{1...12}$ /12= 41.8 (39)

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

(40)m=	0.81	0.81	0.8	0.79	0.79	0.77	0.77	0.77	0.78	0.79	0.79	0.8	

Average = $Sum(40)_{1...12}$ /12= 0.79 (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 1.78 (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 76.44 (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=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08	

Total = $Sum(44)_{1...12}$ = 917.29 (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=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76	

Total = $Sum(45)_{1...12}$ = 1202.71 (45)

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

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0.99 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.53 (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) 0.53 (55)

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

(56)m=	16.57	14.97	16.57	16.04	16.57	16.04	16.57	16.57	16.04	16.57	16.04	16.57	(56)

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

(57)m=	16.57	14.97	16.57	16.04	16.57	16.04	16.57	16.57	16.04	16.57	16.04	16.57	(57)

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

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

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

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

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

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

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

(62)m=	164.53	145.04	152.37	136.66	133.98	119.79	115.11	126.22	125.97	141.71	149.75	160.6	(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=	164.53	145.04	152.37	136.66	133.98	119.79	115.11	126.22	125.97	141.71	149.75	160.6

Output from water heater (annual)$_{1...12}$ — 1671.74 (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=	73.33	65.05	69.29	63.46	63.17	57.85	56.9	60.59	59.91	65.74	67.82	72.02	(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=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

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

(67)m=	13.82	12.27	9.98	7.56	5.65	4.77	5.15	6.7	8.99	11.42	13.32	14.2	(67)

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

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)

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

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(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=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)

Water heating gains (Table 5)

(72)m=	98.56	96.8	93.13	88.14	84.91	80.35	76.48	81.44	83.2	88.36	94.19	96.8	(72)

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

(73)m=	320.08	318.37	308.36	292.32	276.28	260.61	250.28	255.18	263.29	279.5	298.13	311.86	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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Southeast	0.9x	0.54	x	6.66	x	36.79	x	0.45	x	0.67	=	35.91	(77)
Southeast	0.9x	0.77	x	2.6	x	36.79	x	0.45	x	0.67	=	19.99	(77)
Southeast	0.9x	0.54	x	6.66	x	62.67	x	0.45	x	0.67	=	61.16	(77)
Southeast	0.9x	0.77	x	2.6	x	62.67	x	0.45	x	0.67	=	34.05	(77)
Southeast	0.9x	0.54	x	6.66	x	85.75	x	0.45	x	0.67	=	83.68	(77)
Southeast	0.9x	0.77	x	2.6	x	85.75	x	0.45	x	0.67	=	46.58	(77)
Southeast	0.9x	0.54	x	6.66	x	106.25	x	0.45	x	0.67	=	103.69	(77)
Southeast	0.9x	0.77	x	2.6	x	106.25	x	0.45	x	0.67	=	57.72	(77)
Southeast	0.9x	0.54	x	6.66	x	119.01	x	0.45	x	0.67	=	116.14	(77)
Southeast	0.9x	0.77	x	2.6	x	119.01	x	0.45	x	0.67	=	64.65	(77)
Southeast	0.9x	0.54	x	6.66	x	118.15	x	0.45	x	0.67	=	115.3	(77)
Southeast	0.9x	0.77	x	2.6	x	118.15	x	0.45	x	0.67	=	64.18	(77)
Southeast	0.9x	0.54	x	6.66	x	113.91	x	0.45	x	0.67	=	111.16	(77)
Southeast	0.9x	0.77	x	2.6	x	113.91	x	0.45	x	0.67	=	61.88	(77)
Southeast	0.9x	0.54	x	6.66	x	104.39	x	0.45	x	0.67	=	101.87	(77)
Southeast	0.9x	0.77	x	2.6	x	104.39	x	0.45	x	0.67	=	56.71	(77)
Southeast	0.9x	0.54	x	6.66	x	92.85	x	0.45	x	0.67	=	90.61	(77)
Southeast	0.9x	0.77	x	2.6	x	92.85	x	0.45	x	0.67	=	50.44	(77)
Southeast	0.9x	0.54	x	6.66	x	69.27	x	0.45	x	0.67	=	67.6	(77)
Southeast	0.9x	0.77	x	2.6	x	69.27	x	0.45	x	0.67	=	37.63	(77)
Southeast	0.9x	0.54	x	6.66	x	44.07	x	0.45	x	0.67	=	43.01	(77)
Southeast	0.9x	0.77	x	2.6	x	44.07	x	0.45	x	0.67	=	23.94	(77)
Southeast	0.9x	0.54	x	6.66	x	31.49	x	0.45	x	0.67	=	30.73	(77)
Southeast	0.9x	0.77	x	2.6	x	31.49	x	0.45	x	0.67	=	17.11	(77)
South	0.9x	0.77	x	1.68	x	46.75	x	0.45	x	0.67	=	16.41	(78)
South	0.9x	0.77	x	1.68	x	76.57	x	0.45	x	0.67	=	26.88	(78)
South	0.9x	0.77	x	1.68	x	97.53	x	0.45	x	0.67	=	34.24	(78)
South	0.9x	0.77	x	1.68	x	110.23	x	0.45	x	0.67	=	38.69	(78)
South	0.9x	0.77	x	1.68	x	114.87	x	0.45	x	0.67	=	40.32	(78)
South	0.9x	0.77	x	1.68	x	110.55	x	0.45	x	0.67	=	38.8	(78)
South	0.9x	0.77	x	1.68	x	108.01	x	0.45	x	0.67	=	37.91	(78)
South	0.9x	0.77	x	1.68	x	104.89	x	0.45	x	0.67	=	36.82	(78)
South	0.9x	0.77	x	1.68	x	101.89	x	0.45	x	0.67	=	35.76	(78)
South	0.9x	0.77	x	1.68	x	82.59	x	0.45	x	0.67	=	28.99	(78)
South	0.9x	0.77	x	1.68	x	55.42	x	0.45	x	0.67	=	19.45	(78)
South	0.9x	0.77	x	1.68	x	40.4	x	0.45	x	0.67	=	14.18	(78)
Southwest	0.9x	0.77	x	3.36	x	36.79		0.45	x	0.67	=	25.83	(79)
Southwest	0.9x	0.77	x	3.36	x	62.67		0.45	x	0.67	=	44	(79)
Southwest	0.9x	0.77	x	3.36	x	85.75		0.45	x	0.67	=	60.2	(79)
Southwest	0.9x	0.77	x	3.36	x	106.25		0.45	x	0.67	=	74.59	(79)
Southwest	0.9x	0.77	x	3.36	x	119.01		0.45	x	0.67	=	83.55	(79)

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Southwest	0.9x	0.77	x	3.36	x	118.15		0.45	x	0.67	=	82.95	(79)
Southwest	0.9x	0.77	x	3.36	x	113.91		0.45	x	0.67	=	79.97	(79)
Southwest	0.9x	0.77	x	3.36	x	104.39		0.45	x	0.67	=	73.29	(79)
Southwest	0.9x	0.77	x	3.36	x	92.85		0.45	x	0.67	=	65.19	(79)
Southwest	0.9x	0.77	x	3.36	x	69.27		0.45	x	0.67	=	48.63	(79)
Southwest	0.9x	0.77	x	3.36	x	44.07		0.45	x	0.67	=	30.94	(79)
Southwest	0.9x	0.77	x	3.36	x	31.49		0.45	x	0.67	=	22.11	(79)
West	0.9x	0.77	x	1.68	x	19.64	x	0.45	x	0.67	=	6.89	(80)
West	0.9x	0.77	x	1.68	x	38.42	x	0.45	x	0.67	=	13.49	(80)
West	0.9x	0.77	x	1.68	x	63.27	x	0.45	x	0.67	=	22.21	(80)
West	0.9x	0.77	x	1.68	x	92.28	x	0.45	x	0.67	=	32.39	(80)
West	0.9x	0.77	x	1.68	x	113.09	x	0.45	x	0.67	=	39.7	(80)
West	0.9x	0.77	x	1.68	x	115.77	x	0.45	x	0.67	=	40.64	(80)
West	0.9x	0.77	x	1.68	x	110.22	x	0.45	x	0.67	=	38.69	(80)
West	0.9x	0.77	x	1.68	x	94.68	x	0.45	x	0.67	=	33.23	(80)
West	0.9x	0.77	x	1.68	x	73.59	x	0.45	x	0.67	=	25.83	(80)
West	0.9x	0.77	x	1.68	x	45.59	x	0.45	x	0.67	=	16	(80)
West	0.9x	0.77	x	1.68	x	24.49	x	0.45	x	0.67	=	8.6	(80)
West	0.9x	0.77	x	1.68	x	16.15	x	0.45	x	0.67	=	5.67	(80)

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

(83)m=	105.03	179.57	246.92	307.09	344.36	341.87	329.61	301.92	267.83	198.85	125.94	89.79	(83)

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

(84)m=	425.11	497.95	555.28	599.41	620.65	602.48	579.89	557.1	531.12	478.35	424.07	401.65	(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	0.97	0.91	0.79	0.62	0.43	0.31	0.34	0.53	0.83	0.97	0.99	(86)

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

(87)m=	20.54	20.67	20.8	20.91	20.95	20.96	20.96	20.96	20.96	20.91	20.71	20.52	(87)

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

(88)m=	20.25	20.25	20.25	20.26	20.27	20.28	20.28	20.28	20.27	20.27	20.26	20.26	(88)

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

(89)m=	0.98	0.96	0.89	0.75	0.57	0.39	0.26	0.28	0.48	0.79	0.96	0.99	(89)

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

(90)m=	19.64	19.82	20.01	20.15	20.2	20.22	20.22	20.22	20.21	20.15	19.9	19.61	(90)

fLA = Living area ÷ (4) = | 0.85 | (91)

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

(92)m=	20.4	20.53	20.68	20.8	20.84	20.85	20.85	20.85	20.84	20.79	20.59	20.38	(92)

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

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(93)m=	20.25	20.38	20.53	20.65	20.69	20.7	20.7	20.7	20.69	20.64	20.44	20.23	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.96	0.9	0.77	0.6	0.41	0.29	0.31	0.51	0.81	0.96	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	418.36	477.57	500.15	462.73	369.88	249.2	167.65	175.19	270.58	386.47	406.75	396.91	(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=	684.03	661.76	597.45	491.35	374.56	249.51	167.67	175.23	271.84	418.48	559.94	677.67	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	197.66	123.78	72.39	20.61	3.48	0	0	0	0	23.81	110.29	208.88	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 760.9 (98)

Space heating requirement in kWh/m²/year 14.36 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)														
	197.66	123.78	72.39	20.61	3.48	0	0	0	0	23.81	110.29	208.88		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	215.09	134.69	78.77	22.42	3.78	0	0	0	0	25.91	120.01	227.29		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													827.96	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	164.53	145.04	152.37	136.66	133.98	119.79	115.11	126.22	125.97	141.71	149.75	160.6		
Efficiency of water heater													81.8	(216)
(217)m=	87.02	86.16	84.8	83	82.03	81.8	81.8	81.8	81.8	83.11	85.8	87.22		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	189.07	168.34	179.68	164.67	163.33	146.44	140.73	154.3	153.99	170.5	174.54	184.13		
Total = Sum(219a)$_{1...12}$ =													1989.73	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		827.96

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Water heating fuel used			1989.73	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		198.59		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		228.59	(231)
Electricity for lighting			244.06	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	178.84	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	429.78	(264)
Space and water heating	(261) + (262) + (263) + (264) =			608.62	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	118.64	(267)
Electricity for lighting	(232) x	0.519	=	126.67	(268)
Total CO2, kg/year		sum of (265)…(271) =		853.93	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.11	(273)
EI rating (section 14)				88	(274)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 15 - 3B6P - MF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	169	(1a) x	2.7	(2a) =	456.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	169	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	456.3	(5)

2. Ventilation rate:

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

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		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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) = 74.8 (23c)

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

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

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

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

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

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

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

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

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

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

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			3.6		x1/[1/(1.1)+ 0.04]	=	3.79			(27)
Windows Type 2			2.4		x1/[1/(1.1)+ 0.04]	=	2.53			(27)
Windows Type 3			9.36		x1/[1/(1.1)+ 0.04]	=	9.86			(27)
Windows Type 4			2.4		x1/[1/(1.1)+ 0.04]	=	2.53			(27)
Windows Type 5			1.78		x1/[1/(1.1)+ 0.04]	=	1.88			(27)
Windows Type 6			1.05		x1/[1/(1.1)+ 0.04]	=	1.11			(27)
Windows Type 7			1.05		x1/[1/(1.1)+ 0.04]	=	1.11			(27)
Windows Type 8			3.6		x1/[1/(1.1)+ 0.04]	=	3.79			(27)
Walls Type1	86.43	27.64	58.79	x	0.12	=	7.05			(29)
Walls Type2	27.27	0	27.27	x	0.14	=	3.86			(29)
Total area of elements, m²			113.7							(31)
Party wall			52.38	x	0	=	0			(32)
Party floor			175.4							(32a)
Party ceiling			175.8							(32b)

** 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) = 40.04 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 20671.09 (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		17.05	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	57.09	(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=	43.45	42.97	42.49	40.09	39.61	37.21	37.21	36.73	38.17	39.61	40.57	41.53	(38)

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

(39)m=	100.54	100.06	99.58	97.18	96.7	94.3	94.3	93.82	95.26	96.7	97.66	98.62	

Average = $Sum(39)_{1...12}$ /12= 97.06 (39)

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

(40)m=	0.59	0.59	0.59	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.58	

Average = $Sum(40)_{1...12}$ /12= 0.57 (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 2.96 (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) + 36 104.53 (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=	114.98	110.8	106.62	102.44	98.26	94.08	94.08	98.26	102.44	106.62	110.8	114.98	

Total = $Sum(44)_{1...12}$ = 1254.35 (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=	170.52	149.13	153.89	134.17	128.74	111.09	102.94	118.13	119.54	139.31	152.07	165.13	

Total = $Sum(45)_{1...12}$ = 1644.65 (45)

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

(46)m=	25.58	22.37	23.08	20.13	19.31	16.66	15.44	17.72	17.93	20.9	22.81	24.77	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		305	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)			
Water storage loss:			
a) If manufacturer's declared loss factor is known (kWh/day):		1.63	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.88	(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) 0.88 (55)

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

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(57)

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

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

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

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

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

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

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

(62)m=	221.06	194.79	204.44	183.09	179.29	160.01	153.49	168.68	168.46	189.86	200.99	215.68	(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=	221.06	194.79	204.44	183.09	179.29	160.01	153.49	168.68	168.46	189.86	200.99	215.68

Output from water heater (annual)$_{1...12}$ 2239.82 (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=	97.14	86.11	91.61	83.75	83.24	76.07	74.67	79.72	78.88	86.76	89.7	95.35	(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=	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	(66)

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

(67)m=	32.26	28.65	23.3	17.64	13.19	11.13	12.03	15.64	20.99	26.65	31.1	33.16	(67)

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

(68)m=	340.53	344.06	335.16	316.2	292.27	269.78	254.76	251.22	260.13	279.08	303.01	325.5	(68)

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

(69)m=	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	(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=	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	(71)

Water heating gains (Table 5)

(72)m=	130.56	128.14	123.13	116.31	111.89	105.66	100.36	107.15	109.56	116.61	124.58	128.15	(72)

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

(73)m=	573.77	571.28	552.01	520.57	487.76	456.99	437.56	444.42	461.09	492.76	529.11	557.23	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.6	x	10.63	x	0.45	x	0.67	=	8	(74)
North	0.9x	0.77	x	2.4	x	10.63	x	0.45	x	0.67	=	5.33	(74)
North	0.9x	0.77	x	3.6	x	10.63	x	0.45	x	0.67	=	8	(74)
North	0.9x	0.77	x	3.6	x	20.32	x	0.45	x	0.67	=	15.29	(74)
North	0.9x	0.77	x	2.4	x	20.32	x	0.45	x	0.67	=	10.19	(74)
North	0.9x	0.77	x	3.6	x	20.32	x	0.45	x	0.67	=	15.29	(74)
North	0.9x	0.77	x	3.6	x	34.53	x	0.45	x	0.67	=	25.97	(74)
North	0.9x	0.77	x	2.4	x	34.53	x	0.45	x	0.67	=	17.32	(74)
North	0.9x	0.77	x	3.6	x	34.53	x	0.45	x	0.67	=	25.97	(74)
North	0.9x	0.77	x	3.6	x	55.46	x	0.45	x	0.67	=	41.72	(74)
North	0.9x	0.77	x	2.4	x	55.46	x	0.45	x	0.67	=	27.81	(74)
North	0.9x	0.77	x	3.6	x	55.46	x	0.45	x	0.67	=	41.72	(74)
North	0.9x	0.77	x	3.6	x	74.72	x	0.45	x	0.67	=	56.2	(74)
North	0.9x	0.77	x	2.4	x	74.72	x	0.45	x	0.67	=	37.47	(74)
North	0.9x	0.77	x	3.6	x	74.72	x	0.45	x	0.67	=	56.2	(74)
North	0.9x	0.77	x	3.6	x	79.99	x	0.45	x	0.67	=	60.16	(74)
North	0.9x	0.77	x	2.4	x	79.99	x	0.45	x	0.67	=	40.11	(74)
North	0.9x	0.77	x	3.6	x	79.99	x	0.45	x	0.67	=	60.16	(74)
North	0.9x	0.77	x	3.6	x	74.68	x	0.45	x	0.67	=	56.17	(74)
North	0.9x	0.77	x	2.4	x	74.68	x	0.45	x	0.67	=	37.45	(74)
North	0.9x	0.77	x	3.6	x	74.68	x	0.45	x	0.67	=	56.17	(74)
North	0.9x	0.77	x	3.6	x	59.25	x	0.45	x	0.67	=	44.56	(74)
North	0.9x	0.77	x	2.4	x	59.25	x	0.45	x	0.67	=	29.71	(74)
North	0.9x	0.77	x	3.6	x	59.25	x	0.45	x	0.67	=	44.56	(74)
North	0.9x	0.77	x	3.6	x	41.52	x	0.45	x	0.67	=	31.23	(74)
North	0.9x	0.77	x	2.4	x	41.52	x	0.45	x	0.67	=	20.82	(74)
North	0.9x	0.77	x	3.6	x	41.52	x	0.45	x	0.67	=	31.23	(74)
North	0.9x	0.77	x	3.6	x	24.19	x	0.45	x	0.67	=	18.19	(74)
North	0.9x	0.77	x	2.4	x	24.19	x	0.45	x	0.67	=	12.13	(74)
North	0.9x	0.77	x	3.6	x	24.19	x	0.45	x	0.67	=	18.19	(74)
North	0.9x	0.77	x	3.6	x	13.12	x	0.45	x	0.67	=	9.87	(74)
North	0.9x	0.77	x	2.4	x	13.12	x	0.45	x	0.67	=	6.58	(74)
North	0.9x	0.77	x	3.6	x	13.12	x	0.45	x	0.67	=	9.87	(74)
North	0.9x	0.77	x	3.6	x	8.86	x	0.45	x	0.67	=	6.67	(74)
North	0.9x	0.77	x	2.4	x	8.86	x	0.45	x	0.67	=	4.45	(74)
North	0.9x	0.77	x	3.6	x	8.86	x	0.45	x	0.67	=	6.67	(74)
Northeast	0.9x	0.77	x	1.05	x	11.28	x	0.45	x	0.67	=	2.48	(75)
Northeast	0.9x	0.77	x	1.05	x	22.97	x	0.45	x	0.67	=	5.04	(75)
Northeast	0.9x	0.77	x	1.05	x	41.38	x	0.45	x	0.67	=	9.08	(75)

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Northeast	0.9x	0.77	x	1.05	x	67.96	x	0.45	x	0.67	=	14.91	(75)
Northeast	0.9x	0.77	x	1.05	x	91.35	x	0.45	x	0.67	=	20.04	(75)
Northeast	0.9x	0.77	x	1.05	x	97.38	x	0.45	x	0.67	=	21.36	(75)
Northeast	0.9x	0.77	x	1.05	x	91.1	x	0.45	x	0.67	=	19.99	(75)
Northeast	0.9x	0.77	x	1.05	x	72.63	x	0.45	x	0.67	=	15.93	(75)
Northeast	0.9x	0.77	x	1.05	x	50.42	x	0.45	x	0.67	=	11.06	(75)
Northeast	0.9x	0.77	x	1.05	x	28.07	x	0.45	x	0.67	=	6.16	(75)
Northeast	0.9x	0.77	x	1.05	x	14.2	x	0.45	x	0.67	=	3.11	(75)
Northeast	0.9x	0.77	x	1.05	x	9.21	x	0.45	x	0.67	=	2.02	(75)
Southeast	0.9x	0.77	x	1.78	x	36.79	x	0.45	x	0.67	=	13.68	(77)
Southeast	0.9x	0.77	x	1.78	x	62.67	x	0.45	x	0.67	=	23.31	(77)
Southeast	0.9x	0.77	x	1.78	x	85.75	x	0.45	x	0.67	=	31.89	(77)
Southeast	0.9x	0.77	x	1.78	x	106.25	x	0.45	x	0.67	=	39.52	(77)
Southeast	0.9x	0.77	x	1.78	x	119.01	x	0.45	x	0.67	=	44.26	(77)
Southeast	0.9x	0.77	x	1.78	x	118.15	x	0.45	x	0.67	=	43.94	(77)
Southeast	0.9x	0.77	x	1.78	x	113.91	x	0.45	x	0.67	=	42.36	(77)
Southeast	0.9x	0.77	x	1.78	x	104.39	x	0.45	x	0.67	=	38.82	(77)
Southeast	0.9x	0.77	x	1.78	x	92.85	x	0.45	x	0.67	=	34.53	(77)
Southeast	0.9x	0.77	x	1.78	x	69.27	x	0.45	x	0.67	=	25.76	(77)
Southeast	0.9x	0.77	x	1.78	x	44.07	x	0.45	x	0.67	=	16.39	(77)
Southeast	0.9x	0.77	x	1.78	x	31.49	x	0.45	x	0.67	=	11.71	(77)
South	0.9x	0.54	x	9.36	x	46.75	x	0.45	x	0.67	=	64.12	(78)
South	0.9x	0.77	x	2.4	x	46.75	x	0.45	x	0.67	=	46.89	(78)
South	0.9x	0.54	x	9.36	x	76.57	x	0.45	x	0.67	=	105.01	(78)
South	0.9x	0.77	x	2.4	x	76.57	x	0.45	x	0.67	=	76.79	(78)
South	0.9x	0.54	x	9.36	x	97.53	x	0.45	x	0.67	=	133.77	(78)
South	0.9x	0.77	x	2.4	x	97.53	x	0.45	x	0.67	=	97.82	(78)
South	0.9x	0.54	x	9.36	x	110.23	x	0.45	x	0.67	=	151.19	(78)
South	0.9x	0.77	x	2.4	x	110.23	x	0.45	x	0.67	=	110.56	(78)
South	0.9x	0.54	x	9.36	x	114.87	x	0.45	x	0.67	=	157.55	(78)
South	0.9x	0.77	x	2.4	x	114.87	x	0.45	x	0.67	=	115.21	(78)
South	0.9x	0.54	x	9.36	x	110.55	x	0.45	x	0.67	=	151.62	(78)
South	0.9x	0.77	x	2.4	x	110.55	x	0.45	x	0.67	=	110.87	(78)
South	0.9x	0.54	x	9.36	x	108.01	x	0.45	x	0.67	=	148.14	(78)
South	0.9x	0.77	x	2.4	x	108.01	x	0.45	x	0.67	=	108.33	(78)
South	0.9x	0.54	x	9.36	x	104.89	x	0.45	x	0.67	=	143.86	(78)
South	0.9x	0.77	x	2.4	x	104.89	x	0.45	x	0.67	=	105.2	(78)
South	0.9x	0.54	x	9.36	x	101.89	x	0.45	x	0.67	=	139.74	(78)
South	0.9x	0.77	x	2.4	x	101.89	x	0.45	x	0.67	=	102.18	(78)
South	0.9x	0.54	x	9.36	x	82.59	x	0.45	x	0.67	=	113.27	(78)
South	0.9x	0.77	x	2.4	x	82.59	x	0.45	x	0.67	=	82.83	(78)

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South	0.9x	0.54	x	9.36	x	55.42	x	0.45	x	0.67	=	76.01	(78)
South	0.9x	0.77	x	2.4	x	55.42	x	0.45	x	0.67	=	55.58	(78)
South	0.9x	0.54	x	9.36	x	40.4	x	0.45	x	0.67	=	55.41	(78)
South	0.9x	0.77	x	2.4	x	40.4	x	0.45	x	0.67	=	40.52	(78)
Northwest	0.9x	0.77	x	1.05	x	11.28	x	0.45	x	0.67	=	2.48	(81)
Northwest	0.9x	0.77	x	1.05	x	22.97	x	0.45	x	0.67	=	5.04	(81)
Northwest	0.9x	0.77	x	1.05	x	41.38	x	0.45	x	0.67	=	9.08	(81)
Northwest	0.9x	0.77	x	1.05	x	67.96	x	0.45	x	0.67	=	14.91	(81)
Northwest	0.9x	0.77	x	1.05	x	91.35	x	0.45	x	0.67	=	20.04	(81)
Northwest	0.9x	0.77	x	1.05	x	97.38	x	0.45	x	0.67	=	21.36	(81)
Northwest	0.9x	0.77	x	1.05	x	91.1	x	0.45	x	0.67	=	19.99	(81)
Northwest	0.9x	0.77	x	1.05	x	72.63	x	0.45	x	0.67	=	15.93	(81)
Northwest	0.9x	0.77	x	1.05	x	50.42	x	0.45	x	0.67	=	11.06	(81)
Northwest	0.9x	0.77	x	1.05	x	28.07	x	0.45	x	0.67	=	6.16	(81)
Northwest	0.9x	0.77	x	1.05	x	14.2	x	0.45	x	0.67	=	3.11	(81)
Northwest	0.9x	0.77	x	1.05	x	9.21	x	0.45	x	0.67	=	2.02	(81)

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

(83)m=	150.97	255.95	350.9	442.33	506.96	509.59	488.59	438.59	381.85	282.69	180.51	129.46	(83)

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

(84)m=	724.74	827.23	902.9	962.9	994.72	966.58	926.15	883.01	842.94	775.45	709.63	686.69	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.85	0.62	0.45	0.49	0.76	0.98	1	1	(86)

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

(87)m=	20.53	20.6	20.72	20.86	20.94	20.97	20.97	20.97	20.96	20.85	20.67	20.52	(87)

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

(88)m=	20.43	20.44	20.44	20.45	20.46	20.47	20.47	20.47	20.46	20.46	20.45	20.44	(88)

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

(89)m=	1	1	0.99	0.95	0.81	0.57	0.39	0.43	0.71	0.97	1	1	(89)

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

(90)m=	19.78	19.9	20.06	20.27	20.39	20.42	20.42	20.43	20.41	20.27	20	19.78	(90)

fLA = Living area ÷ (4) = 0.24 (91)

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

(92)m=	19.96	20.07	20.22	20.41	20.52	20.56	20.56	20.56	20.55	20.42	20.16	19.96	(92)

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

(93)m=	19.81	19.92	20.07	20.26	20.37	20.41	20.41	20.41	20.4	20.27	20.01	19.81	(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

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Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.95	0.81	0.57	0.39	0.43	0.7	0.96	1	1	(94)

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

(95)m=	724.27	825.3	894.32	915.19	804.75	546.46	359.12	376.21	592.2	746.93	707.88	686.41	(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=	1559.64	1502.94	1351.37	1104.3	838.72	547.67	359.16	376.29	599.98	934.64	1261.15	1539.35	(97)

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

(98)m=	621.51	455.37	340.05	136.16	25.27	0	0	0	0	139.66	398.36	634.59

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2750.97 (98)

Space heating requirement in kWh/m²/year 16.28 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)	621.51	455.37	340.05	136.16	25.27	0	0	0	0	139.66	398.36	634.59	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	676.29	495.51	370.02	148.16	27.5	0	0	0	0	151.97	433.47	690.52	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2993.44 (211)

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

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

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

Water heating

Output from water heater (calculated above)

221.06	194.79	204.44	183.09	179.29	160.01	153.49	168.68	168.46	189.86	200.99	215.68

Efficiency of water heater 81.8 (216)

(217)m=	89.02	88.62	87.83	85.82	82.93	81.8	81.8	81.8	81.8	85.8	88.25	89.11	(217)

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

(219)m=	248.34	219.8	232.77	213.33	216.2	195.61	187.64	206.2	205.94	221.29	227.76	242.04

Total = Sum(219a)$_{1...12}$ = 2616.92 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2993.44
Water heating fuel used		2616.92
Electricity for pumps, fans and electric keep-hot		

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mechanical ventilation - balanced, extract or positive input from outside		521.89	(230a)
central heating pump:		30	(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	551.89	(231)
Electricity for lighting		569.73	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	646.58	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	565.26	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1211.84	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	286.43	(267)
Electricity for lighting	(232) x	0.519	=	295.69	(268)
Total CO2, kg/year		sum of (265)…(271) =		1793.96	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		10.62	(273)
El rating (section 14)				89	(274)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.4.23

Property Address: Flat 23 - 2B4P - MF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	97.32	(1a)	x	2.7	(2a)	=	262.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	97.32	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	262.76	(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) =	73.95	(23c)

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

(24a)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(24a)

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			2.85	x1/[1/(1.1)+ 0.04]		=	3			(27)
Windows Type 2			2.85	x1/[1/(1.1)+ 0.04]		=	3			(27)
Windows Type 3			8.88	x1/[1/(1.1)+ 0.04]		=	9.36			(27)
Windows Type 4			2.67	x1/[1/(1.1)+ 0.04]		=	2.81			(27)
Windows Type 5			1.78	x1/[1/(1.1)+ 0.04]		=	1.88			(27)
Walls Type1	92.42	27.4	65.02	x	0.12	=	7.8			(29)
Walls Type2	29.89	0	29.89	x	0.14	=	4.23			(29)
Total area of elements, m²			122.31							(31)
Party wall			23.22	x	0	=	0			(32)
Party floor			97.32							(32a)
Party ceiling			97.32							(32b)

** 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) =	40.9	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14501	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		18.35	(36)

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

Total fabric heat loss	(33) + (36) =	59.25	(37)

DER WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.39	25.11	24.84	23.46	23.18	21.8	21.8	21.52	22.35	23.18	23.73	24.28	(38)

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

(39)m=	84.64	84.36	84.09	82.7	82.43	81.05	81.05	80.77	81.6	82.43	82.98	83.53	

Average = Sum(39)$_{1\ldots12}$ /12= 82.63 (39)

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

(40)m=	0.87	0.87	0.86	0.85	0.85	0.83	0.83	0.83	0.84	0.85	0.85	0.86	

Average = Sum(40)$_{1\ldots12}$ /12= 0.85 (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 2.71 (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 98.64 (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=	108.5	104.56	100.61	96.67	92.72	88.78	88.78	92.72	96.67	100.61	104.56	108.5	

Total = Sum(44)$_{1\ldots12}$ = 1183.69 (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=	160.91	140.73	145.22	126.61	121.48	104.83	97.14	111.47	112.8	131.46	143.5	155.83	

Total = Sum(45)$_{1\ldots12}$ = 1552 (45)

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

(46)m=	24.14	21.11	21.78	18.99	18.22	15.72	14.57	16.72	16.92	19.72	21.53	23.37	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 255 (47)

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.49 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.8 (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) 0.8 (55)

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

(56)m=	24.94	22.53	24.94	24.14	24.94	24.14	24.94	24.94	24.14	24.94	24.14	24.94	(56)

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

(57)m=	24.94	22.53	24.94	24.14	24.94	24.14	24.94	24.94	24.14	24.94	24.14	24.94	(57)

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

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

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

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

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

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

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

(62)m=	209.11	184.27	193.43	173.26	169.69	151.48	145.35	159.68	159.45	179.67	190.15	204.04	(62)

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

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

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

Output from water heater

(64)m=	209.11	184.27	193.43	173.26	169.69	151.48	145.35	159.68	159.45	179.67	190.15	204.04

Output from water heater (annual)$_{1…12}$ | 2119.58 | (64)

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

(65)m=	92.07	81.63	86.85	79.42	78.96	72.18	70.86	75.63	74.83	82.27	85.03	90.38	(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=	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	(66)

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

(67)m=	22.46	19.95	16.22	12.28	9.18	7.75	8.37	10.89	14.61	18.55	21.65	23.08	(67)

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

(68)m=	251.92	254.54	247.95	233.92	216.22	199.58	188.47	185.85	192.44	206.46	224.17	240.81	(68)

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

(69)m=	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	(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=	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	(71)

Water heating gains (Table 5)

(72)m=	123.75	121.47	116.73	110.3	106.13	100.25	95.25	101.65	103.93	110.58	118.1	121.48	(72)

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

(73)m=	464.82	462.65	447.6	423.21	398.23	374.28	358.79	365.09	377.68	402.3	430.62	452.06	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

DER WorkSheet: New dwelling design stage

Southeast	0.9x	0.77	x	8.88	x	36.79	x	0.45	x	0.67	=	68.27	(77)
Southeast	0.9x	0.77	x	1.78	x	36.79	x	0.45	x	0.67	=	13.68	(77)
Southeast	0.9x	0.77	x	8.88	x	62.67	x	0.45	x	0.67	=	116.28	(77)
Southeast	0.9x	0.77	x	1.78	x	62.67	x	0.45	x	0.67	=	23.31	(77)
Southeast	0.9x	0.77	x	8.88	x	85.75	x	0.45	x	0.67	=	159.1	(77)
Southeast	0.9x	0.77	x	1.78	x	85.75	x	0.45	x	0.67	=	31.89	(77)
Southeast	0.9x	0.77	x	8.88	x	106.25	x	0.45	x	0.67	=	197.14	(77)
Southeast	0.9x	0.77	x	1.78	x	106.25	x	0.45	x	0.67	=	39.52	(77)
Southeast	0.9x	0.77	x	8.88	x	119.01	x	0.45	x	0.67	=	220.81	(77)
Southeast	0.9x	0.77	x	1.78	x	119.01	x	0.45	x	0.67	=	44.26	(77)
Southeast	0.9x	0.77	x	8.88	x	118.15	x	0.45	x	0.67	=	219.21	(77)
Southeast	0.9x	0.77	x	1.78	x	118.15	x	0.45	x	0.67	=	43.94	(77)
Southeast	0.9x	0.77	x	8.88	x	113.91	x	0.45	x	0.67	=	211.35	(77)
Southeast	0.9x	0.77	x	1.78	x	113.91	x	0.45	x	0.67	=	42.36	(77)
Southeast	0.9x	0.77	x	8.88	x	104.39	x	0.45	x	0.67	=	193.68	(77)
Southeast	0.9x	0.77	x	1.78	x	104.39	x	0.45	x	0.67	=	38.82	(77)
Southeast	0.9x	0.77	x	8.88	x	92.85	x	0.45	x	0.67	=	172.28	(77)
Southeast	0.9x	0.77	x	1.78	x	92.85	x	0.45	x	0.67	=	34.53	(77)
Southeast	0.9x	0.77	x	8.88	x	69.27	x	0.45	x	0.67	=	128.52	(77)
Southeast	0.9x	0.77	x	1.78	x	69.27	x	0.45	x	0.67	=	25.76	(77)
Southeast	0.9x	0.77	x	8.88	x	44.07	x	0.45	x	0.67	=	81.77	(77)
Southeast	0.9x	0.77	x	1.78	x	44.07	x	0.45	x	0.67	=	16.39	(77)
Southeast	0.9x	0.77	x	8.88	x	31.49	x	0.45	x	0.67	=	58.42	(77)
Southeast	0.9x	0.77	x	1.78	x	31.49	x	0.45	x	0.67	=	11.71	(77)
South	0.9x	0.77	x	2.85	x	46.75	x	0.45	x	0.67	=	55.68	(78)
South	0.9x	0.77	x	2.85	x	46.75	x	0.45	x	0.67	=	55.68	(78)
South	0.9x	0.77	x	2.85	x	76.57	x	0.45	x	0.67	=	91.19	(78)
South	0.9x	0.77	x	2.85	x	76.57	x	0.45	x	0.67	=	91.19	(78)
South	0.9x	0.77	x	2.85	x	97.53	x	0.45	x	0.67	=	116.16	(78)
South	0.9x	0.77	x	2.85	x	97.53	x	0.45	x	0.67	=	116.16	(78)
South	0.9x	0.77	x	2.85	x	110.23	x	0.45	x	0.67	=	131.28	(78)
South	0.9x	0.77	x	2.85	x	110.23	x	0.45	x	0.67	=	131.28	(78)
South	0.9x	0.77	x	2.85	x	114.87	x	0.45	x	0.67	=	136.81	(78)
South	0.9x	0.77	x	2.85	x	114.87	x	0.45	x	0.67	=	136.81	(78)
South	0.9x	0.77	x	2.85	x	110.55	x	0.45	x	0.67	=	131.66	(78)
South	0.9x	0.77	x	2.85	x	110.55	x	0.45	x	0.67	=	131.66	(78)
South	0.9x	0.77	x	2.85	x	108.01	x	0.45	x	0.67	=	128.64	(78)
South	0.9x	0.77	x	2.85	x	108.01	x	0.45	x	0.67	=	128.64	(78)
South	0.9x	0.77	x	2.85	x	104.89	x	0.45	x	0.67	=	124.92	(78)
South	0.9x	0.77	x	2.85	x	104.89	x	0.45	x	0.67	=	124.92	(78)
South	0.9x	0.77	x	2.85	x	101.89	x	0.45	x	0.67	=	121.34	(78)

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South	0.9x	0.77	x	2.85	x	101.89	x	0.45	x	0.67	=	121.34	(78)
South	0.9x	0.77	x	2.85	x	82.59	x	0.45	x	0.67	=	98.36	(78)
South	0.9x	0.77	x	2.85	x	82.59	x	0.45	x	0.67	=	98.36	(78)
South	0.9x	0.77	x	2.85	x	55.42	x	0.45	x	0.67	=	66	(78)
South	0.9x	0.77	x	2.85	x	55.42	x	0.45	x	0.67	=	66	(78)
South	0.9x	0.77	x	2.85	x	40.4	x	0.45	x	0.67	=	48.11	(78)
South	0.9x	0.77	x	2.85	x	40.4	x	0.45	x	0.67	=	48.11	(78)
Southwest	0.9x	0.77	x	2.67	x	36.79		0.45	x	0.67	=	41.05	(79)
Southwest	0.9x	0.77	x	2.67	x	62.67		0.45	x	0.67	=	69.93	(79)
Southwest	0.9x	0.77	x	2.67	x	85.75		0.45	x	0.67	=	95.68	(79)
Southwest	0.9x	0.77	x	2.67	x	106.25		0.45	x	0.67	=	118.55	(79)
Southwest	0.9x	0.77	x	2.67	x	119.01		0.45	x	0.67	=	132.78	(79)
Southwest	0.9x	0.77	x	2.67	x	118.15		0.45	x	0.67	=	131.82	(79)
Southwest	0.9x	0.77	x	2.67	x	113.91		0.45	x	0.67	=	127.09	(79)
Southwest	0.9x	0.77	x	2.67	x	104.39		0.45	x	0.67	=	116.47	(79)
Southwest	0.9x	0.77	x	2.67	x	92.85		0.45	x	0.67	=	103.6	(79)
Southwest	0.9x	0.77	x	2.67	x	69.27		0.45	x	0.67	=	77.28	(79)
Southwest	0.9x	0.77	x	2.67	x	44.07		0.45	x	0.67	=	49.17	(79)
Southwest	0.9x	0.77	x	2.67	x	31.49		0.45	x	0.67	=	35.13	(79)

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

(83)m=	234.36	391.9	518.99	617.77	671.47	658.29	638.08	598.83	553.09	428.28	279.33	201.49	(83)

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

(84)m=	699.19	854.55	966.59	1040.98	1069.7	1032.57	996.86	963.92	930.77	830.58	709.95	653.55	(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	0.94	0.85	0.69	0.5	0.36	0.38	0.6	0.88	0.98	1	(86)

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

(87)m=	20.41	20.56	20.72	20.87	20.94	20.96	20.96	20.96	20.95	20.86	20.61	20.38	(87)

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

(88)m=	20.19	20.2	20.2	20.21	20.21	20.23	20.23	20.23	20.22	20.21	20.21	20.2	(88)

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

(89)m=	0.99	0.97	0.93	0.82	0.64	0.44	0.29	0.32	0.53	0.84	0.98	0.99	(89)

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

(90)m=	19.4	19.62	19.85	20.05	20.13	20.16	20.16	20.17	20.15	20.05	19.7	19.37	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	19.78	19.97	20.18	20.36	20.44	20.46	20.46	20.46	20.45	20.35	20.04	19.75	(92)

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

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(93)m=	19.63	19.82	20.03	20.21	20.29	20.31	20.31	20.31	20.3	20.2	19.89	19.6	(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	0.97	0.92	0.82	0.65	0.45	0.3	0.33	0.54	0.84	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	692.65	829.57	892.72	848.61	690.29	461.55	300.83	316.02	501.86	701.35	691.32	649.29	(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=	1297.6	1259.01	1137.48	935.24	707.65	462.87	300.91	316.16	506.26	791.68	1061.67	1286.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	450.08	288.58	182.11	62.37	12.91	0	0	0	0	67.21	266.65	474.13	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1804.05 (98)

Space heating requirement in kWh/m²/year 18.54 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)														
	450.08	288.58	182.11	62.37	12.91	0	0	0	0	67.21	266.65	474.13		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	489.75	314.02	198.16	67.87	14.05	0	0	0	0	73.13	290.16	515.92		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1963.06	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	209.11	184.27	193.43	173.26	169.69	151.48	145.35	159.68	159.45	179.67	190.15	204.04		
Efficiency of water heater													81.8	(216)
(217)m=	88.44	87.68	86.4	84.25	82.44	81.8	81.8	81.8	81.8	84.32	87.41	88.61		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	236.46	210.16	223.86	205.65	205.83	185.19	177.69	195.2	194.93	213.07	217.54	230.27		
Total = Sum(219a)$_{1...12}$ =													2495.85	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1963.06

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Water heating fuel used			2495.85	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		272.49		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		302.49	(231)
Electricity for lighting			396.63	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	424.02	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	539.1	(264)
Space and water heating	(261) + (262) + (263) + (264) =			963.12	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	156.99	(267)
Electricity for lighting	(232) x	0.519	=	205.85	(268)
Total CO2, kg/year		sum of (265)…(271) =		1325.97	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.62	(273)
EI rating (section 14)				88	(274)

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User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 31 - 3B6P - TF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	192.4	(1a) x	2.6	(2a) =	500.24	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	192.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	500.24	(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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(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

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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

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) = 75.65 (23c)

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.34	x1/[1/(1.1)+ 0.04]		=	10.89			(27)
Windows Type 2			9.9	x1/[1/(1.1)+ 0.04]		=	10.43			(27)
Windows Type 3			5.25	x1/[1/(1.1)+ 0.04]		=	5.53			(27)
Windows Type 4			5.5	x1/[1/(1.1)+ 0.04]		=	5.8			(27)
Walls Type1	146.45	30.99	115.46	x	0.12	=	13.85			(29)
Walls Type2	26.73	0	26.73	x	0.14	=	3.78			(29)
Roof	191	0	191	x	0.13	=	24.83			(30)
Total area of elements, m²			364.18							(31)
Party floor			191							(32a)

** 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) = 75.12 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 19312.16 (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 54.63 (36)

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

Total fabric heat loss (33) + (36) = 129.75 (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=	49.3	48.73	48.16	45.29	44.72	41.86	41.86	41.29	43	44.72	45.87	47.01	(38)

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

(39)m=	179.05	178.48	177.9	175.04	174.47	171.6	171.6	171.03	172.75	174.47	175.61	176.76	

Average = Sum(39)$_{1…12}$ /12= 174.9 (39)

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

(40)m=	0.93	0.93	0.92	0.91	0.91	0.89	0.89	0.89	0.9	0.91	0.91	0.92

Average = Sum(40)$_{1…12}$ /12= 0.91 (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 2.99 (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) + 36 105.26 (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=	115.79	111.58	107.37	103.16	98.94	94.73	94.73	98.94	103.16	107.37	111.58	115.79	
											Total = Sum(44)$_{1…12}$ =	1263.13	(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=	171.71	150.18	154.97	135.11	129.64	111.87	103.66	118.95	120.37	140.28	153.13	166.29	
											Total = Sum(45)$_{1…12}$ =	1656.16	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	25.76	22.53	23.25	20.27	19.45	16.78	15.55	17.84	18.06	21.04	22.97	24.94	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 305 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.63 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.88 (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) 0.88 (55)

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

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(57)

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

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

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

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

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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=	222.26	195.83	205.52	184.02	180.19	160.79	154.21	169.5	169.29	190.83	202.05	216.84	(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=	222.26	195.83	205.52	184.02	180.19	160.79	154.21	169.5	169.29	190.83	202.05	216.84

Output from water heater (annual)$_{1...12}$ 2251.33 (64)

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

(65)m=	97.53	86.46	91.97	84.06	83.54	76.33	74.91	79.99	79.16	87.08	90.05	95.73	(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=	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	(66)

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

(67)m=	35.19	31.26	25.42	19.24	14.38	12.14	13.12	17.06	22.89	29.07	33.93	36.17	(67)

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

(68)m=	363.76	367.54	358.03	337.78	312.21	288.19	272.14	268.36	277.88	298.13	323.69	347.71	(68)

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

(69)m=	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	(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=	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	(71)

Water heating gains (Table 5)

(72)m=	131.09	128.66	123.61	116.75	112.29	106.01	100.68	107.51	109.94	117.05	125.07	128.67	(72)

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

(73)m=	600.93	598.33	577.94	544.65	509.77	477.23	456.82	463.82	481.59	515.12	553.57	583.43	(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	0.3	x	5.5	x	11.28	x	0.45	x	0.67	=	5.05	(75)
Northeast 0.9x	0.3	x	5.5	x	22.97	x	0.45	x	0.67	=	10.28	(75)
Northeast 0.9x	0.3	x	5.5	x	41.38	x	0.45	x	0.67	=	18.53	(75)
Northeast 0.9x	0.3	x	5.5	x	67.96	x	0.45	x	0.67	=	30.43	(75)
Northeast 0.9x	0.3	x	5.5	x	91.35	x	0.45	x	0.67	=	40.9	(75)

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Northeast	0.9x	0.3	x	5.5	x	97.38	x	0.45	x	0.67	=	43.6	(75)
Northeast	0.9x	0.3	x	5.5	x	91.1	x	0.45	x	0.67	=	40.79	(75)
Northeast	0.9x	0.3	x	5.5	x	72.63	x	0.45	x	0.67	=	32.52	(75)
Northeast	0.9x	0.3	x	5.5	x	50.42	x	0.45	x	0.67	=	22.57	(75)
Northeast	0.9x	0.3	x	5.5	x	28.07	x	0.45	x	0.67	=	12.57	(75)
Northeast	0.9x	0.3	x	5.5	x	14.2	x	0.45	x	0.67	=	6.36	(75)
Northeast	0.9x	0.3	x	5.5	x	9.21	x	0.45	x	0.67	=	4.13	(75)
Southeast	0.9x	0.77	x	9.9	x	36.79	x	0.45	x	0.67	=	76.11	(77)
Southeast	0.9x	0.77	x	9.9	x	62.67	x	0.45	x	0.67	=	129.64	(77)
Southeast	0.9x	0.77	x	9.9	x	85.75	x	0.45	x	0.67	=	177.38	(77)
Southeast	0.9x	0.77	x	9.9	x	106.25	x	0.45	x	0.67	=	219.78	(77)
Southeast	0.9x	0.77	x	9.9	x	119.01	x	0.45	x	0.67	=	246.17	(77)
Southeast	0.9x	0.77	x	9.9	x	118.15	x	0.45	x	0.67	=	244.39	(77)
Southeast	0.9x	0.77	x	9.9	x	113.91	x	0.45	x	0.67	=	235.62	(77)
Southeast	0.9x	0.77	x	9.9	x	104.39	x	0.45	x	0.67	=	215.93	(77)
Southeast	0.9x	0.77	x	9.9	x	92.85	x	0.45	x	0.67	=	192.06	(77)
Southeast	0.9x	0.77	x	9.9	x	69.27	x	0.45	x	0.67	=	143.28	(77)
Southeast	0.9x	0.77	x	9.9	x	44.07	x	0.45	x	0.67	=	91.16	(77)
Southeast	0.9x	0.77	x	9.9	x	31.49	x	0.45	x	0.67	=	65.13	(77)
Southwest	0.9x	0.77	x	10.34	x	36.79		0.45	x	0.67	=	79.49	(79)
Southwest	0.9x	0.77	x	10.34	x	62.67		0.45	x	0.67	=	135.4	(79)
Southwest	0.9x	0.77	x	10.34	x	85.75		0.45	x	0.67	=	185.26	(79)
Southwest	0.9x	0.77	x	10.34	x	106.25		0.45	x	0.67	=	229.55	(79)
Southwest	0.9x	0.77	x	10.34	x	119.01		0.45	x	0.67	=	257.11	(79)
Southwest	0.9x	0.77	x	10.34	x	118.15		0.45	x	0.67	=	255.26	(79)
Southwest	0.9x	0.77	x	10.34	x	113.91		0.45	x	0.67	=	246.09	(79)
Southwest	0.9x	0.77	x	10.34	x	104.39		0.45	x	0.67	=	225.53	(79)
Southwest	0.9x	0.77	x	10.34	x	92.85		0.45	x	0.67	=	200.6	(79)
Southwest	0.9x	0.77	x	10.34	x	69.27		0.45	x	0.67	=	149.65	(79)
Southwest	0.9x	0.77	x	10.34	x	44.07		0.45	x	0.67	=	95.21	(79)
Southwest	0.9x	0.77	x	10.34	x	31.49		0.45	x	0.67	=	68.03	(79)
Northwest	0.9x	0.3	x	5.25	x	11.28	x	0.45	x	0.67	=	4.82	(81)
Northwest	0.9x	0.3	x	5.25	x	22.97	x	0.45	x	0.67	=	9.82	(81)
Northwest	0.9x	0.3	x	5.25	x	41.38	x	0.45	x	0.67	=	17.68	(81)
Northwest	0.9x	0.3	x	5.25	x	67.96	x	0.45	x	0.67	=	29.04	(81)
Northwest	0.9x	0.3	x	5.25	x	91.35	x	0.45	x	0.67	=	39.04	(81)
Northwest	0.9x	0.3	x	5.25	x	97.38	x	0.45	x	0.67	=	41.62	(81)
Northwest	0.9x	0.3	x	5.25	x	91.1	x	0.45	x	0.67	=	38.93	(81)
Northwest	0.9x	0.3	x	5.25	x	72.63	x	0.45	x	0.67	=	31.04	(81)
Northwest	0.9x	0.3	x	5.25	x	50.42	x	0.45	x	0.67	=	21.55	(81)
Northwest	0.9x	0.3	x	5.25	x	28.07	x	0.45	x	0.67	=	12	(81)

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Northwest	0.9x	0.3	x	5.25	x	14.2	x	0.45	x	0.67	=	6.07	(81)
Northwest	0.9x	0.3	x	5.25	x	9.21	x	0.45	x	0.67	=	3.94	(81)

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

(83)m=	165.47	285.14	398.85	508.8	583.23	584.87	561.44	505.02	436.79	317.49	198.8	141.22	(83)

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

(84)m=	766.4	883.47	976.79	1053.45	1092.99	1062.1	1018.26	968.83	918.38	832.61	752.36	724.66	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.97	0.87	0.71	0.76	0.95	1	1	1	(86)

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

(87)m=	20.11	20.2	20.34	20.54	20.74	20.89	20.94	20.94	20.83	20.58	20.31	20.1	(87)

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

(88)m=	20.14	20.14	20.15	20.16	20.16	20.17	20.17	20.18	20.17	20.16	20.16	20.15	(88)

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

(89)m=	1	1	1	0.99	0.95	0.81	0.59	0.65	0.91	0.99	1	1	(89)

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

(90)m=	18.92	19.05	19.27	19.57	19.85	20.06	20.1	20.1	19.99	19.62	19.23	18.91	(90)

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

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

(92)m=	19.14	19.27	19.47	19.76	20.02	20.22	20.26	20.26	20.15	19.81	19.43	19.14	(92)

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

(93)m=	18.99	19.12	19.32	19.61	19.87	20.07	20.11	20.11	20	19.66	19.28	18.99	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.95	0.8	0.58	0.64	0.9	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	766.06	882.44	973.36	1039.39	1033.65	852	593.11	618.06	827.13	824.64	751.51	724.43	(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=	2631.04	2537.61	2281.07	1874.34	1425.63	937.95	602.93	634.69	1018.57	1579.92	2139.51	2613.92	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1387.55	1112.27	972.94	601.16	291.63	0	0	0	0	561.93	999.36	1405.78	

Total per year (kWh/year) = Sum(98)$_{1…5,9…12}$ = | 7332.63 | (98)

Space heating requirement in kWh/m²/year | 38.11 | (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system | 0 | (201)

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Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)	1387.55	1112.27	972.94	601.16	291.63	0	0	0	0	561.93	999.36	1405.78		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1509.85	1210.31	1058.7	654.15	317.34	0	0	0	0	611.45	1087.45	1529.68		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													7978.92	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	222.26	195.83	205.52	184.02	180.19	160.79	154.21	169.5	169.29	190.83	202.05	216.84		
Efficiency of water heater													81.8	(216)
(217)m=	90.36	90.23	89.96	89.32	87.76	81.8	81.8	81.8	81.8	89.11	90.03	90.41		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	245.97	217.03	228.45	206.04	205.31	196.56	188.52	207.21	206.96	214.15	224.42	239.84		
Total = Sum(219a)$_{1...12}$ =													2580.47	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			7978.92	
Water heating fuel used			2580.47	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		465.35		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		495.35	(231)
Electricity for lighting			621.47	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	1723.45	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	557.38	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2280.83	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	257.09	(267)
Electricity for lighting	(232)	x	0.519	=	322.54	(268)

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Total CO2, kg/year	sum of (265)…(271) =	2860.46	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =	14.87	(273)
EI rating (section 14)		84	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 32 - 2B4P - TF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	118	(1a) x	2.4	(2a) =	283.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	118	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	283.2	(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)

DRAFT

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

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		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) = 73.95 (23c)

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

(24a)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(24a)

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			6.2	x1/[1/(1.1)+ 0.04]		=	6.53			(27)
Windows Type 2			0.36	x1/[1/(1.1)+ 0.04]		=	0.38			(27)
Walls Type1	103.96	6.56	97.4	x	0.12	=	11.69			(29)
Walls Type2	4.93	0	4.93	x	0.14	=	0.7			(29)
Roof	118	0	118	x	0.13	=	15.34			(30)
Total area of elements, m²			226.89							(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) = 34.64 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8224.82 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 34.03 (36)

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

Total fabric heat loss (33) + (36) = 68.67 (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=	27.37	27.07	26.77	25.28	24.98	23.49	23.49	23.19	24.09	24.98	25.58	26.17	(38)

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

(39)m=	96.03	95.74	95.44	93.95	93.65	92.16	92.16	91.86	92.76	93.65	94.25	94.84	

Average = Sum(39)$_{1…12}$ /12= 93.88 (39)

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

(40)m=	0.81	0.81	0.81	0.8	0.79	0.78	0.78	0.78	0.79	0.79	0.8	0.8

Average = Sum(40)$_{1…12}$ /12= 0.8 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.86 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.01 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	112.21	108.13	104.05	99.97	95.89	91.81	91.81	95.89	99.97	104.05	108.13	112.21	
											Total = Sum(44)$_{1…12}$ =	1224.14	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	166.41	145.54	150.19	130.94	125.64	108.41	100.46	115.28	116.66	135.95	148.41	161.16	
											Total = Sum(45)$_{1…12}$ =	1605.05	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	24.96	21.83	22.53	19.64	18.85	16.26	15.07	17.29	17.5	20.39	22.26	24.17	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.49 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.8 (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) 0.8 (55)

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

(56)m=	24.94	22.53	24.94	24.14	24.94	24.14	24.94	24.94	24.14	24.94	24.14	24.94	(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=	24.94	22.53	24.94	24.14	24.94	24.14	24.94	24.94	24.14	24.94	24.14	24.94	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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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=	214.61	189.08	198.39	177.59	173.84	155.06	148.67	163.49	163.31	184.16	195.06	209.36	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	214.61	189.08	198.39	177.59	173.84	155.06	148.67	163.49	163.31	184.16	195.06	209.36

Output from water heater (annual)$_{1...12}$ 2172.62 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	93.89	83.22	88.5	80.86	80.34	73.37	71.97	76.9	76.11	83.77	86.66	92.15	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	32.48	28.85	23.46	17.76	13.28	11.21	12.11	15.74	21.13	26.83	31.31	33.38	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	282.59	285.52	278.13	262.4	242.54	223.88	211.41	208.48	215.86	231.6	251.45	270.12	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	(71)
Water heating gains (Table 5)													
(72)m=	126.2	123.85	118.95	112.3	107.98	101.9	96.73	103.35	105.71	112.59	120.37	123.86	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	510.1	507.04	489.37	461.29	432.63	405.81	389.08	396.4	411.53	439.85	471.96	496.18	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	0.36	x	10.63	x	0.45	x	0.67	=	0.8	(74)
North	0.9x	0.77	x	0.36	x	20.32	x	0.45	x	0.67	=	1.53	(74)
North	0.9x	0.77	x	0.36	x	34.53	x	0.45	x	0.67	=	2.6	(74)
North	0.9x	0.77	x	0.36	x	55.46	x	0.45	x	0.67	=	4.17	(74)
North	0.9x	0.77	x	0.36	x	74.72	x	0.45	x	0.67	=	5.62	(74)

North	0.9x	0.77	x	0.36	x	79.99	x	0.45	x	0.67	=	6.02	(74)
North	0.9x	0.77	x	0.36	x	74.68	x	0.45	x	0.67	=	5.62	(74)
North	0.9x	0.77	x	0.36	x	59.25	x	0.45	x	0.67	=	4.46	(74)
North	0.9x	0.77	x	0.36	x	41.52	x	0.45	x	0.67	=	3.12	(74)
North	0.9x	0.77	x	0.36	x	24.19	x	0.45	x	0.67	=	1.82	(74)
North	0.9x	0.77	x	0.36	x	13.12	x	0.45	x	0.67	=	0.99	(74)
North	0.9x	0.77	x	0.36	x	8.86	x	0.45	x	0.67	=	0.67	(74)
South	0.9x	0.77	x	6.2	x	46.75	x	0.45	x	0.67	=	60.56	(78)
South	0.9x	0.77	x	6.2	x	76.57	x	0.45	x	0.67	=	99.19	(78)
South	0.9x	0.77	x	6.2	x	97.53	x	0.45	x	0.67	=	126.35	(78)
South	0.9x	0.77	x	6.2	x	110.23	x	0.45	x	0.67	=	142.8	(78)
South	0.9x	0.77	x	6.2	x	114.87	x	0.45	x	0.67	=	148.81	(78)
South	0.9x	0.77	x	6.2	x	110.55	x	0.45	x	0.67	=	143.21	(78)
South	0.9x	0.77	x	6.2	x	108.01	x	0.45	x	0.67	=	139.92	(78)
South	0.9x	0.77	x	6.2	x	104.89	x	0.45	x	0.67	=	135.88	(78)
South	0.9x	0.77	x	6.2	x	101.89	x	0.45	x	0.67	=	131.99	(78)
South	0.9x	0.77	x	6.2	x	82.59	x	0.45	x	0.67	=	106.98	(78)
South	0.9x	0.77	x	6.2	x	55.42	x	0.45	x	0.67	=	71.79	(78)
South	0.9x	0.77	x	6.2	x	40.4	x	0.45	x	0.67	=	52.33	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	61.36	100.72	128.95	146.97	154.43	149.22	145.54	140.34	135.11	108.8	72.78	53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	571.46	607.76	618.32	608.26	587.05	555.04	534.62	536.74	546.64	548.65	544.74	549.18	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.98	0.9	0.73	0.75	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.3	20.37	20.47	20.62	20.77	20.9	20.95	20.95	20.88	20.69	20.47	20.29	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.24	20.24	20.25	20.26	20.26	20.27	20.27	20.27	20.27	20.26	20.25	20.25	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.97	0.85	0.62	0.65	0.89	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.29	19.38	19.54	19.76	19.98	20.16	20.21	20.21	20.13	19.86	19.55	19.28	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.6	19.69	19.83	20.03	20.23	20.39	20.44	20.44	20.36	20.12	19.83	19.6	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.45	19.54	19.68	19.88	20.08	20.24	20.29	20.29	20.21	19.97	19.68	19.45	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	1	1	1	0.99	0.96	0.84	0.63	0.65	0.89	0.98	1	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	570.79	606.48	615.65	601.33	564.32	468.23	334.34	349.78	485.69	540.11	543.25	548.69		(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=	1455.17	1401.21	1257.64	1031.53	784.39	519.98	339.87	357.11	566.81	877.21	1185.89	1446.03		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	657.98	534.06	477.64	309.75	163.74	0	0	0	0	250.8	462.7	667.62		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													3524.29	(98)
Space heating requirement in kWh/m²/year													29.87	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)														
	657.98	534.06	477.64	309.75	163.74	0	0	0	0	250.8	462.7	667.62		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	715.97	581.13	519.74	337.05	178.17	0	0	0	0	272.91	503.48	726.46		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3834.91	(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)														
	214.61	189.08	198.39	177.59	173.84	155.06	148.67	163.49	163.31	184.16	195.06	209.36		
Efficiency of water heater													81.8	(216)
(217)m=	89.19	89.03	88.69	87.94	86.41	81.8	81.8	81.8	81.8	87.33	88.65	89.27		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	240.62	212.39	223.7	201.93	201.19	189.57	181.74	199.86	199.64	210.87	220.02	234.53		
Total = Sum(219a)$_{1...12}$ =													2516.07	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3834.91

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Water heating fuel used			2516.07	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		293.68		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		323.68	(231)
Electricity for lighting			573.57	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	828.34	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	543.47	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1371.81	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	167.99	(267)
Electricity for lighting	(232) x	0.519	=	297.68	(268)
Total CO2, kg/year		sum of (265)…(271) =		1837.48	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.57	(273)
EI rating (section 14)				85	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 33 - 1B2P -TF (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	59.88	(1a) x	2.4	(2a) =	143.71	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.88	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	143.71	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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

envision

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.1 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	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	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	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	
Windows			4.6	x1/[1/(1.1)+ 0.04]		=	4.85			(27)
Walls Type1	72.9	4.6	68.3	x	0.12	=	8.2			(29)
Walls Type2	26.57	0	26.57	x	0.14	=	3.76			(29)
Roof	55	0	55	x	0.13	=	7.15			(30)
Total area of elements, m²			154.47							(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) = 23.95 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7135.62 (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 23.17 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.12 (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=	13.41	13.27	13.13	12.44	12.31	11.62	11.62	11.48	11.89	12.31	12.58	12.86	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	60.53	60.39	60.25	59.57	59.43	58.74	58.74	58.6	59.01	59.43	59.7	59.98	

Average = Sum(39)$_{1…12}$ /12= 59.53 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.01	1.01	1.01	0.99	0.99	0.98	0.98	0.98	0.99	0.99	1	1	

Average = Sum(40)$_{1…12}$ /12= 0.99 (40)

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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 — 1.98 (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 — 81.18 (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=	89.3	86.05	82.81	79.56	76.31	73.06	73.06	76.31	79.56	82.81	86.05	89.3	

Total = Sum(44)$_{1\ldots12}$ = 974.2 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	132.43	115.83	119.52	104.2	99.98	86.28	79.95	91.74	92.84	108.2	118.1	128.25

Total = Sum(45)$_{1\ldots12}$ = 1277.33 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	19.86	17.37	17.93	15.63	15	12.94	11.99	13.76	13.93	16.23	17.72	19.24	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0.99 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.53 (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) — 0.53 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	16.57	14.97	16.57	16.04	16.57	16.04	16.57	16.57	16.04	16.57	16.04	16.57	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	16.57	14.97	16.57	16.04	16.57	16.04	16.57	16.57	16.04	16.57	16.04	16.57	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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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=	172.27	151.81	159.36	142.75	139.82	124.83	119.78	131.58	131.39	148.03	156.65	168.09	(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=	172.27	151.81	159.36	142.75	139.82	124.83	119.78	131.58	131.39	148.03	156.65	168.09	

Output from water heater (annual)$_{1...12}$ 1746.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	75.9	67.3	71.61	65.49	65.11	59.53	58.45	62.37	61.71	67.84	70.11	74.51	(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=	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.86	16.76	13.63	10.32	7.71	6.51	7.03	9.14	12.27	15.58	18.19	19.39	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	172.64	174.44	169.92	160.31	148.18	136.78	129.16	127.37	131.88	141.49	153.62	165.03	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	(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=	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	(71)

Water heating gains (Table 5)

(72)m=	102.02	100.14	96.25	90.95	87.52	82.68	78.56	83.83	85.71	91.19	97.37	100.15	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	349.2	347.01	335.47	317.25	299.08	281.64	270.43	276.02	285.53	303.94	324.86	340.24	(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)	
North	0.9x	0.77	x	4.6	x	10.63	x	0.45	x	0.67	=	10.22	(74)
North	0.9x	0.77	x	4.6	x	20.32	x	0.45	x	0.67	=	19.53	(74)
North	0.9x	0.77	x	4.6	x	34.53	x	0.45	x	0.67	=	33.19	(74)
North	0.9x	0.77	x	4.6	x	55.46	x	0.45	x	0.67	=	53.31	(74)
North	0.9x	0.77	x	4.6	x	74.72	x	0.45	x	0.67	=	71.81	(74)
North	0.9x	0.77	x	4.6	x	79.99	x	0.45	x	0.67	=	76.88	(74)
North	0.9x	0.77	x	4.6	x	74.68	x	0.45	x	0.67	=	71.77	(74)
North	0.9x	0.77	x	4.6	x	59.25	x	0.45	x	0.67	=	56.94	(74)

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North	0.9x	0.77	x	4.6	x	41.52	x	0.45	x	0.67	=	39.9	(74)
North	0.9x	0.77	x	4.6	x	24.19	x	0.45	x	0.67	=	23.25	(74)
North	0.9x	0.77	x	4.6	x	13.12	x	0.45	x	0.67	=	12.61	(74)
North	0.9x	0.77	x	4.6	x	8.86	x	0.45	x	0.67	=	8.52	(74)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	10.22	19.53	33.19	53.31	71.81	76.88	71.77	56.94	39.9	23.25	12.61	8.52	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	359.42	366.54	368.66	370.56	370.89	358.51	342.2	332.96	325.44	327.18	337.47	348.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.87	0.71	0.75	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.16	20.22	20.34	20.52	20.72	20.88	20.93	20.93	20.82	20.59	20.35	20.15	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.07	20.08	20.08	20.09	20.09	20.1	20.1	20.1	20.1	20.09	20.09	20.08	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.94	0.8	0.59	0.63	0.88	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.95	19.03	19.21	19.48	19.76	19.97	20.02	20.02	19.91	19.59	19.24	18.94	(90)

fLA = Living area ÷ (4) = | 0.61 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.69	19.76	19.9	20.12	20.34	20.52	20.58	20.57	20.47	20.2	19.92	19.68	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.54	19.61	19.75	19.97	20.19	20.37	20.43	20.42	20.32	20.05	19.77	19.53	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.95	0.83	0.64	0.68	0.9	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	358.28	365.01	366.02	364.18	351.19	296.28	217.5	225.28	291.82	320.61	335.49	347.83	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	922.58	888.17	798.33	659.28	504.68	339.05	224.93	235.86	366.97	561.78	756.42	919.62	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	419.84	351.56	321.64	212.47	114.2	0	0	0	0	179.43	303.07	425.41	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 2327.63 | (98)

Space heating requirement in kWh/m²/year | 38.87 | (99)

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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)	419.84	351.56	321.64	212.47	114.2	0	0	0	0	179.43	303.07	425.41		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	456.84	382.55	349.99	231.2	124.26	0	0	0	0	195.24	329.78	462.91		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2532.78	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	172.27	151.81	159.36	142.75	139.82	124.83	119.78	131.58	131.39	148.03	156.65	168.09		
Efficiency of water heater													81.8	(216)
(217)m=	88.71	88.6	88.29	87.56	86.05	81.8	81.8	81.8	81.8	87.04	88.19	88.79		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	194.18	171.34	180.5	163.04	162.48	152.6	146.44	160.85	160.62	170.07	177.63	189.3		
Total = Sum(219a)$_{1...12}$ =													2029.05	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2532.78	
Water heating fuel used			2029.05	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		199.44		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		229.44	(231)
Electricity for lighting			333.16	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	547.08	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	438.28	(264)
Space and water heating	(261) + (262) + (263) + (264) =				985.36	(265)

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Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	119.08	(267)
Electricity for lighting	(232) x		0.519	=	172.91	(268)
Total CO2, kg/year		sum of (265)…(271) =			1277.34	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =			21.33	(273)
EI rating (section 14)					84	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Gate House (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	36.22	(1a)	x	3.2	(2a)	=	115.9	(3a)
Ground floor	47.4	(1b)	x	3.2	(2b)	=	151.68	(3b)
First floor	36.22	(1c)	x	3.2	(2c)	=	115.9	(3c)
Second floor	37.02	(1d)	x	2.76	(2d)	=	102.18	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	156.86	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	485.66	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

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) = 74.8 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.3	0.3	0.3	0.28	0.28	0.26	0.26	0.25	0.26	0.28	0.28	0.29	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.3	0.3	0.3	0.28	0.28	0.26	0.26	0.25	0.26	0.28	0.28	0.29	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			4.08	x	1.2	=	4.896			(26)
Doors Type 2			2.43	x	1.2	=	2.916			(26)
Doors Type 3			2.43	x	1.2	=	2.916			(26)
Windows Type 1			0.408		x1/[1/(1.1)+ 0.04]	=	0.43			(27)
Windows Type 2			1.84		x1/[1/(1.1)+ 0.04]	=	1.94			(27)
Windows Type 3			0.408		x1/[1/(1.1)+ 0.04]	=	0.43			(27)
Windows Type 4			1.84		x1/[1/(1.1)+ 0.04]	=	1.94			(27)
Windows Type 5			0.907		x1/[1/(1.1)+ 0.04]	=	0.96			(27)
Windows Type 6			0.907		x1/[1/(1.1)+ 0.04]	=	0.96			(27)
Windows Type 7			1.34		x1/[1/(1.1)+ 0.04]	=	1.41			(27)
Windows Type 8			2.72		x1/[1/(1.1)+ 0.04]	=	2.87			(27)
Windows Type 9			1.82		x1/[1/(1.1)+ 0.04]	=	1.92			(27)
Windows Type 10			2.72		x1/[1/(1.1)+ 0.04]	=	2.87			(27)
Windows Type 11			1.45		x1/[1/(1.1)+ 0.04]	=	1.53			(27)

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Windows Type 12			2.91	x1/[1/(1.1)+ 0.04]		=	3.07			(27)
Windows Type 13			0.58	x1/[1/(1.1)+ 0.04]		=	0.61			(27)
Floor Type 1			36.22	x	0.12	=	4.3464			(28)
Floor Type 2			47.41	x	0.12	=	5.6892			(28)
Walls Type1	66.24	4.08	62.16	x	0.12	=	7.46			(29)
Walls Type2	76.51	11.17	65.34	x	0.11	=	7.48			(29)
Walls Type3	66.24	8.6	57.64	x	0.12	=	6.92			(29)
Walls Type4	75.9	4.94	70.96	x	0.12	=	8.52			(29)
Roof	45	0	45	x	0.13	=	5.85			(30)
Total area of elements, m²			413.52							(31)
Party wall			14.08	x	0	=	0			(32)
Party wall			14.08	x	0	=	0			(32)
Party wall			14.08	x	0	=	0			(32)
Party wall			9.91	x	0	=	0			(32)
Party floor			36.22							(32a)
Party floor			37.02							(32a)
Party ceiling			36.22							(32b)
Party ceiling			47.4							(32b)
Party ceiling			36.22							(32b)

** 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) = 77.9 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 37002.6 (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 62.03 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 139.93 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	48.55	47.99	47.43	44.65	44.1	41.32	41.32	40.76	42.43	44.1	45.21	46.32	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	188.48	187.92	187.36	184.58	184.03	181.25	181.25	180.69	182.36	184.03	185.14	186.25	

Average = Sum(39)$_{1…12}$ /12= 184.45 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.2	1.2	1.19	1.18	1.17	1.16	1.16	1.15	1.16	1.17	1.18	1.19

Average = Sum(40)$_{1…12}$ /12= 1.18 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.94 (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) + 36 104.13 (43)

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Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	169.86	148.56	153.31	133.66	128.25	110.67	102.55	117.68	119.08	138.78	151.49	164.5

Total = Sum(45)1...12 = 1638.38 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.48	22.28	23	20.05	19.24	16.6	15.38	17.65	17.86	20.82	22.72	24.68	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		305	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)			
Water storage loss:			
a) If manufacturer's declared loss factor is known (kWh/day):		1.63	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.88	(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)		0.88	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	220.41	194.22	203.85	182.57	178.79	159.58	153.1	168.22	168	189.33	200.4	215.05	(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=	220.41	194.22	203.85	182.57	178.79	159.58	153.1	168.22	168	189.33	200.4	215.05

Output from water heater (annual)1...12 2233.55 (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=	96.92	85.92	91.41	83.57	83.08	75.93	74.54	79.57	78.73	86.58	89.5	95.14	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(66)m=	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	32.38	28.76	23.39	17.71	13.24	11.17	12.07	15.69	21.07	26.75	31.22	33.28	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	327.89	331.29	322.72	304.46	281.42	259.77	245.3	241.9	250.47	268.73	291.77	313.42	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	(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=	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	(71)

Water heating gains (Table 5)

(72)m=	130.27	127.86	122.87	116.08	111.67	105.46	100.18	106.94	109.35	116.37	124.31	127.87	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	560.7	558.08	539.14	508.41	476.49	446.57	427.72	434.7	451.05	482.01	517.46	544.74	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	0.41	x	10.63	x	0.45	x	0.67	=	0.91	(74)
North	0.9x	0.77	x	1.84	x	10.63	x	0.45	x	0.67	=	4.09	(74)
North	0.9x	0.77	x	1.34	x	10.63	x	0.45	x	0.67	=	2.98	(74)
North	0.9x	0.77	x	2.72	x	10.63	x	0.45	x	0.67	=	6.04	(74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.45	x	0.67	=	3.22	(74)
North	0.9x	0.77	x	0.58	x	10.63	x	0.45	x	0.67	=	1.29	(74)
North	0.9x	0.77	x	0.41	x	20.32	x	0.45	x	0.67	=	1.73	(74)
North	0.9x	0.77	x	1.84	x	20.32	x	0.45	x	0.67	=	7.81	(74)
North	0.9x	0.77	x	1.34	x	20.32	x	0.45	x	0.67	=	5.69	(74)
North	0.9x	0.77	x	2.72	x	20.32	x	0.45	x	0.67	=	11.55	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.45	x	0.67	=	6.16	(74)
North	0.9x	0.77	x	0.58	x	20.32	x	0.45	x	0.67	=	2.46	(74)
North	0.9x	0.77	x	0.41	x	34.53	x	0.45	x	0.67	=	2.94	(74)
North	0.9x	0.77	x	1.84	x	34.53	x	0.45	x	0.67	=	13.28	(74)
North	0.9x	0.77	x	1.34	x	34.53	x	0.45	x	0.67	=	9.67	(74)
North	0.9x	0.77	x	2.72	x	34.53	x	0.45	x	0.67	=	19.62	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.45	x	0.67	=	10.46	(74)
North	0.9x	0.77	x	0.58	x	34.53	x	0.45	x	0.67	=	4.18	(74)
North	0.9x	0.77	x	0.41	x	55.46	x	0.45	x	0.67	=	4.73	(74)
North	0.9x	0.77	x	1.84	x	55.46	x	0.45	x	0.67	=	21.32	(74)
North	0.9x	0.77	x	1.34	x	55.46	x	0.45	x	0.67	=	15.53	(74)

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North	0.9x	0.77	x	2.72	x	55.46	x	0.45	x	0.67	=	31.52	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.45	x	0.67	=	16.8	(74)
North	0.9x	0.77	x	0.58	x	55.46	x	0.45	x	0.67	=	6.72	(74)
North	0.9x	0.77	x	0.41	x	74.72	x	0.45	x	0.67	=	6.37	(74)
North	0.9x	0.77	x	1.84	x	74.72	x	0.45	x	0.67	=	28.72	(74)
North	0.9x	0.77	x	1.34	x	74.72	x	0.45	x	0.67	=	20.92	(74)
North	0.9x	0.77	x	2.72	x	74.72	x	0.45	x	0.67	=	42.46	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.45	x	0.67	=	22.64	(74)
North	0.9x	0.77	x	0.58	x	74.72	x	0.45	x	0.67	=	9.05	(74)
North	0.9x	0.77	x	0.41	x	79.99	x	0.45	x	0.67	=	6.82	(74)
North	0.9x	0.77	x	1.84	x	79.99	x	0.45	x	0.67	=	30.75	(74)
North	0.9x	0.77	x	1.34	x	79.99	x	0.45	x	0.67	=	22.39	(74)
North	0.9x	0.77	x	2.72	x	79.99	x	0.45	x	0.67	=	45.46	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.45	x	0.67	=	24.23	(74)
North	0.9x	0.77	x	0.58	x	79.99	x	0.45	x	0.67	=	9.69	(74)
North	0.9x	0.77	x	0.41	x	74.68	x	0.45	x	0.67	=	6.37	(74)
North	0.9x	0.77	x	1.84	x	74.68	x	0.45	x	0.67	=	28.71	(74)
North	0.9x	0.77	x	1.34	x	74.68	x	0.45	x	0.67	=	20.91	(74)
North	0.9x	0.77	x	2.72	x	74.68	x	0.45	x	0.67	=	42.44	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.45	x	0.67	=	22.62	(74)
North	0.9x	0.77	x	0.58	x	74.68	x	0.45	x	0.67	=	9.05	(74)
North	0.9x	0.77	x	0.41	x	59.25	x	0.45	x	0.67	=	5.05	(74)
North	0.9x	0.77	x	1.84	x	59.25	x	0.45	x	0.67	=	22.78	(74)
North	0.9x	0.77	x	1.34	x	59.25	x	0.45	x	0.67	=	16.59	(74)
North	0.9x	0.77	x	2.72	x	59.25	x	0.45	x	0.67	=	33.67	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.45	x	0.67	=	17.95	(74)
North	0.9x	0.77	x	0.58	x	59.25	x	0.45	x	0.67	=	7.18	(74)
North	0.9x	0.77	x	0.41	x	41.52	x	0.45	x	0.67	=	3.54	(74)
North	0.9x	0.77	x	1.84	x	41.52	x	0.45	x	0.67	=	15.96	(74)
North	0.9x	0.77	x	1.34	x	41.52	x	0.45	x	0.67	=	11.62	(74)
North	0.9x	0.77	x	2.72	x	41.52	x	0.45	x	0.67	=	23.59	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.45	x	0.67	=	12.58	(74)
North	0.9x	0.77	x	0.58	x	41.52	x	0.45	x	0.67	=	5.03	(74)
North	0.9x	0.77	x	0.41	x	24.19	x	0.45	x	0.67	=	2.06	(74)
North	0.9x	0.77	x	1.84	x	24.19	x	0.45	x	0.67	=	9.3	(74)
North	0.9x	0.77	x	1.34	x	24.19	x	0.45	x	0.67	=	6.77	(74)
North	0.9x	0.77	x	2.72	x	24.19	x	0.45	x	0.67	=	13.75	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.45	x	0.67	=	7.33	(74)
North	0.9x	0.77	x	0.58	x	24.19	x	0.45	x	0.67	=	2.93	(74)
North	0.9x	0.77	x	0.41	x	13.12	x	0.45	x	0.67	=	1.12	(74)
North	0.9x	0.77	x	1.84	x	13.12	x	0.45	x	0.67	=	5.04	(74)

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North	0.9x	0.77	x	1.34	x	13.12	x	0.45	x	0.67	=	3.67	(74)
North	0.9x	0.77	x	2.72	x	13.12	x	0.45	x	0.67	=	7.45	(74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.45	x	0.67	=	3.97	(74)
North	0.9x	0.77	x	0.58	x	13.12	x	0.45	x	0.67	=	1.59	(74)
North	0.9x	0.77	x	0.41	x	8.86	x	0.45	x	0.67	=	0.76	(74)
North	0.9x	0.77	x	1.84	x	8.86	x	0.45	x	0.67	=	3.41	(74)
North	0.9x	0.77	x	1.34	x	8.86	x	0.45	x	0.67	=	2.48	(74)
North	0.9x	0.77	x	2.72	x	8.86	x	0.45	x	0.67	=	5.04	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.45	x	0.67	=	2.69	(74)
North	0.9x	0.77	x	0.58	x	8.86	x	0.45	x	0.67	=	1.07	(74)
Northeast	0.9x	0.77	x	0.91	x	11.28	x	0.45	x	0.67	=	2.14	(75)
Northeast	0.9x	0.77	x	0.91	x	22.97	x	0.45	x	0.67	=	4.35	(75)
Northeast	0.9x	0.77	x	0.91	x	41.38	x	0.45	x	0.67	=	7.84	(75)
Northeast	0.9x	0.77	x	0.91	x	67.96	x	0.45	x	0.67	=	12.88	(75)
Northeast	0.9x	0.77	x	0.91	x	91.35	x	0.45	x	0.67	=	17.31	(75)
Northeast	0.9x	0.77	x	0.91	x	97.38	x	0.45	x	0.67	=	18.46	(75)
Northeast	0.9x	0.77	x	0.91	x	91.1	x	0.45	x	0.67	=	17.26	(75)
Northeast	0.9x	0.77	x	0.91	x	72.63	x	0.45	x	0.67	=	13.76	(75)
Northeast	0.9x	0.77	x	0.91	x	50.42	x	0.45	x	0.67	=	9.56	(75)
Northeast	0.9x	0.77	x	0.91	x	28.07	x	0.45	x	0.67	=	5.32	(75)
Northeast	0.9x	0.77	x	0.91	x	14.2	x	0.45	x	0.67	=	2.69	(75)
Northeast	0.9x	0.77	x	0.91	x	9.21	x	0.45	x	0.67	=	1.75	(75)
South	0.9x	0.77	x	0.41	x	46.75	x	0.45	x	0.67	=	3.99	(78)
South	0.9x	0.77	x	1.84	x	46.75	x	0.45	x	0.67	=	17.97	(78)
South	0.9x	0.77	x	1.82	x	46.75	x	0.45	x	0.67	=	17.78	(78)
South	0.9x	0.77	x	2.72	x	46.75	x	0.45	x	0.67	=	26.57	(78)
South	0.9x	0.77	x	2.91	x	46.75	x	0.45	x	0.67	=	28.43	(78)
South	0.9x	0.77	x	0.41	x	76.57	x	0.45	x	0.67	=	6.53	(78)
South	0.9x	0.77	x	1.84	x	76.57	x	0.45	x	0.67	=	29.44	(78)
South	0.9x	0.77	x	1.82	x	76.57	x	0.45	x	0.67	=	29.12	(78)
South	0.9x	0.77	x	2.72	x	76.57	x	0.45	x	0.67	=	43.51	(78)
South	0.9x	0.77	x	2.91	x	76.57	x	0.45	x	0.67	=	46.55	(78)
South	0.9x	0.77	x	0.41	x	97.53	x	0.45	x	0.67	=	8.31	(78)
South	0.9x	0.77	x	1.84	x	97.53	x	0.45	x	0.67	=	37.5	(78)
South	0.9x	0.77	x	1.82	x	97.53	x	0.45	x	0.67	=	37.09	(78)
South	0.9x	0.77	x	2.72	x	97.53	x	0.45	x	0.67	=	55.43	(78)
South	0.9x	0.77	x	2.91	x	97.53	x	0.45	x	0.67	=	59.3	(78)
South	0.9x	0.77	x	0.41	x	110.23	x	0.45	x	0.67	=	9.4	(78)
South	0.9x	0.77	x	1.84	x	110.23	x	0.45	x	0.67	=	42.38	(78)
South	0.9x	0.77	x	1.82	x	110.23	x	0.45	x	0.67	=	41.92	(78)
South	0.9x	0.77	x	2.72	x	110.23	x	0.45	x	0.67	=	62.65	(78)

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South	0.9x	0.77	x	2.91	x	110.23	x	0.45	x	0.67	=	67.02	(78)
South	0.9x	0.77	x	0.41	x	114.87	x	0.45	x	0.67	=	9.79	(78)
South	0.9x	0.77	x	1.84	x	114.87	x	0.45	x	0.67	=	44.16	(78)
South	0.9x	0.77	x	1.82	x	114.87	x	0.45	x	0.67	=	43.68	(78)
South	0.9x	0.77	x	2.72	x	114.87	x	0.45	x	0.67	=	65.28	(78)
South	0.9x	0.77	x	2.91	x	114.87	x	0.45	x	0.67	=	69.84	(78)
South	0.9x	0.77	x	0.41	x	110.55	x	0.45	x	0.67	=	9.42	(78)
South	0.9x	0.77	x	1.84	x	110.55	x	0.45	x	0.67	=	42.5	(78)
South	0.9x	0.77	x	1.82	x	110.55	x	0.45	x	0.67	=	42.04	(78)
South	0.9x	0.77	x	2.72	x	110.55	x	0.45	x	0.67	=	62.83	(78)
South	0.9x	0.77	x	2.91	x	110.55	x	0.45	x	0.67	=	67.21	(78)
South	0.9x	0.77	x	0.41	x	108.01	x	0.45	x	0.67	=	9.21	(78)
South	0.9x	0.77	x	1.84	x	108.01	x	0.45	x	0.67	=	41.53	(78)
South	0.9x	0.77	x	1.82	x	108.01	x	0.45	x	0.67	=	41.07	(78)
South	0.9x	0.77	x	2.72	x	108.01	x	0.45	x	0.67	=	61.38	(78)
South	0.9x	0.77	x	2.91	x	108.01	x	0.45	x	0.67	=	65.67	(78)
South	0.9x	0.77	x	0.41	x	104.89	x	0.45	x	0.67	=	8.94	(78)
South	0.9x	0.77	x	1.84	x	104.89	x	0.45	x	0.67	=	40.33	(78)
South	0.9x	0.77	x	1.82	x	104.89	x	0.45	x	0.67	=	39.89	(78)
South	0.9x	0.77	x	2.72	x	104.89	x	0.45	x	0.67	=	59.61	(78)
South	0.9x	0.77	x	2.91	x	104.89	x	0.45	x	0.67	=	63.78	(78)
South	0.9x	0.77	x	0.41	x	101.89	x	0.45	x	0.67	=	8.69	(78)
South	0.9x	0.77	x	1.84	x	101.89	x	0.45	x	0.67	=	39.17	(78)
South	0.9x	0.77	x	1.82	x	101.89	x	0.45	x	0.67	=	38.74	(78)
South	0.9x	0.77	x	2.72	x	101.89	x	0.45	x	0.67	=	57.9	(78)
South	0.9x	0.77	x	2.91	x	101.89	x	0.45	x	0.67	=	61.95	(78)
South	0.9x	0.77	x	0.41	x	82.59	x	0.45	x	0.67	=	7.04	(78)
South	0.9x	0.77	x	1.84	x	82.59	x	0.45	x	0.67	=	31.75	(78)
South	0.9x	0.77	x	1.82	x	82.59	x	0.45	x	0.67	=	31.4	(78)
South	0.9x	0.77	x	2.72	x	82.59	x	0.45	x	0.67	=	46.93	(78)
South	0.9x	0.77	x	2.91	x	82.59	x	0.45	x	0.67	=	50.21	(78)
South	0.9x	0.77	x	0.41	x	55.42	x	0.45	x	0.67	=	4.72	(78)
South	0.9x	0.77	x	1.84	x	55.42	x	0.45	x	0.67	=	21.31	(78)
South	0.9x	0.77	x	1.82	x	55.42	x	0.45	x	0.67	=	21.07	(78)
South	0.9x	0.77	x	2.72	x	55.42	x	0.45	x	0.67	=	31.49	(78)
South	0.9x	0.77	x	2.91	x	55.42	x	0.45	x	0.67	=	33.69	(78)
South	0.9x	0.77	x	0.41	x	40.4	x	0.45	x	0.67	=	3.44	(78)
South	0.9x	0.77	x	1.84	x	40.4	x	0.45	x	0.67	=	15.53	(78)
South	0.9x	0.77	x	1.82	x	40.4	x	0.45	x	0.67	=	15.36	(78)
South	0.9x	0.77	x	2.72	x	40.4	x	0.45	x	0.67	=	22.96	(78)
South	0.9x	0.77	x	2.91	x	40.4	x	0.45	x	0.67	=	24.56	(78)

DER WorkSheet: New dwelling design stage

Northwest	0.9x	0.77	x	0.91	x	11.28	x	0.45	x	0.67	=	2.14	(81)
Northwest	0.9x	0.77	x	0.91	x	22.97	x	0.45	x	0.67	=	4.35	(81)
Northwest	0.9x	0.77	x	0.91	x	41.38	x	0.45	x	0.67	=	7.84	(81)
Northwest	0.9x	0.77	x	0.91	x	67.96	x	0.45	x	0.67	=	12.88	(81)
Northwest	0.9x	0.77	x	0.91	x	91.35	x	0.45	x	0.67	=	17.31	(81)
Northwest	0.9x	0.77	x	0.91	x	97.38	x	0.45	x	0.67	=	18.46	(81)
Northwest	0.9x	0.77	x	0.91	x	91.1	x	0.45	x	0.67	=	17.26	(81)
Northwest	0.9x	0.77	x	0.91	x	72.63	x	0.45	x	0.67	=	13.76	(81)
Northwest	0.9x	0.77	x	0.91	x	50.42	x	0.45	x	0.67	=	9.56	(81)
Northwest	0.9x	0.77	x	0.91	x	28.07	x	0.45	x	0.67	=	5.32	(81)
Northwest	0.9x	0.77	x	0.91	x	14.2	x	0.45	x	0.67	=	2.69	(81)
Northwest	0.9x	0.77	x	0.91	x	9.21	x	0.45	x	0.67	=	1.75	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	117.53	199.26	273.47	345.75	397.55	400.26	383.49	343.29	297.89	220.12	140.53	100.79	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	678.24	757.34	812.61	854.16	874.04	846.83	811.21	777.99	748.94	702.14	657.99	645.53	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.98	0.93	0.83	0.86	0.97	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.85	19.93	20.1	20.33	20.56	20.78	20.89	20.87	20.71	20.4	20.09	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.92	19.92	19.92	19.94	19.94	19.96	19.96	19.96	19.95	19.94	19.94	19.93	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.97	0.88	0.7	0.75	0.94	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.36	18.49	18.73	19.08	19.42	19.73	19.85	19.84	19.63	19.19	18.73	18.36	(90)

fLA = Living area ÷ (4) = 0.22 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.69	18.81	19.03	19.36	19.68	19.96	20.08	20.07	19.87	19.46	19.03	18.69	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.54	18.66	18.88	19.21	19.53	19.81	19.93	19.92	19.72	19.31	18.88	18.54	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.96	0.88	0.69	0.74	0.93	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	677.6	755.97	809.44	845.03	843.43	741.59	561.14	575.76	699.1	695.44	656.73	645.07	(95)

DER WorkSheet: New dwelling design stage

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=	2684.04	2586.4	2320.36	1902.43	1440.45	945.09	603.42	635.74	1025.21	1603.07	2181.46	2670.09	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	1492.8	1230.05	1124.13	761.33	444.18	0	0	0	0	675.28	1097.81	1506.62

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 8332.19 (98)

Space heating requirement in kWh/m²/year 53.12 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)	1492.8	1230.05	1124.13	761.33	444.18	0	0	0	0	675.28	1097.81	1506.62	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1624.37	1338.46	1223.21	828.43	483.33	0	0	0	0	734.8	1194.57	1639.41	(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 9066.58 (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)

	220.41	194.22	203.85	182.57	178.79	159.58	153.1	168.22	168	189.33	200.4	215.05	
Efficiency of water heater												81.8	(216)
(217)m=	90.46	90.38	90.19	89.76	88.75	81.8	81.8	81.8	81.8	89.48	90.18	90.5	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	243.65	214.9	226.03	203.41	201.45	195.09	187.16	205.65	205.38	211.58	222.22	237.62

Total = Sum(219a)$_{1...12}$ = 2554.14 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			9066.58	
Water heating fuel used			2554.14	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		555.48		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		585.48	(231)

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Electricity for lighting	571.83	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	1958.38	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	551.69	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2510.08	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	303.86	(267)
Electricity for lighting	(232)	x	0.519	=	296.78	(268)
Total CO2, kg/year			sum of (265)…(271) =		3110.72	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		19.83	(273)
EI rating (section 14)					79	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Triplex (Be Lean)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	70.32	(1a)	x	3.2	(2a)	=	225.02	(3a)
Ground floor	82.3	(1b)	x	3.2	(2b)	=	263.36	(3b)
First floor	115	(1c)	x	2.7	(2c)	=	310.5	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	267.62	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	798.88	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 74.8 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			3.36	x	1.2	=	4.032			(26)
Doors Type 2			2.8	x	1.2	=	3.36			(26)
Windows Type 1			2.72	x1/[1/(1.1)+ 0.04]		=	2.87			(27)
Windows Type 2			6.18	x1/[1/(1.1)+ 0.04]		=	6.51			(27)
Windows Type 3			5.44	x1/[1/(1.1)+ 0.04]		=	5.73			(27)
Windows Type 4			1.81	x1/[1/(1.1)+ 0.04]		=	1.91			(27)
Windows Type 5			4.55	x1/[1/(1.1)+ 0.04]		=	4.79			(27)
Windows Type 6			4.37	x1/[1/(1.1)+ 0.04]		=	4.6			(27)
Floor Type 1			70.32	x	0.12	=	8.438399			(28)
Floor Type 2			11.98	x	0.12	=	1.4376			(28)
Walls Type1	69.25	6.16	63.09	x	0.12	=	7.57			(29)
Walls Type2	38.21	0	38.21	x	0.14	=	5.41			(29)
Walls Type3	73.6	8.9	64.7	x	0.12	=	7.76			(29)
Walls Type4	28.32	0	28.32	x	0.15	=	4.25			(29)
Walls Type5	90.99	16.17	74.82	x	0.12	=	8.98			(29)
Walls Type6	28.89	0	28.89	x	0.15	=	4.33			(29)
Roof	9.61	0	9.61	x	0.12	=	1.15			(30)

DER WorkSheet: New dwelling design stage

Total area of elements, m²	421.17						(31)
Party wall	25.35	x	0	=	0		(32)
Party floor	70.32						(32a)
Party floor	105.39						(32a)
Party ceiling	70.32						(32b)
Party ceiling	70.32						(32b)

** 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) =	83.14	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	51368.19	(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		63.17	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	146.31	(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=	76.07	75.23	74.39	70.19	69.35	65.15	65.15	64.31	66.83	69.35	71.03	72.71	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	222.39	221.55	220.71	216.5	215.66	211.46	211.46	210.62	213.14	215.66	217.34	219.03	

Average = Sum(39)$_{1\ldots12}$ /12= 216.29 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.83	0.83	0.82	0.81	0.81	0.79	0.79	0.79	0.8	0.81	0.81	0.82	

Average = Sum(40)$_{1\ldots12}$ /12= 0.81 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.09 (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) + 36 107.58 (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=	118.34	114.04	109.74	105.43	101.13	96.83	96.83	101.13	105.43	109.74	114.04	118.34	

Total = Sum(44)$_{1\ldots12}$ = 1291 (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=	175.5	153.49	158.39	138.09	132.5	114.34	105.95	121.58	123.03	143.38	156.51	169.96	

Total = Sum(45)$_{1\ldots12}$ = 1692.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.32	23.02	23.76	20.71	19.87	17.15	15.89	18.24	18.45	21.51	23.48	25.49	(46)

DER WorkSheet: New dwelling design stage

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 305 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): | 1.63 | (48)

Temperature factor from Table 2b | 0.54 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0.88 | (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) | 0.88 | (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	226.05	199.15	208.94	187.01	183.05	163.25	156.5	172.13	171.95	193.93	205.43	220.51	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	226.05	199.15	208.94	187.01	183.05	163.25	156.5	172.13	171.95	193.93	205.43	220.51

Output from water heater (annual)$_{1…12}$ | 2287.88 | (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=	98.79	87.56	93.1	85.05	84.49	77.15	75.67	80.86	80.04	88.11	91.17	96.95	(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=	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	44.81	39.8	32.37	24.5	18.32	15.46	16.71	21.72	29.15	37.02	43.2	46.06	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	431.48	435.96	424.68	400.66	370.34	341.84	322.8	318.32	329.61	353.63	383.95	412.44	(68)

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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	(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=	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	(71)

Water heating gains (Table 5)

(72)m=	132.78	130.3	125.14	118.12	113.57	107.15	101.7	108.69	111.17	118.43	126.63	130.31	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	681.43	678.41	654.53	615.63	574.57	536.8	513.56	521.08	542.28	581.42	626.13	661.16	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.54	x	6.18	x	10.63	x	0.45	x	0.67	=	9.63	(74)
North	0.9x	0.77	x	5.44	x	10.63	x	0.45	x	0.67	=	12.09	(74)
North	0.9x	0.54	x	6.18	x	20.32	x	0.45	x	0.67	=	18.4	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.45	x	0.67	=	23.1	(74)
North	0.9x	0.54	x	6.18	x	34.53	x	0.45	x	0.67	=	31.27	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.45	x	0.67	=	39.25	(74)
North	0.9x	0.54	x	6.18	x	55.46	x	0.45	x	0.67	=	50.23	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.45	x	0.67	=	63.04	(74)
North	0.9x	0.54	x	6.18	x	74.72	x	0.45	x	0.67	=	67.66	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.45	x	0.67	=	84.92	(74)
North	0.9x	0.54	x	6.18	x	79.99	x	0.45	x	0.67	=	72.43	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.45	x	0.67	=	90.91	(74)
North	0.9x	0.54	x	6.18	x	74.68	x	0.45	x	0.67	=	67.62	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.45	x	0.67	=	84.88	(74)
North	0.9x	0.54	x	6.18	x	59.25	x	0.45	x	0.67	=	53.65	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.45	x	0.67	=	67.34	(74)
North	0.9x	0.54	x	6.18	x	41.52	x	0.45	x	0.67	=	37.6	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.45	x	0.67	=	47.19	(74)
North	0.9x	0.54	x	6.18	x	24.19	x	0.45	x	0.67	=	21.9	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.45	x	0.67	=	27.49	(74)
North	0.9x	0.54	x	6.18	x	13.12	x	0.45	x	0.67	=	11.88	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.45	x	0.67	=	14.91	(74)
North	0.9x	0.54	x	6.18	x	8.86	x	0.45	x	0.67	=	8.03	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.45	x	0.67	=	10.08	(74)
South	0.9x	0.77	x	2.72	x	46.75	x	0.45	x	0.67	=	26.57	(78)
South	0.9x	0.77	x	1.81	x	46.75	x	0.45	x	0.67	=	17.68	(78)

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South	0.9x	0.77	x	4.55	x	46.75	x	0.45	x	0.67	=	44.45	(78)
South	0.9x	0.77	x	4.37	x	46.75	x	0.45	x	0.67	=	42.69	(78)
South	0.9x	0.77	x	2.72	x	76.57	x	0.45	x	0.67	=	43.51	(78)
South	0.9x	0.77	x	1.81	x	76.57	x	0.45	x	0.67	=	28.96	(78)
South	0.9x	0.77	x	4.55	x	76.57	x	0.45	x	0.67	=	72.79	(78)
South	0.9x	0.77	x	4.37	x	76.57	x	0.45	x	0.67	=	69.91	(78)
South	0.9x	0.77	x	2.72	x	97.53	x	0.45	x	0.67	=	55.43	(78)
South	0.9x	0.77	x	1.81	x	97.53	x	0.45	x	0.67	=	36.89	(78)
South	0.9x	0.77	x	4.55	x	97.53	x	0.45	x	0.67	=	92.72	(78)
South	0.9x	0.77	x	4.37	x	97.53	x	0.45	x	0.67	=	89.05	(78)
South	0.9x	0.77	x	2.72	x	110.23	x	0.45	x	0.67	=	62.65	(78)
South	0.9x	0.77	x	1.81	x	110.23	x	0.45	x	0.67	=	41.69	(78)
South	0.9x	0.77	x	4.55	x	110.23	x	0.45	x	0.67	=	104.8	(78)
South	0.9x	0.77	x	4.37	x	110.23	x	0.45	x	0.67	=	100.65	(78)
South	0.9x	0.77	x	2.72	x	114.87	x	0.45	x	0.67	=	65.28	(78)
South	0.9x	0.77	x	1.81	x	114.87	x	0.45	x	0.67	=	43.44	(78)
South	0.9x	0.77	x	4.55	x	114.87	x	0.45	x	0.67	=	109.21	(78)
South	0.9x	0.77	x	4.37	x	114.87	x	0.45	x	0.67	=	104.88	(78)
South	0.9x	0.77	x	2.72	x	110.55	x	0.45	x	0.67	=	62.83	(78)
South	0.9x	0.77	x	1.81	x	110.55	x	0.45	x	0.67	=	41.81	(78)
South	0.9x	0.77	x	4.55	x	110.55	x	0.45	x	0.67	=	105.1	(78)
South	0.9x	0.77	x	4.37	x	110.55	x	0.45	x	0.67	=	100.94	(78)
South	0.9x	0.77	x	2.72	x	108.01	x	0.45	x	0.67	=	61.38	(78)
South	0.9x	0.77	x	1.81	x	108.01	x	0.45	x	0.67	=	40.85	(78)
South	0.9x	0.77	x	4.55	x	108.01	x	0.45	x	0.67	=	102.68	(78)
South	0.9x	0.77	x	4.37	x	108.01	x	0.45	x	0.67	=	98.62	(78)
South	0.9x	0.77	x	2.72	x	104.89	x	0.45	x	0.67	=	59.61	(78)
South	0.9x	0.77	x	1.81	x	104.89	x	0.45	x	0.67	=	39.67	(78)
South	0.9x	0.77	x	4.55	x	104.89	x	0.45	x	0.67	=	99.72	(78)
South	0.9x	0.77	x	4.37	x	104.89	x	0.45	x	0.67	=	95.78	(78)
South	0.9x	0.77	x	2.72	x	101.89	x	0.45	x	0.67	=	57.9	(78)
South	0.9x	0.77	x	1.81	x	101.89	x	0.45	x	0.67	=	38.53	(78)
South	0.9x	0.77	x	4.55	x	101.89	x	0.45	x	0.67	=	96.86	(78)
South	0.9x	0.77	x	4.37	x	101.89	x	0.45	x	0.67	=	93.03	(78)
South	0.9x	0.77	x	2.72	x	82.59	x	0.45	x	0.67	=	46.93	(78)
South	0.9x	0.77	x	1.81	x	82.59	x	0.45	x	0.67	=	31.23	(78)
South	0.9x	0.77	x	4.55	x	82.59	x	0.45	x	0.67	=	78.51	(78)
South	0.9x	0.77	x	4.37	x	82.59	x	0.45	x	0.67	=	75.41	(78)
South	0.9x	0.77	x	2.72	x	55.42	x	0.45	x	0.67	=	31.49	(78)
South	0.9x	0.77	x	1.81	x	55.42	x	0.45	x	0.67	=	20.96	(78)
South	0.9x	0.77	x	4.55	x	55.42	x	0.45	x	0.67	=	52.68	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	4.37	x	55.42	x	0.45	x	0.67	=	50.6	(78)
South	0.9x	0.77	x	2.72	x	40.4	x	0.45	x	0.67	=	22.96	(78)
South	0.9x	0.77	x	1.81	x	40.4	x	0.45	x	0.67	=	15.28	(78)
South	0.9x	0.77	x	4.55	x	40.4	x	0.45	x	0.67	=	38.41	(78)
South	0.9x	0.77	x	4.37	x	40.4	x	0.45	x	0.67	=	36.89	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	153.1	256.67	344.61	423.05	475.4	474.01	456.04	415.77	371.11	281.48	182.52	131.63	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	834.53	935.08	999.14	1038.69	1049.97	1010.81	969.6	936.85	913.38	862.9	808.65	792.79	(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	1	1	1	0.99	0.96	0.85	0.89	0.98	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.15	20.22	20.34	20.52	20.69	20.85	20.93	20.92	20.8	20.57	20.34	20.15	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.23	20.23	20.23	20.25	20.25	20.26	20.26	20.26	20.26	20.25	20.24	20.24	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	1	0.99	0.93	0.76	0.8	0.97	1	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.06	19.16	19.34	19.6	19.86	20.1	20.19	20.18	20.02	19.69	19.34	19.06	(90)

fLA = Living area ÷ (4) = 0.22 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.3	19.39	19.56	19.8	20.04	20.26	20.35	20.34	20.19	19.88	19.56	19.3	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.15	19.24	19.41	19.65	19.89	20.11	20.2	20.19	20.04	19.73	19.41	19.15	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	1	0.99	0.93	0.75	0.79	0.97	1	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	834.45	934.87	998.51	1036.15	1036.99	935.95	724.69	744.02	883.62	861.05	808.47	792.74	(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=	3301.96	3177.72	2849.06	2327.99	1766.39	1166.05	761.29	799.03	1266.75	1969.29	2675.58	3274.43	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1835.83	1507.2	1376.81	930.12	542.68	0	0	0	0	824.54	1344.32	1846.38	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 10207.86 (98)

Space heating requirement in kWh/m²/year 38.14 (99)

envision

DER WorkSheet: New dwelling design stage

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)	1835.83	1507.2	1376.81	930.12	542.68	0	0	0	0	824.54	1344.32	1846.38		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1997.63	1640.04	1498.16	1012.1	590.51	0	0	0	0	897.21	1462.81	2009.12		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													11107.58	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	226.05	199.15	208.94	187.01	183.05	163.25	156.5	172.13	171.95	193.93	205.43	220.51		
Efficiency of water heater													81.8	(216)
(217)m=	90.67	90.59	90.43	90.04	89.12	81.8	81.8	81.8	81.8	89.79	90.42	90.71		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	249.3	219.82	231.05	207.69	205.38	199.58	191.32	210.42	210.21	215.98	227.19	243.1		
Total = Sum(219a)$_{1...12}$ =													2611.06	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			11107.58	
Water heating fuel used			2611.06	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		913.72		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		943.72	(231)
Electricity for lighting			791.38	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	2399.24	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	563.99	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2963.23	(265)

DER WorkSheet: New dwelling design stage

Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	489.79	(267)
Electricity for lighting	(232)	x	0.519	=	410.73	(268)
Total CO2, kg/year			sum of (265)…(271) =		3863.74	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		14.44	(273)
EI rating (section 14)					83	(274)

APPENDIX VIII – BE-GREEN DER WORKSHEETS (NEW-BUILD)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 3 - 2B4P - GF (Be Green)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	140.3	(1a) x	2.7	(2a) =	378.81	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	140.3	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	378.81	(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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.95 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.31	0.3	0.3	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.29	0.29	(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=	0.31	0.3	0.3	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.29	0.29	(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	
Windows Type 1			2.85	x1/[1/(1.1)+ 0.04]		=	3			(27)
Windows Type 2			2.85	x1/[1/(1.1)+ 0.04]		=	3			(27)
Windows Type 3			8.88	x1/[1/(1.1)+ 0.04]		=	9.36			(27)
Windows Type 4			2.67	x1/[1/(1.1)+ 0.04]		=	2.81			(27)
Windows Type 5			1.78	x1/[1/(1.1)+ 0.04]		=	1.88			(27)
Floor			139.42	x	0.11	=	15.3362			(28)
Walls Type1	99.06	27.4	71.66	x	0.12	=	8.6			(29)
Walls Type2	30.1	0	30.1	x	0.14	=	4.26			(29)
Total area of elements, m²			268.59							(31)
Party wall			25.35	x	0	=	0			(32)
Party ceiling			139.42							(32b)

** 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) = 57.07 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27783.44 (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 40.29 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 97.35 (37)

DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	38.4	37.96	37.53	35.36	34.93	32.76	32.76	32.33	33.63	34.93	35.8	36.66	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	135.75	135.32	134.88	132.72	132.28	130.11	130.11	129.68	130.98	132.28	133.15	134.02	

Average = Sum(39)1…12 /12= 132.61 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.97	0.96	0.96	0.95	0.94	0.93	0.93	0.92	0.93	0.94	0.95	0.96	

Average = Sum(40)1…12 /12= 0.95 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.92 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 103.49 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	113.84	109.7	105.56	101.42	97.28	93.14	93.14	97.28	101.42	105.56	109.7	113.84	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Total = Sum(44)1…12 = 1241.93 (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=	168.83	147.66	152.37	132.84	127.46	109.99	101.92	116.96	118.35	137.93	150.56	163.5	

Total = Sum(45)1…12 = 1628.37 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.32	22.15	22.86	19.93	19.12	16.5	15.29	17.54	17.75	20.69	22.58	24.52	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.49 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.8 (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) 0.8 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	24.94	22.53	24.94	24.14	24.94	24.14	24.94	24.94	24.14	24.94	24.14	24.94	(56)

DER WorkSheet: New dwelling design stage

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=	24.94	22.53	24.94	24.14	24.94	24.14	24.94	24.94	24.14	24.94	24.14	24.94	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	217.03	191.2	200.57	179.49	175.67	156.64	150.13	165.16	165	186.13	197.21	211.7	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	217.03	191.2	200.57	179.49	175.67	156.64	150.13	165.16	165	186.13	197.21	211.7

Output from water heater (annual)$_{1...12}$ — 2195.94 (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=	94.7	83.93	89.23	81.49	80.95	73.89	72.45	77.45	76.67	84.43	87.38	92.93	(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=	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	145.88	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	29.16	25.9	21.06	15.94	11.92	10.06	10.87	14.13	18.97	24.08	28.11	29.97	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	309.75	312.97	304.87	287.62	265.86	245.4	231.73	228.52	236.62	253.86	275.63	296.09	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	37.59	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	-116.71	(71)

Water heating gains (Table 5)

(72)m=	127.28	124.89	119.93	113.18	108.8	102.63	97.38	104.1	106.49	113.48	121.36	124.9	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	532.96	530.52	512.62	483.51	453.34	424.85	406.75	413.52	428.84	458.18	491.87	517.72	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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Southeast	0.9x	0.54	x	8.88	x	36.79	x	0.45	x	0.67	=	47.88	(77)
Southeast	0.9x	0.54	x	1.78	x	36.79	x	0.45	x	0.67	=	9.6	(77)
Southeast	0.9x	0.54	x	8.88	x	62.67	x	0.45	x	0.67	=	81.55	(77)
Southeast	0.9x	0.54	x	1.78	x	62.67	x	0.45	x	0.67	=	16.35	(77)
Southeast	0.9x	0.54	x	8.88	x	85.75	x	0.45	x	0.67	=	111.58	(77)
Southeast	0.9x	0.54	x	1.78	x	85.75	x	0.45	x	0.67	=	22.37	(77)
Southeast	0.9x	0.54	x	8.88	x	106.25	x	0.45	x	0.67	=	138.25	(77)
Southeast	0.9x	0.54	x	1.78	x	106.25	x	0.45	x	0.67	=	27.71	(77)
Southeast	0.9x	0.54	x	8.88	x	119.01	x	0.45	x	0.67	=	154.85	(77)
Southeast	0.9x	0.54	x	1.78	x	119.01	x	0.45	x	0.67	=	31.04	(77)
Southeast	0.9x	0.54	x	8.88	x	118.15	x	0.45	x	0.67	=	153.73	(77)
Southeast	0.9x	0.54	x	1.78	x	118.15	x	0.45	x	0.67	=	30.82	(77)
Southeast	0.9x	0.54	x	8.88	x	113.91	x	0.45	x	0.67	=	148.22	(77)
Southeast	0.9x	0.54	x	1.78	x	113.91	x	0.45	x	0.67	=	29.71	(77)
Southeast	0.9x	0.54	x	8.88	x	104.39	x	0.45	x	0.67	=	135.83	(77)
Southeast	0.9x	0.54	x	1.78	x	104.39	x	0.45	x	0.67	=	27.23	(77)
Southeast	0.9x	0.54	x	8.88	x	92.85	x	0.45	x	0.67	=	120.82	(77)
Southeast	0.9x	0.54	x	1.78	x	92.85	x	0.45	x	0.67	=	24.22	(77)
Southeast	0.9x	0.54	x	8.88	x	69.27	x	0.45	x	0.67	=	90.13	(77)
Southeast	0.9x	0.54	x	1.78	x	69.27	x	0.45	x	0.67	=	18.07	(77)
Southeast	0.9x	0.54	x	8.88	x	44.07	x	0.45	x	0.67	=	57.34	(77)
Southeast	0.9x	0.54	x	1.78	x	44.07	x	0.45	x	0.67	=	11.49	(77)
Southeast	0.9x	0.54	x	8.88	x	31.49	x	0.45	x	0.67	=	40.97	(77)
Southeast	0.9x	0.54	x	1.78	x	31.49	x	0.45	x	0.67	=	8.21	(77)
South	0.9x	0.54	x	2.85	x	46.75	x	0.45	x	0.67	=	39.05	(78)
South	0.9x	0.54	x	2.85	x	46.75	x	0.45	x	0.67	=	39.05	(78)
South	0.9x	0.54	x	2.85	x	76.57	x	0.45	x	0.67	=	63.95	(78)
South	0.9x	0.54	x	2.85	x	76.57	x	0.45	x	0.67	=	63.95	(78)
South	0.9x	0.54	x	2.85	x	97.53	x	0.45	x	0.67	=	81.46	(78)
South	0.9x	0.54	x	2.85	x	97.53	x	0.45	x	0.67	=	81.46	(78)
South	0.9x	0.54	x	2.85	x	110.23	x	0.45	x	0.67	=	92.07	(78)
South	0.9x	0.54	x	2.85	x	110.23	x	0.45	x	0.67	=	92.07	(78)
South	0.9x	0.54	x	2.85	x	114.87	x	0.45	x	0.67	=	95.94	(78)
South	0.9x	0.54	x	2.85	x	114.87	x	0.45	x	0.67	=	95.94	(78)
South	0.9x	0.54	x	2.85	x	110.55	x	0.45	x	0.67	=	92.33	(78)
South	0.9x	0.54	x	2.85	x	110.55	x	0.45	x	0.67	=	92.33	(78)
South	0.9x	0.54	x	2.85	x	108.01	x	0.45	x	0.67	=	90.21	(78)
South	0.9x	0.54	x	2.85	x	108.01	x	0.45	x	0.67	=	90.21	(78)
South	0.9x	0.54	x	2.85	x	104.89	x	0.45	x	0.67	=	87.61	(78)
South	0.9x	0.54	x	2.85	x	104.89	x	0.45	x	0.67	=	87.61	(78)
South	0.9x	0.54	x	2.85	x	101.89	x	0.45	x	0.67	=	85.1	(78)

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South	0.9x	0.54	x	2.85	x	101.89	x	0.45	x	0.67	=	85.1	(78)
South	0.9x	0.54	x	2.85	x	82.59	x	0.45	x	0.67	=	68.98	(78)
South	0.9x	0.54	x	2.85	x	82.59	x	0.45	x	0.67	=	68.98	(78)
South	0.9x	0.54	x	2.85	x	55.42	x	0.45	x	0.67	=	46.29	(78)
South	0.9x	0.54	x	2.85	x	55.42	x	0.45	x	0.67	=	46.29	(78)
South	0.9x	0.54	x	2.85	x	40.4	x	0.45	x	0.67	=	33.74	(78)
South	0.9x	0.54	x	2.85	x	40.4	x	0.45	x	0.67	=	33.74	(78)
Southwest	0.9x	0.54	x	2.67	x	36.79		0.45	x	0.67	=	28.79	(79)
Southwest	0.9x	0.54	x	2.67	x	62.67		0.45	x	0.67	=	49.04	(79)
Southwest	0.9x	0.54	x	2.67	x	85.75		0.45	x	0.67	=	67.1	(79)
Southwest	0.9x	0.54	x	2.67	x	106.25		0.45	x	0.67	=	83.14	(79)
Southwest	0.9x	0.54	x	2.67	x	119.01		0.45	x	0.67	=	93.12	(79)
Southwest	0.9x	0.54	x	2.67	x	118.15		0.45	x	0.67	=	92.45	(79)
Southwest	0.9x	0.54	x	2.67	x	113.91		0.45	x	0.67	=	89.13	(79)
Southwest	0.9x	0.54	x	2.67	x	104.39		0.45	x	0.67	=	81.68	(79)
Southwest	0.9x	0.54	x	2.67	x	92.85		0.45	x	0.67	=	72.65	(79)
Southwest	0.9x	0.54	x	2.67	x	69.27		0.45	x	0.67	=	54.2	(79)
Southwest	0.9x	0.54	x	2.67	x	44.07		0.45	x	0.67	=	34.48	(79)
Southwest	0.9x	0.54	x	2.67	x	31.49		0.45	x	0.67	=	24.64	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	164.36	274.84	363.97	433.24	470.9	461.66	447.48	419.96	387.88	300.35	195.89	141.3	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	697.31	805.36	876.59	916.75	924.24	886.51	854.23	833.48	816.72	758.53	687.76	659.02	(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	0.95	0.83	0.65	0.69	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.14	20.24	20.39	20.58	20.77	20.9	20.95	20.94	20.86	20.63	20.34	20.13	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.11	20.11	20.12	20.13	20.13	20.14	20.14	20.15	20.14	20.13	20.13	20.12	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.92	0.76	0.53	0.57	0.84	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.94	19.09	19.31	19.61	19.86	20.04	20.07	20.07	19.99	19.67	19.26	18.93	(90)

fLA = Living area ÷ (4) = | 0.32 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.32	19.46	19.66	19.92	20.15	20.31	20.35	20.35	20.27	19.97	19.6	19.31	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.32	19.46	19.66	19.92	20.15	20.31	20.35	20.35	20.27	19.97	19.6	19.31	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.92	0.77	0.56	0.6	0.85	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	696.39	802.69	869.19	894.03	853.17	684.5	480.71	501.43	695.7	741.85	685.52	658.4	(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=	2039.29	1969.69	1774.55	1462.36	1118.1	743.59	488.18	512.41	808.29	1240.08	1664.87	2025.09	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	999.12	784.23	673.59	409.19	197.11	0	0	0	0	370.68	705.13	1016.82	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5155.87 (98)

Space heating requirement in kWh/m²/year 36.75 (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		336.29	(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)														
	999.12	784.23	673.59	409.19	197.11	0	0	0	0	370.68	705.13	1016.82		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	297.1	233.2	200.3	121.68	58.61	0	0	0	0	110.23	209.68	302.36		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1533.16	(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)														
	217.03	191.2	200.57	179.49	175.67	156.64	150.13	165.16	165	186.13	197.21	211.7		
Efficiency of water heater													305.24	(216)
(217)m=	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	71.1	62.64	65.71	58.8	57.55	51.32	49.18	54.11	54.06	60.98	64.61	69.36		
Total = Sum(219a)$_{1...12}$ =													719.43	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1533.16

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Water heating fuel used		719.43	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	392.83		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	392.83	(231)
Electricity for lighting		514.89	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	795.71	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	373.38	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1169.09	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	203.88	(267)
Electricity for lighting	(232) x	0.519	=	267.23	(268)
Total CO2, kg/year		sum of (265)…(271) =		1640.2	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		11.69	(273)
EI rating (section 14)				88	(274)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 8 - 4B8P - GF (Be Green)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	220	(1a) x	2.7	(2a) =	594	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	220	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	594	(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) = 74.8 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			6.74	x1/[1/(1.1)+ 0.04]		=	7.1			(27)
Windows Type 2			0.88	x1/[1/(1.1)+ 0.04]		=	0.93			(27)
Windows Type 3			0.88	x1/[1/(1.1)+ 0.04]		=	0.93			(27)
Windows Type 4			11.41	x1/[1/(1.1)+ 0.04]		=	12.02			(27)
Windows Type 5			0.88	x1/[1/(1.1)+ 0.04]		=	0.93			(27)
Windows Type 6			4.1	x1/[1/(1.1)+ 0.04]		=	4.32			(27)
Windows Type 7			1.54	x1/[1/(1.1)+ 0.04]		=	1.62			(27)
Windows Type 8			2.68	x1/[1/(1.1)+ 0.04]		=	2.82			(27)
Floor			220	x	0.11	=	24.2			(28)
Walls Type1	115.69	49.54	66.16	x	0.12	=	7.94			(29)
Walls Type2	57.78	0	57.78	x	0.14	=	8.18			(29)
Total area of elements, m²			393.47							(31)
Party wall			35.24	x	0	=	0			(32)
Party ceiling			220							(32b)

** 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) = 92.51 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 41061.02 (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		59.02	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	151.53	(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=	56.56	55.94	55.31	52.19	51.57	48.44	48.44	47.82	49.69	51.57	52.82	54.06	(38)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	208.1	207.47	206.85	203.72	203.1	199.98	199.98	199.35	201.22	203.1	204.35	205.6	

Average = Sum(39)1…12 /12= 203.57 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	0.95	0.94	0.94	0.93	0.92	0.91	0.91	0.91	0.91	0.92	0.93	0.93	

Average = Sum(40)1…12 /12= 0.93 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 3.03 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 106.11 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	116.72	112.48	108.24	103.99	99.75	95.5	95.5	99.75	103.99	108.24	112.48	116.72

Total = Sum(44)1…12 = 1273.36 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	173.1	151.39	156.22	136.2	130.69	112.77	104.5	119.92	121.35	141.42	154.37	167.64

Total = Sum(45)1…12 = 1669.58 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.96	22.71	23.43	20.43	19.6	16.92	15.68	17.99	18.2	21.21	23.16	25.15	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		305	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)			
Water storage loss:			
a) If manufacturer’s declared loss factor is known (kWh/day):		1.63	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.88	(50)
b) If manufacturer’s declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0.88	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	223.65	197.05	206.77	185.12	181.24	161.69	155.05	170.47	170.27	191.97	203.29	218.19	(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=	223.65	197.05	206.77	185.12	181.24	161.69	155.05	170.47	170.27	191.97	203.29	218.19	

Output from water heater (annual)1…12 — 2264.74 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	97.99	86.86	92.38	84.42	83.89	76.63	75.19	80.31	79.48	87.46	90.46	96.18	(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=	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	151.4	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	34.92	31.01	25.22	19.09	14.27	12.05	13.02	16.92	22.72	28.84	33.66	35.89	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	389.68	393.72	383.53	361.84	334.46	308.72	291.52	287.48	297.67	319.36	346.75	372.48	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	38.14	(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=	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	-121.12	(71)
Water heating gains (Table 5)													
(72)m=	131.71	129.26	124.17	117.25	112.76	106.43	101.06	107.95	110.39	117.56	125.64	129.27	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	624.73	622.42	601.34	566.6	529.91	495.62	474.02	480.77	499.2	534.18	574.47	606.06	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.74	x	10.63	x	0.45	x	0.67	=	14.97	(74)
North	0.9x	0.77	x	11.41	x	10.63	x	0.45	x	0.67	=	50.7	(74)
North	0.9x	0.77	x	2.68	x	10.63	x	0.45	x	0.67	=	5.95	(74)
North	0.9x	0.77	x	6.74	x	20.32	x	0.45	x	0.67	=	28.62	(74)
North	0.9x	0.77	x	11.41	x	20.32	x	0.45	x	0.67	=	96.89	(74)
North	0.9x	0.77	x	2.68	x	20.32	x	0.45	x	0.67	=	11.38	(74)
North	0.9x	0.77	x	6.74	x	34.53	x	0.45	x	0.67	=	48.63	(74)
North	0.9x	0.77	x	11.41	x	34.53	x	0.45	x	0.67	=	164.64	(74)
North	0.9x	0.77	x	2.68	x	34.53	x	0.45	x	0.67	=	19.34	(74)
North	0.9x	0.77	x	6.74	x	55.46	x	0.45	x	0.67	=	78.11	(74)
North	0.9x	0.77	x	11.41	x	55.46	x	0.45	x	0.67	=	264.45	(74)
North	0.9x	0.77	x	2.68	x	55.46	x	0.45	x	0.67	=	31.06	(74)
North	0.9x	0.77	x	6.74	x	74.72	x	0.45	x	0.67	=	105.22	(74)
North	0.9x	0.77	x	11.41	x	74.72	x	0.45	x	0.67	=	356.24	(74)
North	0.9x	0.77	x	2.68	x	74.72	x	0.45	x	0.67	=	41.84	(74)
North	0.9x	0.77	x	6.74	x	79.99	x	0.45	x	0.67	=	112.64	(74)
North	0.9x	0.77	x	11.41	x	79.99	x	0.45	x	0.67	=	381.37	(74)
North	0.9x	0.77	x	2.68	x	79.99	x	0.45	x	0.67	=	44.79	(74)
North	0.9x	0.77	x	6.74	x	74.68	x	0.45	x	0.67	=	105.16	(74)
North	0.9x	0.77	x	11.41	x	74.68	x	0.45	x	0.67	=	356.06	(74)
North	0.9x	0.77	x	2.68	x	74.68	x	0.45	x	0.67	=	41.82	(74)
North	0.9x	0.77	x	6.74	x	59.25	x	0.45	x	0.67	=	83.43	(74)
North	0.9x	0.77	x	11.41	x	59.25	x	0.45	x	0.67	=	282.49	(74)
North	0.9x	0.77	x	2.68	x	59.25	x	0.45	x	0.67	=	33.18	(74)
North	0.9x	0.77	x	6.74	x	41.52	x	0.45	x	0.67	=	58.47	(74)
North	0.9x	0.77	x	11.41	x	41.52	x	0.45	x	0.67	=	197.95	(74)
North	0.9x	0.77	x	2.68	x	41.52	x	0.45	x	0.67	=	23.25	(74)
North	0.9x	0.77	x	6.74	x	24.19	x	0.45	x	0.67	=	34.06	(74)
North	0.9x	0.77	x	11.41	x	24.19	x	0.45	x	0.67	=	115.34	(74)
North	0.9x	0.77	x	2.68	x	24.19	x	0.45	x	0.67	=	13.55	(74)
North	0.9x	0.77	x	6.74	x	13.12	x	0.45	x	0.67	=	18.47	(74)
North	0.9x	0.77	x	11.41	x	13.12	x	0.45	x	0.67	=	62.54	(74)
North	0.9x	0.77	x	2.68	x	13.12	x	0.45	x	0.67	=	7.35	(74)
North	0.9x	0.77	x	6.74	x	8.86	x	0.45	x	0.67	=	12.48	(74)
North	0.9x	0.77	x	11.41	x	8.86	x	0.45	x	0.67	=	42.27	(74)
North	0.9x	0.77	x	2.68	x	8.86	x	0.45	x	0.67	=	4.96	(74)
Northeast	0.9x	0.77	x	0.88	x	11.28	x	0.45	x	0.67	=	4.15	(75)
Northeast	0.9x	0.77	x	0.88	x	22.97	x	0.45	x	0.67	=	8.45	(75)
Northeast	0.9x	0.77	x	0.88	x	41.38	x	0.45	x	0.67	=	15.22	(75)

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Northeast	0.9x	0.77	x	0.88	x	67.96	x	0.45	x	0.67	=	24.99	(75)
Northeast	0.9x	0.77	x	0.88	x	91.35	x	0.45	x	0.67	=	33.59	(75)
Northeast	0.9x	0.77	x	0.88	x	97.38	x	0.45	x	0.67	=	35.81	(75)
Northeast	0.9x	0.77	x	0.88	x	91.1	x	0.45	x	0.67	=	33.5	(75)
Northeast	0.9x	0.77	x	0.88	x	72.63	x	0.45	x	0.67	=	26.71	(75)
Northeast	0.9x	0.77	x	0.88	x	50.42	x	0.45	x	0.67	=	18.54	(75)
Northeast	0.9x	0.77	x	0.88	x	28.07	x	0.45	x	0.67	=	10.32	(75)
Northeast	0.9x	0.77	x	0.88	x	14.2	x	0.45	x	0.67	=	5.22	(75)
Northeast	0.9x	0.77	x	0.88	x	9.21	x	0.45	x	0.67	=	3.39	(75)
South	0.9x	0.54	x	0.88	x	46.75	x	0.45	x	0.67	=	24.11	(78)
South	0.9x	0.54	x	4.1	x	46.75	x	0.45	x	0.67	=	28.09	(78)
South	0.9x	0.54	x	1.54	x	46.75	x	0.45	x	0.67	=	42.2	(78)
South	0.9x	0.54	x	0.88	x	76.57	x	0.45	x	0.67	=	39.49	(78)
South	0.9x	0.54	x	4.1	x	76.57	x	0.45	x	0.67	=	46	(78)
South	0.9x	0.54	x	1.54	x	76.57	x	0.45	x	0.67	=	69.11	(78)
South	0.9x	0.54	x	0.88	x	97.53	x	0.45	x	0.67	=	50.31	(78)
South	0.9x	0.54	x	4.1	x	97.53	x	0.45	x	0.67	=	58.6	(78)
South	0.9x	0.54	x	1.54	x	97.53	x	0.45	x	0.67	=	88.04	(78)
South	0.9x	0.54	x	0.88	x	110.23	x	0.45	x	0.67	=	56.86	(78)
South	0.9x	0.54	x	4.1	x	110.23	x	0.45	x	0.67	=	66.23	(78)
South	0.9x	0.54	x	1.54	x	110.23	x	0.45	x	0.67	=	99.5	(78)
South	0.9x	0.54	x	0.88	x	114.87	x	0.45	x	0.67	=	59.25	(78)
South	0.9x	0.54	x	4.1	x	114.87	x	0.45	x	0.67	=	69.01	(78)
South	0.9x	0.54	x	1.54	x	114.87	x	0.45	x	0.67	=	103.68	(78)
South	0.9x	0.54	x	0.88	x	110.55	x	0.45	x	0.67	=	57.02	(78)
South	0.9x	0.54	x	4.1	x	110.55	x	0.45	x	0.67	=	66.41	(78)
South	0.9x	0.54	x	1.54	x	110.55	x	0.45	x	0.67	=	99.78	(78)
South	0.9x	0.54	x	0.88	x	108.01	x	0.45	x	0.67	=	55.71	(78)
South	0.9x	0.54	x	4.1	x	108.01	x	0.45	x	0.67	=	64.89	(78)
South	0.9x	0.54	x	1.54	x	108.01	x	0.45	x	0.67	=	97.49	(78)
South	0.9x	0.54	x	0.88	x	104.89	x	0.45	x	0.67	=	54.1	(78)
South	0.9x	0.54	x	4.1	x	104.89	x	0.45	x	0.67	=	63.02	(78)
South	0.9x	0.54	x	1.54	x	104.89	x	0.45	x	0.67	=	94.68	(78)
South	0.9x	0.54	x	0.88	x	101.89	x	0.45	x	0.67	=	52.55	(78)
South	0.9x	0.54	x	4.1	x	101.89	x	0.45	x	0.67	=	61.21	(78)
South	0.9x	0.54	x	1.54	x	101.89	x	0.45	x	0.67	=	91.96	(78)
South	0.9x	0.54	x	0.88	x	82.59	x	0.45	x	0.67	=	42.6	(78)
South	0.9x	0.54	x	4.1	x	82.59	x	0.45	x	0.67	=	49.61	(78)
South	0.9x	0.54	x	1.54	x	82.59	x	0.45	x	0.67	=	74.54	(78)
South	0.9x	0.54	x	0.88	x	55.42	x	0.45	x	0.67	=	28.58	(78)
South	0.9x	0.54	x	4.1	x	55.42	x	0.45	x	0.67	=	33.29	(78)

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South	0.9x	0.54	x	1.54	x	55.42	x	0.45	x	0.67	=	50.02	(78)
South	0.9x	0.54	x	0.88	x	40.4	x	0.45	x	0.67	=	20.84	(78)
South	0.9x	0.54	x	4.1	x	40.4	x	0.45	x	0.67	=	24.27	(78)
South	0.9x	0.54	x	1.54	x	40.4	x	0.45	x	0.67	=	36.46	(78)
Northwest	0.9x	0.77	x	0.88	x	11.28	x	0.45	x	0.67	=	4.15	(81)
Northwest	0.9x	0.77	x	0.88	x	22.97	x	0.45	x	0.67	=	8.45	(81)
Northwest	0.9x	0.77	x	0.88	x	41.38	x	0.45	x	0.67	=	15.22	(81)
Northwest	0.9x	0.77	x	0.88	x	67.96	x	0.45	x	0.67	=	24.99	(81)
Northwest	0.9x	0.77	x	0.88	x	91.35	x	0.45	x	0.67	=	33.59	(81)
Northwest	0.9x	0.77	x	0.88	x	97.38	x	0.45	x	0.67	=	35.81	(81)
Northwest	0.9x	0.77	x	0.88	x	91.1	x	0.45	x	0.67	=	33.5	(81)
Northwest	0.9x	0.77	x	0.88	x	72.63	x	0.45	x	0.67	=	26.71	(81)
Northwest	0.9x	0.77	x	0.88	x	50.42	x	0.45	x	0.67	=	18.54	(81)
Northwest	0.9x	0.77	x	0.88	x	28.07	x	0.45	x	0.67	=	10.32	(81)
Northwest	0.9x	0.77	x	0.88	x	14.2	x	0.45	x	0.67	=	5.22	(81)
Northwest	0.9x	0.77	x	0.88	x	9.21	x	0.45	x	0.67	=	3.39	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	174.33	308.38	459.97	646.18	802.43	833.64	788.13	664.31	522.47	350.34	210.7	148.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	799.05	930.8	1061.32	1212.78	1332.33	1329.26	1262.15	1145.08	1021.67	884.52	785.18	754.12	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.84	0.67	0.75	0.95	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.07	20.15	20.31	20.53	20.75	20.9	20.94	20.94	20.81	20.54	20.26	20.06	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.13	20.13	20.13	20.15	20.15	20.16	20.16	20.16	20.16	20.15	20.14	20.14	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.94	0.77	0.56	0.64	0.92	1	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.85	18.98	19.21	19.55	19.86	20.05	20.09	20.09	19.95	19.56	19.16	18.84	(90)

fLA = Living area ÷ (4) = 0.15 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.03	19.15	19.37	19.69	19.99	20.18	20.22	20.21	20.08	19.71	19.32	19.02	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.03	19.15	19.37	19.69	19.99	20.18	20.22	20.21	20.08	19.71	19.32	19.02	(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

DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	1	1	1	0.99	0.94	0.77	0.56	0.64	0.92	0.99	1	1	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	798.84	930.11	1058.57	1197.22	1247.93	1028.99	712.71	738.05	938.29	879.04	784.65	753.98	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	3064.74	2956.88	2662.48	2198.59	1683.5	1115.67	723.29	760.17	1203.71	1850.15	2497.52	3047.16	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	1685.83	1361.99	1193.31	720.99	324.06	0	0	0	0	722.5	1233.27	1706.12

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 8948.08 (98)

Space heating requirement in kWh/m²/year 40.67 (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		415.82	(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)														
	1685.83	1361.99	1193.31	720.99	324.06	0	0	0	0	722.5	1233.27	1706.12		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	405.43	327.55	286.98	173.39	77.93	0	0	0	0	173.76	296.59	410.31		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2151.93	(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)														
	223.65	197.05	206.77	185.12	181.24	161.69	155.05	170.47	170.27	191.97	203.29	218.19		
Efficiency of water heater													300.39	(216)
(217)m=	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	74.45	65.6	68.83	61.63	60.33	53.83	51.62	56.75	56.68	63.91	67.68	72.63		
Total = Sum(219a)$_{1...12}$ =													753.93	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2151.93
Water heating fuel used		753.93
Electricity for pumps, fans and electric keep-hot		

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mechanical ventilation - balanced, extract or positive input from outside		679.39	(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	679.39	(231)
Electricity for lighting		616.65	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	1116.85	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	391.29	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1508.14	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	352.6	(267)
Electricity for lighting	(232) x	0.519	=	320.04	(268)
Total CO2, kg/year		sum of (265)…(271) =		2180.79	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		9.91	(273)
EI rating (section 14)				89	(274)

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User Details:

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.23

Property Address: Flat 10 - 1B2P - MF (Be Green)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53	(1a) x	2.7	(2a) =	143.1	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	143.1	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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) = 73.1 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.3	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			1.68	x1/[1/(1.1)+ 0.04]	=	1.77			(27)
Windows Type 2			1.68	x1/[1/(1.1)+ 0.04]	=	1.77			(27)
Windows Type 3			6.66	x1/[1/(1.1)+ 0.04]	=	7.02			(27)
Windows Type 4			3.36	x1/[1/(1.1)+ 0.04]	=	3.54			(27)
Windows Type 5			2.6	x1/[1/(1.1)+ 0.04]	=	2.74			(27)
Walls Type1	47.55	15.98	31.57	x 0.12	=	3.79			(29)
Walls Type2	3.78	0	3.78	x 0.14	=	0.53			(29)
Total area of elements, m²			51.33						(31)
Party wall			39.56	x 0	=	0			(32)
Party floor			53.93						(32a)
Party ceiling			53.93						(32b)

** 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) = 21.16 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8029.37 (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 7.7 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 28.86 (37)

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Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	14.03	13.88	13.73	12.97	12.82	12.07	12.07	11.92	12.37	12.82	13.13	13.43	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	42.89	42.74	42.59	41.83	41.68	40.93	40.93	40.78	41.23	41.68	41.98	42.29	

Average = Sum(39)$_{1…12}$ /12= 41.8 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.81	0.81	0.8	0.79	0.79	0.77	0.77	0.77	0.78	0.79	0.79	0.8	

Average = Sum(40)$_{1…12}$ /12= 0.79 (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 1.78 (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 76.44 (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=	84.08	81.03	77.97	74.91	71.85	68.8	68.8	71.85	74.91	77.97	81.03	84.08	

Total = Sum(44)$_{1…12}$ = 917.29 (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=	124.7	109.06	112.54	98.11	94.14	81.24	75.28	86.38	87.42	101.88	111.2	120.76	

Total = Sum(45)$_{1…12}$ = 1202.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.7	16.36	16.88	14.72	14.12	12.19	11.29	12.96	13.11	15.28	16.68	18.11	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0.99 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.53 (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) 0.53 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	16.57	14.97	16.57	16.04	16.57	16.04	16.57	16.57	16.04	16.57	16.04	16.57	(56)

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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	16.57	14.97	16.57	16.04	16.57	16.04	16.57	16.57	16.04	16.57	16.04	16.57	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	164.53	145.04	152.37	136.66	133.98	119.79	115.11	126.22	125.97	141.71	149.75	160.6	(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=	164.53	145.04	152.37	136.66	133.98	119.79	115.11	126.22	125.97	141.71	149.75	160.6

Output from water heater (annual)$_{1...12}$ — 1671.74 (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=	73.33	65.05	69.29	63.46	63.17	57.85	56.9	60.59	59.91	65.74	67.82	72.02	(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=	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	88.93	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.82	12.27	9.98	7.56	5.65	4.77	5.15	6.7	8.99	11.42	13.32	14.2	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	155.02	156.63	152.57	143.94	133.05	122.81	115.97	114.36	118.42	127.05	137.94	148.18	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	31.89	(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=	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	-71.14	(71)

Water heating gains (Table 5)

(72)m=	98.56	96.8	93.13	88.14	84.91	80.35	76.48	81.44	83.2	88.36	94.19	96.8	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	317.08	315.37	305.36	289.32	273.28	257.61	247.28	252.18	260.29	276.5	295.13	308.86	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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Southeast	0.9x	0.54	x	6.66	x	36.79	x	0.45	x	0.67	=	35.91	(77)
Southeast	0.9x	0.77	x	2.6	x	36.79	x	0.45	x	0.67	=	19.99	(77)
Southeast	0.9x	0.54	x	6.66	x	62.67	x	0.45	x	0.67	=	61.16	(77)
Southeast	0.9x	0.77	x	2.6	x	62.67	x	0.45	x	0.67	=	34.05	(77)
Southeast	0.9x	0.54	x	6.66	x	85.75	x	0.45	x	0.67	=	83.68	(77)
Southeast	0.9x	0.77	x	2.6	x	85.75	x	0.45	x	0.67	=	46.58	(77)
Southeast	0.9x	0.54	x	6.66	x	106.25	x	0.45	x	0.67	=	103.69	(77)
Southeast	0.9x	0.77	x	2.6	x	106.25	x	0.45	x	0.67	=	57.72	(77)
Southeast	0.9x	0.54	x	6.66	x	119.01	x	0.45	x	0.67	=	116.14	(77)
Southeast	0.9x	0.77	x	2.6	x	119.01	x	0.45	x	0.67	=	64.65	(77)
Southeast	0.9x	0.54	x	6.66	x	118.15	x	0.45	x	0.67	=	115.3	(77)
Southeast	0.9x	0.77	x	2.6	x	118.15	x	0.45	x	0.67	=	64.18	(77)
Southeast	0.9x	0.54	x	6.66	x	113.91	x	0.45	x	0.67	=	111.16	(77)
Southeast	0.9x	0.77	x	2.6	x	113.91	x	0.45	x	0.67	=	61.88	(77)
Southeast	0.9x	0.54	x	6.66	x	104.39	x	0.45	x	0.67	=	101.87	(77)
Southeast	0.9x	0.77	x	2.6	x	104.39	x	0.45	x	0.67	=	56.71	(77)
Southeast	0.9x	0.54	x	6.66	x	92.85	x	0.45	x	0.67	=	90.61	(77)
Southeast	0.9x	0.77	x	2.6	x	92.85	x	0.45	x	0.67	=	50.44	(77)
Southeast	0.9x	0.54	x	6.66	x	69.27	x	0.45	x	0.67	=	67.6	(77)
Southeast	0.9x	0.77	x	2.6	x	69.27	x	0.45	x	0.67	=	37.63	(77)
Southeast	0.9x	0.54	x	6.66	x	44.07	x	0.45	x	0.67	=	43.01	(77)
Southeast	0.9x	0.77	x	2.6	x	44.07	x	0.45	x	0.67	=	23.94	(77)
Southeast	0.9x	0.54	x	6.66	x	31.49	x	0.45	x	0.67	=	30.73	(77)
Southeast	0.9x	0.77	x	2.6	x	31.49	x	0.45	x	0.67	=	17.11	(77)
South	0.9x	0.77	x	1.68	x	46.75	x	0.45	x	0.67	=	16.41	(78)
South	0.9x	0.77	x	1.68	x	76.57	x	0.45	x	0.67	=	26.88	(78)
South	0.9x	0.77	x	1.68	x	97.53	x	0.45	x	0.67	=	34.24	(78)
South	0.9x	0.77	x	1.68	x	110.23	x	0.45	x	0.67	=	38.69	(78)
South	0.9x	0.77	x	1.68	x	114.87	x	0.45	x	0.67	=	40.32	(78)
South	0.9x	0.77	x	1.68	x	110.55	x	0.45	x	0.67	=	38.8	(78)
South	0.9x	0.77	x	1.68	x	108.01	x	0.45	x	0.67	=	37.91	(78)
South	0.9x	0.77	x	1.68	x	104.89	x	0.45	x	0.67	=	36.82	(78)
South	0.9x	0.77	x	1.68	x	101.89	x	0.45	x	0.67	=	35.76	(78)
South	0.9x	0.77	x	1.68	x	82.59	x	0.45	x	0.67	=	28.99	(78)
South	0.9x	0.77	x	1.68	x	55.42	x	0.45	x	0.67	=	19.45	(78)
South	0.9x	0.77	x	1.68	x	40.4	x	0.45	x	0.67	=	14.18	(78)
Southwest	0.9x	0.77	x	3.36	x	36.79		0.45	x	0.67	=	25.83	(79)
Southwest	0.9x	0.77	x	3.36	x	62.67		0.45	x	0.67	=	44	(79)
Southwest	0.9x	0.77	x	3.36	x	85.75		0.45	x	0.67	=	60.2	(79)
Southwest	0.9x	0.77	x	3.36	x	106.25		0.45	x	0.67	=	74.59	(79)
Southwest	0.9x	0.77	x	3.36	x	119.01		0.45	x	0.67	=	83.55	(79)

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Southwest	0.9x	0.77	x	3.36	x	118.15		0.45	x	0.67	=	82.95	(79)
Southwest	0.9x	0.77	x	3.36	x	113.91		0.45	x	0.67	=	79.97	(79)
Southwest	0.9x	0.77	x	3.36	x	104.39		0.45	x	0.67	=	73.29	(79)
Southwest	0.9x	0.77	x	3.36	x	92.85		0.45	x	0.67	=	65.19	(79)
Southwest	0.9x	0.77	x	3.36	x	69.27		0.45	x	0.67	=	48.63	(79)
Southwest	0.9x	0.77	x	3.36	x	44.07		0.45	x	0.67	=	30.94	(79)
Southwest	0.9x	0.77	x	3.36	x	31.49		0.45	x	0.67	=	22.11	(79)
West	0.9x	0.77	x	1.68	x	19.64	x	0.45	x	0.67	=	6.89	(80)
West	0.9x	0.77	x	1.68	x	38.42	x	0.45	x	0.67	=	13.49	(80)
West	0.9x	0.77	x	1.68	x	63.27	x	0.45	x	0.67	=	22.21	(80)
West	0.9x	0.77	x	1.68	x	92.28	x	0.45	x	0.67	=	32.39	(80)
West	0.9x	0.77	x	1.68	x	113.09	x	0.45	x	0.67	=	39.7	(80)
West	0.9x	0.77	x	1.68	x	115.77	x	0.45	x	0.67	=	40.64	(80)
West	0.9x	0.77	x	1.68	x	110.22	x	0.45	x	0.67	=	38.69	(80)
West	0.9x	0.77	x	1.68	x	94.68	x	0.45	x	0.67	=	33.23	(80)
West	0.9x	0.77	x	1.68	x	73.59	x	0.45	x	0.67	=	25.83	(80)
West	0.9x	0.77	x	1.68	x	45.59	x	0.45	x	0.67	=	16	(80)
West	0.9x	0.77	x	1.68	x	24.49	x	0.45	x	0.67	=	8.6	(80)
West	0.9x	0.77	x	1.68	x	16.15	x	0.45	x	0.67	=	5.67	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	105.03	179.57	246.92	307.09	344.36	341.87	329.61	301.92	267.83	198.85	125.94	89.79	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	422.11	494.95	552.28	596.41	617.65	599.48	576.89	554.1	528.12	475.35	421.07	398.65	(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	0.97	0.91	0.79	0.62	0.44	0.31	0.34	0.54	0.83	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.54	20.66	20.8	20.91	20.95	20.96	20.96	20.96	20.96	20.9	20.71	20.51	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.25	20.25	20.25	20.26	20.27	20.28	20.28	20.28	20.27	20.27	20.26	20.26	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.9	0.76	0.57	0.39	0.26	0.29	0.48	0.79	0.96	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.63	19.81	20	20.15	20.2	20.22	20.22	20.22	20.21	20.15	19.89	19.6	(90)

fLA = Living area ÷ (4) = 0.85 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.4	20.53	20.68	20.79	20.84	20.85	20.85	20.85	20.84	20.79	20.58	20.37	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.4	20.53	20.68	20.79	20.84	20.85	20.85	20.85	20.84	20.79	20.58	20.37	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.96	0.91	0.78	0.61	0.43	0.3	0.33	0.52	0.82	0.96	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	415.96	476.11	500.65	466.27	375.46	255.28	173.78	181.3	276.48	389.31	405.28	394.36	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	690.33	668.02	603.74	497.55	380.8	255.66	173.81	181.35	278.01	424.68	565.98	683.87	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	204.13	128.96	76.7	22.53	3.97	0	0	0	0	26.32	115.71	215.4	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	793.72	(98)
Space heating requirement in kWh/m²/year	14.98	(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		99.83	(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)														
	204.13	128.96	76.7	22.53	3.97	0	0	0	0	26.32	115.71	215.4		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	204.48	129.18	76.83	22.57	3.98	0	0	0	0	26.36	115.91	215.77		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													795.08	(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)														
	164.53	145.04	152.37	136.66	133.98	119.79	115.11	126.22	125.97	141.71	149.75	160.6		
Efficiency of water heater													305.24	(216)
(217)m=	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	53.9	47.52	49.92	44.77	43.89	39.24	37.71	41.35	41.27	46.43	49.06	52.61		
Total = Sum(219a)$_{1...12}$ =													547.69	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		795.08

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Water heating fuel used			547.69	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		198.59		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		198.59	(231)
Electricity for lighting			244.06	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	412.64	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	284.25	(264)
Space and water heating	(261) + (262) + (263) + (264) =				696.89	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	103.07	(267)
Electricity for lighting	(232)	x	0.519	=	126.67	(268)
Total CO2, kg/year			sum of (265)…(271) =		926.63	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		17.48	(273)
El rating (section 14)					87	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 15 - 3B6P - MF (Be Green)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	169	(1a) x	2.7	(2a) =	456.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	169	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	456.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		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) =	74.8	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			3.6	x1/[1/(1.1)+ 0.04]		=	3.79			(27)
Windows Type 2			2.4	x1/[1/(1.1)+ 0.04]		=	2.53			(27)
Windows Type 3			9.36	x1/[1/(1.1)+ 0.04]		=	9.86			(27)
Windows Type 4			2.4	x1/[1/(1.1)+ 0.04]		=	2.53			(27)
Windows Type 5			1.78	x1/[1/(1.1)+ 0.04]		=	1.88			(27)
Windows Type 6			1.05	x1/[1/(1.1)+ 0.04]		=	1.11			(27)
Windows Type 7			1.05	x1/[1/(1.1)+ 0.04]		=	1.11			(27)
Windows Type 8			3.6	x1/[1/(1.1)+ 0.04]		=	3.79			(27)
Walls Type1	86.43	27.64	58.79	x	0.12	=	7.05			(29)
Walls Type2	27.27	0	27.27	x	0.14	=	3.86			(29)
Total area of elements, m²			113.7							(31)
Party wall			52.38	x	0	=	0			(32)
Party floor			175.4							(32a)
Party ceiling			175.8							(32b)

** 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) =	40.04	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	20671.09	(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	17.05	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	57.09	(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=	43.45	42.97	42.49	40.09	39.61	37.21	37.21	36.73	38.17	39.61	40.57	41.53	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	100.54	100.06	99.58	97.18	96.7	94.3	94.3	93.82	95.26	96.7	97.66	98.62	

Average = $Sum(39)_{1…12}$ /12= 97.06 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.59	0.59	0.59	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.58	

Average = $Sum(40)_{1…12}$ /12= 0.57 (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 2.96 (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) + 36 104.53 (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=	114.98	110.8	106.62	102.44	98.26	94.08	94.08	98.26	102.44	106.62	110.8	114.98	

Total = $Sum(44)_{1…12}$ = 1254.35 (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=	170.52	149.13	153.89	134.17	128.74	111.09	102.94	118.13	119.54	139.31	152.07	165.13	

Total = $Sum(45)_{1…12}$ = 1644.65 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.58	22.37	23.08	20.13	19.31	16.66	15.44	17.72	17.93	20.9	22.81	24.77	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 305 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.63 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.88 (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) 0.88 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	221.06	194.79	204.44	183.09	179.29	160.01	153.49	168.68	168.46	189.86	200.99	215.68	(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=	221.06	194.79	204.44	183.09	179.29	160.01	153.49	168.68	168.46	189.86	200.99	215.68	

Output from water heater (annual)$_{1...12}$ 2239.82 (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=	97.14	86.11	91.61	83.75	83.24	76.07	74.67	79.72	78.88	86.76	89.7	95.35	(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=	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	148.06	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	32.26	28.65	23.3	17.64	13.19	11.13	12.03	15.64	20.99	26.65	31.1	33.16	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	340.53	344.06	335.16	316.2	292.27	269.78	254.76	251.22	260.13	279.08	303.01	325.5	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	(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=	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	-118.45	(71)

Water heating gains (Table 5)

(72)m=	130.56	128.14	123.13	116.31	111.89	105.66	100.36	107.15	109.56	116.61	124.58	128.15	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	570.77	568.28	549.01	517.57	484.76	453.99	434.56	441.42	458.09	489.76	526.11	554.23	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.6	x	10.63	x	0.45	x	0.67	=	8	(74)
North	0.9x	0.77	x	2.4	x	10.63	x	0.45	x	0.67	=	5.33	(74)
North	0.9x	0.77	x	3.6	x	10.63	x	0.45	x	0.67	=	8	(74)
North	0.9x	0.77	x	3.6	x	20.32	x	0.45	x	0.67	=	15.29	(74)
North	0.9x	0.77	x	2.4	x	20.32	x	0.45	x	0.67	=	10.19	(74)
North	0.9x	0.77	x	3.6	x	20.32	x	0.45	x	0.67	=	15.29	(74)
North	0.9x	0.77	x	3.6	x	34.53	x	0.45	x	0.67	=	25.97	(74)
North	0.9x	0.77	x	2.4	x	34.53	x	0.45	x	0.67	=	17.32	(74)
North	0.9x	0.77	x	3.6	x	34.53	x	0.45	x	0.67	=	25.97	(74)
North	0.9x	0.77	x	3.6	x	55.46	x	0.45	x	0.67	=	41.72	(74)
North	0.9x	0.77	x	2.4	x	55.46	x	0.45	x	0.67	=	27.81	(74)
North	0.9x	0.77	x	3.6	x	55.46	x	0.45	x	0.67	=	41.72	(74)
North	0.9x	0.77	x	3.6	x	74.72	x	0.45	x	0.67	=	56.2	(74)
North	0.9x	0.77	x	2.4	x	74.72	x	0.45	x	0.67	=	37.47	(74)
North	0.9x	0.77	x	3.6	x	74.72	x	0.45	x	0.67	=	56.2	(74)
North	0.9x	0.77	x	3.6	x	79.99	x	0.45	x	0.67	=	60.16	(74)
North	0.9x	0.77	x	2.4	x	79.99	x	0.45	x	0.67	=	40.11	(74)
North	0.9x	0.77	x	3.6	x	79.99	x	0.45	x	0.67	=	60.16	(74)
North	0.9x	0.77	x	3.6	x	74.68	x	0.45	x	0.67	=	56.17	(74)
North	0.9x	0.77	x	2.4	x	74.68	x	0.45	x	0.67	=	37.45	(74)
North	0.9x	0.77	x	3.6	x	74.68	x	0.45	x	0.67	=	56.17	(74)
North	0.9x	0.77	x	3.6	x	59.25	x	0.45	x	0.67	=	44.56	(74)
North	0.9x	0.77	x	2.4	x	59.25	x	0.45	x	0.67	=	29.71	(74)
North	0.9x	0.77	x	3.6	x	59.25	x	0.45	x	0.67	=	44.56	(74)
North	0.9x	0.77	x	3.6	x	41.52	x	0.45	x	0.67	=	31.23	(74)
North	0.9x	0.77	x	2.4	x	41.52	x	0.45	x	0.67	=	20.82	(74)
North	0.9x	0.77	x	3.6	x	41.52	x	0.45	x	0.67	=	31.23	(74)
North	0.9x	0.77	x	3.6	x	24.19	x	0.45	x	0.67	=	18.19	(74)
North	0.9x	0.77	x	2.4	x	24.19	x	0.45	x	0.67	=	12.13	(74)
North	0.9x	0.77	x	3.6	x	24.19	x	0.45	x	0.67	=	18.19	(74)
North	0.9x	0.77	x	3.6	x	13.12	x	0.45	x	0.67	=	9.87	(74)
North	0.9x	0.77	x	2.4	x	13.12	x	0.45	x	0.67	=	6.58	(74)
North	0.9x	0.77	x	3.6	x	13.12	x	0.45	x	0.67	=	9.87	(74)
North	0.9x	0.77	x	3.6	x	8.86	x	0.45	x	0.67	=	6.67	(74)
North	0.9x	0.77	x	2.4	x	8.86	x	0.45	x	0.67	=	4.45	(74)
North	0.9x	0.77	x	3.6	x	8.86	x	0.45	x	0.67	=	6.67	(74)
Northeast	0.9x	0.77	x	1.05	x	11.28	x	0.45	x	0.67	=	2.48	(75)
Northeast	0.9x	0.77	x	1.05	x	22.97	x	0.45	x	0.67	=	5.04	(75)
Northeast	0.9x	0.77	x	1.05	x	41.38	x	0.45	x	0.67	=	9.08	(75)

DER WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	1.05	x	67.96	x	0.45	x	0.67	=	14.91	(75)
Northeast	0.9x	0.77	x	1.05	x	91.35	x	0.45	x	0.67	=	20.04	(75)
Northeast	0.9x	0.77	x	1.05	x	97.38	x	0.45	x	0.67	=	21.36	(75)
Northeast	0.9x	0.77	x	1.05	x	91.1	x	0.45	x	0.67	=	19.99	(75)
Northeast	0.9x	0.77	x	1.05	x	72.63	x	0.45	x	0.67	=	15.93	(75)
Northeast	0.9x	0.77	x	1.05	x	50.42	x	0.45	x	0.67	=	11.06	(75)
Northeast	0.9x	0.77	x	1.05	x	28.07	x	0.45	x	0.67	=	6.16	(75)
Northeast	0.9x	0.77	x	1.05	x	14.2	x	0.45	x	0.67	=	3.11	(75)
Northeast	0.9x	0.77	x	1.05	x	9.21	x	0.45	x	0.67	=	2.02	(75)
Southeast	0.9x	0.77	x	1.78	x	36.79	x	0.45	x	0.67	=	13.68	(77)
Southeast	0.9x	0.77	x	1.78	x	62.67	x	0.45	x	0.67	=	23.31	(77)
Southeast	0.9x	0.77	x	1.78	x	85.75	x	0.45	x	0.67	=	31.89	(77)
Southeast	0.9x	0.77	x	1.78	x	106.25	x	0.45	x	0.67	=	39.52	(77)
Southeast	0.9x	0.77	x	1.78	x	119.01	x	0.45	x	0.67	=	44.26	(77)
Southeast	0.9x	0.77	x	1.78	x	118.15	x	0.45	x	0.67	=	43.94	(77)
Southeast	0.9x	0.77	x	1.78	x	113.91	x	0.45	x	0.67	=	42.36	(77)
Southeast	0.9x	0.77	x	1.78	x	104.39	x	0.45	x	0.67	=	38.82	(77)
Southeast	0.9x	0.77	x	1.78	x	92.85	x	0.45	x	0.67	=	34.53	(77)
Southeast	0.9x	0.77	x	1.78	x	69.27	x	0.45	x	0.67	=	25.76	(77)
Southeast	0.9x	0.77	x	1.78	x	44.07	x	0.45	x	0.67	=	16.39	(77)
Southeast	0.9x	0.77	x	1.78	x	31.49	x	0.45	x	0.67	=	11.71	(77)
South	0.9x	0.54	x	9.36	x	46.75	x	0.45	x	0.67	=	64.12	(78)
South	0.9x	0.77	x	2.4	x	46.75	x	0.45	x	0.67	=	46.89	(78)
South	0.9x	0.54	x	9.36	x	76.57	x	0.45	x	0.67	=	105.01	(78)
South	0.9x	0.77	x	2.4	x	76.57	x	0.45	x	0.67	=	76.79	(78)
South	0.9x	0.54	x	9.36	x	97.53	x	0.45	x	0.67	=	133.77	(78)
South	0.9x	0.77	x	2.4	x	97.53	x	0.45	x	0.67	=	97.82	(78)
South	0.9x	0.54	x	9.36	x	110.23	x	0.45	x	0.67	=	151.19	(78)
South	0.9x	0.77	x	2.4	x	110.23	x	0.45	x	0.67	=	110.56	(78)
South	0.9x	0.54	x	9.36	x	114.87	x	0.45	x	0.67	=	157.55	(78)
South	0.9x	0.77	x	2.4	x	114.87	x	0.45	x	0.67	=	115.21	(78)
South	0.9x	0.54	x	9.36	x	110.55	x	0.45	x	0.67	=	151.62	(78)
South	0.9x	0.77	x	2.4	x	110.55	x	0.45	x	0.67	=	110.87	(78)
South	0.9x	0.54	x	9.36	x	108.01	x	0.45	x	0.67	=	148.14	(78)
South	0.9x	0.77	x	2.4	x	108.01	x	0.45	x	0.67	=	108.33	(78)
South	0.9x	0.54	x	9.36	x	104.89	x	0.45	x	0.67	=	143.86	(78)
South	0.9x	0.77	x	2.4	x	104.89	x	0.45	x	0.67	=	105.2	(78)
South	0.9x	0.54	x	9.36	x	101.89	x	0.45	x	0.67	=	139.74	(78)
South	0.9x	0.77	x	2.4	x	101.89	x	0.45	x	0.67	=	102.18	(78)
South	0.9x	0.54	x	9.36	x	82.59	x	0.45	x	0.67	=	113.27	(78)
South	0.9x	0.77	x	2.4	x	82.59	x	0.45	x	0.67	=	82.83	(78)

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South	0.9x	0.54	x	9.36	x	55.42	x	0.45	x	0.67	=	76.01	(78)
South	0.9x	0.77	x	2.4	x	55.42	x	0.45	x	0.67	=	55.58	(78)
South	0.9x	0.54	x	9.36	x	40.4	x	0.45	x	0.67	=	55.41	(78)
South	0.9x	0.77	x	2.4	x	40.4	x	0.45	x	0.67	=	40.52	(78)
Northwest	0.9x	0.77	x	1.05	x	11.28	x	0.45	x	0.67	=	2.48	(81)
Northwest	0.9x	0.77	x	1.05	x	22.97	x	0.45	x	0.67	=	5.04	(81)
Northwest	0.9x	0.77	x	1.05	x	41.38	x	0.45	x	0.67	=	9.08	(81)
Northwest	0.9x	0.77	x	1.05	x	67.96	x	0.45	x	0.67	=	14.91	(81)
Northwest	0.9x	0.77	x	1.05	x	91.35	x	0.45	x	0.67	=	20.04	(81)
Northwest	0.9x	0.77	x	1.05	x	97.38	x	0.45	x	0.67	=	21.36	(81)
Northwest	0.9x	0.77	x	1.05	x	91.1	x	0.45	x	0.67	=	19.99	(81)
Northwest	0.9x	0.77	x	1.05	x	72.63	x	0.45	x	0.67	=	15.93	(81)
Northwest	0.9x	0.77	x	1.05	x	50.42	x	0.45	x	0.67	=	11.06	(81)
Northwest	0.9x	0.77	x	1.05	x	28.07	x	0.45	x	0.67	=	6.16	(81)
Northwest	0.9x	0.77	x	1.05	x	14.2	x	0.45	x	0.67	=	3.11	(81)
Northwest	0.9x	0.77	x	1.05	x	9.21	x	0.45	x	0.67	=	2.02	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	150.97	255.95	350.9	442.33	506.96	509.59	488.59	438.59	381.85	282.69	180.51	129.46	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	721.74	824.23	899.9	959.9	991.72	963.58	923.15	880.01	839.94	772.45	706.63	683.69	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.85	0.62	0.45	0.49	0.76	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.53	20.6	20.71	20.85	20.94	20.97	20.97	20.97	20.96	20.85	20.66	20.52	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.43	20.44	20.44	20.45	20.46	20.47	20.47	20.47	20.46	20.46	20.45	20.44	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.82	0.57	0.4	0.43	0.71	0.97	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.78	19.89	20.06	20.27	20.39	20.42	20.42	20.43	20.41	20.27	20	19.77	(90)

fLA = Living area ÷ (4) = | 0.24 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.96	20.07	20.22	20.41	20.52	20.56	20.56	20.56	20.55	20.41	20.16	19.96	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.96	20.07	20.22	20.41	20.52	20.56	20.56	20.56	20.55	20.41	20.16	19.96	(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

DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.95	0.82	0.58	0.4	0.44	0.72	0.97	1	1	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	721.32	822.5	892.17	916.5	814.32	560.26	373.26	390.25	604.62	747.17	705.09	683.44	(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=	1574.56	1517.76	1366.15	1118.72	853.18	561.82	373.3	390.36	614.25	949.01	1275.55	1553.98	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	634.81	467.22	352.65	145.6	28.91	0	0	0	0	150.18	410.73	647.68

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2837.77 (98)

Space heating requirement in kWh/m²/year 16.79 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		191.14	(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)	634.81	467.22	352.65	145.6	28.91	0	0	0	0	150.18	410.73	647.68	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	332.11	244.43	184.49	76.17	15.13	0	0	0	0	78.57	214.88	338.85	(211)

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 1484.62 (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)

221.06	194.79	204.44	183.09	179.29	160.01	153.49	168.68	168.46	189.86	200.99	215.68

Efficiency of water heater 300.39 (216)

(217)m=	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	73.59	64.85	68.06	60.95	59.68	53.27	51.1	56.15	56.08	63.2	66.91	71.8

Total = $Sum(219a)_{1...12}$ = 745.64 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1484.62
Water heating fuel used		745.64
Electricity for pumps, fans and electric keep-hot		

mechanical ventilation - balanced, extract or positive input from outside			521.89		(230a)
Total electricity for the above, kWh/year		sum of (230a)…(230g) =		521.89	(231)
Electricity for lighting				569.73	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	770.52	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	386.99	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1157.51	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	270.86	(267)
Electricity for lighting	(232) x	0.519	=	295.69	(268)
Total CO2, kg/year		sum of (265)…(271) =		1724.06	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		10.2	(273)
EI rating (section 14)				89	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 23 - 2B4P - MF (Be Green)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	97.32	(1a) x	2.7	(2a) =	262.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	97.32	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	262.76	(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 *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.95 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			2.85	x1/[1/(1.1)+ 0.04]		=	3			(27)
Windows Type 2			2.85	x1/[1/(1.1)+ 0.04]		=	3			(27)
Windows Type 3			8.88	x1/[1/(1.1)+ 0.04]		=	9.36			(27)
Windows Type 4			2.67	x1/[1/(1.1)+ 0.04]		=	2.81			(27)
Windows Type 5			1.78	x1/[1/(1.1)+ 0.04]		=	1.88			(27)
Walls Type1	92.42	27.4	65.02	x	0.12	=	7.8			(29)
Walls Type2	29.89	0	29.89	x	0.14	=	4.23			(29)
Total area of elements, m²			122.31							(31)
Party wall			23.22	x	0	=	0			(32)
Party floor			97.32							(32a)
Party ceiling			97.32							(32b)

** 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) = 40.9 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 14501 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.35 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 59.25 (37)

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DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.39	25.11	24.84	23.46	23.18	21.8	21.8	21.52	22.35	23.18	23.73	24.28	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	84.64	84.36	84.09	82.7	82.43	81.05	81.05	80.77	81.6	82.43	82.98	83.53	

Average = Sum(39)$_{1\ldots12}$ /12= 82.63 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.87	0.87	0.86	0.85	0.85	0.83	0.83	0.83	0.84	0.85	0.85	0.86	

Average = Sum(40)$_{1\ldots12}$ /12= 0.85 (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 2.71 (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 98.64 (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=	108.5	104.56	100.61	96.67	92.72	88.78	88.78	92.72	96.67	100.61	104.56	108.5	

Total = Sum(44)$_{1\ldots12}$ = 1183.69 (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=	160.91	140.73	145.22	126.61	121.48	104.83	97.14	111.47	112.8	131.46	143.5	155.83	

Total = Sum(45)$_{1\ldots12}$ = 1552 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	24.14	21.11	21.78	18.99	18.22	15.72	14.57	16.72	16.92	19.72	21.53	23.37	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 255 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.49 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.8 (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) 0.8 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	24.94	22.53	24.94	24.14	24.94	24.14	24.94	24.94	24.14	24.94	24.14	24.94	(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=	24.94	22.53	24.94	24.14	24.94	24.14	24.94	24.94	24.14	24.94	24.14	24.94	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	209.11	184.27	193.43	173.26	169.69	151.48	145.35	159.68	159.45	179.67	190.15	204.04	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	209.11	184.27	193.43	173.26	169.69	151.48	145.35	159.68	159.45	179.67	190.15	204.04

Output from water heater (annual)$_{1…12}$ | 2119.58 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.07	81.63	86.85	79.42	78.96	72.18	70.86	75.63	74.83	82.27	85.03	90.38	(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=	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	135.66	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	22.46	19.95	16.22	12.28	9.18	7.75	8.37	10.89	14.61	18.55	21.65	23.08	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	251.92	254.54	247.95	233.92	216.22	199.58	188.47	185.85	192.44	206.46	224.17	240.81	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	36.57	(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=	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	-108.53	(71)

Water heating gains (Table 5)

(72)m=	123.75	121.47	116.73	110.3	106.13	100.25	95.25	101.65	103.93	110.58	118.1	121.48	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	461.82	459.65	444.6	420.21	395.23	371.28	355.79	362.09	374.68	399.3	427.62	449.06	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

DER WorkSheet: New dwelling design stage

Southeast	0.9x	0.77	x	8.88	x	36.79	x	0.45	x	0.67	=	68.27	(77)
Southeast	0.9x	0.77	x	1.78	x	36.79	x	0.45	x	0.67	=	13.68	(77)
Southeast	0.9x	0.77	x	8.88	x	62.67	x	0.45	x	0.67	=	116.28	(77)
Southeast	0.9x	0.77	x	1.78	x	62.67	x	0.45	x	0.67	=	23.31	(77)
Southeast	0.9x	0.77	x	8.88	x	85.75	x	0.45	x	0.67	=	159.1	(77)
Southeast	0.9x	0.77	x	1.78	x	85.75	x	0.45	x	0.67	=	31.89	(77)
Southeast	0.9x	0.77	x	8.88	x	106.25	x	0.45	x	0.67	=	197.14	(77)
Southeast	0.9x	0.77	x	1.78	x	106.25	x	0.45	x	0.67	=	39.52	(77)
Southeast	0.9x	0.77	x	8.88	x	119.01	x	0.45	x	0.67	=	220.81	(77)
Southeast	0.9x	0.77	x	1.78	x	119.01	x	0.45	x	0.67	=	44.26	(77)
Southeast	0.9x	0.77	x	8.88	x	118.15	x	0.45	x	0.67	=	219.21	(77)
Southeast	0.9x	0.77	x	1.78	x	118.15	x	0.45	x	0.67	=	43.94	(77)
Southeast	0.9x	0.77	x	8.88	x	113.91	x	0.45	x	0.67	=	211.35	(77)
Southeast	0.9x	0.77	x	1.78	x	113.91	x	0.45	x	0.67	=	42.36	(77)
Southeast	0.9x	0.77	x	8.88	x	104.39	x	0.45	x	0.67	=	193.68	(77)
Southeast	0.9x	0.77	x	1.78	x	104.39	x	0.45	x	0.67	=	38.82	(77)
Southeast	0.9x	0.77	x	8.88	x	92.85	x	0.45	x	0.67	=	172.28	(77)
Southeast	0.9x	0.77	x	1.78	x	92.85	x	0.45	x	0.67	=	34.53	(77)
Southeast	0.9x	0.77	x	8.88	x	69.27	x	0.45	x	0.67	=	128.52	(77)
Southeast	0.9x	0.77	x	1.78	x	69.27	x	0.45	x	0.67	=	25.76	(77)
Southeast	0.9x	0.77	x	8.88	x	44.07	x	0.45	x	0.67	=	81.77	(77)
Southeast	0.9x	0.77	x	1.78	x	44.07	x	0.45	x	0.67	=	16.39	(77)
Southeast	0.9x	0.77	x	8.88	x	31.49	x	0.45	x	0.67	=	58.42	(77)
Southeast	0.9x	0.77	x	1.78	x	31.49	x	0.45	x	0.67	=	11.71	(77)
South	0.9x	0.77	x	2.85	x	46.75	x	0.45	x	0.67	=	55.68	(78)
South	0.9x	0.77	x	2.85	x	46.75	x	0.45	x	0.67	=	55.68	(78)
South	0.9x	0.77	x	2.85	x	76.57	x	0.45	x	0.67	=	91.19	(78)
South	0.9x	0.77	x	2.85	x	76.57	x	0.45	x	0.67	=	91.19	(78)
South	0.9x	0.77	x	2.85	x	97.53	x	0.45	x	0.67	=	116.16	(78)
South	0.9x	0.77	x	2.85	x	97.53	x	0.45	x	0.67	=	116.16	(78)
South	0.9x	0.77	x	2.85	x	110.23	x	0.45	x	0.67	=	131.28	(78)
South	0.9x	0.77	x	2.85	x	110.23	x	0.45	x	0.67	=	131.28	(78)
South	0.9x	0.77	x	2.85	x	114.87	x	0.45	x	0.67	=	136.81	(78)
South	0.9x	0.77	x	2.85	x	114.87	x	0.45	x	0.67	=	136.81	(78)
South	0.9x	0.77	x	2.85	x	110.55	x	0.45	x	0.67	=	131.66	(78)
South	0.9x	0.77	x	2.85	x	110.55	x	0.45	x	0.67	=	131.66	(78)
South	0.9x	0.77	x	2.85	x	108.01	x	0.45	x	0.67	=	128.64	(78)
South	0.9x	0.77	x	2.85	x	108.01	x	0.45	x	0.67	=	128.64	(78)
South	0.9x	0.77	x	2.85	x	104.89	x	0.45	x	0.67	=	124.92	(78)
South	0.9x	0.77	x	2.85	x	104.89	x	0.45	x	0.67	=	124.92	(78)
South	0.9x	0.77	x	2.85	x	101.89	x	0.45	x	0.67	=	121.34	(78)

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South	0.9x	0.77	x	2.85	x	101.89	x	0.45	x	0.67	=	121.34	(78)
South	0.9x	0.77	x	2.85	x	82.59	x	0.45	x	0.67	=	98.36	(78)
South	0.9x	0.77	x	2.85	x	82.59	x	0.45	x	0.67	=	98.36	(78)
South	0.9x	0.77	x	2.85	x	55.42	x	0.45	x	0.67	=	66	(78)
South	0.9x	0.77	x	2.85	x	55.42	x	0.45	x	0.67	=	66	(78)
South	0.9x	0.77	x	2.85	x	40.4	x	0.45	x	0.67	=	48.11	(78)
South	0.9x	0.77	x	2.85	x	40.4	x	0.45	x	0.67	=	48.11	(78)
Southwest	0.9x	0.77	x	2.67	x	36.79		0.45	x	0.67	=	41.05	(79)
Southwest	0.9x	0.77	x	2.67	x	62.67		0.45	x	0.67	=	69.93	(79)
Southwest	0.9x	0.77	x	2.67	x	85.75		0.45	x	0.67	=	95.68	(79)
Southwest	0.9x	0.77	x	2.67	x	106.25		0.45	x	0.67	=	118.55	(79)
Southwest	0.9x	0.77	x	2.67	x	119.01		0.45	x	0.67	=	132.78	(79)
Southwest	0.9x	0.77	x	2.67	x	118.15		0.45	x	0.67	=	131.82	(79)
Southwest	0.9x	0.77	x	2.67	x	113.91		0.45	x	0.67	=	127.09	(79)
Southwest	0.9x	0.77	x	2.67	x	104.39		0.45	x	0.67	=	116.47	(79)
Southwest	0.9x	0.77	x	2.67	x	92.85		0.45	x	0.67	=	103.6	(79)
Southwest	0.9x	0.77	x	2.67	x	69.27		0.45	x	0.67	=	77.28	(79)
Southwest	0.9x	0.77	x	2.67	x	44.07		0.45	x	0.67	=	49.17	(79)
Southwest	0.9x	0.77	x	2.67	x	31.49		0.45	x	0.67	=	35.13	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	234.36	391.9	518.99	617.77	671.47	658.29	638.08	598.83	553.09	428.28	279.33	201.49	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	696.19	851.55	963.59	1037.98	1066.7	1029.57	993.86	960.92	927.77	827.58	706.95	650.55	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.94	0.85	0.69	0.5	0.36	0.39	0.6	0.88	0.98	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.41	20.56	20.72	20.87	20.94	20.96	20.96	20.96	20.95	20.86	20.6	20.38	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.2	20.2	20.21	20.21	20.23	20.23	20.23	20.22	20.21	20.21	20.2	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.97	0.93	0.82	0.64	0.44	0.3	0.32	0.53	0.85	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.4	19.62	19.85	20.05	20.13	20.16	20.16	20.17	20.15	20.05	19.7	19.37	(90)

fLA = Living area ÷ (4) = 0.38 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.78	19.97	20.18	20.36	20.43	20.46	20.46	20.46	20.45	20.35	20.04	19.75	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.78	19.97	20.18	20.36	20.43	20.46	20.46	20.46	20.45	20.35	20.04	19.75	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.97	0.93	0.82	0.66	0.46	0.31	0.34	0.55	0.85	0.98	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	690.14	828.17	893.87	854.47	700.53	473.43	312.96	328.1	513.27	706.08	689.74	646.63		(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=	1310.11	1271.45	1149.95	947.52	719.99	475.04	313.07	328.28	518.48	803.95	1073.79	1298.9		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	461.25	297.88	190.52	67	14.48	0	0	0	0	72.81	276.51	485.3		
									Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =				1865.76	(98)
Space heating requirement in kWh/m²/year													19.17	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		202.67	(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)														
	461.25	297.88	190.52	67	14.48	0	0	0	0	72.81	276.51	485.3		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	227.58	146.98	94	33.06	7.14	0	0	0	0	35.93	136.43	239.45		
									Total (kWh/year) =Sum(211)$_{1...5,10...12}$=				920.57	(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)														
	209.11	184.27	193.43	173.26	169.69	151.48	145.35	159.68	159.45	179.67	190.15	204.04		
Efficiency of water heater													305.24	(216)
(217)m=	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	68.51	60.37	63.37	56.76	55.59	49.63	47.62	52.31	52.24	58.86	62.3	66.85		
									Total = Sum(219a)$_{1...12}$ =				694.41	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		920.57

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Water heating fuel used			694.41	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		272.49		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		272.49	(231)
Electricity for lighting			396.63	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	477.78	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	360.4	(264)
Space and water heating	(261) + (262) + (263) + (264) =			838.18	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	141.42	(267)
Electricity for lighting	(232) x	0.519	=	205.85	(268)
Total CO2, kg/year		sum of (265)…(271) =		1185.45	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		12.18	(273)
EI rating (section 14)				89	(274)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 33 - 1B2P -TF (Be Green)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	59.88	(1a) x	2.4	(2a) =	143.71	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.88	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	143.71	(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		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(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

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.1 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	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	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	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	
Windows			4.6	x1/[1/(1.1)+ 0.04]		=	4.85			(27)
Walls Type1	72.9	4.6	68.3	x	0.12	=	8.2			(29)
Walls Type2	26.57	0	26.57	x	0.14	=	3.76			(29)
Roof	55	0	55	x	0.13	=	7.15			(30)
Total area of elements, m²			154.47							(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) = 23.95 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7135.62 (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 23.17 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 47.12 (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=	13.41	13.27	13.13	12.44	12.31	11.62	11.62	11.48	11.89	12.31	12.58	12.86	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	60.53	60.39	60.25	59.57	59.43	58.74	58.74	58.6	59.01	59.43	59.7	59.98	

Average = Sum(39)$_{1…12}$ /12= 59.53 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.01	1.01	1.01	0.99	0.99	0.98	0.98	0.98	0.99	0.99	1	1	

Average = Sum(40)$_{1…12}$ /12= 0.99 (40)

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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 — 1.98 (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 — 81.18 (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=	89.3	86.05	82.81	79.56	76.31	73.06	73.06	76.31	79.56	82.81	86.05	89.3	
											Total = $\text{Sum}(44)_{1...12}$ =	974.2	(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=	132.43	115.83	119.52	104.2	99.98	86.28	79.95	91.74	92.84	108.2	118.1	128.25	
											Total = $\text{Sum}(45)_{1...12}$ =	1277.33	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.86	17.37	17.93	15.63	15	12.94	11.99	13.76	13.93	16.23	17.72	19.24	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0.99 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.53 (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) — 0.53 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	16.57	14.97	16.57	16.04	16.57	16.04	16.57	16.57	16.04	16.57	16.04	16.57	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	16.57	14.97	16.57	16.04	16.57	16.04	16.57	16.57	16.04	16.57	16.04	16.57	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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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=	172.27	151.81	159.36	142.75	139.82	124.83	119.78	131.58	131.39	148.03	156.65	168.09	(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=	172.27	151.81	159.36	142.75	139.82	124.83	119.78	131.58	131.39	148.03	156.65	168.09	

Output from water heater (annual)$_{1...12}$ 1746.35 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	75.9	67.3	71.61	65.49	65.11	59.53	58.45	62.37	61.71	67.84	70.11	74.51	(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=	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	98.91	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.86	16.76	13.63	10.32	7.71	6.51	7.03	9.14	12.27	15.58	18.19	19.39	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	172.64	174.44	169.92	160.31	148.18	136.78	129.16	127.37	131.88	141.49	153.62	165.03	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	32.89	(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=	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	-79.13	(71)
Water heating gains (Table 5)													
(72)m=	102.02	100.14	96.25	90.95	87.52	82.68	78.56	83.83	85.71	91.19	97.37	100.15	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	346.2	344.01	332.47	314.25	296.08	278.64	267.43	273.02	282.53	300.94	321.86	337.24	(73)

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6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	4.6	x	10.63	x	0.45	x	0.67	=	10.22	(74)
North	0.9x	0.77	x	4.6	x	20.32	x	0.45	x	0.67	=	19.53	(74)
North	0.9x	0.77	x	4.6	x	34.53	x	0.45	x	0.67	=	33.19	(74)
North	0.9x	0.77	x	4.6	x	55.46	x	0.45	x	0.67	=	53.31	(74)
North	0.9x	0.77	x	4.6	x	74.72	x	0.45	x	0.67	=	71.81	(74)
North	0.9x	0.77	x	4.6	x	79.99	x	0.45	x	0.67	=	76.88	(74)
North	0.9x	0.77	x	4.6	x	74.68	x	0.45	x	0.67	=	71.77	(74)
North	0.9x	0.77	x	4.6	x	59.25	x	0.45	x	0.67	=	56.94	(74)

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North	0.9x	0.77	x	4.6	x	41.52	x	0.45	x	0.67	=	39.9	(74)
North	0.9x	0.77	x	4.6	x	24.19	x	0.45	x	0.67	=	23.25	(74)
North	0.9x	0.77	x	4.6	x	13.12	x	0.45	x	0.67	=	12.61	(74)
North	0.9x	0.77	x	4.6	x	8.86	x	0.45	x	0.67	=	8.52	(74)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	10.22	19.53	33.19	53.31	71.81	76.88	71.77	56.94	39.9	23.25	12.61	8.52	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	356.42	363.54	365.66	367.56	367.89	355.51	339.2	329.96	322.44	324.18	334.47	345.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.96	0.87	0.72	0.75	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.16	20.22	20.34	20.51	20.71	20.87	20.93	20.93	20.82	20.59	20.34	20.15	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.07	20.08	20.08	20.09	20.09	20.1	20.1	20.1	20.1	20.09	20.09	20.08	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.95	0.81	0.59	0.64	0.89	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.94	19.02	19.2	19.48	19.75	19.97	20.02	20.02	19.91	19.58	19.23	18.94	(90)

fLA = Living area ÷ (4) = 0.61 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.69	19.75	19.9	20.11	20.34	20.52	20.58	20.57	20.46	20.2	19.91	19.68	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.69	19.75	19.9	20.11	20.34	20.52	20.58	20.57	20.46	20.2	19.91	19.68	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.95	0.84	0.66	0.7	0.91	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	355.38	362.15	363.27	361.81	350.19	299.23	224.32	231.48	292.56	318.35	332.69	344.92	(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=	931.47	896.97	807.18	667.81	513.42	347.79	233.72	244.61	375.61	570.5	764.9	928.44	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	428.61	359.4	330.26	220.33	121.45	0	0	0	0	187.59	311.19	434.14	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2392.97 (98)

Space heating requirement in kWh/m²/year 39.96 (99)

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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		143.82	(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)	428.61	359.4	330.26	220.33	121.45	0	0	0	0	187.59	311.19	434.14		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	298.01	249.89	229.63	153.19	84.44	0	0	0	0	130.43	216.37	301.86		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1663.84	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	172.27	151.81	159.36	142.75	139.82	124.83	119.78	131.58	131.39	148.03	156.65	168.09		
Efficiency of water heater													305.24	(216)
(217)m=	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	56.44	49.73	52.21	46.77	45.81	40.9	39.24	43.11	43.05	48.5	51.32	55.07		
Total = Sum(219a)$_{1...12}$ =													572.13	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1663.84	
Water heating fuel used			572.13	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		199.44		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		199.44	(231)
Electricity for lighting			333.16	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	863.53	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	296.94	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1160.47	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	103.51	(267)

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Electricity for lighting	(232) x	0.519	=	172.91	(268)
Total CO2, kg/year		sum of (265)…(271) =		1436.89	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		24	(273)
EI rating (section 14)				82	(274)

DRAFT

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 31 - 3B6P - TF (Be Green)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	192.4	(1a) x	2.6	(2a) =	500.24	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	192.4	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		500.24	(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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

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) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.3	0.3	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.3	0.3	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.34	x1/[1/(1.1)+ 0.04]		=	10.89			(27)
Windows Type 2			9.9	x1/[1/(1.1)+ 0.04]		=	10.43			(27)
Windows Type 3			5.25	x1/[1/(1.1)+ 0.04]		=	5.53			(27)
Windows Type 4			5.5	x1/[1/(1.1)+ 0.04]		=	5.8			(27)
Walls Type1	146.45	30.99	115.46	x	0.12	=	13.85			(29)
Walls Type2	26.73	0	26.73	x	0.14	=	3.78			(29)
Roof	191	0	191	x	0.13	=	24.83			(30)
Total area of elements, m²			364.18							(31)
Party floor			191							(32a)

** 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) = 75.12 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 19312.16 (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 54.63 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 129.75 (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=	49.3	48.73	48.16	45.29	44.72	41.86	41.86	41.29	43	44.72	45.87	47.01	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	179.05	178.48	177.9	175.04	174.47	171.6	171.6	171.03	172.75	174.47	175.61	176.76	

Average = $Sum(39)_{1…12}$ /12= 174.9 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.93	0.93	0.92	0.91	0.91	0.89	0.89	0.89	0.9	0.91	0.91	0.92

Average = Sum(40)1…12 /12= 0.91 (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 2.99 (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) + 36 105.26 (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=	115.79	111.58	107.37	103.16	98.94	94.73	94.73	98.94	103.16	107.37	111.58	115.79

Total = Sum(44)1…12 = 1263.13 (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=	171.71	150.18	154.97	135.11	129.64	111.87	103.66	118.95	120.37	140.28	153.13	166.29

Total = Sum(45)1…12 = 1656.16 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.76	22.53	23.25	20.27	19.45	16.78	15.55	17.84	18.06	21.04	22.97	24.94

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 305 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.63 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.88 (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) 0.88 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29

(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26

(59)

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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=	222.26	195.83	205.52	184.02	180.19	160.79	154.21	169.5	169.29	190.83	202.05	216.84	(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=	222.26	195.83	205.52	184.02	180.19	160.79	154.21	169.5	169.29	190.83	202.05	216.84	

Output from water heater (annual)$_{1...12}$ 2251.33 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	97.53	86.46	91.97	84.06	83.54	76.33	74.91	79.99	79.16	87.08	90.05	95.73	(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=	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	149.6	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	35.19	31.26	25.42	19.24	14.38	12.14	13.12	17.06	22.89	29.07	33.93	36.17	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	363.76	367.54	358.03	337.78	312.21	288.19	272.14	268.36	277.88	298.13	323.69	347.71	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	37.96	(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=	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	-119.68	(71)

Water heating gains (Table 5)

(72)m=	131.09	128.66	123.61	116.75	112.29	106.01	100.68	107.51	109.94	117.05	125.07	128.67	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	597.93	595.33	574.94	541.65	506.77	474.23	453.82	460.82	478.59	512.12	550.57	580.43	(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	0.3	x	5.5	x	11.28	x	0.45	x	0.67	=	5.05	(75)
Northeast 0.9x	0.3	x	5.5	x	22.97	x	0.45	x	0.67	=	10.28	(75)
Northeast 0.9x	0.3	x	5.5	x	41.38	x	0.45	x	0.67	=	18.53	(75)
Northeast 0.9x	0.3	x	5.5	x	67.96	x	0.45	x	0.67	=	30.43	(75)
Northeast 0.9x	0.3	x	5.5	x	91.35	x	0.45	x	0.67	=	40.9	(75)

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Northeast	0.9x	0.3	x	5.5	x	97.38	x	0.45	x	0.67	=	43.6	(75)
Northeast	0.9x	0.3	x	5.5	x	91.1	x	0.45	x	0.67	=	40.79	(75)
Northeast	0.9x	0.3	x	5.5	x	72.63	x	0.45	x	0.67	=	32.52	(75)
Northeast	0.9x	0.3	x	5.5	x	50.42	x	0.45	x	0.67	=	22.57	(75)
Northeast	0.9x	0.3	x	5.5	x	28.07	x	0.45	x	0.67	=	12.57	(75)
Northeast	0.9x	0.3	x	5.5	x	14.2	x	0.45	x	0.67	=	6.36	(75)
Northeast	0.9x	0.3	x	5.5	x	9.21	x	0.45	x	0.67	=	4.13	(75)
Southeast	0.9x	0.77	x	9.9	x	36.79	x	0.45	x	0.67	=	76.11	(77)
Southeast	0.9x	0.77	x	9.9	x	62.67	x	0.45	x	0.67	=	129.64	(77)
Southeast	0.9x	0.77	x	9.9	x	85.75	x	0.45	x	0.67	=	177.38	(77)
Southeast	0.9x	0.77	x	9.9	x	106.25	x	0.45	x	0.67	=	219.78	(77)
Southeast	0.9x	0.77	x	9.9	x	119.01	x	0.45	x	0.67	=	246.17	(77)
Southeast	0.9x	0.77	x	9.9	x	118.15	x	0.45	x	0.67	=	244.39	(77)
Southeast	0.9x	0.77	x	9.9	x	113.91	x	0.45	x	0.67	=	235.62	(77)
Southeast	0.9x	0.77	x	9.9	x	104.39	x	0.45	x	0.67	=	215.93	(77)
Southeast	0.9x	0.77	x	9.9	x	92.85	x	0.45	x	0.67	=	192.06	(77)
Southeast	0.9x	0.77	x	9.9	x	69.27	x	0.45	x	0.67	=	143.28	(77)
Southeast	0.9x	0.77	x	9.9	x	44.07	x	0.45	x	0.67	=	91.16	(77)
Southeast	0.9x	0.77	x	9.9	x	31.49	x	0.45	x	0.67	=	65.13	(77)
Southwest	0.9x	0.77	x	10.34	x	36.79		0.45	x	0.67	=	79.49	(79)
Southwest	0.9x	0.77	x	10.34	x	62.67		0.45	x	0.67	=	135.4	(79)
Southwest	0.9x	0.77	x	10.34	x	85.75		0.45	x	0.67	=	185.26	(79)
Southwest	0.9x	0.77	x	10.34	x	106.25		0.45	x	0.67	=	229.55	(79)
Southwest	0.9x	0.77	x	10.34	x	119.01		0.45	x	0.67	=	257.11	(79)
Southwest	0.9x	0.77	x	10.34	x	118.15		0.45	x	0.67	=	255.26	(79)
Southwest	0.9x	0.77	x	10.34	x	113.91		0.45	x	0.67	=	246.09	(79)
Southwest	0.9x	0.77	x	10.34	x	104.39		0.45	x	0.67	=	225.53	(79)
Southwest	0.9x	0.77	x	10.34	x	92.85		0.45	x	0.67	=	200.6	(79)
Southwest	0.9x	0.77	x	10.34	x	69.27		0.45	x	0.67	=	149.65	(79)
Southwest	0.9x	0.77	x	10.34	x	44.07		0.45	x	0.67	=	95.21	(79)
Southwest	0.9x	0.77	x	10.34	x	31.49		0.45	x	0.67	=	68.03	(79)
Northwest	0.9x	0.3	x	5.25	x	11.28	x	0.45	x	0.67	=	4.82	(81)
Northwest	0.9x	0.3	x	5.25	x	22.97	x	0.45	x	0.67	=	9.82	(81)
Northwest	0.9x	0.3	x	5.25	x	41.38	x	0.45	x	0.67	=	17.68	(81)
Northwest	0.9x	0.3	x	5.25	x	67.96	x	0.45	x	0.67	=	29.04	(81)
Northwest	0.9x	0.3	x	5.25	x	91.35	x	0.45	x	0.67	=	39.04	(81)
Northwest	0.9x	0.3	x	5.25	x	97.38	x	0.45	x	0.67	=	41.62	(81)
Northwest	0.9x	0.3	x	5.25	x	91.1	x	0.45	x	0.67	=	38.93	(81)
Northwest	0.9x	0.3	x	5.25	x	72.63	x	0.45	x	0.67	=	31.04	(81)
Northwest	0.9x	0.3	x	5.25	x	50.42	x	0.45	x	0.67	=	21.55	(81)
Northwest	0.9x	0.3	x	5.25	x	28.07	x	0.45	x	0.67	=	12	(81)

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Northwest	0.9x	0.3	x	5.25	x	14.2	x	0.45	x	0.67	=	6.07	(81)
Northwest	0.9x	0.3	x	5.25	x	9.21	x	0.45	x	0.67	=	3.94	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	165.47	285.14	398.85	508.8	583.23	584.87	561.44	505.02	436.79	317.49	198.8	141.22	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	763.4	880.47	973.79	1050.45	1089.99	1059.1	1015.26	965.83	915.38	829.61	749.36	721.66	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.97	0.88	0.71	0.76	0.95	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.11	20.19	20.34	20.54	20.74	20.89	20.94	20.94	20.83	20.58	20.3	20.1	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.14	20.15	20.16	20.16	20.17	20.17	20.18	20.17	20.16	20.16	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.95	0.81	0.59	0.65	0.91	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.92	19.05	19.27	19.57	19.85	20.06	20.1	20.1	19.98	19.62	19.23	18.91	(90)

fLA = Living area ÷ (4) = 0.19 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.14	19.27	19.47	19.76	20.02	20.22	20.26	20.26	20.14	19.8	19.43	19.14	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.14	19.27	19.47	19.76	20.02	20.22	20.26	20.26	20.14	19.8	19.43	19.14	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.95	0.82	0.61	0.66	0.91	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	763.08	879.52	970.62	1037.53	1035.68	865.45	615.93	639.26	833.12	822.44	748.58	721.45	(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=	2657.69	2564.1	2307.53	1900.19	1451.61	963.62	628.65	660.33	1044.27	1605.86	2165.36	2640.22	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1409.59	1132.04	994.66	621.11	309.45	0	0	0	0	582.87	1020.08	1427.57	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 7497.37 (98)

Space heating requirement in kWh/m²/year 38.97 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

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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			361.62	(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)	1409.59	1132.04	994.66	621.11	309.45	0	0	0	0	582.87	1020.08	1427.57		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	389.8	313.05	275.06	171.76	85.57	0	0	0	0	161.18	282.09	394.77		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2073.27	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	222.26	195.83	205.52	184.02	180.19	160.79	154.21	169.5	169.29	190.83	202.05	216.84		
Efficiency of water heater													300.39	(216)
(217)m=	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	73.99	65.19	68.42	61.26	59.98	53.53	51.34	56.43	56.36	63.53	67.26	72.19		
Total = Sum(219a)$_{1...12}$ =													749.47	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2073.27	
Water heating fuel used			749.47	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		465.35		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		465.35	(231)
Electricity for lighting			621.47	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	1076.03	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	388.97	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1465	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	241.52	(267)
Electricity for lighting	(232)	x	0.519	=	322.54	(268)
Total CO2, kg/year			sum of (265)…(271) =		2029.06	(272)

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Dwelling CO2 Emission Rate	(272) ÷ (4) =	10.55	(273)
EI rating (section 14)		89	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 32 - 2B4P - TF (Be Green)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	118	(1a) x	2.4	(2a) =	283.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	118	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	283.2	(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)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		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) = 73.95 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			6.2	x1/[1/(1.1)+ 0.04]		=	6.53			(27)
Windows Type 2			0.36	x1/[1/(1.1)+ 0.04]		=	0.38			(27)
Walls Type1	103.96	6.56	97.4	x	0.12	=	11.69			(29)
Walls Type2	4.93	0	4.93	x	0.14	=	0.7			(29)
Roof	118	0	118	x	0.13	=	15.34			(30)
Total area of elements, m²			226.89							(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) = 34.64 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 8224.82 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 34.03 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 68.67 (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=	27.37	27.07	26.77	25.28	24.98	23.49	23.49	23.19	24.09	24.98	25.58	26.17	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	96.03	95.74	95.44	93.95	93.65	92.16	92.16	91.86	92.76	93.65	94.25	94.84	

Average = Sum(39)$_{1…12}$ /12= 93.88 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.81	0.81	0.81	0.8	0.79	0.78	0.78	0.78	0.79	0.79	0.8	0.8

Average = Sum(40)$_{1…12}$ /12= 0.8 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.86 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 102.01 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	112.21	108.13	104.05	99.97	95.89	91.81	91.81	95.89	99.97	104.05	108.13	112.21	
											Total = Sum(44)$_{1…12}$ =	1224.14	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	166.41	145.54	150.19	130.94	125.64	108.41	100.46	115.28	116.66	135.95	148.41	161.16	
											Total = Sum(45)$_{1…12}$ =	1605.05	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	24.96	21.83	22.53	19.64	18.85	16.26	15.07	17.29	17.5	20.39	22.26	24.17	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 250 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.49 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.8 (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) 0.8 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	24.94	22.53	24.94	24.14	24.94	24.14	24.94	24.94	24.14	24.94	24.14	24.94	(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=	24.94	22.53	24.94	24.14	24.94	24.14	24.94	24.94	24.14	24.94	24.14	24.94	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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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=	214.61	189.08	198.39	177.59	173.84	155.06	148.67	163.49	163.31	184.16	195.06	209.36	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	214.61	189.08	198.39	177.59	173.84	155.06	148.67	163.49	163.31	184.16	195.06	209.36	

Output from water heater (annual)$_{1…12}$ 2172.62 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	93.89	83.22	88.5	80.86	80.34	73.37	71.97	76.9	76.11	83.77	86.66	92.15	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	142.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	32.48	28.85	23.46	17.76	13.28	11.21	12.11	15.74	21.13	26.83	31.31	33.38	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	282.59	285.52	278.13	262.4	242.54	223.88	211.41	208.48	215.86	231.6	251.45	270.12	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	(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=	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	-114.21	(71)

Water heating gains (Table 5)

(72)m=	126.2	123.85	118.95	112.3	107.98	101.9	96.73	103.35	105.71	112.59	120.37	123.86	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	507.1	504.04	486.37	458.29	429.63	402.81	386.08	393.4	408.53	436.85	468.96	493.18	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	0.36	x	10.63	x	0.45	x	0.67	=	0.8	(74)
North	0.9x	0.77	x	0.36	x	20.32	x	0.45	x	0.67	=	1.53	(74)
North	0.9x	0.77	x	0.36	x	34.53	x	0.45	x	0.67	=	2.6	(74)
North	0.9x	0.77	x	0.36	x	55.46	x	0.45	x	0.67	=	4.17	(74)
North	0.9x	0.77	x	0.36	x	74.72	x	0.45	x	0.67	=	5.62	(74)

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North	0.9x	0.77	x	0.36	x	79.99	x	0.45	x	0.67	=	6.02	(74)
North	0.9x	0.77	x	0.36	x	74.68	x	0.45	x	0.67	=	5.62	(74)
North	0.9x	0.77	x	0.36	x	59.25	x	0.45	x	0.67	=	4.46	(74)
North	0.9x	0.77	x	0.36	x	41.52	x	0.45	x	0.67	=	3.12	(74)
North	0.9x	0.77	x	0.36	x	24.19	x	0.45	x	0.67	=	1.82	(74)
North	0.9x	0.77	x	0.36	x	13.12	x	0.45	x	0.67	=	0.99	(74)
North	0.9x	0.77	x	0.36	x	8.86	x	0.45	x	0.67	=	0.67	(74)
South	0.9x	0.77	x	6.2	x	46.75	x	0.45	x	0.67	=	60.56	(78)
South	0.9x	0.77	x	6.2	x	76.57	x	0.45	x	0.67	=	99.19	(78)
South	0.9x	0.77	x	6.2	x	97.53	x	0.45	x	0.67	=	126.35	(78)
South	0.9x	0.77	x	6.2	x	110.23	x	0.45	x	0.67	=	142.8	(78)
South	0.9x	0.77	x	6.2	x	114.87	x	0.45	x	0.67	=	148.81	(78)
South	0.9x	0.77	x	6.2	x	110.55	x	0.45	x	0.67	=	143.21	(78)
South	0.9x	0.77	x	6.2	x	108.01	x	0.45	x	0.67	=	139.92	(78)
South	0.9x	0.77	x	6.2	x	104.89	x	0.45	x	0.67	=	135.88	(78)
South	0.9x	0.77	x	6.2	x	101.89	x	0.45	x	0.67	=	131.99	(78)
South	0.9x	0.77	x	6.2	x	82.59	x	0.45	x	0.67	=	106.98	(78)
South	0.9x	0.77	x	6.2	x	55.42	x	0.45	x	0.67	=	71.79	(78)
South	0.9x	0.77	x	6.2	x	40.4	x	0.45	x	0.67	=	52.33	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	61.36	100.72	128.95	146.97	154.43	149.22	145.54	140.34	135.11	108.8	72.78	53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	568.46	604.76	615.32	605.26	584.05	552.04	531.62	533.74	543.64	545.65	541.74	546.18	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.98	0.9	0.73	0.75	0.93	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.3	20.36	20.47	20.61	20.77	20.9	20.95	20.95	20.87	20.68	20.46	20.29	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.24	20.24	20.25	20.26	20.26	20.27	20.27	20.27	20.27	20.26	20.25	20.25	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.97	0.85	0.63	0.65	0.89	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.28	19.38	19.54	19.76	19.98	20.16	20.21	20.21	20.13	19.86	19.54	19.28	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.6	19.68	19.83	20.03	20.22	20.39	20.44	20.44	20.36	20.11	19.83	19.59	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.6	19.68	19.83	20.03	20.22	20.39	20.44	20.44	20.36	20.11	19.83	19.59	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.97	0.86	0.65	0.68	0.9	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	567.85	603.6	612.9	599.02	563.77	474	346.35	361.32	489.29	538.07	540.4	545.74	(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=	1469.38	1415.33	1271.76	1045.3	798.26	533.74	353.67	370.88	580.56	891.06	1199.64	1460.07	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	670.74	545.49	490.19	321.32	174.47	0	0	0	0	262.62	474.66	680.26	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3619.74 (98)

Space heating requirement in kWh/m²/year 30.68 (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		231.96	(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)														
	670.74	545.49	490.19	321.32	174.47	0	0	0	0	262.62	474.66	680.26		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	289.17	235.17	211.33	138.53	75.22	0	0	0	0	113.22	204.63	293.27		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1560.52	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	214.61	189.08	198.39	177.59	173.84	155.06	148.67	163.49	163.31	184.16	195.06	209.36		
Efficiency of water heater													305.24	(216)
(217)m=	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24	305.24		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	70.31	61.95	65	58.18	56.95	50.8	48.71	53.56	53.5	60.33	63.9	68.59		
Total = Sum(219a)$_{1...12}$ =													711.79	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1560.52

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Water heating fuel used		711.79	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	293.68		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	293.68	(231)
Electricity for lighting		573.57	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	809.91	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	369.42	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1179.33	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	152.42	(267)
Electricity for lighting	(232) x	0.519	=	297.68	(268)
Total CO2, kg/year		sum of (265)…(271) =		1629.43	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.81	(273)
EI rating (section 14)				87	(274)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Gate House (Be Green)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	36.22	(1a)	x	3.2	(2a)	=	115.9	(3a)
Ground floor	47.4	(1b)	x	3.2	(2b)	=	151.68	(3b)
First floor	36.22	(1c)	x	3.2	(2c)	=	115.9	(3c)
Second floor	37.02	(1d)	x	2.76	(2d)	=	102.18	(3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	156.86	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			485.66	(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		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

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) = 74.8 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.3	0.3	0.3	0.28	0.28	0.26	0.26	0.25	0.26	0.28	0.28	0.29	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.3	0.3	0.3	0.28	0.28	0.26	0.26	0.25	0.26	0.28	0.28	0.29	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			4.08	x	1.2	=	4.896			(26)
Doors Type 2			2.43	x	1.2	=	2.916			(26)
Doors Type 3			2.43	x	1.2	=	2.916			(26)
Windows Type 1			0.408	x1/[1/(1.1)+ 0.04]		=	0.43			(27)
Windows Type 2			1.84	x1/[1/(1.1)+ 0.04]		=	1.94			(27)
Windows Type 3			0.408	x1/[1/(1.1)+ 0.04]		=	0.43			(27)
Windows Type 4			1.84	x1/[1/(1.1)+ 0.04]		=	1.94			(27)
Windows Type 5			0.907	x1/[1/(1.1)+ 0.04]		=	0.96			(27)
Windows Type 6			0.907	x1/[1/(1.1)+ 0.04]		=	0.96			(27)
Windows Type 7			1.34	x1/[1/(1.1)+ 0.04]		=	1.41			(27)
Windows Type 8			2.72	x1/[1/(1.1)+ 0.04]		=	2.87			(27)
Windows Type 9			1.82	x1/[1/(1.1)+ 0.04]		=	1.92			(27)
Windows Type 10			2.72	x1/[1/(1.1)+ 0.04]		=	2.87			(27)
Windows Type 11			1.45	x1/[1/(1.1)+ 0.04]		=	1.53			(27)

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Windows Type 12			2.91	x1/[1/(1.1)+ 0.04]		=	3.07			(27)
Windows Type 13			0.58	x1/[1/(1.1)+ 0.04]		=	0.61			(27)
Floor Type 1			36.22	x	0.12	=	4.3464			(28)
Floor Type 2			47.41	x	0.12	=	5.6892			(28)
Walls Type1	66.24	4.08	62.16	x	0.12	=	7.46			(29)
Walls Type2	76.51	11.17	65.34	x	0.11	=	7.48			(29)
Walls Type3	66.24	8.6	57.64	x	0.12	=	6.92			(29)
Walls Type4	75.9	4.94	70.96	x	0.12	=	8.52			(29)
Roof	45	0	45	x	0.13	=	5.85			(30)
Total area of elements, m²			413.52							(31)
Party wall			14.08	x	0	=	0			(32)
Party wall			14.08	x	0	=	0			(32)
Party wall			14.08	x	0	=	0			(32)
Party wall			9.91	x	0	=	0			(32)
Party floor			36.22							(32a)
Party floor			37.02							(32a)
Party ceiling			36.22							(32b)
Party ceiling			47.4							(32b)
Party ceiling			36.22							(32b)

** 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) = 77.9 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 37002.6 (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 62.03 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 139.93 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	48.55	47.99	47.43	44.65	44.1	41.32	41.32	40.76	42.43	44.1	45.21	46.32	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	188.48	187.92	187.36	184.58	184.03	181.25	181.25	180.69	182.36	184.03	185.14	186.25	

Average = Sum(39)$_{1…12}$ /12= 184.45 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.2	1.2	1.19	1.18	1.17	1.16	1.16	1.15	1.16	1.17	1.18	1.19	

Average = Sum(40)$_{1…12}$ /12= 1.18 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.94 (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) + 36 104.13 (43)

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Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	169.86	148.56	153.31	133.66	128.25	110.67	102.55	117.68	119.08	138.78	151.49	164.5

Total = Sum(45)$_{1...12}$ = 1638.38 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.48	22.28	23	20.05	19.24	16.6	15.38	17.65	17.86	20.82	22.72	24.68	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 305 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.63 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.88 (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) 0.88 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	220.41	194.22	203.85	182.57	178.79	159.58	153.1	168.22	168	189.33	200.4	215.05	(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=	220.41	194.22	203.85	182.57	178.79	159.58	153.1	168.22	168	189.33	200.4	215.05

Output from water heater (annual)$_{1...12}$ 2233.55 (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=	96.92	85.92	91.41	83.57	83.08	75.93	74.54	79.57	78.73	86.58	89.5	95.14	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(66)m=	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	147.22	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	32.38	28.76	23.39	17.71	13.24	11.17	12.07	15.69	21.07	26.75	31.22	33.28	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	327.89	331.29	322.72	304.46	281.42	259.77	245.3	241.9	250.47	268.73	291.77	313.42	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	37.72	(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=	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	-117.78	(71)

Water heating gains (Table 5)

(72)m=	130.27	127.86	122.87	116.08	111.67	105.46	100.18	106.94	109.35	116.37	124.31	127.87	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	557.7	555.08	536.14	505.41	473.49	443.57	424.72	431.7	448.05	479.01	514.46	541.74	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	0.41	x	10.63	x	0.45	x	0.67	=	0.91	(74)
North	0.9x	0.77	x	1.84	x	10.63	x	0.45	x	0.67	=	4.09	(74)
North	0.9x	0.77	x	1.34	x	10.63	x	0.45	x	0.67	=	2.98	(74)
North	0.9x	0.77	x	2.72	x	10.63	x	0.45	x	0.67	=	6.04	(74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.45	x	0.67	=	3.22	(74)
North	0.9x	0.77	x	0.58	x	10.63	x	0.45	x	0.67	=	1.29	(74)
North	0.9x	0.77	x	0.41	x	20.32	x	0.45	x	0.67	=	1.73	(74)
North	0.9x	0.77	x	1.84	x	20.32	x	0.45	x	0.67	=	7.81	(74)
North	0.9x	0.77	x	1.34	x	20.32	x	0.45	x	0.67	=	5.69	(74)
North	0.9x	0.77	x	2.72	x	20.32	x	0.45	x	0.67	=	11.55	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.45	x	0.67	=	6.16	(74)
North	0.9x	0.77	x	0.58	x	20.32	x	0.45	x	0.67	=	2.46	(74)
North	0.9x	0.77	x	0.41	x	34.53	x	0.45	x	0.67	=	2.94	(74)
North	0.9x	0.77	x	1.84	x	34.53	x	0.45	x	0.67	=	13.28	(74)
North	0.9x	0.77	x	1.34	x	34.53	x	0.45	x	0.67	=	9.67	(74)
North	0.9x	0.77	x	2.72	x	34.53	x	0.45	x	0.67	=	19.62	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.45	x	0.67	=	10.46	(74)
North	0.9x	0.77	x	0.58	x	34.53	x	0.45	x	0.67	=	4.18	(74)
North	0.9x	0.77	x	0.41	x	55.46	x	0.45	x	0.67	=	4.73	(74)
North	0.9x	0.77	x	1.84	x	55.46	x	0.45	x	0.67	=	21.32	(74)
North	0.9x	0.77	x	1.34	x	55.46	x	0.45	x	0.67	=	15.53	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	2.72	x	55.46	x	0.45	x	0.67	=	31.52	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.45	x	0.67	=	16.8	(74)
North	0.9x	0.77	x	0.58	x	55.46	x	0.45	x	0.67	=	6.72	(74)
North	0.9x	0.77	x	0.41	x	74.72	x	0.45	x	0.67	=	6.37	(74)
North	0.9x	0.77	x	1.84	x	74.72	x	0.45	x	0.67	=	28.72	(74)
North	0.9x	0.77	x	1.34	x	74.72	x	0.45	x	0.67	=	20.92	(74)
North	0.9x	0.77	x	2.72	x	74.72	x	0.45	x	0.67	=	42.46	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.45	x	0.67	=	22.64	(74)
North	0.9x	0.77	x	0.58	x	74.72	x	0.45	x	0.67	=	9.05	(74)
North	0.9x	0.77	x	0.41	x	79.99	x	0.45	x	0.67	=	6.82	(74)
North	0.9x	0.77	x	1.84	x	79.99	x	0.45	x	0.67	=	30.75	(74)
North	0.9x	0.77	x	1.34	x	79.99	x	0.45	x	0.67	=	22.39	(74)
North	0.9x	0.77	x	2.72	x	79.99	x	0.45	x	0.67	=	45.46	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.45	x	0.67	=	24.23	(74)
North	0.9x	0.77	x	0.58	x	79.99	x	0.45	x	0.67	=	9.69	(74)
North	0.9x	0.77	x	0.41	x	74.68	x	0.45	x	0.67	=	6.37	(74)
North	0.9x	0.77	x	1.84	x	74.68	x	0.45	x	0.67	=	28.71	(74)
North	0.9x	0.77	x	1.34	x	74.68	x	0.45	x	0.67	=	20.91	(74)
North	0.9x	0.77	x	2.72	x	74.68	x	0.45	x	0.67	=	42.44	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.45	x	0.67	=	22.62	(74)
North	0.9x	0.77	x	0.58	x	74.68	x	0.45	x	0.67	=	9.05	(74)
North	0.9x	0.77	x	0.41	x	59.25	x	0.45	x	0.67	=	5.05	(74)
North	0.9x	0.77	x	1.84	x	59.25	x	0.45	x	0.67	=	22.78	(74)
North	0.9x	0.77	x	1.34	x	59.25	x	0.45	x	0.67	=	16.59	(74)
North	0.9x	0.77	x	2.72	x	59.25	x	0.45	x	0.67	=	33.67	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.45	x	0.67	=	17.95	(74)
North	0.9x	0.77	x	0.58	x	59.25	x	0.45	x	0.67	=	7.18	(74)
North	0.9x	0.77	x	0.41	x	41.52	x	0.45	x	0.67	=	3.54	(74)
North	0.9x	0.77	x	1.84	x	41.52	x	0.45	x	0.67	=	15.96	(74)
North	0.9x	0.77	x	1.34	x	41.52	x	0.45	x	0.67	=	11.62	(74)
North	0.9x	0.77	x	2.72	x	41.52	x	0.45	x	0.67	=	23.59	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.45	x	0.67	=	12.58	(74)
North	0.9x	0.77	x	0.58	x	41.52	x	0.45	x	0.67	=	5.03	(74)
North	0.9x	0.77	x	0.41	x	24.19	x	0.45	x	0.67	=	2.06	(74)
North	0.9x	0.77	x	1.84	x	24.19	x	0.45	x	0.67	=	9.3	(74)
North	0.9x	0.77	x	1.34	x	24.19	x	0.45	x	0.67	=	6.77	(74)
North	0.9x	0.77	x	2.72	x	24.19	x	0.45	x	0.67	=	13.75	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.45	x	0.67	=	7.33	(74)
North	0.9x	0.77	x	0.58	x	24.19	x	0.45	x	0.67	=	2.93	(74)
North	0.9x	0.77	x	0.41	x	13.12	x	0.45	x	0.67	=	1.12	(74)
North	0.9x	0.77	x	1.84	x	13.12	x	0.45	x	0.67	=	5.04	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.34	x	13.12	x	0.45	x	0.67	=	3.67	(74)
North	0.9x	0.77	x	2.72	x	13.12	x	0.45	x	0.67	=	7.45	(74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.45	x	0.67	=	3.97	(74)
North	0.9x	0.77	x	0.58	x	13.12	x	0.45	x	0.67	=	1.59	(74)
North	0.9x	0.77	x	0.41	x	8.86	x	0.45	x	0.67	=	0.76	(74)
North	0.9x	0.77	x	1.84	x	8.86	x	0.45	x	0.67	=	3.41	(74)
North	0.9x	0.77	x	1.34	x	8.86	x	0.45	x	0.67	=	2.48	(74)
North	0.9x	0.77	x	2.72	x	8.86	x	0.45	x	0.67	=	5.04	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.45	x	0.67	=	2.69	(74)
North	0.9x	0.77	x	0.58	x	8.86	x	0.45	x	0.67	=	1.07	(74)
Northeast	0.9x	0.77	x	0.91	x	11.28	x	0.45	x	0.67	=	2.14	(75)
Northeast	0.9x	0.77	x	0.91	x	22.97	x	0.45	x	0.67	=	4.35	(75)
Northeast	0.9x	0.77	x	0.91	x	41.38	x	0.45	x	0.67	=	7.84	(75)
Northeast	0.9x	0.77	x	0.91	x	67.96	x	0.45	x	0.67	=	12.88	(75)
Northeast	0.9x	0.77	x	0.91	x	91.35	x	0.45	x	0.67	=	17.31	(75)
Northeast	0.9x	0.77	x	0.91	x	97.38	x	0.45	x	0.67	=	18.46	(75)
Northeast	0.9x	0.77	x	0.91	x	91.1	x	0.45	x	0.67	=	17.26	(75)
Northeast	0.9x	0.77	x	0.91	x	72.63	x	0.45	x	0.67	=	13.76	(75)
Northeast	0.9x	0.77	x	0.91	x	50.42	x	0.45	x	0.67	=	9.56	(75)
Northeast	0.9x	0.77	x	0.91	x	28.07	x	0.45	x	0.67	=	5.32	(75)
Northeast	0.9x	0.77	x	0.91	x	14.2	x	0.45	x	0.67	=	2.69	(75)
Northeast	0.9x	0.77	x	0.91	x	9.21	x	0.45	x	0.67	=	1.75	(75)
South	0.9x	0.77	x	0.41	x	46.75	x	0.45	x	0.67	=	3.99	(78)
South	0.9x	0.77	x	1.84	x	46.75	x	0.45	x	0.67	=	17.97	(78)
South	0.9x	0.77	x	1.82	x	46.75	x	0.45	x	0.67	=	17.78	(78)
South	0.9x	0.77	x	2.72	x	46.75	x	0.45	x	0.67	=	26.57	(78)
South	0.9x	0.77	x	2.91	x	46.75	x	0.45	x	0.67	=	28.43	(78)
South	0.9x	0.77	x	0.41	x	76.57	x	0.45	x	0.67	=	6.53	(78)
South	0.9x	0.77	x	1.84	x	76.57	x	0.45	x	0.67	=	29.44	(78)
South	0.9x	0.77	x	1.82	x	76.57	x	0.45	x	0.67	=	29.12	(78)
South	0.9x	0.77	x	2.72	x	76.57	x	0.45	x	0.67	=	43.51	(78)
South	0.9x	0.77	x	2.91	x	76.57	x	0.45	x	0.67	=	46.55	(78)
South	0.9x	0.77	x	0.41	x	97.53	x	0.45	x	0.67	=	8.31	(78)
South	0.9x	0.77	x	1.84	x	97.53	x	0.45	x	0.67	=	37.5	(78)
South	0.9x	0.77	x	1.82	x	97.53	x	0.45	x	0.67	=	37.09	(78)
South	0.9x	0.77	x	2.72	x	97.53	x	0.45	x	0.67	=	55.43	(78)
South	0.9x	0.77	x	2.91	x	97.53	x	0.45	x	0.67	=	59.3	(78)
South	0.9x	0.77	x	0.41	x	110.23	x	0.45	x	0.67	=	9.4	(78)
South	0.9x	0.77	x	1.84	x	110.23	x	0.45	x	0.67	=	42.38	(78)
South	0.9x	0.77	x	1.82	x	110.23	x	0.45	x	0.67	=	41.92	(78)
South	0.9x	0.77	x	2.72	x	110.23	x	0.45	x	0.67	=	62.65	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	2.91	x	110.23	x	0.45	x	0.67	=	67.02	(78)
South	0.9x	0.77	x	0.41	x	114.87	x	0.45	x	0.67	=	9.79	(78)
South	0.9x	0.77	x	1.84	x	114.87	x	0.45	x	0.67	=	44.16	(78)
South	0.9x	0.77	x	1.82	x	114.87	x	0.45	x	0.67	=	43.68	(78)
South	0.9x	0.77	x	2.72	x	114.87	x	0.45	x	0.67	=	65.28	(78)
South	0.9x	0.77	x	2.91	x	114.87	x	0.45	x	0.67	=	69.84	(78)
South	0.9x	0.77	x	0.41	x	110.55	x	0.45	x	0.67	=	9.42	(78)
South	0.9x	0.77	x	1.84	x	110.55	x	0.45	x	0.67	=	42.5	(78)
South	0.9x	0.77	x	1.82	x	110.55	x	0.45	x	0.67	=	42.04	(78)
South	0.9x	0.77	x	2.72	x	110.55	x	0.45	x	0.67	=	62.83	(78)
South	0.9x	0.77	x	2.91	x	110.55	x	0.45	x	0.67	=	67.21	(78)
South	0.9x	0.77	x	0.41	x	108.01	x	0.45	x	0.67	=	9.21	(78)
South	0.9x	0.77	x	1.84	x	108.01	x	0.45	x	0.67	=	41.53	(78)
South	0.9x	0.77	x	1.82	x	108.01	x	0.45	x	0.67	=	41.07	(78)
South	0.9x	0.77	x	2.72	x	108.01	x	0.45	x	0.67	=	61.38	(78)
South	0.9x	0.77	x	2.91	x	108.01	x	0.45	x	0.67	=	65.67	(78)
South	0.9x	0.77	x	0.41	x	104.89	x	0.45	x	0.67	=	8.94	(78)
South	0.9x	0.77	x	1.84	x	104.89	x	0.45	x	0.67	=	40.33	(78)
South	0.9x	0.77	x	1.82	x	104.89	x	0.45	x	0.67	=	39.89	(78)
South	0.9x	0.77	x	2.72	x	104.89	x	0.45	x	0.67	=	59.61	(78)
South	0.9x	0.77	x	2.91	x	104.89	x	0.45	x	0.67	=	63.78	(78)
South	0.9x	0.77	x	0.41	x	101.89	x	0.45	x	0.67	=	8.69	(78)
South	0.9x	0.77	x	1.84	x	101.89	x	0.45	x	0.67	=	39.17	(78)
South	0.9x	0.77	x	1.82	x	101.89	x	0.45	x	0.67	=	38.74	(78)
South	0.9x	0.77	x	2.72	x	101.89	x	0.45	x	0.67	=	57.9	(78)
South	0.9x	0.77	x	2.91	x	101.89	x	0.45	x	0.67	=	61.95	(78)
South	0.9x	0.77	x	0.41	x	82.59	x	0.45	x	0.67	=	7.04	(78)
South	0.9x	0.77	x	1.84	x	82.59	x	0.45	x	0.67	=	31.75	(78)
South	0.9x	0.77	x	1.82	x	82.59	x	0.45	x	0.67	=	31.4	(78)
South	0.9x	0.77	x	2.72	x	82.59	x	0.45	x	0.67	=	46.93	(78)
South	0.9x	0.77	x	2.91	x	82.59	x	0.45	x	0.67	=	50.21	(78)
South	0.9x	0.77	x	0.41	x	55.42	x	0.45	x	0.67	=	4.72	(78)
South	0.9x	0.77	x	1.84	x	55.42	x	0.45	x	0.67	=	21.31	(78)
South	0.9x	0.77	x	1.82	x	55.42	x	0.45	x	0.67	=	21.07	(78)
South	0.9x	0.77	x	2.72	x	55.42	x	0.45	x	0.67	=	31.49	(78)
South	0.9x	0.77	x	2.91	x	55.42	x	0.45	x	0.67	=	33.69	(78)
South	0.9x	0.77	x	0.41	x	40.4	x	0.45	x	0.67	=	3.44	(78)
South	0.9x	0.77	x	1.84	x	40.4	x	0.45	x	0.67	=	15.53	(78)
South	0.9x	0.77	x	1.82	x	40.4	x	0.45	x	0.67	=	15.36	(78)
South	0.9x	0.77	x	2.72	x	40.4	x	0.45	x	0.67	=	22.96	(78)
South	0.9x	0.77	x	2.91	x	40.4	x	0.45	x	0.67	=	24.56	(78)

DER WorkSheet: New dwelling design stage

Northwest	0.9x	0.77	x	0.91	x	11.28	x	0.45	x	0.67	=	2.14	(81)
Northwest	0.9x	0.77	x	0.91	x	22.97	x	0.45	x	0.67	=	4.35	(81)
Northwest	0.9x	0.77	x	0.91	x	41.38	x	0.45	x	0.67	=	7.84	(81)
Northwest	0.9x	0.77	x	0.91	x	67.96	x	0.45	x	0.67	=	12.88	(81)
Northwest	0.9x	0.77	x	0.91	x	91.35	x	0.45	x	0.67	=	17.31	(81)
Northwest	0.9x	0.77	x	0.91	x	97.38	x	0.45	x	0.67	=	18.46	(81)
Northwest	0.9x	0.77	x	0.91	x	91.1	x	0.45	x	0.67	=	17.26	(81)
Northwest	0.9x	0.77	x	0.91	x	72.63	x	0.45	x	0.67	=	13.76	(81)
Northwest	0.9x	0.77	x	0.91	x	50.42	x	0.45	x	0.67	=	9.56	(81)
Northwest	0.9x	0.77	x	0.91	x	28.07	x	0.45	x	0.67	=	5.32	(81)
Northwest	0.9x	0.77	x	0.91	x	14.2	x	0.45	x	0.67	=	2.69	(81)
Northwest	0.9x	0.77	x	0.91	x	9.21	x	0.45	x	0.67	=	1.75	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	117.53	199.26	273.47	345.75	397.55	400.26	383.49	343.29	297.89	220.12	140.53	100.79	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	675.24	754.34	809.61	851.16	871.04	843.83	808.21	774.99	745.94	699.14	654.99	642.53	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.98	0.93	0.83	0.86	0.97	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.85	19.93	20.1	20.32	20.56	20.78	20.89	20.87	20.7	20.4	20.08	19.84	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.92	19.92	19.92	19.94	19.94	19.96	19.96	19.96	19.95	19.94	19.94	19.93	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.97	0.89	0.7	0.75	0.94	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.36	18.49	18.73	19.08	19.42	19.73	19.85	19.84	19.63	19.19	18.73	18.35	(90)

fLA = Living area ÷ (4) = | 0.22 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.69	18.81	19.03	19.35	19.68	19.96	20.08	20.07	19.87	19.46	19.03	18.68	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.69	18.81	19.03	19.35	19.68	19.96	20.08	20.07	19.87	19.46	19.03	18.68	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Utilisation factor for gains, hm:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	1	1	1	0.99	0.97	0.89	0.72	0.76	0.94	0.99	1	1	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	674.64	753.06	806.66	842.71	842.98	748.09	578.93	591.01	701.09	693.04	653.82	642.1	(95)

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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=	2712.09	2614.25	2348.22	1929.54	1467.8	972.15	630.54	662.77	1052.2	1630.41	2208.54	2697.8	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	1515.86	1250.71	1146.92	782.51	464.87	0	0	0	0	697.41	1119.4	1529.44	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 8507.12 (98)

Space heating requirement in kWh/m²/year 54.23 (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		383.71	(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)	1515.86	1250.71	1146.92	782.51	464.87	0	0	0	0	697.41	1119.4	1529.44		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	395.05	325.95	298.9	203.93	121.15	0	0	0	0	181.75	291.73	398.59		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2217.05	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	220.41	194.22	203.85	182.57	178.79	159.58	153.1	168.22	168	189.33	200.4	215.05		
Efficiency of water heater													300.39	(216)
(217)m=	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	73.38	64.66	67.86	60.78	59.52	53.13	50.97	56	55.93	63.03	66.71	71.59		
Total = Sum(219a)$_{1...12}$ =													743.55	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2217.05	
Water heating fuel used			743.55	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		555.48		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		555.48	(231)
Electricity for lighting			571.83	(232)

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12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	1150.65	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	385.9	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1536.55	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	288.29	(267)
Electricity for lighting	(232)	x	0.519	=	296.78	(268)
Total CO2, kg/year			sum of (265)…(271) =		2121.62	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		13.53	(273)
EI rating (section 14)					86	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Triplex (Be Green)

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	70.32	(1a)	x	3.2	(2a)	=	225.02	(3a)
Ground floor	82.3	(1b)	x	3.2	(2b)	=	263.36	(3b)
First floor	115	(1c)	x	2.7	(2c)	=	310.5	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	267.62	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	798.88	(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

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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	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) = 74.8 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors Type 1			3.36	x	1.2	=	4.032			(26)
Doors Type 2			2.8	x	1.2	=	3.36			(26)
Windows Type 1			2.72	x1/[1/(1.1)+ 0.04]		=	2.87			(27)
Windows Type 2			6.18	x1/[1/(1.1)+ 0.04]		=	6.51			(27)
Windows Type 3			5.44	x1/[1/(1.1)+ 0.04]		=	5.73			(27)
Windows Type 4			1.81	x1/[1/(1.1)+ 0.04]		=	1.91			(27)
Windows Type 5			4.55	x1/[1/(1.1)+ 0.04]		=	4.79			(27)
Windows Type 6			4.37	x1/[1/(1.1)+ 0.04]		=	4.6			(27)
Floor Type 1			70.32	x	0.12	=	8.438399			(28)
Floor Type 2			11.98	x	0.12	=	1.4376			(28)
Walls Type1	69.25	6.16	63.09	x	0.12	=	7.57			(29)
Walls Type2	38.21	0	38.21	x	0.14	=	5.41			(29)
Walls Type3	73.6	8.9	64.7	x	0.12	=	7.76			(29)
Walls Type4	28.32	0	28.32	x	0.15	=	4.25			(29)
Walls Type5	90.99	16.17	74.82	x	0.12	=	8.98			(29)
Walls Type6	28.89	0	28.89	x	0.15	=	4.33			(29)
Roof	9.61	0	9.61	x	0.12	=	1.15			(30)

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Total area of elements, m²	421.17						(31)
Party wall	25.35	x	0	=	0		(32)
Party floor	70.32						(32a)
Party floor	105.39						(32a)
Party ceiling	70.32						(32b)
Party ceiling	70.32						(32b)

** 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) =	83.14	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	51368.19	(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		63.17	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	146.31	(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=	76.07	75.23	74.39	70.19	69.35	65.15	65.15	64.31	66.83	69.35	71.03	72.71	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	222.39	221.55	220.71	216.5	215.66	211.46	211.46	210.62	213.14	215.66	217.34	219.03	

Average = Sum(39)$_{1…12}$ /12= 216.29 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.83	0.83	0.82	0.81	0.81	0.79	0.79	0.79	0.8	0.81	0.81	0.82	

Average = Sum(40)$_{1…12}$ /12= 0.81 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N	3.09	(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	107.58	(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=	118.34	114.04	109.74	105.43	101.13	96.83	96.83	101.13	105.43	109.74	114.04	118.34	

Total = Sum(44)$_{1…12}$ = 1291 (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=	175.5	153.49	158.39	138.09	132.5	114.34	105.95	121.58	123.03	143.38	156.51	169.96	

Total = Sum(45)$_{1…12}$ = 1692.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.32	23.02	23.76	20.71	19.87	17.15	15.89	18.24	18.45	21.51	23.48	25.49	(46)

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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		305	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)			
Water storage loss:			
a) If manufacturer’s declared loss factor is known (kWh/day):		1.63	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.88	(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)		0.88	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	226.05	199.15	208.94	187.01	183.05	163.25	156.5	172.13	171.95	193.93	205.43	220.51	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	226.05	199.15	208.94	187.01	183.05	163.25	156.5	172.13	171.95	193.93	205.43	220.51

Output from water heater (annual)$_{1...12}$ — 2287.88 (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=	98.79	87.56	93.1	85.05	84.49	77.15	75.67	80.86	80.04	88.11	91.17	96.95	(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=	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	154.49	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	44.81	39.8	32.37	24.5	18.32	15.46	16.71	21.72	29.15	37.02	43.2	46.06	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	431.48	435.96	424.68	400.66	370.34	341.84	322.8	318.32	329.61	353.63	383.95	412.44	(68)

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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45	(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=	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	-123.59	(71)

Water heating gains (Table 5)

(72)m=	132.78	130.3	125.14	118.12	113.57	107.15	101.7	108.69	111.17	118.43	126.63	130.31	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	678.43	675.41	651.53	612.63	571.57	533.8	510.56	518.08	539.28	578.42	623.13	658.16	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.54	x	6.18	x	10.63	x	0.45	x	0.67	=	9.63	(74)
North	0.9x	0.77	x	5.44	x	10.63	x	0.45	x	0.67	=	12.09	(74)
North	0.9x	0.54	x	6.18	x	20.32	x	0.45	x	0.67	=	18.4	(74)
North	0.9x	0.77	x	5.44	x	20.32	x	0.45	x	0.67	=	23.1	(74)
North	0.9x	0.54	x	6.18	x	34.53	x	0.45	x	0.67	=	31.27	(74)
North	0.9x	0.77	x	5.44	x	34.53	x	0.45	x	0.67	=	39.25	(74)
North	0.9x	0.54	x	6.18	x	55.46	x	0.45	x	0.67	=	50.23	(74)
North	0.9x	0.77	x	5.44	x	55.46	x	0.45	x	0.67	=	63.04	(74)
North	0.9x	0.54	x	6.18	x	74.72	x	0.45	x	0.67	=	67.66	(74)
North	0.9x	0.77	x	5.44	x	74.72	x	0.45	x	0.67	=	84.92	(74)
North	0.9x	0.54	x	6.18	x	79.99	x	0.45	x	0.67	=	72.43	(74)
North	0.9x	0.77	x	5.44	x	79.99	x	0.45	x	0.67	=	90.91	(74)
North	0.9x	0.54	x	6.18	x	74.68	x	0.45	x	0.67	=	67.62	(74)
North	0.9x	0.77	x	5.44	x	74.68	x	0.45	x	0.67	=	84.88	(74)
North	0.9x	0.54	x	6.18	x	59.25	x	0.45	x	0.67	=	53.65	(74)
North	0.9x	0.77	x	5.44	x	59.25	x	0.45	x	0.67	=	67.34	(74)
North	0.9x	0.54	x	6.18	x	41.52	x	0.45	x	0.67	=	37.6	(74)
North	0.9x	0.77	x	5.44	x	41.52	x	0.45	x	0.67	=	47.19	(74)
North	0.9x	0.54	x	6.18	x	24.19	x	0.45	x	0.67	=	21.9	(74)
North	0.9x	0.77	x	5.44	x	24.19	x	0.45	x	0.67	=	27.49	(74)
North	0.9x	0.54	x	6.18	x	13.12	x	0.45	x	0.67	=	11.88	(74)
North	0.9x	0.77	x	5.44	x	13.12	x	0.45	x	0.67	=	14.91	(74)
North	0.9x	0.54	x	6.18	x	8.86	x	0.45	x	0.67	=	8.03	(74)
North	0.9x	0.77	x	5.44	x	8.86	x	0.45	x	0.67	=	10.08	(74)
South	0.9x	0.77	x	2.72	x	46.75	x	0.45	x	0.67	=	26.57	(78)
South	0.9x	0.77	x	1.81	x	46.75	x	0.45	x	0.67	=	17.68	(78)

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South	0.9x	0.77	x	4.55	x	46.75	x	0.45	x	0.67	=	44.45	(78)
South	0.9x	0.77	x	4.37	x	46.75	x	0.45	x	0.67	=	42.69	(78)
South	0.9x	0.77	x	2.72	x	76.57	x	0.45	x	0.67	=	43.51	(78)
South	0.9x	0.77	x	1.81	x	76.57	x	0.45	x	0.67	=	28.96	(78)
South	0.9x	0.77	x	4.55	x	76.57	x	0.45	x	0.67	=	72.79	(78)
South	0.9x	0.77	x	4.37	x	76.57	x	0.45	x	0.67	=	69.91	(78)
South	0.9x	0.77	x	2.72	x	97.53	x	0.45	x	0.67	=	55.43	(78)
South	0.9x	0.77	x	1.81	x	97.53	x	0.45	x	0.67	=	36.89	(78)
South	0.9x	0.77	x	4.55	x	97.53	x	0.45	x	0.67	=	92.72	(78)
South	0.9x	0.77	x	4.37	x	97.53	x	0.45	x	0.67	=	89.05	(78)
South	0.9x	0.77	x	2.72	x	110.23	x	0.45	x	0.67	=	62.65	(78)
South	0.9x	0.77	x	1.81	x	110.23	x	0.45	x	0.67	=	41.69	(78)
South	0.9x	0.77	x	4.55	x	110.23	x	0.45	x	0.67	=	104.8	(78)
South	0.9x	0.77	x	4.37	x	110.23	x	0.45	x	0.67	=	100.65	(78)
South	0.9x	0.77	x	2.72	x	114.87	x	0.45	x	0.67	=	65.28	(78)
South	0.9x	0.77	x	1.81	x	114.87	x	0.45	x	0.67	=	43.44	(78)
South	0.9x	0.77	x	4.55	x	114.87	x	0.45	x	0.67	=	109.21	(78)
South	0.9x	0.77	x	4.37	x	114.87	x	0.45	x	0.67	=	104.88	(78)
South	0.9x	0.77	x	2.72	x	110.55	x	0.45	x	0.67	=	62.83	(78)
South	0.9x	0.77	x	1.81	x	110.55	x	0.45	x	0.67	=	41.81	(78)
South	0.9x	0.77	x	4.55	x	110.55	x	0.45	x	0.67	=	105.1	(78)
South	0.9x	0.77	x	4.37	x	110.55	x	0.45	x	0.67	=	100.94	(78)
South	0.9x	0.77	x	2.72	x	108.01	x	0.45	x	0.67	=	61.38	(78)
South	0.9x	0.77	x	1.81	x	108.01	x	0.45	x	0.67	=	40.85	(78)
South	0.9x	0.77	x	4.55	x	108.01	x	0.45	x	0.67	=	102.68	(78)
South	0.9x	0.77	x	4.37	x	108.01	x	0.45	x	0.67	=	98.62	(78)
South	0.9x	0.77	x	2.72	x	104.89	x	0.45	x	0.67	=	59.61	(78)
South	0.9x	0.77	x	1.81	x	104.89	x	0.45	x	0.67	=	39.67	(78)
South	0.9x	0.77	x	4.55	x	104.89	x	0.45	x	0.67	=	99.72	(78)
South	0.9x	0.77	x	4.37	x	104.89	x	0.45	x	0.67	=	95.78	(78)
South	0.9x	0.77	x	2.72	x	101.89	x	0.45	x	0.67	=	57.9	(78)
South	0.9x	0.77	x	1.81	x	101.89	x	0.45	x	0.67	=	38.53	(78)
South	0.9x	0.77	x	4.55	x	101.89	x	0.45	x	0.67	=	96.86	(78)
South	0.9x	0.77	x	4.37	x	101.89	x	0.45	x	0.67	=	93.03	(78)
South	0.9x	0.77	x	2.72	x	82.59	x	0.45	x	0.67	=	46.93	(78)
South	0.9x	0.77	x	1.81	x	82.59	x	0.45	x	0.67	=	31.23	(78)
South	0.9x	0.77	x	4.55	x	82.59	x	0.45	x	0.67	=	78.51	(78)
South	0.9x	0.77	x	4.37	x	82.59	x	0.45	x	0.67	=	75.41	(78)
South	0.9x	0.77	x	2.72	x	55.42	x	0.45	x	0.67	=	31.49	(78)
South	0.9x	0.77	x	1.81	x	55.42	x	0.45	x	0.67	=	20.96	(78)
South	0.9x	0.77	x	4.55	x	55.42	x	0.45	x	0.67	=	52.68	(78)

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South	0.9x	0.77	x	4.37	x	55.42	x	0.45	x	0.67	=	50.6	(78)
South	0.9x	0.77	x	2.72	x	40.4	x	0.45	x	0.67	=	22.96	(78)
South	0.9x	0.77	x	1.81	x	40.4	x	0.45	x	0.67	=	15.28	(78)
South	0.9x	0.77	x	4.55	x	40.4	x	0.45	x	0.67	=	38.41	(78)
South	0.9x	0.77	x	4.37	x	40.4	x	0.45	x	0.67	=	36.89	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	153.1	256.67	344.61	423.05	475.4	474.01	456.04	415.77	371.11	281.48	182.52	131.63	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	831.53	932.08	996.14	1035.69	1046.97	1007.81	966.6	933.85	910.38	859.9	805.65	789.79	(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	1	1	1	0.99	0.96	0.86	0.89	0.99	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.16	20.22	20.34	20.51	20.69	20.85	20.93	20.92	20.8	20.57	20.33	20.15	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.23	20.23	20.23	20.25	20.25	20.26	20.26	20.26	20.26	20.25	20.24	20.24	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	1	0.99	0.93	0.76	0.81	0.97	1	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.06	19.16	19.34	19.6	19.86	20.1	20.19	20.18	20.02	19.69	19.34	19.06	(90)

fLA = Living area ÷ (4) = 0.22 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.3	19.39	19.56	19.8	20.04	20.26	20.35	20.34	20.19	19.88	19.56	19.3	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.3	19.39	19.56	19.8	20.04	20.26	20.35	20.34	20.19	19.88	19.56	19.3	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	1	0.99	0.93	0.77	0.82	0.97	1	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	831.46	931.89	995.56	1033.39	1035.42	941.94	746.54	762.57	884.55	858.26	805.48	789.75	(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=	3335.16	3210.7	2881.98	2360	1798.54	1197.65	792.96	830.56	1298.42	2001.44	2707.63	3307.13	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1862.75	1531.36	1403.5	955.16	567.76	0	0	0	0	850.53	1369.55	1872.93	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 10413.54 (98)

Space heating requirement in kWh/m²/year 38.91 (99)

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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		299.66	(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)	1862.75	1531.36	1403.5	955.16	567.76	0	0	0	0	850.53	1369.55	1872.93		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	621.62	511.03	468.36	318.75	189.47	0	0	0	0	283.83	457.03	625.02		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3475.1	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	226.05	199.15	208.94	187.01	183.05	163.25	156.5	172.13	171.95	193.93	205.43	220.51		
Efficiency of water heater													291.08	(216)
(217)m=	291.08	291.08	291.08	291.08	291.08	291.08	291.08	291.08	291.08	291.08	291.08	291.08		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	77.66	68.42	71.78	64.25	62.89	56.09	53.76	59.13	59.07	66.62	70.57	75.76		
Total = Sum(219a)$_{1...12}$ =													786	(219)

Annual totals

		kWh/year	kWh/year	
Space heating fuel used, main system 1			3475.1	
Water heating fuel used			786	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		913.72		(230a)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		913.72	(231)
Electricity for lighting			791.38	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	1803.58	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	407.93	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2211.51	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	474.22	(267)

DER WorkSheet: New dwelling design stage

Electricity for lighting	(232) x	0.519	=	410.73	(268)
Total CO2, kg/year		sum of (265)…(271) =		3096.46	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		11.57	(273)
EI rating (section 14)				87	(274)

APPENDIX IX – TER WORKSHEETS (REFURB)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 1 - Existing - 3B6P - GF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	178	(1a) x	2.9	(2a) =	516.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	178	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	516.2	(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							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.06	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.81	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.75	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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 created by change of use

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.95	0.93	0.92	0.82	0.8	0.71	0.71	0.69	0.75	0.8	0.84	0.88

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.95	0.94	0.92	0.84	0.82	0.75	0.75	0.74	0.78	0.82	0.85	0.89	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.95	0.94	0.92	0.84	0.82	0.75	0.75	0.74	0.78	0.82	0.85	0.89	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.698	x1/[1/(3.1)+ 0.04]		=	29.51			(27)
Windows Type 2			3.14	x1/[1/(3.1)+ 0.04]		=	8.66			(27)
Windows Type 3			3.61	x1/[1/(3.1)+ 0.04]		=	9.96			(27)
Floor			178.51	x	0.25	=	44.6275			(28)
Walls	134.39	17.45	116.94	x	0.6	=	70.16			(29)
Roof	51.42	0	51.42	x	0.68	=	34.97			(30)
Total area of elements, m²			364.32							(31)
Party wall			54.81	x	0	=	0			(32)
Party ceiling			127.04							(32b)

** 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) = 197.88 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 34562.19 (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 54.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 252.53 (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=	162.54	159.54	156.59	142.76	140.17	128.12	128.12	125.89	132.76	140.17	145.41	150.88	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	415.06	412.06	409.12	395.28	392.7	380.65	380.65	378.42	385.29	392.7	397.93	403.4

Average = Sum(39)$_{1…12}$ /12= 395.27 (39)

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DER WorkSheet: New dwelling created by change of use

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

(40)m=	2.33	2.31	2.3	2.22	2.21	2.14	2.14	2.13	2.16	2.21	2.24	2.27

Average = Sum(40)$_{1\ldots12}$ /12= 2.22 (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 2.97 (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) + 36 104.81 (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=	115.29	111.1	106.91	102.72	98.52	94.33	94.33	98.52	102.72	106.91	111.1	115.29	
										Total = Sum(44)$_{1\ldots12}$ =		1257.76	(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=	170.98	149.54	154.31	134.53	129.09	111.39	103.22	118.45	119.86	139.69	152.48	165.58	
										Total = Sum(45)$_{1\ldots12}$ =		1649.12	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	25.65	22.43	23.15	20.18	19.36	16.71	15.48	17.77	17.98	20.95	22.87	24.84	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (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) = 210 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 0.83 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.59 (54)

Enter (50) or (54) in (55) 1.59 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	49.22	44.46	49.22	47.63	49.22	47.63	49.22	49.22	47.63	49.22	47.63	49.22	(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=	49.22	44.46	49.22	47.63	49.22	47.63	49.22	49.22	47.63	49.22	47.63	49.22	(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=	54.55	49.27	54.55	52.79	54.55	36.09	37.3	37.3	36.09	54.55	52.79	54.55	(59)

DER WorkSheet: New dwelling created by change of use

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=	274.75	243.27	258.08	234.96	232.86	195.12	189.74	204.97	203.59	243.46	252.91	269.36	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	274.75	243.27	258.08	234.96	232.86	195.12	189.74	204.97	203.59	243.46	252.91	269.36	

Output from water heater (annual)$_{1...12}$ 2803.06 (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=	139.87	124.71	134.33	125.07	125.94	104.02	103.54	108.6	106.84	129.46	131.04	138.08	(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=	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	62.89	55.86	45.43	34.39	25.71	21.7	23.45	30.48	40.91	51.95	60.63	64.64	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	349.62	353.25	344.11	324.65	300.08	276.99	261.56	257.93	267.07	286.54	311.11	334.2	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	(71)

Water heating gains (Table 5)

(72)m=	188	185.58	180.55	173.71	169.27	144.47	139.16	145.96	148.38	174.01	182	185.59	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	678.11	672.28	647.68	610.35	572.66	520.76	501.77	511.98	533.97	590.1	631.34	662.02	(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	3.14	x	11.28	x	0.76	x	0.65	=	12.13	(75)
Northeast 0.9x	0.54	x	3.61	x	11.28	x	0.76	x	0.65	=	9.78	(75)
Northeast 0.9x	0.77	x	3.14	x	22.97	x	0.76	x	0.65	=	24.69	(75)
Northeast 0.9x	0.54	x	3.61	x	22.97	x	0.76	x	0.65	=	19.91	(75)
Northeast 0.9x	0.77	x	3.14	x	41.38	x	0.76	x	0.65	=	44.48	(75)

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Northeast	0.9x	0.54	x	3.61	x	41.38	x	0.76	x	0.65	=	35.86	(75)
Northeast	0.9x	0.77	x	3.14	x	67.96	x	0.76	x	0.65	=	73.05	(75)
Northeast	0.9x	0.54	x	3.61	x	67.96	x	0.76	x	0.65	=	58.9	(75)
Northeast	0.9x	0.77	x	3.14	x	91.35	x	0.76	x	0.65	=	98.19	(75)
Northeast	0.9x	0.54	x	3.61	x	91.35	x	0.76	x	0.65	=	79.17	(75)
Northeast	0.9x	0.77	x	3.14	x	97.38	x	0.76	x	0.65	=	104.68	(75)
Northeast	0.9x	0.54	x	3.61	x	97.38	x	0.76	x	0.65	=	84.4	(75)
Northeast	0.9x	0.77	x	3.14	x	91.1	x	0.76	x	0.65	=	97.93	(75)
Northeast	0.9x	0.54	x	3.61	x	91.1	x	0.76	x	0.65	=	78.96	(75)
Northeast	0.9x	0.77	x	3.14	x	72.63	x	0.76	x	0.65	=	78.07	(75)
Northeast	0.9x	0.54	x	3.61	x	72.63	x	0.76	x	0.65	=	62.95	(75)
Northeast	0.9x	0.77	x	3.14	x	50.42	x	0.76	x	0.65	=	54.2	(75)
Northeast	0.9x	0.54	x	3.61	x	50.42	x	0.76	x	0.65	=	43.7	(75)
Northeast	0.9x	0.77	x	3.14	x	28.07	x	0.76	x	0.65	=	30.17	(75)
Northeast	0.9x	0.54	x	3.61	x	28.07	x	0.76	x	0.65	=	24.33	(75)
Northeast	0.9x	0.77	x	3.14	x	14.2	x	0.76	x	0.65	=	15.26	(75)
Northeast	0.9x	0.54	x	3.61	x	14.2	x	0.76	x	0.65	=	12.3	(75)
Northeast	0.9x	0.77	x	3.14	x	9.21	x	0.76	x	0.65	=	9.9	(75)
Northeast	0.9x	0.54	x	3.61	x	9.21	x	0.76	x	0.65	=	7.99	(75)
Southwest	0.9x	0.77	x	10.7	x	36.79		0.76	x	0.65	=	134.75	(79)
Southwest	0.9x	0.77	x	10.7	x	62.67		0.76	x	0.65	=	229.53	(79)
Southwest	0.9x	0.77	x	10.7	x	85.75		0.76	x	0.65	=	314.06	(79)
Southwest	0.9x	0.77	x	10.7	x	106.25		0.76	x	0.65	=	389.13	(79)
Southwest	0.9x	0.77	x	10.7	x	119.01		0.76	x	0.65	=	435.86	(79)
Southwest	0.9x	0.77	x	10.7	x	118.15		0.76	x	0.65	=	432.71	(79)
Southwest	0.9x	0.77	x	10.7	x	113.91		0.76	x	0.65	=	417.18	(79)
Southwest	0.9x	0.77	x	10.7	x	104.39		0.76	x	0.65	=	382.32	(79)
Southwest	0.9x	0.77	x	10.7	x	92.85		0.76	x	0.65	=	340.06	(79)
Southwest	0.9x	0.77	x	10.7	x	69.27		0.76	x	0.65	=	253.68	(79)
Southwest	0.9x	0.77	x	10.7	x	44.07		0.76	x	0.65	=	161.4	(79)
Southwest	0.9x	0.77	x	10.7	x	31.49		0.76	x	0.65	=	115.32	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	156.66	274.13	394.4	521.08	613.22	621.8	594.07	523.33	437.96	308.18	188.97	133.21	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	834.77	946.41	1042.08	1131.43	1185.88	1142.55	1095.83	1035.31	971.93	898.28	820.3	795.23	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.98	0.95	0.89	0.91	0.97	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.35	18.52	18.86	19.38	19.9	20.4	20.69	20.64	20.24	19.59	18.92	18.38	(87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.83	19.84	19.85	19.89	19.9	19.93	19.93	19.94	19.92	19.9	19.88	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.99	0.97	0.92	0.81	0.85	0.96	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.4	17.57	17.92	18.47	18.98	19.49	19.76	19.73	19.33	18.68	18	17.44	(90)

fLA = Living area ÷ (4) = 0.28 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.67	17.84	18.18	18.72	19.24	19.75	20.02	19.99	19.59	18.93	18.26	17.71	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.27	18.44	18.78	19.32	19.84	20.35	20.62	20.59	20.19	19.53	18.86	18.31	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.99	0.97	0.93	0.87	0.89	0.96	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	832.57	942.57	1034.87	1116.12	1150.73	1067.71	952.01	923.62	935.13	888.42	817.08	793.51	(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=	5796.38	5579.33	5025.99	4120.14	3196.26	2187.84	1530.93	1584.44	2345.51	3507.3	4680	5690.37	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3693.08	3115.9	2969.39	2162.9	1521.88	0	0	0	0	1948.44	2781.3	3643.26	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 21836.15 (98)

Space heating requirement in kWh/m²/year 122.67 (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		75	(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)													
	3693.08	3115.9	2969.39	2162.9	1521.88	0	0	0	0	1948.44	2781.3	3643.26	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	4924.1	4154.54	3959.19	2883.86	2029.17	0	0	0	0	2597.92	3708.4	4857.68	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 29114.86 (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)

274.75	243.27	258.08	234.96	232.86	195.12	189.74	204.97	203.59	243.46	252.91	269.36

Efficiency of water heater: 65 (216)

(217)m=	74.21	74.17	74.09	73.89	73.5	65	65	65	65	73.74	74.05	74.21	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	370.24	327.97	348.35	318	316.82	300.18	291.91	315.33	313.21	330.16	341.53	362.95

Total = $Sum(219a)_{1...12}$ = 3936.65 (219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			29114.86	
Water heating fuel used			3936.65	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		156		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		156	(231)
Electricity for lighting			1110.63	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	6288.81	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	850.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7139.13	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	80.96	(267)
Electricity for lighting	(232) x	0.519	=	576.42	(268)
Total CO2, kg/year		sum of (265)…(271) =		7796.51	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		43.8	(273)
EI rating (section 14)				53	(274)

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DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 2 - Existing - 4B8P - GF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	227.6	(1a) x	2.9	(2a) =	660.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	227.6	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	660.04	(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							5	x 10 =	50	(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) =	50	÷ (5) =	0.08	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.83	(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) =	0.7	(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

0.89	0.88	0.86	0.77	0.75	0.67	0.67	0.65	0.7	0.75	0.79	0.82

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=	0.9	0.88	0.87	0.8	0.78	0.72	0.72	0.71	0.75	0.78	0.81	0.84	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.9	0.88	0.87	0.8	0.78	0.72	0.72	0.71	0.75	0.78	0.81	0.84	(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	
Windows Type 1			3.77	x1/[1/(3.1)+ 0.04]		=	10.4			(27)
Windows Type 2			3.77	x1/[1/(3.1)+ 0.04]		=	10.4			(27)
Windows Type 3			3.77	x1/[1/(3.1)+ 0.04]		=	10.4			(27)
Windows Type 4			4.94	x1/[1/(3.1)+ 0.04]		=	13.62			(27)
Floor			227.5	x	0.25	=	56.875			(28)
Walls Type1	94.68	16.25	78.43	x	0.6	=	47.06			(29)
Walls Type2	53.48	0	53.48	x	0.48	=	25.88			(29)
Roof	104.54	0	104.54	x	0.68	=	71.09			(30)
Total area of elements, m²			480.2							(31)
Party wall			83.58	x	0	=	0			(32)
Party ceiling			122.96							(32b)

* *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) = 245.72 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 42649.44 (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 72.03 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 317.75 (37)

DER WorkSheet: New dwelling created by change of use

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=	196.13	192.74	189.42	173.83	170.91	157.33	157.33	154.81	162.56	170.91	176.81	182.98	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	513.87	510.49	507.17	491.57	488.66	475.07	475.07	472.56	480.31	488.66	494.56	500.73	

Average = Sum(39)$_{1...12}$ /12= 491.56 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	2.26	2.24	2.23	2.16	2.15	2.09	2.09	2.08	2.11	2.15	2.17	2.2	

Average = Sum(40)$_{1...12}$ /12= 2.16 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 106.35 (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=	116.98	112.73	108.47	104.22	99.97	95.71	95.71	99.97	104.22	108.47	112.73	116.98	

Total = Sum(44)$_{1...12}$ = 1276.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	173.48	151.73	156.57	136.5	130.98	113.02	104.73	120.18	121.62	141.73	154.71	168.01	

Total = Sum(45)$_{1...12}$ = 1673.27 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.02	22.76	23.49	20.48	19.65	16.95	15.71	18.03	18.24	21.26	23.21	25.2	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (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) = 210 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 0.83 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.59 (54)

Enter (50) or (54) in (55) 1.59 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	49.22	44.46	49.22	47.63	49.22	47.63	49.22	49.22	47.63	49.22	47.63	49.22	(56)

DER WorkSheet: New dwelling created by change of use

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=	49.22	44.46	49.22	47.63	49.22	47.63	49.22	49.22	47.63	49.22	47.63	49.22	(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=	54.55	49.27	54.55	52.79	54.55	36.09	37.3	37.3	36.09	54.55	52.79	54.55	(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=	277.26	245.46	260.34	236.93	234.75	196.75	191.25	206.7	205.34	245.51	255.14	271.78	(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=	277.26	245.46	260.34	236.93	234.75	196.75	191.25	206.7	205.34	245.51	255.14	271.78

Output from water heater (annual)$_{1...12}$ | 2827.21 | (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=	140.7	125.43	135.08	125.73	126.57	104.56	104.04	109.17	107.42	130.15	131.78	138.88	(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=	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	77.42	68.77	55.92	42.34	31.65	26.72	28.87	37.53	50.37	63.96	74.65	79.57	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	396.58	400.69	390.32	368.24	340.38	314.18	296.69	292.57	302.94	325.02	352.89	379.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	(71)

Water heating gains (Table 5)

(72)m=	189.12	186.66	181.56	174.62	170.12	145.22	139.84	146.74	149.19	174.93	183.03	186.67	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	741.68	734.68	706.37	663.77	620.71	564.69	543.96	555.4	581.07	642.47	689.13	723.89	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

DER WorkSheet: New dwelling created by change of use

Northeast	0.9x	0.54	x	4.94	x	11.28	x	0.76	x	0.65	=	13.38	(75)
Northeast	0.9x	0.54	x	4.94	x	22.97	x	0.76	x	0.65	=	27.24	(75)
Northeast	0.9x	0.54	x	4.94	x	41.38	x	0.76	x	0.65	=	49.08	(75)
Northeast	0.9x	0.54	x	4.94	x	67.96	x	0.76	x	0.65	=	80.6	(75)
Northeast	0.9x	0.54	x	4.94	x	91.35	x	0.76	x	0.65	=	108.34	(75)
Northeast	0.9x	0.54	x	4.94	x	97.38	x	0.76	x	0.65	=	115.5	(75)
Northeast	0.9x	0.54	x	4.94	x	91.1	x	0.76	x	0.65	=	108.05	(75)
Northeast	0.9x	0.54	x	4.94	x	72.63	x	0.76	x	0.65	=	86.14	(75)
Northeast	0.9x	0.54	x	4.94	x	50.42	x	0.76	x	0.65	=	59.8	(75)
Northeast	0.9x	0.54	x	4.94	x	28.07	x	0.76	x	0.65	=	33.29	(75)
Northeast	0.9x	0.54	x	4.94	x	14.2	x	0.76	x	0.65	=	16.84	(75)
Northeast	0.9x	0.54	x	4.94	x	9.21	x	0.76	x	0.65	=	10.93	(75)
South	0.9x	0.54	x	3.77	x	46.75	x	0.76	x	0.65	=	42.32	(78)
South	0.9x	0.54	x	3.77	x	76.57	x	0.76	x	0.65	=	69.3	(78)
South	0.9x	0.54	x	3.77	x	97.53	x	0.76	x	0.65	=	88.28	(78)
South	0.9x	0.54	x	3.77	x	110.23	x	0.76	x	0.65	=	99.78	(78)
South	0.9x	0.54	x	3.77	x	114.87	x	0.76	x	0.65	=	103.97	(78)
South	0.9x	0.54	x	3.77	x	110.55	x	0.76	x	0.65	=	100.06	(78)
South	0.9x	0.54	x	3.77	x	108.01	x	0.76	x	0.65	=	97.76	(78)
South	0.9x	0.54	x	3.77	x	104.89	x	0.76	x	0.65	=	94.94	(78)
South	0.9x	0.54	x	3.77	x	101.89	x	0.76	x	0.65	=	92.22	(78)
South	0.9x	0.54	x	3.77	x	82.59	x	0.76	x	0.65	=	74.75	(78)
South	0.9x	0.54	x	3.77	x	55.42	x	0.76	x	0.65	=	50.16	(78)
South	0.9x	0.54	x	3.77	x	40.4	x	0.76	x	0.65	=	36.56	(78)
Southwest	0.9x	0.54	x	3.77	x	36.79		0.76	x	0.65	=	33.3	(79)
Southwest	0.9x	0.54	x	3.77	x	62.67		0.76	x	0.65	=	56.73	(79)
Southwest	0.9x	0.54	x	3.77	x	85.75		0.76	x	0.65	=	77.62	(79)
Southwest	0.9x	0.54	x	3.77	x	106.25		0.76	x	0.65	=	96.17	(79)
Southwest	0.9x	0.54	x	3.77	x	119.01		0.76	x	0.65	=	107.72	(79)
Southwest	0.9x	0.54	x	3.77	x	118.15		0.76	x	0.65	=	106.94	(79)
Southwest	0.9x	0.54	x	3.77	x	113.91		0.76	x	0.65	=	103.1	(79)
Southwest	0.9x	0.54	x	3.77	x	104.39		0.76	x	0.65	=	94.49	(79)
Southwest	0.9x	0.54	x	3.77	x	92.85		0.76	x	0.65	=	84.04	(79)
Southwest	0.9x	0.54	x	3.77	x	69.27		0.76	x	0.65	=	62.7	(79)
Southwest	0.9x	0.54	x	3.77	x	44.07		0.76	x	0.65	=	39.89	(79)
Southwest	0.9x	0.54	x	3.77	x	31.49		0.76	x	0.65	=	28.5	(79)
West	0.9x	0.54	x	3.77	x	19.64	x	0.76	x	0.65	=	17.78	(80)
West	0.9x	0.54	x	3.77	x	38.42	x	0.76	x	0.65	=	34.78	(80)
West	0.9x	0.54	x	3.77	x	63.27	x	0.76	x	0.65	=	57.27	(80)
West	0.9x	0.54	x	3.77	x	92.28	x	0.76	x	0.65	=	83.52	(80)
West	0.9x	0.54	x	3.77	x	113.09	x	0.76	x	0.65	=	102.36	(80)

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West	0.9x	0.54	x	3.77	x	115.77	x	0.76	x	0.65	=	104.79	(80)
West	0.9x	0.54	x	3.77	x	110.22	x	0.76	x	0.65	=	99.76	(80)
West	0.9x	0.54	x	3.77	x	94.68	x	0.76	x	0.65	=	85.69	(80)
West	0.9x	0.54	x	3.77	x	73.59	x	0.76	x	0.65	=	66.61	(80)
West	0.9x	0.54	x	3.77	x	45.59	x	0.76	x	0.65	=	41.26	(80)
West	0.9x	0.54	x	3.77	x	24.49	x	0.76	x	0.65	=	22.17	(80)
West	0.9x	0.54	x	3.77	x	16.15	x	0.76	x	0.65	=	14.62	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	106.78	188.04	272.24	360.07	422.39	427.28	408.67	361.26	302.67	212	129.05	90.61	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	848.46	922.73	978.61	1023.84	1043.1	991.98	952.63	916.66	883.74	854.46	818.18	814.5	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	1	0.99	0.98	0.95	0.96	0.99	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.34	18.49	18.8	19.28	19.77	20.27	20.58	20.54	20.14	19.52	18.89	18.37	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.87	19.88	19.89	19.92	19.93	19.96	19.96	19.96	19.94	19.93	19.91	19.9	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	1	0.99	0.97	0.91	0.93	0.98	1	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.41	17.56	17.88	18.39	18.88	19.4	19.7	19.67	19.26	18.63	17.99	17.46	(90)

fLA = Living area ÷ (4) = 0.22 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.62	17.77	18.09	18.59	19.08	19.59	19.9	19.86	19.46	18.83	18.19	17.66	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.62	17.77	18.09	18.59	19.08	19.59	19.9	19.86	19.46	18.83	18.19	17.66	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.99	0.96	0.91	0.93	0.98	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	847.18	920.79	975.33	1017.42	1028.25	956.18	866.83	848.86	864.44	849.39	816.38	813.49	(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=	6846.17	6570.49	5876.42	4762.14	3607.48	2372.43	1567.02	1637.23	2574.7	4022.27	5486.97	6740.86	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	4463.24	3796.6	3646.41	2696.2	1918.95	0	0	0	0	2360.62	3362.82	4409.97	(98)

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 26654.81 | (98)

Space heating requirement in kWh/m²/year | 117.11 | (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		75	(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)	4463.24	3796.6	3646.41	2696.2	1918.95	0	0	0	0	2360.62	3362.82	4409.97		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	5950.99	5062.14	4861.88	3594.93	2558.6	0	0	0	0	3147.5	4483.77	5879.96		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													35539.75	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	277.26	245.46	260.34	236.93	234.75	196.75	191.25	206.7	205.34	245.51	255.14	271.78		
Efficiency of water heater													65	(216)
(217)m=	74.33	74.31	74.24	74.08	73.76	65	65	65	65	73.93	74.2	74.34		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	373	330.34	350.68	319.83	318.25	302.69	294.23	318	315.91	332.09	343.88	365.61		
Total = Sum(219a)$_{1...12}$ =													3964.51	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			35539.75	
Water heating fuel used			3964.51	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		120		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		120	(231)
Electricity for lighting			1367.31	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	7676.59	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)

DER WorkSheet: New dwelling created by change of use

Water heating	(219) x	0.216	=	856.33	(264)
Space and water heating	(261) + (262) + (263) + (264) =			8532.92	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	62.28	(267)
Electricity for lighting	(232) x	0.519	=	709.63	(268)
Total CO2, kg/year	sum of (265)…(271) =			9304.83	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			40.88	(273)
EI rating (section 14)				54	(274)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 7 - Existing - 3B6P - MF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	250.9	(1a) x	4.4	(2a) =	1103.96	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	250.9	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	1103.96	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.04	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.79	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.73	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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 created by change of use

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.93	0.91	0.89	0.8	0.78	0.69	0.69	0.67	0.73	0.78	0.82	0.85

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=	0.93	0.91	0.9	0.82	0.81	0.74	0.74	0.73	0.76	0.81	0.83	0.87	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.93	0.91	0.9	0.82	0.81	0.74	0.74	0.73	0.76	0.81	0.83	0.87	(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	
Windows Type 1			14.91	x1/[1/(3.1)+ 0.04]		=	41.12			(27)
Windows Type 2			29.57	x1/[1/(3.1)+ 0.04]		=	81.55			(27)
Windows Type 3			10.836	x1/[1/(3.1)+ 0.04]		=	29.89			(27)
Windows Type 4			4.81	x1/[1/(3.1)+ 0.04]		=	13.27			(27)
Windows Type 5			7.72	x1/[1/(3.1)+ 0.04]		=	21.29			(27)
Windows Type 6			7.32	x1/[1/(3.1)+ 0.04]		=	20.19			(27)
Walls Type1	337.79	75.17	262.62	x	0.6	=	157.57			(29)
Walls Type2	58.52	0	58.52	x	0.48	=	28.32			(29)
Total area of elements, m²			396.31							(31)
Party wall			11.35	x	0	=	0			(32)
Party floor			251.47							(32a)
Party ceiling			251.47							(32b)

** 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) = 393.2 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 40593.68 (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 59.45 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

DER WorkSheet: New dwelling created by change of use

Total fabric heat loss (33) + (36) = **452.64** (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	338.77	332.69	326.73	298.73	293.49	269.1	269.1	264.59	278.5	293.49	304.09	315.17	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	791.42	785.33	779.37	751.37	746.13	721.75	721.75	717.23	731.14	746.13	756.73	767.81	

Average = Sum(39)$_{1…12}$ /12= **751.35** (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	3.15	3.13	3.11	2.99	2.97	2.88	2.88	2.86	2.91	2.97	3.02	3.06	

Average = Sum(40)$_{1…12}$ /12= **2.99** (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N **3.07** (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 **107.07** (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=	117.77	113.49	109.21	104.93	100.64	96.36	96.36	100.64	104.93	109.21	113.49	117.77	

Total = Sum(44)$_{1…12}$ = **1284.81** (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=	174.66	152.75	157.63	137.43	131.86	113.79	105.44	120.99	122.44	142.69	155.76	169.14	

Total = Sum(45)$_{1…12}$ = **1684.59** (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.2	22.91	23.64	20.61	19.78	17.07	15.82	18.15	18.37	21.4	23.36	25.37	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel **210** (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) = **210** (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) **0.02** (51)

If community heating see section 4.3

Volume factor from Table 2a **0.83** (52)

Temperature factor from Table 2b **0.6** (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = **1.59** (54)

Enter (50) or (54) in (55) **1.59** (55)

DER WorkSheet: New dwelling created by change of use

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	49.22	44.46	49.22	47.63	49.22	47.63	49.22	49.22	47.63	49.22	47.63	49.22	(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=	49.22	44.46	49.22	47.63	49.22	47.63	49.22	49.22	47.63	49.22	47.63	49.22	(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=	54.55	49.27	54.55	52.79	54.55	36.09	37.3	37.3	36.09	54.55	52.79	54.55	(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=	278.43	246.49	261.4	237.85	235.64	197.51	191.96	207.51	206.17	246.47	256.19	272.92	(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=	278.43	246.49	261.4	237.85	235.64	197.51	191.96	207.51	206.17	246.47	256.19	272.92	

Output from water heater (annual)$_{1...12}$ — 2838.53 (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=	141.09	125.78	135.43	126.03	126.86	104.82	104.27	109.44	107.69	130.46	132.13	139.26	(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=	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	63.22	56.16	45.67	34.57	25.84	21.82	23.58	30.65	41.13	52.23	60.96	64.98	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	417.17	421.5	410.59	387.36	358.05	330.5	312.09	307.76	318.67	341.89	371.21	398.76	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	(71)

Water heating gains (Table 5)

(72)m=	189.64	187.17	182.03	175.05	170.52	145.58	140.15	147.1	149.57	175.35	183.52	187.18	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	749.05	743.84	717.31	676.01	633.43	576.92	554.84	564.53	588.4	648.5	694.7	729.94	(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 created by change of use

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	10.84	x	11.28	x	0.76	x	0.65	=	29.35	(75)
Northeast 0.9x	0.77	x	4.81	x	11.28	x	0.76	x	0.65	=	18.58	(75)
Northeast 0.9x	0.77	x	7.72	x	11.28	x	0.76	x	0.65	=	29.82	(75)
Northeast 0.9x	0.77	x	7.32	x	11.28	x	0.76	x	0.65	=	28.27	(75)
Northeast 0.9x	0.54	x	10.84	x	22.97	x	0.76	x	0.65	=	59.75	(75)
Northeast 0.9x	0.77	x	4.81	x	22.97	x	0.76	x	0.65	=	37.82	(75)
Northeast 0.9x	0.77	x	7.72	x	22.97	x	0.76	x	0.65	=	60.7	(75)
Northeast 0.9x	0.77	x	7.32	x	22.97	x	0.76	x	0.65	=	57.55	(75)
Northeast 0.9x	0.54	x	10.84	x	41.38	x	0.76	x	0.65	=	107.65	(75)
Northeast 0.9x	0.77	x	4.81	x	41.38	x	0.76	x	0.65	=	68.14	(75)
Northeast 0.9x	0.77	x	7.72	x	41.38	x	0.76	x	0.65	=	109.36	(75)
Northeast 0.9x	0.77	x	7.32	x	41.38	x	0.76	x	0.65	=	103.69	(75)
Northeast 0.9x	0.54	x	10.84	x	67.96	x	0.76	x	0.65	=	176.79	(75)
Northeast 0.9x	0.77	x	4.81	x	67.96	x	0.76	x	0.65	=	111.9	(75)
Northeast 0.9x	0.77	x	7.72	x	67.96	x	0.76	x	0.65	=	179.6	(75)
Northeast 0.9x	0.77	x	7.32	x	67.96	x	0.76	x	0.65	=	170.29	(75)
Northeast 0.9x	0.54	x	10.84	x	91.35	x	0.76	x	0.65	=	237.64	(75)
Northeast 0.9x	0.77	x	4.81	x	91.35	x	0.76	x	0.65	=	150.42	(75)
Northeast 0.9x	0.77	x	7.72	x	91.35	x	0.76	x	0.65	=	241.42	(75)
Northeast 0.9x	0.77	x	7.32	x	91.35	x	0.76	x	0.65	=	228.91	(75)
Northeast 0.9x	0.54	x	10.84	x	97.38	x	0.76	x	0.65	=	253.35	(75)
Northeast 0.9x	0.77	x	4.81	x	97.38	x	0.76	x	0.65	=	160.36	(75)
Northeast 0.9x	0.77	x	7.72	x	97.38	x	0.76	x	0.65	=	257.38	(75)
Northeast 0.9x	0.77	x	7.32	x	97.38	x	0.76	x	0.65	=	244.04	(75)
Northeast 0.9x	0.54	x	10.84	x	91.1	x	0.76	x	0.65	=	237	(75)
Northeast 0.9x	0.77	x	4.81	x	91.1	x	0.76	x	0.65	=	150.01	(75)
Northeast 0.9x	0.77	x	7.72	x	91.1	x	0.76	x	0.65	=	240.77	(75)
Northeast 0.9x	0.77	x	7.32	x	91.1	x	0.76	x	0.65	=	228.29	(75)
Northeast 0.9x	0.54	x	10.84	x	72.63	x	0.76	x	0.65	=	188.94	(75)
Northeast 0.9x	0.77	x	4.81	x	72.63	x	0.76	x	0.65	=	119.59	(75)
Northeast 0.9x	0.77	x	7.72	x	72.63	x	0.76	x	0.65	=	191.94	(75)
Northeast 0.9x	0.77	x	7.32	x	72.63	x	0.76	x	0.65	=	182	(75)
Northeast 0.9x	0.54	x	10.84	x	50.42	x	0.76	x	0.65	=	131.17	(75)
Northeast 0.9x	0.77	x	4.81	x	50.42	x	0.76	x	0.65	=	83.03	(75)
Northeast 0.9x	0.77	x	7.72	x	50.42	x	0.76	x	0.65	=	133.26	(75)
Northeast 0.9x	0.77	x	7.32	x	50.42	x	0.76	x	0.65	=	126.35	(75)
Northeast 0.9x	0.54	x	10.84	x	28.07	x	0.76	x	0.65	=	73.02	(75)
Northeast 0.9x	0.77	x	4.81	x	28.07	x	0.76	x	0.65	=	46.22	(75)
Northeast 0.9x	0.77	x	7.72	x	28.07	x	0.76	x	0.65	=	74.18	(75)

DER WorkSheet: New dwelling created by change of use

Northeast 0.9x	0.77	x	7.32	x	28.07	x	0.76	x	0.65	=	70.33	(75)
Northeast 0.9x	0.54	x	10.84	x	14.2	x	0.76	x	0.65	=	36.93	(75)
Northeast 0.9x	0.77	x	4.81	x	14.2	x	0.76	x	0.65	=	23.38	(75)
Northeast 0.9x	0.77	x	7.72	x	14.2	x	0.76	x	0.65	=	37.52	(75)
Northeast 0.9x	0.77	x	7.32	x	14.2	x	0.76	x	0.65	=	35.58	(75)
Northeast 0.9x	0.54	x	10.84	x	9.21	x	0.76	x	0.65	=	23.97	(75)
Northeast 0.9x	0.77	x	4.81	x	9.21	x	0.76	x	0.65	=	15.17	(75)
Northeast 0.9x	0.77	x	7.72	x	9.21	x	0.76	x	0.65	=	24.35	(75)
Northeast 0.9x	0.77	x	7.32	x	9.21	x	0.76	x	0.65	=	23.09	(75)
Southwest 0.9x	0.77	x	14.91	x	36.79		0.76	x	0.65	=	187.81	(79)
Southwest 0.9x	0.77	x	29.57	x	36.79		0.76	x	0.65	=	372.47	(79)
Southwest 0.9x	0.77	x	14.91	x	62.67		0.76	x	0.65	=	319.91	(79)
Southwest 0.9x	0.77	x	29.57	x	62.67		0.76	x	0.65	=	634.45	(79)
Southwest 0.9x	0.77	x	14.91	x	85.75		0.76	x	0.65	=	437.71	(79)
Southwest 0.9x	0.77	x	29.57	x	85.75		0.76	x	0.65	=	868.08	(79)
Southwest 0.9x	0.77	x	14.91	x	106.25		0.76	x	0.65	=	542.34	(79)
Southwest 0.9x	0.77	x	29.57	x	106.25		0.76	x	0.65	=	1075.59	(79)
Southwest 0.9x	0.77	x	14.91	x	119.01		0.76	x	0.65	=	607.47	(79)
Southwest 0.9x	0.77	x	29.57	x	119.01		0.76	x	0.65	=	1204.75	(79)
Southwest 0.9x	0.77	x	14.91	x	118.15		0.76	x	0.65	=	603.08	(79)
Southwest 0.9x	0.77	x	29.57	x	118.15		0.76	x	0.65	=	1196.04	(79)
Southwest 0.9x	0.77	x	14.91	x	113.91		0.76	x	0.65	=	581.43	(79)
Southwest 0.9x	0.77	x	29.57	x	113.91		0.76	x	0.65	=	1153.11	(79)
Southwest 0.9x	0.77	x	14.91	x	104.39		0.76	x	0.65	=	532.84	(79)
Southwest 0.9x	0.77	x	29.57	x	104.39		0.76	x	0.65	=	1056.75	(79)
Southwest 0.9x	0.77	x	14.91	x	92.85		0.76	x	0.65	=	473.95	(79)
Southwest 0.9x	0.77	x	29.57	x	92.85		0.76	x	0.65	=	939.94	(79)
Southwest 0.9x	0.77	x	14.91	x	69.27		0.76	x	0.65	=	353.56	(79)
Southwest 0.9x	0.77	x	29.57	x	69.27		0.76	x	0.65	=	701.2	(79)
Southwest 0.9x	0.77	x	14.91	x	44.07		0.76	x	0.65	=	224.95	(79)
Southwest 0.9x	0.77	x	29.57	x	44.07		0.76	x	0.65	=	446.13	(79)
Southwest 0.9x	0.77	x	14.91	x	31.49		0.76	x	0.65	=	160.72	(79)
Southwest 0.9x	0.77	x	29.57	x	31.49		0.76	x	0.65	=	318.75	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	666.3	1170.17	1694.62	2256.52	2670.6	2714.24	2590.62	2272.07	1887.7	1318.51	804.49	566.06	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	1415.35	1914.01	2411.93	2932.52	3304.03	3291.15	3145.46	2836.6	2476.09	1967.01	1499.19	1296	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	0.99	0.98	0.96	0.92	0.83	0.73	0.78	0.91	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	17.76	18.04	18.54	19.24	19.9	20.46	20.75	20.69	20.21	19.36	18.48	17.78	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.42	19.43	19.45	19.5	19.51	19.56	19.56	19.57	19.54	19.51	19.49	19.47	(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	0.75	0.57	0.64	0.86	0.97	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.53	16.82	17.31	18.05	18.69	19.25	19.47	19.44	19.02	18.18	17.29	16.57	(90)

fLA = Living area ÷ (4) = 0.17 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	16.74	17.02	17.52	18.25	18.9	19.45	19.68	19.65	19.22	18.38	17.49	16.78	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	16.74	17.02	17.52	18.25	18.9	19.45	19.68	19.65	19.22	18.38	17.49	16.78	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.93	0.86	0.75	0.59	0.65	0.85	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1405.22	1885.25	2337.68	2739.14	2857.73	2452.35	1855.75	1843	2104.65	1883.49	1480.96	1288.78	(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=	9842.87	9521.82	8589.34	7027.36	5371.79	3503.35	2226.04	2331.97	3746.37	5804.96	7862.26	9656.87	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	6277.6	5131.77	4651.24	3087.51	1870.46	0	0	0	0	2917.58	4594.54	6225.86	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 34756.56 (98)

Space heating requirement in kWh/m²/year 138.53 (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		75	(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)													
	6277.6	5131.77	4651.24	3087.51	1870.46	0	0	0	0	2917.58	4594.54	6225.86	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	8370.14	6842.36	6201.65	4116.69	2493.95	0	0	0	0	3890.1	6126.05	8301.14	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 46342.08 (211)

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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)

278.43	246.49	261.4	237.85	235.64	197.51	191.96	207.51	206.17	246.47	256.19	272.92

Efficiency of water heater 65 (216)

(217)m=	74.51	74.47	74.39	74.18	73.73	65	65	65	65	74.11	74.4	74.52

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	373.66	330.97	351.39	320.62	319.59	303.87	295.32	319.25	317.18	332.56	344.36	366.24

Total = Sum(219a)$_{1...12}$ = 3975.01 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		46342.08	
Water heating fuel used		3975.01	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	120		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	120	(231)
Electricity for lighting		1116.56	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	10009.89	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	858.6	(264)
Space and water heating	(261) + (262) + (263) + (264) =			10868.49	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	62.28	(267)
Electricity for lighting	(232) x	0.519	=	579.5	(268)
Total CO2, kg/year		sum of (265)…(271) =		11510.27	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		45.88	(273)
EI rating (section 14)				49	(274)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 16 - Existing - 3B4P - MF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	270	(1a)	x	3.28	(2a)	=	885.6	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	270	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			885.6	(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							3	x 10 =	30	(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) =	30	÷ (5) =	0.03	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.78	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.73	(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

0.92	0.91	0.89	0.8	0.78	0.69	0.69	0.67	0.73	0.78	0.82	0.85

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=	0.93	0.91	0.89	0.82	0.8	0.74	0.74	0.72	0.76	0.8	0.83	0.86	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.93	0.91	0.89	0.82	0.8	0.74	0.74	0.72	0.76	0.8	0.83	0.86	(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	
Windows Type 1			22.26		x1/[1/(3.1)+ 0.04]	=	61.39			(27)
Windows Type 2			2.47		x1/[1/(3.1)+ 0.04]	=	6.81			(27)
Windows Type 3			2.47		x1/[1/(3.1)+ 0.04]	=	6.81			(27)
Windows Type 4			3.861		x1/[1/(3.1)+ 0.04]	=	10.65			(27)
Windows Type 5			7.356		x1/[1/(3.1)+ 0.04]	=	20.29			(27)
Windows Type 6			10.782		x1/[1/(3.1)+ 0.04]	=	29.74			(27)
Windows Type 7			4.904		x1/[1/(3.1)+ 0.04]	=	13.53			(27)
Walls Type1	258.53	54.1	204.43	x	0.6	=	122.66			(29)
Walls Type2	40.28	0	40.28	x	0.48	=	19.49			(29)
Total area of elements, m²			298.81							(31)
Party wall			17.06	x	0	=	0			(32)
Party floor			271.8							(32a)
Party ceiling			271.8							(32b)

** 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) = 291.36 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 36922.87 (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 44.82 (36)

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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 336.18 (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=	271.01	266.16	261.41	239.08	234.9	215.46	215.46	211.86	222.95	234.9	243.35	252.19	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	607.19	602.35	597.59	575.26	571.09	551.64	551.64	548.04	559.13	571.09	579.54	588.37	

Average = $Sum(39)_{1...12}$ /12= 575.24 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	2.25	2.23	2.21	2.13	2.12	2.04	2.04	2.03	2.07	2.12	2.15	2.18	

Average = $Sum(40)_{1...12}$ /12= 2.13 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.09 (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) + 36 107.66 (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=	118.42	114.12	109.81	105.5	101.2	96.89	96.89	101.2	105.5	109.81	114.12	118.42

Total = $Sum(44)_{1...12}$ = 1291.89 (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=	175.62	153.6	158.5	138.18	132.59	114.41	106.02	121.66	123.11	143.48	156.62	170.08

Total = $Sum(45)_{1...12}$ = 1693.87 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.34	23.04	23.77	20.73	19.89	17.16	15.9	18.25	18.47	21.52	23.49	25.51	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (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) = 210 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 0.83 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.59 (54)

Enter (50) or (54) in (55) 1.59 (55)

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Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	49.22	44.46	49.22	47.63	49.22	47.63	49.22	49.22	47.63	49.22	47.63	49.22	(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=	49.22	44.46	49.22	47.63	49.22	47.63	49.22	49.22	47.63	49.22	47.63	49.22	(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=	54.55	49.27	54.55	52.79	54.55	36.09	37.3	37.3	36.09	54.55	52.79	54.55	(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=	279.39	247.33	262.27	238.61	236.36	198.14	192.54	208.18	206.84	247.25	257.04	273.85	(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=	279.39	247.33	262.27	238.61	236.36	198.14	192.54	208.18	206.84	247.25	257.04	273.85

Output from water heater (annual)$_{1\ldots12}$ 2847.81 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	141.41	126.06	135.72	126.29	127.1	105.02	104.47	109.67	107.92	130.73	132.42	139.57	(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=	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	67.23	59.71	48.56	36.76	27.48	23.2	25.07	32.59	43.74	55.53	64.81	69.1	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	433.49	437.99	426.65	402.52	372.06	343.43	324.3	319.8	331.14	355.27	385.73	414.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	(71)

Water heating gains (Table 5)

(72)m=	190.07	187.58	182.42	175.4	170.84	145.87	140.41	147.4	149.88	175.71	183.91	187.59	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	770.18	764.68	737.03	694.08	649.77	591.89	569.18	579.19	604.15	665.9	713.85	750.45	(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 created by change of use

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.86	x	11.28	x	0.76	x	0.65	=	14.91	(75)
Northeast 0.9x	0.54	x	7.36	x	11.28	x	0.76	x	0.65	=	19.93	(75)
Northeast 0.9x	0.77	x	10.78	x	11.28	x	0.76	x	0.65	=	41.65	(75)
Northeast 0.9x	0.54	x	4.9	x	11.28	x	0.76	x	0.65	=	13.28	(75)
Northeast 0.9x	0.77	x	3.86	x	22.97	x	0.76	x	0.65	=	30.36	(75)
Northeast 0.9x	0.54	x	7.36	x	22.97	x	0.76	x	0.65	=	40.56	(75)
Northeast 0.9x	0.77	x	10.78	x	22.97	x	0.76	x	0.65	=	84.77	(75)
Northeast 0.9x	0.54	x	4.9	x	22.97	x	0.76	x	0.65	=	27.04	(75)
Northeast 0.9x	0.77	x	3.86	x	41.38	x	0.76	x	0.65	=	54.69	(75)
Northeast 0.9x	0.54	x	7.36	x	41.38	x	0.76	x	0.65	=	73.08	(75)
Northeast 0.9x	0.77	x	10.78	x	41.38	x	0.76	x	0.65	=	152.73	(75)
Northeast 0.9x	0.54	x	4.9	x	41.38	x	0.76	x	0.65	=	48.72	(75)
Northeast 0.9x	0.77	x	3.86	x	67.96	x	0.76	x	0.65	=	89.82	(75)
Northeast 0.9x	0.54	x	7.36	x	67.96	x	0.76	x	0.65	=	120.01	(75)
Northeast 0.9x	0.77	x	10.78	x	67.96	x	0.76	x	0.65	=	250.83	(75)
Northeast 0.9x	0.54	x	4.9	x	67.96	x	0.76	x	0.65	=	80.01	(75)
Northeast 0.9x	0.77	x	3.86	x	91.35	x	0.76	x	0.65	=	120.74	(75)
Northeast 0.9x	0.54	x	7.36	x	91.35	x	0.76	x	0.65	=	161.32	(75)
Northeast 0.9x	0.77	x	10.78	x	91.35	x	0.76	x	0.65	=	337.17	(75)
Northeast 0.9x	0.54	x	4.9	x	91.35	x	0.76	x	0.65	=	107.55	(75)
Northeast 0.9x	0.77	x	3.86	x	97.38	x	0.76	x	0.65	=	128.72	(75)
Northeast 0.9x	0.54	x	7.36	x	97.38	x	0.76	x	0.65	=	171.99	(75)
Northeast 0.9x	0.77	x	10.78	x	97.38	x	0.76	x	0.65	=	359.46	(75)
Northeast 0.9x	0.54	x	4.9	x	97.38	x	0.76	x	0.65	=	114.66	(75)
Northeast 0.9x	0.77	x	3.86	x	91.1	x	0.76	x	0.65	=	120.42	(75)
Northeast 0.9x	0.54	x	7.36	x	91.1	x	0.76	x	0.65	=	160.89	(75)
Northeast 0.9x	0.77	x	10.78	x	91.1	x	0.76	x	0.65	=	336.27	(75)
Northeast 0.9x	0.54	x	4.9	x	91.1	x	0.76	x	0.65	=	107.26	(75)
Northeast 0.9x	0.77	x	3.86	x	72.63	x	0.76	x	0.65	=	96	(75)
Northeast 0.9x	0.54	x	7.36	x	72.63	x	0.76	x	0.65	=	128.26	(75)
Northeast 0.9x	0.77	x	10.78	x	72.63	x	0.76	x	0.65	=	268.08	(75)
Northeast 0.9x	0.54	x	4.9	x	72.63	x	0.76	x	0.65	=	85.51	(75)
Northeast 0.9x	0.77	x	3.86	x	50.42	x	0.76	x	0.65	=	66.65	(75)
Northeast 0.9x	0.54	x	7.36	x	50.42	x	0.76	x	0.65	=	89.05	(75)
Northeast 0.9x	0.77	x	10.78	x	50.42	x	0.76	x	0.65	=	186.11	(75)
Northeast 0.9x	0.54	x	4.9	x	50.42	x	0.76	x	0.65	=	59.36	(75)
Northeast 0.9x	0.77	x	3.86	x	28.07	x	0.76	x	0.65	=	37.1	(75)
Northeast 0.9x	0.54	x	7.36	x	28.07	x	0.76	x	0.65	=	49.57	(75)
Northeast 0.9x	0.77	x	10.78	x	28.07	x	0.76	x	0.65	=	103.6	(75)

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DER WorkSheet: New dwelling created by change of use

Northeast	0.9x	0.54	x	4.9	x	28.07	x	0.76	x	0.65	=	33.05	(75)
Northeast	0.9x	0.77	x	3.86	x	14.2	x	0.76	x	0.65	=	18.77	(75)
Northeast	0.9x	0.54	x	7.36	x	14.2	x	0.76	x	0.65	=	25.07	(75)
Northeast	0.9x	0.77	x	10.78	x	14.2	x	0.76	x	0.65	=	52.4	(75)
Northeast	0.9x	0.54	x	4.9	x	14.2	x	0.76	x	0.65	=	16.71	(75)
Northeast	0.9x	0.77	x	3.86	x	9.21	x	0.76	x	0.65	=	12.18	(75)
Northeast	0.9x	0.54	x	7.36	x	9.21	x	0.76	x	0.65	=	16.27	(75)
Northeast	0.9x	0.77	x	10.78	x	9.21	x	0.76	x	0.65	=	34.01	(75)
Northeast	0.9x	0.54	x	4.9	x	9.21	x	0.76	x	0.65	=	10.85	(75)
South	0.9x	0.77	x	2.47	x	46.75	x	0.76	x	0.65	=	39.53	(78)
South	0.9x	0.77	x	2.47	x	76.57	x	0.76	x	0.65	=	64.74	(78)
South	0.9x	0.77	x	2.47	x	97.53	x	0.76	x	0.65	=	82.47	(78)
South	0.9x	0.77	x	2.47	x	110.23	x	0.76	x	0.65	=	93.21	(78)
South	0.9x	0.77	x	2.47	x	114.87	x	0.76	x	0.65	=	97.13	(78)
South	0.9x	0.77	x	2.47	x	110.55	x	0.76	x	0.65	=	93.48	(78)
South	0.9x	0.77	x	2.47	x	108.01	x	0.76	x	0.65	=	91.33	(78)
South	0.9x	0.77	x	2.47	x	104.89	x	0.76	x	0.65	=	88.7	(78)
South	0.9x	0.77	x	2.47	x	101.89	x	0.76	x	0.65	=	86.15	(78)
South	0.9x	0.77	x	2.47	x	82.59	x	0.76	x	0.65	=	69.83	(78)
South	0.9x	0.77	x	2.47	x	55.42	x	0.76	x	0.65	=	46.86	(78)
South	0.9x	0.77	x	2.47	x	40.4	x	0.76	x	0.65	=	34.16	(78)
Southwest	0.9x	0.77	x	22.26	x	36.79		0.76	x	0.65	=	280.39	(79)
Southwest	0.9x	0.77	x	22.26	x	62.67		0.76	x	0.65	=	477.61	(79)
Southwest	0.9x	0.77	x	22.26	x	85.75		0.76	x	0.65	=	653.48	(79)
Southwest	0.9x	0.77	x	22.26	x	106.25		0.76	x	0.65	=	809.69	(79)
Southwest	0.9x	0.77	x	22.26	x	119.01		0.76	x	0.65	=	906.92	(79)
Southwest	0.9x	0.77	x	22.26	x	118.15		0.76	x	0.65	=	900.37	(79)
Southwest	0.9x	0.77	x	22.26	x	113.91		0.76	x	0.65	=	868.05	(79)
Southwest	0.9x	0.77	x	22.26	x	104.39		0.76	x	0.65	=	795.51	(79)
Southwest	0.9x	0.77	x	22.26	x	92.85		0.76	x	0.65	=	707.58	(79)
Southwest	0.9x	0.77	x	22.26	x	69.27		0.76	x	0.65	=	527.86	(79)
Southwest	0.9x	0.77	x	22.26	x	44.07		0.76	x	0.65	=	335.84	(79)
Southwest	0.9x	0.77	x	22.26	x	31.49		0.76	x	0.65	=	239.95	(79)
West	0.9x	0.77	x	2.47	x	19.64	x	0.76	x	0.65	=	16.61	(80)
West	0.9x	0.77	x	2.47	x	38.42	x	0.76	x	0.65	=	32.49	(80)
West	0.9x	0.77	x	2.47	x	63.27	x	0.76	x	0.65	=	53.5	(80)
West	0.9x	0.77	x	2.47	x	92.28	x	0.76	x	0.65	=	78.03	(80)
West	0.9x	0.77	x	2.47	x	113.09	x	0.76	x	0.65	=	95.63	(80)
West	0.9x	0.77	x	2.47	x	115.77	x	0.76	x	0.65	=	97.89	(80)
West	0.9x	0.77	x	2.47	x	110.22	x	0.76	x	0.65	=	93.2	(80)
West	0.9x	0.77	x	2.47	x	94.68	x	0.76	x	0.65	=	80.06	(80)

DER WorkSheet: New dwelling created by change of use

West	0.9x	0.77	x	2.47	x	73.59	x	0.76	x	0.65	=	62.23	(80)
West	0.9x	0.77	x	2.47	x	45.59	x	0.76	x	0.65	=	38.55	(80)
West	0.9x	0.77	x	2.47	x	24.49	x	0.76	x	0.65	=	20.71	(80)
West	0.9x	0.77	x	2.47	x	16.15	x	0.76	x	0.65	=	13.66	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	426.3	757.57	1118.68	1521.62	1826.47	1866.56	1777.41	1542.11	1257.12	859.55	516.36	361.08	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	1196.48	1522.25	1855.71	2215.69	2476.24	2458.45	2346.59	2121.29	1861.28	1525.46	1230.22	1111.53	(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	0.95	0.88	0.78	0.83	0.95	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.41	18.62	19.01	19.59	20.13	20.59	20.82	20.77	20.38	19.69	18.99	18.43	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.88	19.88	19.89	19.93	19.94	19.98	19.98	19.99	19.96	19.94	19.93	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.93	0.83	0.67	0.74	0.92	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.48	17.7	18.1	18.7	19.23	19.7	19.89	19.86	19.5	18.81	18.1	17.53	(90)

fLA = Living area ÷ (4) = | 0.16 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.63	17.85	18.24	18.84	19.38	19.84	20.04	20.01	19.64	18.95	18.24	17.67	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.63	17.85	18.24	18.84	19.38	19.84	20.04	20.01	19.64	18.95	18.24	17.67	(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	0.99	0.97	0.92	0.82	0.68	0.74	0.91	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1193.53	1514.18	1833.26	2147.37	2284.29	2024.73	1592.65	1567.02	1699.54	1497.82	1224.9	1109.46	(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=	8092.07	7798.88	7016.69	5718.12	4383.11	2892.25	1896.82	1976.94	3096.68	4767.6	6456	7925.52	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	5132.51	4223.32	3856.47	2570.94	1561.53	0	0	0	0	2432.72	3766.39	5071.14	

Total per year (kWh/year) = Sum(98)$_{1…5,9…12}$ = | 28615.02 | (98)

Space heating requirement in kWh/m²/year | 105.98 | (99)

DER WorkSheet: New dwelling created by change of use

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		75	(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)	5132.51	4223.32	3856.47	2570.94	1561.53	0	0	0	0	2432.72	3766.39	5071.14		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	6843.35	5631.09	5141.96	3427.93	2082.03	0	0	0	0	3243.62	5021.86	6761.52		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													38153.36	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	279.39	247.33	262.27	238.61	236.36	198.14	192.54	208.18	206.84	247.25	257.04	273.85		
Efficiency of water heater													65	(216)
(217)m=	74.41	74.37	74.27	74.03	73.51	65	65	65	65	73.95	74.27	74.41		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	375.48	332.58	353.12	322.3	321.52	304.83	296.21	320.28	318.22	334.35	346.09	368.01		
Total = Sum(219a)$_{1...12}$ =													3992.99	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			38153.36	
Water heating fuel used			3992.99	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		120		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		120	(231)
Electricity for lighting			1187.24	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	8241.13	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	862.49	(264)
Space and water heating	(261) + (262) + (263) + (264) =				9103.61	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	62.28	(267)

DER WorkSheet: New dwelling created by change of use

Electricity for lighting	(232) x	0.519	=	616.18	(268)
Total CO2, kg/year		sum of (265)…(271) =		9782.07	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		36.23	(273)
EI rating (section 14)				58	(274)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 24 Existing - 3B4P - TF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	229	(1a) x	2.76	(2a) =	632.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	229	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	632.04	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.06	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.81	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.75	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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 created by change of use

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.96	0.94	0.92	0.83	0.81	0.71	0.71	0.7	0.75	0.81	0.85	0.88

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.96	0.94	0.92	0.84	0.83	0.76	0.76	0.74	0.78	0.83	0.86	0.89	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.96	0.94	0.92	0.84	0.83	0.76	0.76	0.74	0.78	0.83	0.86	0.89	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			5.71	x1/[1/(3.1)+ 0.04]		=	15.75			(27)
Windows Type 2			1.13	x1/[1/(3.1)+ 0.04]		=	3.12			(27)
Windows Type 3			7.2	x1/[1/(3.1)+ 0.04]		=	19.86			(27)
Windows Type 4			3.08	x1/[1/(3.1)+ 0.04]		=	8.49			(27)
Windows Type 5			3.29	x1/[1/(3.1)+ 0.04]		=	9.07			(27)
Windows Type 6			2.67	x1/[1/(3.1)+ 0.04]		=	7.36			(27)
Windows Type 7			8.172	x1/[1/(3.1)+ 0.04]		=	22.54			(27)
Walls Type1	220.77	31.25	189.52	x	0.6	=	113.71			(29)
Walls Type2	31.6	0	31.6	x	0.48	=	15.29			(29)
Roof	222.14	0	222.14	x	0.68	=	151.06			(30)
Total area of elements, m²			474.51							(31)
Party wall			14.63	x	0	=	0			(32)
Party floor			222.14							(32a)

* *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) = 366.25 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27021.66 (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 71.18 (36)

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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 437.43 (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=	200.23	196.51	192.85	175.7	172.49	157.55	157.55	154.79	163.31	172.49	178.98	185.77	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	637.66	633.93	630.28	613.13	609.92	594.98	594.98	592.21	600.74	609.92	616.41	623.2	

Average = Sum(39)1…12 /12= 613.11 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	2.78	2.77	2.75	2.68	2.66	2.6	2.6	2.59	2.62	2.66	2.69	2.72	

Average = Sum(40)1…12 /12= 2.68 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 106.39 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	117.03	112.77	108.52	104.26	100.01	95.75	95.75	100.01	104.26	108.52	112.77	117.03	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Total = Sum(44)1…12 = 1276.69 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	173.55	151.79	156.63	136.56	131.03	113.07	104.77	120.23	121.67	141.79	154.78	168.08	

Total = Sum(45)1…12 = 1673.95 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.03	22.77	23.5	20.48	19.65	16.96	15.72	18.03	18.25	21.27	23.22	25.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (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) = 210 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 0.83 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.59 (54)

Enter (50) or (54) in (55) 1.59 (55)

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Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	49.22	44.46	49.22	47.63	49.22	47.63	49.22	49.22	47.63	49.22	47.63	49.22	(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=	49.22	44.46	49.22	47.63	49.22	47.63	49.22	49.22	47.63	49.22	47.63	49.22	(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=	54.55	49.27	54.55	52.79	54.55	36.09	37.3	37.3	36.09	54.55	52.79	54.55	(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=	277.33	245.52	260.41	236.98	234.8	196.8	191.29	206.75	205.39	245.56	255.2	271.85	(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=	277.33	245.52	260.41	236.98	234.8	196.8	191.29	206.75	205.39	245.56	255.2	271.85	

Output from water heater (annual)$_{1...12}$ | 2827.89 | (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=	140.73	125.46	135.1	125.75	126.59	104.58	104.05	109.19	107.44	130.16	131.8	138.9	(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=	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	67.2	59.69	48.54	36.75	27.47	23.19	25.06	32.57	43.72	55.51	64.79	69.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	397.84	401.96	391.56	369.41	341.46	315.18	297.63	293.5	303.9	326.05	354.01	380.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	(71)

Water heating gains (Table 5)

(72)m=	189.15	186.69	181.59	174.65	170.14	145.25	139.85	146.76	149.22	174.95	183.06	186.7	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	732.78	726.94	700.28	659.41	617.67	562.21	541.14	551.43	575.43	635.11	680.45	714.65	(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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DER WorkSheet: New dwelling created by change of use

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.08	x	11.28	x	0.76	x	0.65	=	11.9	(75)
Northeast 0.9x	0.54	x	3.29	x	11.28	x	0.76	x	0.65	=	8.91	(75)
Northeast 0.9x	0.77	x	2.67	x	11.28	x	0.76	x	0.65	=	10.31	(75)
Northeast 0.9x	0.54	x	8.17	x	11.28	x	0.76	x	0.65	=	22.14	(75)
Northeast 0.9x	0.77	x	3.08	x	22.97	x	0.76	x	0.65	=	24.22	(75)
Northeast 0.9x	0.54	x	3.29	x	22.97	x	0.76	x	0.65	=	18.14	(75)
Northeast 0.9x	0.77	x	2.67	x	22.97	x	0.76	x	0.65	=	20.99	(75)
Northeast 0.9x	0.54	x	8.17	x	22.97	x	0.76	x	0.65	=	45.06	(75)
Northeast 0.9x	0.77	x	3.08	x	41.38	x	0.76	x	0.65	=	43.63	(75)
Northeast 0.9x	0.54	x	3.29	x	41.38	x	0.76	x	0.65	=	32.68	(75)
Northeast 0.9x	0.77	x	2.67	x	41.38	x	0.76	x	0.65	=	37.82	(75)
Northeast 0.9x	0.54	x	8.17	x	41.38	x	0.76	x	0.65	=	81.18	(75)
Northeast 0.9x	0.77	x	3.08	x	67.96	x	0.76	x	0.65	=	71.65	(75)
Northeast 0.9x	0.54	x	3.29	x	67.96	x	0.76	x	0.65	=	53.68	(75)
Northeast 0.9x	0.77	x	2.67	x	67.96	x	0.76	x	0.65	=	62.12	(75)
Northeast 0.9x	0.54	x	8.17	x	67.96	x	0.76	x	0.65	=	133.33	(75)
Northeast 0.9x	0.77	x	3.08	x	91.35	x	0.76	x	0.65	=	96.32	(75)
Northeast 0.9x	0.54	x	3.29	x	91.35	x	0.76	x	0.65	=	72.15	(75)
Northeast 0.9x	0.77	x	2.67	x	91.35	x	0.76	x	0.65	=	83.5	(75)
Northeast 0.9x	0.54	x	8.17	x	91.35	x	0.76	x	0.65	=	179.22	(75)
Northeast 0.9x	0.77	x	3.08	x	97.38	x	0.76	x	0.65	=	102.68	(75)
Northeast 0.9x	0.54	x	3.29	x	97.38	x	0.76	x	0.65	=	76.92	(75)
Northeast 0.9x	0.77	x	2.67	x	97.38	x	0.76	x	0.65	=	89.01	(75)
Northeast 0.9x	0.54	x	8.17	x	97.38	x	0.76	x	0.65	=	191.07	(75)
Northeast 0.9x	0.77	x	3.08	x	91.1	x	0.76	x	0.65	=	96.06	(75)
Northeast 0.9x	0.54	x	3.29	x	91.1	x	0.76	x	0.65	=	71.96	(75)
Northeast 0.9x	0.77	x	2.67	x	91.1	x	0.76	x	0.65	=	83.27	(75)
Northeast 0.9x	0.54	x	8.17	x	91.1	x	0.76	x	0.65	=	178.74	(75)
Northeast 0.9x	0.77	x	3.08	x	72.63	x	0.76	x	0.65	=	76.58	(75)
Northeast 0.9x	0.54	x	3.29	x	72.63	x	0.76	x	0.65	=	57.37	(75)
Northeast 0.9x	0.77	x	2.67	x	72.63	x	0.76	x	0.65	=	66.38	(75)
Northeast 0.9x	0.54	x	8.17	x	72.63	x	0.76	x	0.65	=	142.49	(75)
Northeast 0.9x	0.77	x	3.08	x	50.42	x	0.76	x	0.65	=	53.16	(75)
Northeast 0.9x	0.54	x	3.29	x	50.42	x	0.76	x	0.65	=	39.83	(75)
Northeast 0.9x	0.77	x	2.67	x	50.42	x	0.76	x	0.65	=	46.09	(75)
Northeast 0.9x	0.54	x	8.17	x	50.42	x	0.76	x	0.65	=	98.92	(75)
Northeast 0.9x	0.77	x	3.08	x	28.07	x	0.76	x	0.65	=	29.59	(75)
Northeast 0.9x	0.54	x	3.29	x	28.07	x	0.76	x	0.65	=	22.17	(75)
Northeast 0.9x	0.77	x	2.67	x	28.07	x	0.76	x	0.65	=	25.65	(75)

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Northeast	0.9x	0.54	x	8.17	x	28.07	x	0.76	x	0.65	=	55.07	(75)
Northeast	0.9x	0.77	x	3.08	x	14.2	x	0.76	x	0.65	=	14.97	(75)
Northeast	0.9x	0.54	x	3.29	x	14.2	x	0.76	x	0.65	=	11.21	(75)
Northeast	0.9x	0.77	x	2.67	x	14.2	x	0.76	x	0.65	=	12.98	(75)
Northeast	0.9x	0.54	x	8.17	x	14.2	x	0.76	x	0.65	=	27.85	(75)
Northeast	0.9x	0.77	x	3.08	x	9.21	x	0.76	x	0.65	=	9.72	(75)
Northeast	0.9x	0.54	x	3.29	x	9.21	x	0.76	x	0.65	=	7.28	(75)
Northeast	0.9x	0.77	x	2.67	x	9.21	x	0.76	x	0.65	=	8.42	(75)
Northeast	0.9x	0.54	x	8.17	x	9.21	x	0.76	x	0.65	=	18.08	(75)
Southwest	0.9x	0.77	x	5.71	x	36.79		0.76	x	0.65	=	71.92	(79)
Southwest	0.9x	0.77	x	1.13	x	36.79		0.76	x	0.65	=	14.23	(79)
Southwest	0.9x	0.77	x	7.2	x	36.79		0.76	x	0.65	=	90.69	(79)
Southwest	0.9x	0.77	x	5.71	x	62.67		0.76	x	0.65	=	122.51	(79)
Southwest	0.9x	0.77	x	1.13	x	62.67		0.76	x	0.65	=	24.25	(79)
Southwest	0.9x	0.77	x	7.2	x	62.67		0.76	x	0.65	=	154.48	(79)
Southwest	0.9x	0.77	x	5.71	x	85.75		0.76	x	0.65	=	167.63	(79)
Southwest	0.9x	0.77	x	1.13	x	85.75		0.76	x	0.65	=	33.17	(79)
Southwest	0.9x	0.77	x	7.2	x	85.75		0.76	x	0.65	=	211.37	(79)
Southwest	0.9x	0.77	x	5.71	x	106.25		0.76	x	0.65	=	207.7	(79)
Southwest	0.9x	0.77	x	1.13	x	106.25		0.76	x	0.65	=	41.1	(79)
Southwest	0.9x	0.77	x	7.2	x	106.25		0.76	x	0.65	=	261.9	(79)
Southwest	0.9x	0.77	x	5.71	x	119.01		0.76	x	0.65	=	232.64	(79)
Southwest	0.9x	0.77	x	1.13	x	119.01		0.76	x	0.65	=	46.04	(79)
Southwest	0.9x	0.77	x	7.2	x	119.01		0.76	x	0.65	=	293.34	(79)
Southwest	0.9x	0.77	x	5.71	x	118.15		0.76	x	0.65	=	230.96	(79)
Southwest	0.9x	0.77	x	1.13	x	118.15		0.76	x	0.65	=	45.71	(79)
Southwest	0.9x	0.77	x	7.2	x	118.15		0.76	x	0.65	=	291.22	(79)
Southwest	0.9x	0.77	x	5.71	x	113.91		0.76	x	0.65	=	222.67	(79)
Southwest	0.9x	0.77	x	1.13	x	113.91		0.76	x	0.65	=	44.07	(79)
Southwest	0.9x	0.77	x	7.2	x	113.91		0.76	x	0.65	=	280.77	(79)
Southwest	0.9x	0.77	x	5.71	x	104.39		0.76	x	0.65	=	204.06	(79)
Southwest	0.9x	0.77	x	1.13	x	104.39		0.76	x	0.65	=	40.38	(79)
Southwest	0.9x	0.77	x	7.2	x	104.39		0.76	x	0.65	=	257.31	(79)
Southwest	0.9x	0.77	x	5.71	x	92.85		0.76	x	0.65	=	181.5	(79)
Southwest	0.9x	0.77	x	1.13	x	92.85		0.76	x	0.65	=	35.92	(79)
Southwest	0.9x	0.77	x	7.2	x	92.85		0.76	x	0.65	=	228.87	(79)
Southwest	0.9x	0.77	x	5.71	x	69.27		0.76	x	0.65	=	135.4	(79)
Southwest	0.9x	0.77	x	1.13	x	69.27		0.76	x	0.65	=	26.8	(79)
Southwest	0.9x	0.77	x	7.2	x	69.27		0.76	x	0.65	=	170.74	(79)
Southwest	0.9x	0.77	x	5.71	x	44.07		0.76	x	0.65	=	86.15	(79)
Southwest	0.9x	0.77	x	1.13	x	44.07		0.76	x	0.65	=	17.05	(79)

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Southwest 0.9x	0.77	x	7.2	x	44.07		0.76	x	0.65	=	108.63	(79)
Southwest 0.9x	0.77	x	5.71	x	31.49		0.76	x	0.65	=	61.55	(79)
Southwest 0.9x	0.77	x	1.13	x	31.49		0.76	x	0.65	=	12.18	(79)
Southwest 0.9x	0.77	x	7.2	x	31.49		0.76	x	0.65	=	77.61	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	230.11	409.65	607.49	831.47	1003.2	1027.57	977.53	844.57	684.29	465.42	278.84	194.84	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	962.89	1136.59	1307.77	1490.87	1620.87	1589.78	1518.67	1396	1259.73	1100.53	959.29	909.49	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.98	0.95	0.89	0.92	0.97	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	17.94	18.13	18.51	19.09	19.69	20.25	20.59	20.53	20.06	19.31	18.56	17.95	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.61	19.62	19.62	19.66	19.67	19.7	19.7	19.71	19.69	19.67	19.65	19.64	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.99	0.97	0.91	0.8	0.85	0.96	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.83	17.02	17.41	18.02	18.61	19.19	19.5	19.45	18.99	18.24	17.48	16.86	(90)

fLA = Living area ÷ (4) = | 0.15 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	16.99	17.18	17.57	18.18	18.77	19.35	19.66	19.61	19.15	18.4	17.64	17.02	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	16.99	17.18	17.57	18.18	18.77	19.35	19.66	19.61	19.15	18.4	17.64	17.02	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.96	0.9	0.8	0.84	0.95	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	959.96	1130.91	1295.84	1462.21	1549.62	1431.22	1212.38	1169.4	1192.46	1085.1	954.8	907.21	(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=	8093.54	7787.82	6980.31	5687.96	4312.14	2824	1821.14	1903.8	3034.62	4757.64	6499.29	7991.68	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	5307.39	4473.44	4229.24	3042.54	2055.31	0	0	0	0	2732.37	3992.04	5270.84	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 31103.17 | (98)

Space heating requirement in kWh/m²/year | 135.82 | (99)

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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		75	(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)	5307.39	4473.44	4229.24	3042.54	2055.31	0	0	0	0	2732.37	3992.04	5270.84		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	7076.52	5964.59	5638.99	4056.72	2740.42	0	0	0	0	3643.16	5322.71	7027.79		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													41470.89	(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)	277.33	245.52	260.41	236.98	234.8	196.8	191.29	206.75	205.39	245.56	255.2	271.85		
Efficiency of water heater													65	(216)
(217)m=	74.43	74.4	74.34	74.18	73.84	65	65	65	65	74.06	74.31	74.44		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	372.59	329.98	350.31	319.49	318.01	302.76	294.3	318.07	315.99	331.57	343.41	365.2		
Total = Sum(219a)$_{1...12}$ =													3961.7	(219)

Annual totals — kWh/year — kWh/year

Space heating fuel used, main system 1			41470.89	
Water heating fuel used			3961.7	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		120		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		120	(231)
Electricity for lighting			1186.84	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	8957.71	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	855.73	(264)
Space and water heating	(261) + (262) + (263) + (264) =			9813.44	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	62.28	(267)

DER WorkSheet: New dwelling created by change of use

Electricity for lighting	(232) x	0.519	=	615.97	(268)
Total CO_2, kg/year		sum of (265)…(271) =		10491.69	(272)
Dwelling CO_2 Emission Rate		(272) ÷ (4) =		45.82	(273)
EI rating (section 14)				50	(274)

APPENDIX X – BE-LEAN DER WORKSHEETS (REFURB)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.23

Property Address: Flat 1 - Existing Be Lean - 3B6P - GF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	178	(1a) x	2.9	(2a) =	516.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	178	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	516.2	(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							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.06	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.81	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.75	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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 created by change of use

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.95	0.93	0.92	0.82	0.8	0.71	0.71	0.69	0.75	0.8	0.84	0.88

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.95	0.94	0.92	0.84	0.82	0.75	0.75	0.74	0.78	0.82	0.85	0.89	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.95	0.94	0.92	0.84	0.82	0.75	0.75	0.74	0.78	0.82	0.85	0.89	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.698	x1/[1/(1.8)+ 0.04] =	17.96			(27)
Windows Type 2			3.14	x1/[1/(1.8)+ 0.04] =	5.27			(27)
Windows Type 3			3.61	x1/[1/(1.8)+ 0.04] =	6.06			(27)
Floor			178.51	x 0.25 =	44.6275			(28)
Walls	134.39	17.45	116.94	x 0.35 =	40.93			(29)
Roof	51.42	0	51.42	x 0.16 =	8.23			(30)
Total area of elements, m²			364.32					(31)
Party wall			54.81	x 0 =	0			(32)
Party ceiling			127.04					(32b)

** 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) =	123.08	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	34562.19	(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		54.65	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	177.73	(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=	162.54	159.54	156.59	142.76	140.17	128.12	128.12	125.89	132.76	140.17	145.41	150.88	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	340.27	337.26	334.32	320.49	317.9	305.85	305.85	303.62	310.49	317.9	323.13	328.61	

Average = Sum(39)$_{1…12}$ /12= 320.47 (39)

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Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.91	1.89	1.88	1.8	1.79	1.72	1.72	1.71	1.74	1.79	1.82	1.85

Average = Sum(40)$_{1\ldots12}$ /12= 1.8 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.97 (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 — 104.81 (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=	115.29	111.1	106.91	102.72	98.52	94.33	94.33	98.52	102.72	106.91	111.1	115.29	
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=	170.98	149.54	154.31	134.53	129.09	111.39	103.22	118.45	119.86	139.69	152.48	165.58	
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	25.65	22.43	23.15	20.18	19.36	16.71	15.48	17.77	17.98	20.95	22.87	24.84	(46)

Total = Sum(44)$_{1\ldots12}$ = 1257.76 (44)

Total = Sum(45)$_{1\ldots12}$ = 1649.12 (45)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 305 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): — 1.63 (48)

Temperature factor from Table 2b — 0.6 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.98 (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) — 0.98 (55)

Water storage loss calculated for each month — ((56)m = (55) × (41)m

(56)m=	30.32	27.38	30.32	29.34	30.32	29.34	30.32	30.32	29.34	30.32	29.34	30.32	(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=	30.32	27.38	30.32	29.34	30.32	29.34	30.32	30.32	29.34	30.32	29.34	30.32	(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=	54.55	49.27	54.55	52.79	54.55	36.09	37.3	37.3	36.09	54.55	52.79	54.55	(59)

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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=	255.85	226.2	239.18	216.67	213.96	176.83	170.84	186.06	185.3	224.56	234.61	250.46	(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=	255.85	226.2	239.18	216.67	213.96	176.83	170.84	186.06	185.3	224.56	234.61	250.46

Output from water heater (annual)$_{1...12}$ | 2580.51 | (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=	124.75	111.05	119.21	110.44	110.82	89.39	88.41	93.48	92.2	114.34	116.41	122.95	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	36.99	32.86	26.72	20.23	15.12	12.77	13.79	17.93	24.07	30.56	35.67	38.02	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	349.62	353.25	344.11	324.65	300.08	276.99	261.56	257.93	267.07	286.54	311.11	334.2	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	(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=	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	(71)
Water heating gains (Table 5)													
(72)m=	167.67	165.25	160.22	153.39	148.95	124.15	118.84	125.64	128.06	153.69	161.68	165.26	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	624.89	621.96	601.65	568.86	534.75	484.5	464.79	472.1	489.8	541.38	579.05	608.08	(73)

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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	3.14	x	11.28	x	0.55	x	0.65	=	8.78	(75)
Northeast 0.9x	0.54	x	3.61	x	11.28	x	0.55	x	0.65	=	7.08	(75)
Northeast 0.9x	0.77	x	3.14	x	22.97	x	0.55	x	0.65	=	17.87	(75)
Northeast 0.9x	0.54	x	3.61	x	22.97	x	0.55	x	0.65	=	14.41	(75)
Northeast 0.9x	0.77	x	3.14	x	41.38	x	0.55	x	0.65	=	32.19	(75)

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Northeast 0.9x	0.54	x	3.61	x	41.38	x	0.55	x	0.65	=	25.95	(75)
Northeast 0.9x	0.77	x	3.14	x	67.96	x	0.55	x	0.65	=	52.86	(75)
Northeast 0.9x	0.54	x	3.61	x	67.96	x	0.55	x	0.65	=	42.62	(75)
Northeast 0.9x	0.77	x	3.14	x	91.35	x	0.55	x	0.65	=	71.06	(75)
Northeast 0.9x	0.54	x	3.61	x	91.35	x	0.55	x	0.65	=	57.29	(75)
Northeast 0.9x	0.77	x	3.14	x	97.38	x	0.55	x	0.65	=	75.76	(75)
Northeast 0.9x	0.54	x	3.61	x	97.38	x	0.55	x	0.65	=	61.08	(75)
Northeast 0.9x	0.77	x	3.14	x	91.1	x	0.55	x	0.65	=	70.87	(75)
Northeast 0.9x	0.54	x	3.61	x	91.1	x	0.55	x	0.65	=	57.14	(75)
Northeast 0.9x	0.77	x	3.14	x	72.63	x	0.55	x	0.65	=	56.5	(75)
Northeast 0.9x	0.54	x	3.61	x	72.63	x	0.55	x	0.65	=	45.55	(75)
Northeast 0.9x	0.77	x	3.14	x	50.42	x	0.55	x	0.65	=	39.22	(75)
Northeast 0.9x	0.54	x	3.61	x	50.42	x	0.55	x	0.65	=	31.62	(75)
Northeast 0.9x	0.77	x	3.14	x	28.07	x	0.55	x	0.65	=	21.83	(75)
Northeast 0.9x	0.54	x	3.61	x	28.07	x	0.55	x	0.65	=	17.6	(75)
Northeast 0.9x	0.77	x	3.14	x	14.2	x	0.55	x	0.65	=	11.04	(75)
Northeast 0.9x	0.54	x	3.61	x	14.2	x	0.55	x	0.65	=	8.9	(75)
Northeast 0.9x	0.77	x	3.14	x	9.21	x	0.55	x	0.65	=	7.17	(75)
Northeast 0.9x	0.54	x	3.61	x	9.21	x	0.55	x	0.65	=	5.78	(75)
Southwest0.9x	0.77	x	10.7	x	36.79		0.55	x	0.65	=	97.52	(79)
Southwest0.9x	0.77	x	10.7	x	62.67		0.55	x	0.65	=	166.11	(79)
Southwest0.9x	0.77	x	10.7	x	85.75		0.55	x	0.65	=	227.28	(79)
Southwest0.9x	0.77	x	10.7	x	106.25		0.55	x	0.65	=	281.61	(79)
Southwest0.9x	0.77	x	10.7	x	119.01		0.55	x	0.65	=	315.43	(79)
Southwest0.9x	0.77	x	10.7	x	118.15		0.55	x	0.65	=	313.15	(79)
Southwest0.9x	0.77	x	10.7	x	113.91		0.55	x	0.65	=	301.91	(79)
Southwest0.9x	0.77	x	10.7	x	104.39		0.55	x	0.65	=	276.68	(79)
Southwest0.9x	0.77	x	10.7	x	92.85		0.55	x	0.65	=	246.1	(79)
Southwest0.9x	0.77	x	10.7	x	69.27		0.55	x	0.65	=	183.59	(79)
Southwest0.9x	0.77	x	10.7	x	44.07		0.55	x	0.65	=	116.8	(79)
Southwest0.9x	0.77	x	10.7	x	31.49		0.55	x	0.65	=	83.46	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	113.37	198.38	285.42	377.1	443.78	449.98	429.92	378.73	316.94	223.03	136.75	96.4	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	738.26	820.34	887.07	945.96	978.53	934.48	894.7	850.83	806.74	764.41	715.8	704.48	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	1	0.99	0.96	0.91	0.93	0.98	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.71	18.86	19.15	19.61	20.06	20.5	20.75	20.71	20.36	19.8	19.22	18.74	(87)

DER WorkSheet: New dwelling created by change of use

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.4	19.42	19.47	19.48	19.53	19.53	19.54	19.51	19.48	19.46	19.44	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.98	0.93	0.79	0.83	0.96	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.41	16.63	17.07	17.78	18.43	19.08	19.39	19.36	18.88	18.05	17.2	16.49	(90)

fLA = Living area ÷ (4) = 0.28 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.05	17.26	17.66	18.29	18.89	19.48	19.77	19.74	19.29	18.54	17.77	17.12	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	16.9	17.11	17.51	18.14	18.74	19.33	19.62	19.59	19.14	18.39	17.62	16.97	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.99	0.97	0.92	0.8	0.84	0.96	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	736.77	817.8	882.2	934.98	949.65	858.81	715.63	711.23	770.46	756.63	713.56	703.36	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	4288.87	4117.28	3680.02	2962.52	2237.19	1445.74	924.92	969.2	1566.4	2476.8	3398.57	4196.59	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	2642.76	2217.25	2081.58	1459.83	957.93	0	0	0	0	1279.81	1933.21	2598.96	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 15171.33 (98)

Space heating requirement in kWh/m²/year 85.23 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)													
	2642.76	2217.25	2081.58	1459.83	957.93	0	0	0	0	1279.81	1933.21	2598.96	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	2875.69	2412.68	2265.05	1588.5	1042.36	0	0	0	0	1392.61	2103.6	2828.03	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 16508.52 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

DER WorkSheet: New dwelling created by change of use

Water heating

Output from water heater (calculated above)

255.85	226.2	239.18	216.67	213.96	176.83	170.84	186.06	185.3	224.56	234.61	250.46

Efficiency of water heater 81.8 (216)

(217)m=	90.91	90.86	90.75	90.46	89.87	81.8	81.8	81.8	81.8	90.24	90.69	90.91	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	281.43	248.95	263.58	239.52	238.06	216.17	208.85	227.46	226.52	248.86	258.7	275.49

Total = Sum(219a)$_{1...12}$ = 2933.6 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		16508.52	
Water heating fuel used		2933.6	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		30	(231)
Electricity for lighting		653.31	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	3565.84	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	633.66	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4199.5	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)
Electricity for lighting	(232)	x	0.519	=	339.07	(268)
Total CO2, kg/year			sum of (265)…(271) =		4554.14	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		25.59	(273)
EI rating (section 14)					73	(274)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.23

Property Address: Flat 2 - Existing Be Lean - 4B8P - GF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	227.6	(1a) x	2.9	(2a) =	660.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	227.6	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	660.04	(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							5	x 10 =	50	(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) =	50	÷ (5) =	0.08	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.83	(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) =	0.7	(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

DER WorkSheet: New dwelling created by change of use

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.89	0.88	0.86	0.77	0.75	0.67	0.67	0.65	0.7	0.75	0.79	0.82

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=	0.9	0.88	0.87	0.8	0.78	0.72	0.72	0.71	0.75	0.78	0.81	0.84	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.9	0.88	0.87	0.8	0.78	0.72	0.72	0.71	0.75	0.78	0.81	0.84	(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	
Windows Type 1			3.77	x1/[1/(1.8)+ 0.04]		=	6.33			(27)
Windows Type 2			3.77	x1/[1/(1.8)+ 0.04]		=	6.33			(27)
Windows Type 3			3.77	x1/[1/(1.8)+ 0.04]		=	6.33			(27)
Windows Type 4			4.94	x1/[1/(1.8)+ 0.04]		=	8.29			(27)
Floor			227.5	x	0.25	=	56.875			(28)
Walls Type1	94.68	16.25	78.43	x	0.35	=	27.45			(29)
Walls Type2	53.48	0	53.48	x	0.31	=	16.42			(29)
Roof	104.54	0	104.54	x	0.16	=	16.73			(30)
Total area of elements, m²			480.2							(31)
Party wall			83.58	x	0	=	0			(32)
Party ceiling			122.96							(32b)

* *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) = 144.76 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 42649.44 (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 72.03 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 216.79 (37)

DER WorkSheet: New dwelling created by change of use

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=	196.13	192.74	189.42	173.83	170.91	157.33	157.33	154.81	162.56	170.91	176.81	182.98	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	412.91	409.53	406.21	390.61	387.7	374.12	374.12	371.6	379.35	387.7	393.6	399.77	

Average = Sum(39)$_{1…12}$ /12= 390.6 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.81	1.8	1.78	1.72	1.7	1.64	1.64	1.63	1.67	1.7	1.73	1.76

Average = Sum(40)$_{1…12}$ /12= 1.72 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 106.35 (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=	116.98	112.73	108.47	104.22	99.97	95.71	95.71	99.97	104.22	108.47	112.73	116.98

Total = Sum(44)$_{1…12}$ = 1276.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	173.48	151.73	156.57	136.5	130.98	113.02	104.73	120.18	121.62	141.73	154.71	168.01

Total = Sum(45)$_{1…12}$ = 1673.27 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.02	22.76	23.49	20.48	19.65	16.95	15.71	18.03	18.24	21.26	23.21	25.2	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 305 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.63 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.98 (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) 0.98 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	30.32	27.38	30.32	29.34	30.32	29.34	30.32	30.32	29.34	30.32	29.34	30.32	(56)

DER WorkSheet: New dwelling created by change of use

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=	30.32	27.38	30.32	29.34	30.32	29.34	30.32	30.32	29.34	30.32	29.34	30.32	(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=	54.55	49.27	54.55	52.79	54.55	36.09	37.3	37.3	36.09	54.55	52.79	54.55	(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=	258.35	228.39	241.44	218.64	215.85	178.46	172.35	187.8	187.05	226.6	236.85	252.88	(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=	258.35	228.39	241.44	218.64	215.85	178.46	172.35	187.8	187.05	226.6	236.85	252.88

Output from water heater (annual)$_{1...12}$ | 2604.65 | (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=	125.58	111.78	119.96	111.09	111.45	89.93	88.92	94.05	92.79	115.02	117.15	123.76	(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=	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	45.54	40.45	32.9	24.9	18.62	15.72	16.98	22.07	29.63	37.62	43.91	46.81	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	396.58	400.69	390.32	368.24	340.38	314.18	296.69	292.57	302.94	325.02	352.89	379.08	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	(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=	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	(71)
Water heating gains (Table 5)													
(72)m=	168.79	166.33	161.23	154.3	149.79	124.9	119.51	126.42	128.87	154.6	162.71	166.34	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	682.48	679.04	656.02	619.01	580.35	526.37	504.75	512.63	533	588.81	631.07	663.8	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

DER WorkSheet: New dwelling created by change of use

Northeast	0.9x	0.54	x	4.94	x	11.28	x	0.55	x	0.65	=	9.68	(75)
Northeast	0.9x	0.54	x	4.94	x	22.97	x	0.55	x	0.65	=	19.71	(75)
Northeast	0.9x	0.54	x	4.94	x	41.38	x	0.55	x	0.65	=	35.52	(75)
Northeast	0.9x	0.54	x	4.94	x	67.96	x	0.55	x	0.65	=	58.33	(75)
Northeast	0.9x	0.54	x	4.94	x	91.35	x	0.55	x	0.65	=	78.4	(75)
Northeast	0.9x	0.54	x	4.94	x	97.38	x	0.55	x	0.65	=	83.59	(75)
Northeast	0.9x	0.54	x	4.94	x	91.1	x	0.55	x	0.65	=	78.19	(75)
Northeast	0.9x	0.54	x	4.94	x	72.63	x	0.55	x	0.65	=	62.34	(75)
Northeast	0.9x	0.54	x	4.94	x	50.42	x	0.55	x	0.65	=	43.28	(75)
Northeast	0.9x	0.54	x	4.94	x	28.07	x	0.55	x	0.65	=	24.09	(75)
Northeast	0.9x	0.54	x	4.94	x	14.2	x	0.55	x	0.65	=	12.19	(75)
Northeast	0.9x	0.54	x	4.94	x	9.21	x	0.55	x	0.65	=	7.91	(75)
South	0.9x	0.54	x	3.77	x	46.75	x	0.55	x	0.65	=	30.62	(78)
South	0.9x	0.54	x	3.77	x	76.57	x	0.55	x	0.65	=	50.15	(78)
South	0.9x	0.54	x	3.77	x	97.53	x	0.55	x	0.65	=	63.89	(78)
South	0.9x	0.54	x	3.77	x	110.23	x	0.55	x	0.65	=	72.21	(78)
South	0.9x	0.54	x	3.77	x	114.87	x	0.55	x	0.65	=	75.24	(78)
South	0.9x	0.54	x	3.77	x	110.55	x	0.55	x	0.65	=	72.41	(78)
South	0.9x	0.54	x	3.77	x	108.01	x	0.55	x	0.65	=	70.75	(78)
South	0.9x	0.54	x	3.77	x	104.89	x	0.55	x	0.65	=	68.71	(78)
South	0.9x	0.54	x	3.77	x	101.89	x	0.55	x	0.65	=	66.74	(78)
South	0.9x	0.54	x	3.77	x	82.59	x	0.55	x	0.65	=	54.1	(78)
South	0.9x	0.54	x	3.77	x	55.42	x	0.55	x	0.65	=	36.3	(78)
South	0.9x	0.54	x	3.77	x	40.4	x	0.55	x	0.65	=	26.46	(78)
Southwest	0.9x	0.54	x	3.77	x	36.79		0.55	x	0.65	=	24.1	(79)
Southwest	0.9x	0.54	x	3.77	x	62.67		0.55	x	0.65	=	41.05	(79)
Southwest	0.9x	0.54	x	3.77	x	85.75		0.55	x	0.65	=	56.17	(79)
Southwest	0.9x	0.54	x	3.77	x	106.25		0.55	x	0.65	=	69.6	(79)
Southwest	0.9x	0.54	x	3.77	x	119.01		0.55	x	0.65	=	77.95	(79)
Southwest	0.9x	0.54	x	3.77	x	118.15		0.55	x	0.65	=	77.39	(79)
Southwest	0.9x	0.54	x	3.77	x	113.91		0.55	x	0.65	=	74.61	(79)
Southwest	0.9x	0.54	x	3.77	x	104.39		0.55	x	0.65	=	68.38	(79)
Southwest	0.9x	0.54	x	3.77	x	92.85		0.55	x	0.65	=	60.82	(79)
Southwest	0.9x	0.54	x	3.77	x	69.27		0.55	x	0.65	=	45.37	(79)
Southwest	0.9x	0.54	x	3.77	x	44.07		0.55	x	0.65	=	28.87	(79)
Southwest	0.9x	0.54	x	3.77	x	31.49		0.55	x	0.65	=	20.63	(79)
West	0.9x	0.54	x	3.77	x	19.64	x	0.55	x	0.65	=	12.86	(80)
West	0.9x	0.54	x	3.77	x	38.42	x	0.55	x	0.65	=	25.17	(80)
West	0.9x	0.54	x	3.77	x	63.27	x	0.55	x	0.65	=	41.45	(80)
West	0.9x	0.54	x	3.77	x	92.28	x	0.55	x	0.65	=	60.45	(80)
West	0.9x	0.54	x	3.77	x	113.09	x	0.55	x	0.65	=	74.08	(80)

DER WorkSheet: New dwelling created by change of use

West	0.9x	0.54	x	3.77	x	115.77	x	0.55	x	0.65	=	75.83	(80)
West	0.9x	0.54	x	3.77	x	110.22	x	0.55	x	0.65	=	72.2	(80)
West	0.9x	0.54	x	3.77	x	94.68	x	0.55	x	0.65	=	62.01	(80)
West	0.9x	0.54	x	3.77	x	73.59	x	0.55	x	0.65	=	48.2	(80)
West	0.9x	0.54	x	3.77	x	45.59	x	0.55	x	0.65	=	29.86	(80)
West	0.9x	0.54	x	3.77	x	24.49	x	0.55	x	0.65	=	16.04	(80)
West	0.9x	0.54	x	3.77	x	16.15	x	0.55	x	0.65	=	10.58	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	77.27	136.08	197.02	260.57	305.68	309.22	295.75	261.44	219.04	153.42	93.39	65.57	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	759.75	815.13	853.03	879.59	886.03	835.59	800.5	774.06	752.04	742.23	724.46	729.37	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	1	1	0.99	0.97	0.97	0.99	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.74	18.87	19.14	19.56	19.98	20.41	20.67	20.64	20.29	19.77	19.23	18.78	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.46	19.47	19.48	19.53	19.54	19.58	19.58	19.59	19.56	19.54	19.52	19.5	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	1	0.99	0.97	0.9	0.92	0.99	1	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.49	16.69	17.09	17.74	18.35	19	19.36	19.33	18.83	18.04	17.24	16.57	(90)

fLA = Living area ÷ (4) = 0.22 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17	17.17	17.54	18.14	18.72	19.31	19.65	19.62	19.16	18.43	17.69	17.06	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	16.85	17.02	17.39	17.99	18.57	19.16	19.5	19.47	19.01	18.28	17.54	16.91	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	1	0.99	0.97	0.89	0.91	0.98	1	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	759.04	814.06	851.18	875.79	876.08	806.76	715.3	707.7	737.24	739.03	723.45	728.83	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	5180.83	4965.01	4425.39	3552.01	2662.15	1707.39	1086.74	1141.03	1861.45	2976.67	4108.04	5081.85	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3289.81	2789.44	2659.22	1926.88	1328.83	0	0	0	0	1664.8	2436.9	3238.64	

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Total per year (kWh/year) = Sum(98)1...5,9...12 =	19334.53	(98)
Space heating requirement in kWh/m²/year	84.95	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)	3289.81	2789.44	2659.22	1926.88	1328.83	0	0	0	0	1664.8	2436.9	3238.64		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	3579.77	3035.3	2893.6	2096.72	1445.96	0	0	0	0	1811.54	2651.69	3524.09		(211)
Total (kWh/year) =Sum(211)1...5,10...12=													21038.67	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10...12=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	258.35	228.39	241.44	218.64	215.85	178.46	172.35	187.8	187.05	226.6	236.85	252.88		
Efficiency of water heater													81.8	(216)
(217)m=	91.08	91.05	90.97	90.76	90.34	81.8	81.8	81.8	81.8	90.56	90.91	91.09		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	283.65	250.84	265.42	240.9	238.93	218.16	210.69	229.58	228.67	250.23	260.54	277.63		
Total = Sum(219a)1...12 =													2955.25	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			21038.67	
Water heating fuel used			2955.25	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			804.3	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	4544.35	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)

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Water heating	(219) x	0.216	=	638.33	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5182.68	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	417.43	(268)
Total CO2, kg/year	sum of (265)…(271) =			5615.69	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			24.67	(273)
EI rating (section 14)				72	(274)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 7 - Existing Be Lean- 3B6P - MF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	250.9	(1a) x	4.4	(2a) =	1103.96	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	250.9	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	1103.96	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.04	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.79	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.73	(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

DER WorkSheet: New dwelling created by change of use

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.93	0.91	0.89	0.8	0.78	0.69	0.69	0.67	0.73	0.78	0.82	0.85

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=	0.93	0.91	0.9	0.82	0.81	0.74	0.74	0.73	0.76	0.81	0.83	0.87	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.93	0.91	0.9	0.82	0.81	0.74	0.74	0.73	0.76	0.81	0.83	0.87	(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	
Windows Type 1			14.91	x1/[1/(1.8)+ 0.04]	=	25.04			(27)
Windows Type 2			29.57	x1/[1/(1.8)+ 0.04]	=	49.65			(27)
Windows Type 3			10.836	x1/[1/(1.8)+ 0.04]	=	18.19			(27)
Windows Type 4			4.81	x1/[1/(1.8)+ 0.04]	=	8.08			(27)
Windows Type 5			7.72	x1/[1/(1.8)+ 0.04]	=	12.96			(27)
Windows Type 6			7.32	x1/[1/(1.8)+ 0.04]	=	12.29			(27)
Walls Type1	337.79	75.17	262.62	x 0.35	=	91.92			(29)
Walls Type2	58.52	0	58.52	x 0.31	=	17.97			(29)
Total area of elements, m²			396.31						(31)
Party wall			11.35	x 0	=	0			(32)
Party floor			251.47						(32a)
Party ceiling			251.47						(32b)

** 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) = 236.1 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 40593.68 (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 59.45 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

DER WorkSheet: New dwelling created by change of use

Total fabric heat loss (33) + (36) = 295.54 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	338.77	332.69	326.73	298.73	293.49	269.1	269.1	264.59	278.5	293.49	304.09	315.17	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	634.31	628.23	622.27	594.27	589.03	564.65	564.65	560.13	574.04	589.03	599.63	610.71	

Average = Sum(39)$_{1…12}$ /12= 594.25 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	2.53	2.5	2.48	2.37	2.35	2.25	2.25	2.23	2.29	2.35	2.39	2.43

Average = Sum(40)$_{1…12}$ /12= 2.37 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.07 (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) + 36 107.07 (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=	117.77	113.49	109.21	104.93	100.64	96.36	96.36	100.64	104.93	109.21	113.49	117.77

Total = Sum(44)$_{1…12}$ = 1284.81 (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=	174.66	152.75	157.63	137.43	131.86	113.79	105.44	120.99	122.44	142.69	155.76	169.14

Total = Sum(45)$_{1…12}$ = 1684.59 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.2	22.91	23.64	20.61	19.78	17.07	15.82	18.15	18.37	21.4	23.36	25.37	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 305 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.63 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.98 (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) 0.98 (55)

DER WorkSheet: New dwelling created by change of use

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	30.32	27.38	30.32	29.34	30.32	29.34	30.32	30.32	29.34	30.32	29.34	30.32	(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=	30.32	27.38	30.32	29.34	30.32	29.34	30.32	30.32	29.34	30.32	29.34	30.32	(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=	54.55	49.27	54.55	52.79	54.55	36.09	37.3	37.3	36.09	54.55	52.79	54.55	(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=	259.53	229.41	242.5	219.56	216.73	179.22	173.06	188.61	187.87	227.56	237.89	254.02	(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=	259.53	229.41	242.5	219.56	216.73	179.22	173.06	188.61	187.87	227.56	237.89	254.02

Output from water heater (annual)$_{1...12}$ | 2615.97 | (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=	125.97	112.12	120.31	111.4	111.74	90.18	89.15	94.32	93.06	115.34	117.5	124.14	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	37.19	33.03	26.86	20.34	15.2	12.83	13.87	18.03	24.2	30.72	35.86	38.22	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	417.17	421.5	410.59	387.36	358.05	330.5	312.09	307.76	318.67	341.89	371.21	398.76	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	(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=	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	(71)

Water heating gains (Table 5)

(72)m=	169.32	166.84	161.71	154.72	150.19	125.25	119.83	126.78	129.25	155.03	163.19	166.85	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	695.69	693.39	671.18	634.45	595.46	540.61	517.81	524.59	544.14	599.67	642.28	675.86	(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 created by change of use

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	10.84	x	11.28	x	0.55	x	0.65	=	21.24	(75)
Northeast 0.9x	0.77	x	4.81	x	11.28	x	0.55	x	0.65	=	13.45	(75)
Northeast 0.9x	0.77	x	7.72	x	11.28	x	0.55	x	0.65	=	21.58	(75)
Northeast 0.9x	0.77	x	7.32	x	11.28	x	0.55	x	0.65	=	20.46	(75)
Northeast 0.9x	0.54	x	10.84	x	22.97	x	0.55	x	0.65	=	43.24	(75)
Northeast 0.9x	0.77	x	4.81	x	22.97	x	0.55	x	0.65	=	27.37	(75)
Northeast 0.9x	0.77	x	7.72	x	22.97	x	0.55	x	0.65	=	43.93	(75)
Northeast 0.9x	0.77	x	7.32	x	22.97	x	0.55	x	0.65	=	41.65	(75)
Northeast 0.9x	0.54	x	10.84	x	41.38	x	0.55	x	0.65	=	77.9	(75)
Northeast 0.9x	0.77	x	4.81	x	41.38	x	0.55	x	0.65	=	49.31	(75)
Northeast 0.9x	0.77	x	7.72	x	41.38	x	0.55	x	0.65	=	79.14	(75)
Northeast 0.9x	0.77	x	7.32	x	41.38	x	0.55	x	0.65	=	75.04	(75)
Northeast 0.9x	0.54	x	10.84	x	67.96	x	0.55	x	0.65	=	127.94	(75)
Northeast 0.9x	0.77	x	4.81	x	67.96	x	0.55	x	0.65	=	80.98	(75)
Northeast 0.9x	0.77	x	7.72	x	67.96	x	0.55	x	0.65	=	129.97	(75)
Northeast 0.9x	0.77	x	7.32	x	67.96	x	0.55	x	0.65	=	123.24	(75)
Northeast 0.9x	0.54	x	10.84	x	91.35	x	0.55	x	0.65	=	171.98	(75)
Northeast 0.9x	0.77	x	4.81	x	91.35	x	0.55	x	0.65	=	108.85	(75)
Northeast 0.9x	0.77	x	7.72	x	91.35	x	0.55	x	0.65	=	174.71	(75)
Northeast 0.9x	0.77	x	7.32	x	91.35	x	0.55	x	0.65	=	165.66	(75)
Northeast 0.9x	0.54	x	10.84	x	97.38	x	0.55	x	0.65	=	183.35	(75)
Northeast 0.9x	0.77	x	4.81	x	97.38	x	0.55	x	0.65	=	116.05	(75)
Northeast 0.9x	0.77	x	7.72	x	97.38	x	0.55	x	0.65	=	186.26	(75)
Northeast 0.9x	0.77	x	7.32	x	97.38	x	0.55	x	0.65	=	176.61	(75)
Northeast 0.9x	0.54	x	10.84	x	91.1	x	0.55	x	0.65	=	171.52	(75)
Northeast 0.9x	0.77	x	4.81	x	91.1	x	0.55	x	0.65	=	108.56	(75)
Northeast 0.9x	0.77	x	7.72	x	91.1	x	0.55	x	0.65	=	174.24	(75)
Northeast 0.9x	0.77	x	7.32	x	91.1	x	0.55	x	0.65	=	165.21	(75)
Northeast 0.9x	0.54	x	10.84	x	72.63	x	0.55	x	0.65	=	136.73	(75)
Northeast 0.9x	0.77	x	4.81	x	72.63	x	0.55	x	0.65	=	86.55	(75)
Northeast 0.9x	0.77	x	7.72	x	72.63	x	0.55	x	0.65	=	138.91	(75)
Northeast 0.9x	0.77	x	7.32	x	72.63	x	0.55	x	0.65	=	131.71	(75)
Northeast 0.9x	0.54	x	10.84	x	50.42	x	0.55	x	0.65	=	94.93	(75)
Northeast 0.9x	0.77	x	4.81	x	50.42	x	0.55	x	0.65	=	60.08	(75)
Northeast 0.9x	0.77	x	7.72	x	50.42	x	0.55	x	0.65	=	96.44	(75)
Northeast 0.9x	0.77	x	7.32	x	50.42	x	0.55	x	0.65	=	91.44	(75)
Northeast 0.9x	0.54	x	10.84	x	28.07	x	0.55	x	0.65	=	52.84	(75)
Northeast 0.9x	0.77	x	4.81	x	28.07	x	0.55	x	0.65	=	33.45	(75)
Northeast 0.9x	0.77	x	7.72	x	28.07	x	0.55	x	0.65	=	53.68	(75)

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Northeast	0.9x	0.77	x	7.32	x	28.07	x	0.55	x	0.65	=	50.9	(75)
Northeast	0.9x	0.54	x	10.84	x	14.2	x	0.55	x	0.65	=	26.73	(75)
Northeast	0.9x	0.77	x	4.81	x	14.2	x	0.55	x	0.65	=	16.92	(75)
Northeast	0.9x	0.77	x	7.72	x	14.2	x	0.55	x	0.65	=	27.15	(75)
Northeast	0.9x	0.77	x	7.32	x	14.2	x	0.55	x	0.65	=	25.75	(75)
Northeast	0.9x	0.54	x	10.84	x	9.21	x	0.55	x	0.65	=	17.35	(75)
Northeast	0.9x	0.77	x	4.81	x	9.21	x	0.55	x	0.65	=	10.98	(75)
Northeast	0.9x	0.77	x	7.72	x	9.21	x	0.55	x	0.65	=	17.62	(75)
Northeast	0.9x	0.77	x	7.32	x	9.21	x	0.55	x	0.65	=	16.71	(75)
Southwest	0.9x	0.77	x	14.91	x	36.79		0.55	x	0.65	=	135.91	(79)
Southwest	0.9x	0.77	x	29.57	x	36.79		0.55	x	0.65	=	269.55	(79)
Southwest	0.9x	0.77	x	14.91	x	62.67		0.55	x	0.65	=	231.51	(79)
Southwest	0.9x	0.77	x	29.57	x	62.67		0.55	x	0.65	=	459.14	(79)
Southwest	0.9x	0.77	x	14.91	x	85.75		0.55	x	0.65	=	316.76	(79)
Southwest	0.9x	0.77	x	29.57	x	85.75		0.55	x	0.65	=	628.21	(79)
Southwest	0.9x	0.77	x	14.91	x	106.25		0.55	x	0.65	=	392.48	(79)
Southwest	0.9x	0.77	x	29.57	x	106.25		0.55	x	0.65	=	778.39	(79)
Southwest	0.9x	0.77	x	14.91	x	119.01		0.55	x	0.65	=	439.62	(79)
Southwest	0.9x	0.77	x	29.57	x	119.01		0.55	x	0.65	=	871.86	(79)
Southwest	0.9x	0.77	x	14.91	x	118.15		0.55	x	0.65	=	436.44	(79)
Southwest	0.9x	0.77	x	29.57	x	118.15		0.55	x	0.65	=	865.55	(79)
Southwest	0.9x	0.77	x	14.91	x	113.91		0.55	x	0.65	=	420.77	(79)
Southwest	0.9x	0.77	x	29.57	x	113.91		0.55	x	0.65	=	834.49	(79)
Southwest	0.9x	0.77	x	14.91	x	104.39		0.55	x	0.65	=	385.61	(79)
Southwest	0.9x	0.77	x	29.57	x	104.39		0.55	x	0.65	=	764.75	(79)
Southwest	0.9x	0.77	x	14.91	x	92.85		0.55	x	0.65	=	342.99	(79)
Southwest	0.9x	0.77	x	29.57	x	92.85		0.55	x	0.65	=	680.22	(79)
Southwest	0.9x	0.77	x	14.91	x	69.27		0.55	x	0.65	=	255.87	(79)
Southwest	0.9x	0.77	x	29.57	x	69.27		0.55	x	0.65	=	507.45	(79)
Southwest	0.9x	0.77	x	14.91	x	44.07		0.55	x	0.65	=	162.79	(79)
Southwest	0.9x	0.77	x	29.57	x	44.07		0.55	x	0.65	=	322.86	(79)
Southwest	0.9x	0.77	x	14.91	x	31.49		0.55	x	0.65	=	116.31	(79)
Southwest	0.9x	0.77	x	29.57	x	31.49		0.55	x	0.65	=	230.68	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	482.19	846.84	1226.37	1633.01	1932.67	1964.25	1874.79	1644.26	1366.1	954.19	582.19	409.65	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	1177.89	1540.23	1897.55	2267.45	2528.14	2504.86	2392.6	2168.85	1910.23	1553.85	1224.47	1085.51	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)	21	(85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	1	0.99	0.98	0.94	0.87	0.77	0.82	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.18	18.42	18.85	19.48	20.05	20.55	20.8	20.75	20.33	19.59	18.83	18.22	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19	19.02	19.03	19.1	19.11	19.17	19.17	19.18	19.15	19.11	19.09	19.06	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.97	0.91	0.76	0.55	0.62	0.88	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	15.43	15.79	16.42	17.36	18.18	18.87	19.11	19.08	18.6	17.54	16.42	15.51	(90)

fLA = Living area ÷ (4) = 0.17 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	15.9	16.24	16.83	17.72	18.5	19.15	19.39	19.37	18.89	17.89	16.83	15.97	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	15.75	16.09	16.68	17.57	18.35	19	19.24	19.22	18.74	17.74	16.68	15.82	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.88	0.75	0.56	0.62	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1172.16	1524.26	1855.2	2150.6	2231.78	1880.53	1337.02	1355.18	1642.19	1502.01	1214.15	1081.55	(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=	7262.16	7028.81	6334.62	5152.57	3914.57	2486.55	1492.67	1577.77	2663.93	4204.22	5742.14	7095.58	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	4530.96	3699.05	3332.69	2161.42	1251.99	0	0	0	0	2010.45	3260.15	4474.44	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 24721.15 (98)

Space heating requirement in kWh/m²/year 98.53 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)													
	4530.96	3699.05	3332.69	2161.42	1251.99	0	0	0	0	2010.45	3260.15	4474.44	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	4930.31	4025.08	3626.43	2351.93	1362.34	0	0	0	0	2187.65	3547.49	4868.81	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 26900.06 (211)

DER WorkSheet: New dwelling created by change of use

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)

259.53	229.41	242.5	219.56	216.73	179.22	173.06	188.61	187.87	227.56	237.89	254.02

Efficiency of water heater 81.8 (216)

(217)m=	91.29	91.24	91.14	90.87	90.26	81.8	81.8	81.8	81.8	90.76	91.13	91.29	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	284.29	251.43	266.09	241.63	240.13	219.1	211.56	230.58	229.68	250.73	261.03	278.24

Total = Sum(219a)$_{1...12}$ = 2964.49 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		26900.06	
Water heating fuel used		2964.49	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	30	(231)
Electricity for lighting		656.8	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	5810.41	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	640.33	(264)
Space and water heating	(261) + (262) + (263) + (264) =				6450.74	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)
Electricity for lighting	(232)	x	0.519	=	340.88	(268)
Total CO2, kg/year			sum of (265)…(271) =		6807.19	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		27.13	(273)
EI rating (section 14)					69	(274)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 16 - Existing Be Lean - 3B4P - MF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	270	(1a) x	3.28	(2a) =	885.6	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	270	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	885.6	(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							3	x 10 =	30	(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) =	30	÷ (5) =	0.03	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.78	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.73	(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

0.92	0.91	0.89	0.8	0.78	0.69	0.69	0.67	0.73	0.78	0.82	0.85

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=	0.93	0.91	0.89	0.82	0.8	0.74	0.74	0.72	0.76	0.8	0.83	0.86	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.93	0.91	0.89	0.82	0.8	0.74	0.74	0.72	0.76	0.8	0.83	0.86	(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	
Windows Type 1			22.26	x1/[1/(1.8)+ 0.04]		=	37.38			(27)
Windows Type 2			2.47	x1/[1/(1.8)+ 0.04]		=	4.15			(27)
Windows Type 3			2.47	x1/[1/(1.8)+ 0.04]		=	4.15			(27)
Windows Type 4			3.861	x1/[1/(1.8)+ 0.04]		=	6.48			(27)
Windows Type 5			7.356	x1/[1/(1.8)+ 0.04]		=	12.35			(27)
Windows Type 6			10.782	x1/[1/(1.8)+ 0.04]		=	18.1			(27)
Windows Type 7			4.904	x1/[1/(1.8)+ 0.04]		=	8.23			(27)
Walls Type1	258.53	54.1	204.43	x	0.35	=	71.55			(29)
Walls Type2	40.28	0	40.28	x	0.31	=	12.37			(29)
Total area of elements, m²			298.81							(31)
Party wall			17.06	x	0	=	0			(32)
Party floor			271.8							(32a)
Party ceiling			271.8							(32b)

** 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) = 174.76 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 36922.87 (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 44.82 (36)

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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	219.58	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	271.01	266.16	261.41	239.08	234.9	215.46	215.46	211.86	222.95	234.9	243.35	252.19	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	490.59	485.74	480.99	458.66	454.49	435.04	435.04	431.44	442.53	454.49	462.94	471.77	

Average = Sum(39)$_{1...12}$ /12= 458.64 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.82	1.8	1.78	1.7	1.68	1.61	1.61	1.6	1.64	1.68	1.71	1.75	

Average = Sum(40)$_{1...12}$ /12= 1.7 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.09 (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) + 36 107.66 (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=	118.42	114.12	109.81	105.5	101.2	96.89	96.89	101.2	105.5	109.81	114.12	118.42	

Total = Sum(44)$_{1...12}$ = 1291.89 (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=	175.62	153.6	158.5	138.18	132.59	114.41	106.02	121.66	123.11	143.48	156.62	170.08	

Total = Sum(45)$_{1...12}$ = 1693.87 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.34	23.04	23.77	20.73	19.89	17.16	15.9	18.25	18.47	21.52	23.49	25.51	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		305	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)			
Water storage loss:			
a) If manufacturer's declared loss factor is known (kWh/day):		1.63	(48)
Temperature factor from Table 2b		0.6	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.98	(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)		0.98	(55)

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Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	30.32	27.38	30.32	29.34	30.32	29.34	30.32	30.32	29.34	30.32	29.34	30.32	(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=	30.32	27.38	30.32	29.34	30.32	29.34	30.32	30.32	29.34	30.32	29.34	30.32	(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=	54.55	49.27	54.55	52.79	54.55	36.09	37.3	37.3	36.09	54.55	52.79	54.55	(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=	260.49	230.25	243.37	220.32	217.46	179.85	173.64	189.28	188.55	228.35	238.75	254.95	(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=	260.49	230.25	243.37	220.32	217.46	179.85	173.64	189.28	188.55	228.35	238.75	254.95	

Output from water heater (annual)$_{1...12}$ | 2625.25 | (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=	126.29	112.4	120.6	111.65	111.98	90.39	89.34	94.55	93.28	115.6	117.78	124.45	(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=	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	39.55	35.12	28.56	21.63	16.17	13.65	14.75	19.17	25.73	32.67	38.13	40.64	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	433.49	437.99	426.65	402.52	372.06	343.43	324.3	319.8	331.14	355.27	385.73	414.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	(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=	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	(71)

Water heating gains (Table 5)

(72)m=	169.75	167.26	162.09	155.07	150.52	125.54	120.09	127.08	129.56	155.38	163.59	167.27	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	715.18	712.77	689.71	651.61	611.13	555.01	531.53	538.44	558.82	615.71	659.84	694.67	(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	3.86	x	11.28	x	0.55	x	0.65	=	10.79	(75)
Northeast	0.9x	0.54	x	7.36	x	11.28	x	0.55	x	0.65	=	14.42	(75)
Northeast	0.9x	0.77	x	10.78	x	11.28	x	0.55	x	0.65	=	30.14	(75)
Northeast	0.9x	0.54	x	4.9	x	11.28	x	0.55	x	0.65	=	9.61	(75)
Northeast	0.9x	0.77	x	3.86	x	22.97	x	0.55	x	0.65	=	21.97	(75)
Northeast	0.9x	0.54	x	7.36	x	22.97	x	0.55	x	0.65	=	29.35	(75)
Northeast	0.9x	0.77	x	10.78	x	22.97	x	0.55	x	0.65	=	61.35	(75)
Northeast	0.9x	0.54	x	4.9	x	22.97	x	0.55	x	0.65	=	19.57	(75)
Northeast	0.9x	0.77	x	3.86	x	41.38	x	0.55	x	0.65	=	39.58	(75)
Northeast	0.9x	0.54	x	7.36	x	41.38	x	0.55	x	0.65	=	52.88	(75)
Northeast	0.9x	0.77	x	10.78	x	41.38	x	0.55	x	0.65	=	110.53	(75)
Northeast	0.9x	0.54	x	4.9	x	41.38	x	0.55	x	0.65	=	35.26	(75)
Northeast	0.9x	0.77	x	3.86	x	67.96	x	0.55	x	0.65	=	65	(75)
Northeast	0.9x	0.54	x	7.36	x	67.96	x	0.55	x	0.65	=	86.85	(75)
Northeast	0.9x	0.77	x	10.78	x	67.96	x	0.55	x	0.65	=	181.52	(75)
Northeast	0.9x	0.54	x	4.9	x	67.96	x	0.55	x	0.65	=	57.9	(75)
Northeast	0.9x	0.77	x	3.86	x	91.35	x	0.55	x	0.65	=	87.38	(75)
Northeast	0.9x	0.54	x	7.36	x	91.35	x	0.55	x	0.65	=	116.75	(75)
Northeast	0.9x	0.77	x	10.78	x	91.35	x	0.55	x	0.65	=	244	(75)
Northeast	0.9x	0.54	x	4.9	x	91.35	x	0.55	x	0.65	=	77.83	(75)
Northeast	0.9x	0.77	x	3.86	x	97.38	x	0.55	x	0.65	=	93.15	(75)
Northeast	0.9x	0.54	x	7.36	x	97.38	x	0.55	x	0.65	=	124.46	(75)
Northeast	0.9x	0.77	x	10.78	x	97.38	x	0.55	x	0.65	=	260.13	(75)
Northeast	0.9x	0.54	x	4.9	x	97.38	x	0.55	x	0.65	=	82.98	(75)
Northeast	0.9x	0.77	x	3.86	x	91.1	x	0.55	x	0.65	=	87.14	(75)
Northeast	0.9x	0.54	x	7.36	x	91.1	x	0.55	x	0.65	=	116.43	(75)
Northeast	0.9x	0.77	x	10.78	x	91.1	x	0.55	x	0.65	=	243.35	(75)
Northeast	0.9x	0.54	x	4.9	x	91.1	x	0.55	x	0.65	=	77.62	(75)
Northeast	0.9x	0.77	x	3.86	x	72.63	x	0.55	x	0.65	=	69.47	(75)
Northeast	0.9x	0.54	x	7.36	x	72.63	x	0.55	x	0.65	=	92.82	(75)
Northeast	0.9x	0.77	x	10.78	x	72.63	x	0.55	x	0.65	=	194	(75)
Northeast	0.9x	0.54	x	4.9	x	72.63	x	0.55	x	0.65	=	61.88	(75)
Northeast	0.9x	0.77	x	3.86	x	50.42	x	0.55	x	0.65	=	48.23	(75)
Northeast	0.9x	0.54	x	7.36	x	50.42	x	0.55	x	0.65	=	64.44	(75)
Northeast	0.9x	0.77	x	10.78	x	50.42	x	0.55	x	0.65	=	134.68	(75)
Northeast	0.9x	0.54	x	4.9	x	50.42	x	0.55	x	0.65	=	42.96	(75)
Northeast	0.9x	0.77	x	3.86	x	28.07	x	0.55	x	0.65	=	26.85	(75)
Northeast	0.9x	0.54	x	7.36	x	28.07	x	0.55	x	0.65	=	35.87	(75)
Northeast	0.9x	0.77	x	10.78	x	28.07	x	0.55	x	0.65	=	74.97	(75)

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Northeast	0.9x	0.54	x	4.9	x	28.07	x	0.55	x	0.65	=	23.91	(75)
Northeast	0.9x	0.77	x	3.86	x	14.2	x	0.55	x	0.65	=	13.58	(75)
Northeast	0.9x	0.54	x	7.36	x	14.2	x	0.55	x	0.65	=	18.14	(75)
Northeast	0.9x	0.77	x	10.78	x	14.2	x	0.55	x	0.65	=	37.92	(75)
Northeast	0.9x	0.54	x	4.9	x	14.2	x	0.55	x	0.65	=	12.1	(75)
Northeast	0.9x	0.77	x	3.86	x	9.21	x	0.55	x	0.65	=	8.81	(75)
Northeast	0.9x	0.54	x	7.36	x	9.21	x	0.55	x	0.65	=	11.78	(75)
Northeast	0.9x	0.77	x	10.78	x	9.21	x	0.55	x	0.65	=	24.61	(75)
Northeast	0.9x	0.54	x	4.9	x	9.21	x	0.55	x	0.65	=	7.85	(75)
South	0.9x	0.77	x	2.47	x	46.75	x	0.55	x	0.65	=	28.61	(78)
South	0.9x	0.77	x	2.47	x	76.57	x	0.55	x	0.65	=	46.85	(78)
South	0.9x	0.77	x	2.47	x	97.53	x	0.55	x	0.65	=	59.68	(78)
South	0.9x	0.77	x	2.47	x	110.23	x	0.55	x	0.65	=	67.46	(78)
South	0.9x	0.77	x	2.47	x	114.87	x	0.55	x	0.65	=	70.29	(78)
South	0.9x	0.77	x	2.47	x	110.55	x	0.55	x	0.65	=	67.65	(78)
South	0.9x	0.77	x	2.47	x	108.01	x	0.55	x	0.65	=	66.1	(78)
South	0.9x	0.77	x	2.47	x	104.89	x	0.55	x	0.65	=	64.19	(78)
South	0.9x	0.77	x	2.47	x	101.89	x	0.55	x	0.65	=	62.35	(78)
South	0.9x	0.77	x	2.47	x	82.59	x	0.55	x	0.65	=	50.54	(78)
South	0.9x	0.77	x	2.47	x	55.42	x	0.55	x	0.65	=	33.91	(78)
South	0.9x	0.77	x	2.47	x	40.4	x	0.55	x	0.65	=	24.72	(78)
Southwest	0.9x	0.77	x	22.26	x	36.79		0.55	x	0.65	=	202.91	(79)
Southwest	0.9x	0.77	x	22.26	x	62.67		0.55	x	0.65	=	345.64	(79)
Southwest	0.9x	0.77	x	22.26	x	85.75		0.55	x	0.65	=	472.91	(79)
Southwest	0.9x	0.77	x	22.26	x	106.25		0.55	x	0.65	=	585.96	(79)
Southwest	0.9x	0.77	x	22.26	x	119.01		0.55	x	0.65	=	656.33	(79)
Southwest	0.9x	0.77	x	22.26	x	118.15		0.55	x	0.65	=	651.58	(79)
Southwest	0.9x	0.77	x	22.26	x	113.91		0.55	x	0.65	=	628.19	(79)
Southwest	0.9x	0.77	x	22.26	x	104.39		0.55	x	0.65	=	575.7	(79)
Southwest	0.9x	0.77	x	22.26	x	92.85		0.55	x	0.65	=	512.07	(79)
Southwest	0.9x	0.77	x	22.26	x	69.27		0.55	x	0.65	=	382	(79)
Southwest	0.9x	0.77	x	22.26	x	44.07		0.55	x	0.65	=	243.04	(79)
Southwest	0.9x	0.77	x	22.26	x	31.49		0.55	x	0.65	=	173.65	(79)
West	0.9x	0.77	x	2.47	x	19.64	x	0.55	x	0.65	=	12.02	(80)
West	0.9x	0.77	x	2.47	x	38.42	x	0.55	x	0.65	=	23.51	(80)
West	0.9x	0.77	x	2.47	x	63.27	x	0.55	x	0.65	=	38.72	(80)
West	0.9x	0.77	x	2.47	x	92.28	x	0.55	x	0.65	=	56.47	(80)
West	0.9x	0.77	x	2.47	x	113.09	x	0.55	x	0.65	=	69.21	(80)
West	0.9x	0.77	x	2.47	x	115.77	x	0.55	x	0.65	=	70.84	(80)
West	0.9x	0.77	x	2.47	x	110.22	x	0.55	x	0.65	=	67.45	(80)
West	0.9x	0.77	x	2.47	x	94.68	x	0.55	x	0.65	=	57.94	(80)

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West	0.9x	0.77	x	2.47	x	73.59	x	0.55	x	0.65	=	45.03	(80)
West	0.9x	0.77	x	2.47	x	45.59	x	0.55	x	0.65	=	27.9	(80)
West	0.9x	0.77	x	2.47	x	24.49	x	0.55	x	0.65	=	14.99	(80)
West	0.9x	0.77	x	2.47	x	16.15	x	0.55	x	0.65	=	9.88	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	308.51	548.24	809.57	1101.17	1321.79	1350.8	1286.29	1116	909.76	622.04	373.68	261.31	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	1023.68	1261.01	1499.28	1752.78	1932.92	1905.81	1817.82	1654.44	1468.58	1237.76	1033.53	955.98	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.97	0.91	0.81	0.86	0.97	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.78	18.96	19.29	19.79	20.25	20.67	20.86	20.82	20.48	19.89	19.3	18.81	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.46	19.47	19.48	19.54	19.55	19.61	19.61	19.61	19.58	19.55	19.53	19.51	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.95	0.84	0.65	0.72	0.94	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.54	16.82	17.31	18.08	18.75	19.34	19.54	19.52	19.09	18.23	17.35	16.63	(90)

fLA = Living area ÷ (4) = | 0.16 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	16.9	17.16	17.62	18.35	18.99	19.55	19.75	19.73	19.31	18.5	17.66	16.97	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	16.75	17.01	17.47	18.2	18.84	19.4	19.6	19.58	19.16	18.35	17.51	16.82	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.94	0.83	0.65	0.72	0.92	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1022.17	1256.96	1487.67	1714.65	1810.36	1580.37	1178.51	1183.27	1352.85	1221.72	1030.8	954.97	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	6106.28	5880.99	5278.35	4266.27	3243.65	2087	1306.23	1370.95	2239.86	3520.08	4817.35	5955.11	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3782.57	3107.35	2820.27	1837.17	1066.37	0	0	0	0	1709.98	2726.32	3720.1	

Total per year (kWh/year) = $\text{Sum}(98)_{1...5,9...12}$ = | 20770.14 | (98)

Space heating requirement in kWh/m²/year | 76.93 | (99)

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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)	3782.57	3107.35	2820.27	1837.17	1066.37	0	0	0	0	1709.98	2726.32	3720.1		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	4115.97	3381.23	3068.85	1999.1	1160.36	0	0	0	0	1860.7	2966.62	4047.99		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													22600.8	(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)	260.49	230.25	243.37	220.32	217.46	179.85	173.64	189.28	188.55	228.35	238.75	254.95		
Efficiency of water heater													81.8	(216)
(217)m=	91.17	91.12	91.01	90.7	90.02	81.8	81.8	81.8	81.8	90.58	91	91.18		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	285.7	252.68	267.42	242.9	241.58	219.86	212.27	231.39	230.5	252.09	262.38	279.62		
Total = Sum(219a)$_{1...12}$ =													2978.39	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			22600.8	
Water heating fuel used			2978.39	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			698.38	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	4881.77	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	643.33	(264)
Space and water heating	(261) + (262) + (263) + (264) =				5525.11	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)

DER WorkSheet: New dwelling created by change of use

Electricity for lighting	(232) x	0.519	=	362.46 (268)
Total CO2, kg/year		sum of (265)…(271) =		5903.13 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		21.86 (273)
EI rating (section 14)				75 (274)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 24Existing Be Lean - 3B4P - TF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	229	(1a) x	2.76	(2a) =	632.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	229	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	632.04	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.06	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.81	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.75	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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

0.96	0.94	0.92	0.83	0.81	0.71	0.71	0.7	0.75	0.81	0.85	0.88

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.96	0.94	0.92	0.84	0.83	0.76	0.76	0.74	0.78	0.83	0.86	0.89	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.96	0.94	0.92	0.84	0.83	0.76	0.76	0.74	0.78	0.83	0.86	0.89	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			5.71		x1/[1/(1.8)+ 0.04]	=	9.59			(27)
Windows Type 2			1.13		x1/[1/(1.8)+ 0.04]	=	1.9			(27)
Windows Type 3			7.2		x1/[1/(1.8)+ 0.04]	=	12.09			(27)
Windows Type 4			3.08		x1/[1/(1.8)+ 0.04]	=	5.17			(27)
Windows Type 5			3.29		x1/[1/(1.8)+ 0.04]	=	5.52			(27)
Windows Type 6			2.67		x1/[1/(1.8)+ 0.04]	=	4.48			(27)
Windows Type 7			8.172		x1/[1/(1.8)+ 0.04]	=	13.72			(27)
Walls Type1	220.77	31.25	189.52	x	0.35	=	66.33			(29)
Walls Type2	31.6	0	31.6	x	0.31	=	9.7			(29)
Roof	222.14	0	222.14	x	0.16	=	35.54			(30)
Total area of elements, m²			474.51							(31)
Party wall			14.63	x	0	=	0			(32)
Party floor			222.14							(32a)

** 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) = 164.05 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27021.66 (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 71.18 (36)

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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 235.23 (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=	200.23	196.51	192.85	175.7	172.49	157.55	157.55	154.79	163.31	172.49	178.98	185.77	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	435.46	431.73	428.08	410.93	407.72	392.78	392.78	390.01	398.54	407.72	414.21	421	

Average = Sum(39)$_{1...12}$ /12= 410.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.9	1.89	1.87	1.79	1.78	1.72	1.72	1.7	1.74	1.78	1.81	1.84	

Average = Sum(40)$_{1...12}$ /12= 1.79 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 106.39 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	117.03	112.77	108.52	104.26	100.01	95.75	95.75	100.01	104.26	108.52	112.77	117.03	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Total = Sum(44)$_{1...12}$ = 1276.69 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	173.55	151.79	156.63	136.56	131.03	113.07	104.77	120.23	121.67	141.79	154.78	168.08	

Total = Sum(45)$_{1...12}$ = 1673.95 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.03	22.77	23.5	20.48	19.65	16.96	15.72	18.03	18.25	21.27	23.22	25.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 305 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.63 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.98 (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) 0.98 (55)

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Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	30.32	27.38	30.32	29.34	30.32	29.34	30.32	30.32	29.34	30.32	29.34	30.32	(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=	30.32	27.38	30.32	29.34	30.32	29.34	30.32	30.32	29.34	30.32	29.34	30.32	(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=	54.55	49.27	54.55	52.79	54.55	36.09	37.3	37.3	36.09	54.55	52.79	54.55	(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=	258.42	228.45	241.51	218.69	215.9	178.5	172.39	187.85	187.1	226.66	236.91	252.95	(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=	258.42	228.45	241.51	218.69	215.9	178.5	172.39	187.85	187.1	226.66	236.91	252.95	

Output from water heater (annual)$_{1...12}$ 2605.33 (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=	125.6	111.8	119.98	111.11	111.46	89.94	88.93	94.07	92.8	115.04	117.17	123.78	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	39.53	35.11	28.55	21.62	16.16	13.64	14.74	19.16	25.72	32.66	38.11	40.63	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	397.84	401.96	391.56	369.41	341.46	315.18	297.63	293.5	303.9	326.05	354.01	380.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	(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=	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	(71)

Water heating gains (Table 5)

(72)m=	168.82	166.36	161.26	154.32	149.82	124.92	119.53	126.44	128.89	154.63	162.74	166.37	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	677.78	675.03	652.97	616.95	579.03	525.34	503.49	510.69	530.11	584.93	626.45	658.88	(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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DER WorkSheet: New dwelling created by change of use

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	3.08	x	11.28	x	0.55	x	0.65	=	8.61	(75)
Northeast	0.9x	0.54	x	3.29	x	11.28	x	0.55	x	0.65	=	6.45	(75)
Northeast	0.9x	0.77	x	2.67	x	11.28	x	0.55	x	0.65	=	7.46	(75)
Northeast	0.9x	0.54	x	8.17	x	11.28	x	0.55	x	0.65	=	16.02	(75)
Northeast	0.9x	0.77	x	3.08	x	22.97	x	0.55	x	0.65	=	17.53	(75)
Northeast	0.9x	0.54	x	3.29	x	22.97	x	0.55	x	0.65	=	13.13	(75)
Northeast	0.9x	0.77	x	2.67	x	22.97	x	0.55	x	0.65	=	15.19	(75)
Northeast	0.9x	0.54	x	8.17	x	22.97	x	0.55	x	0.65	=	32.61	(75)
Northeast	0.9x	0.77	x	3.08	x	41.38	x	0.55	x	0.65	=	31.57	(75)
Northeast	0.9x	0.54	x	3.29	x	41.38	x	0.55	x	0.65	=	23.65	(75)
Northeast	0.9x	0.77	x	2.67	x	41.38	x	0.55	x	0.65	=	27.37	(75)
Northeast	0.9x	0.54	x	8.17	x	41.38	x	0.55	x	0.65	=	58.75	(75)
Northeast	0.9x	0.77	x	3.08	x	67.96	x	0.55	x	0.65	=	51.85	(75)
Northeast	0.9x	0.54	x	3.29	x	67.96	x	0.55	x	0.65	=	38.84	(75)
Northeast	0.9x	0.77	x	2.67	x	67.96	x	0.55	x	0.65	=	44.95	(75)
Northeast	0.9x	0.54	x	8.17	x	67.96	x	0.55	x	0.65	=	96.49	(75)
Northeast	0.9x	0.77	x	3.08	x	91.35	x	0.55	x	0.65	=	69.7	(75)
Northeast	0.9x	0.54	x	3.29	x	91.35	x	0.55	x	0.65	=	52.22	(75)
Northeast	0.9x	0.77	x	2.67	x	91.35	x	0.55	x	0.65	=	60.42	(75)
Northeast	0.9x	0.54	x	8.17	x	91.35	x	0.55	x	0.65	=	129.7	(75)
Northeast	0.9x	0.77	x	3.08	x	97.38	x	0.55	x	0.65	=	74.31	(75)
Northeast	0.9x	0.54	x	3.29	x	97.38	x	0.55	x	0.65	=	55.67	(75)
Northeast	0.9x	0.77	x	2.67	x	97.38	x	0.55	x	0.65	=	64.42	(75)
Northeast	0.9x	0.54	x	8.17	x	97.38	x	0.55	x	0.65	=	138.27	(75)
Northeast	0.9x	0.77	x	3.08	x	91.1	x	0.55	x	0.65	=	69.52	(75)
Northeast	0.9x	0.54	x	3.29	x	91.1	x	0.55	x	0.65	=	52.08	(75)
Northeast	0.9x	0.77	x	2.67	x	91.1	x	0.55	x	0.65	=	60.26	(75)
Northeast	0.9x	0.54	x	8.17	x	91.1	x	0.55	x	0.65	=	129.35	(75)
Northeast	0.9x	0.77	x	3.08	x	72.63	x	0.55	x	0.65	=	55.42	(75)
Northeast	0.9x	0.54	x	3.29	x	72.63	x	0.55	x	0.65	=	41.52	(75)
Northeast	0.9x	0.77	x	2.67	x	72.63	x	0.55	x	0.65	=	48.04	(75)
Northeast	0.9x	0.54	x	8.17	x	72.63	x	0.55	x	0.65	=	103.12	(75)
Northeast	0.9x	0.77	x	3.08	x	50.42	x	0.55	x	0.65	=	38.47	(75)
Northeast	0.9x	0.54	x	3.29	x	50.42	x	0.55	x	0.65	=	28.82	(75)
Northeast	0.9x	0.77	x	2.67	x	50.42	x	0.55	x	0.65	=	33.35	(75)
Northeast	0.9x	0.54	x	8.17	x	50.42	x	0.55	x	0.65	=	71.59	(75)
Northeast	0.9x	0.77	x	3.08	x	28.07	x	0.55	x	0.65	=	21.42	(75)
Northeast	0.9x	0.54	x	3.29	x	28.07	x	0.55	x	0.65	=	16.04	(75)
Northeast	0.9x	0.77	x	2.67	x	28.07	x	0.55	x	0.65	=	18.57	(75)

DER WorkSheet: New dwelling created by change of use

Northeast	0.9x	0.54	x	8.17	x	28.07	x	0.55	x	0.65	=	39.85	(75)
Northeast	0.9x	0.77	x	3.08	x	14.2	x	0.55	x	0.65	=	10.83	(75)
Northeast	0.9x	0.54	x	3.29	x	14.2	x	0.55	x	0.65	=	8.12	(75)
Northeast	0.9x	0.77	x	2.67	x	14.2	x	0.55	x	0.65	=	9.39	(75)
Northeast	0.9x	0.54	x	8.17	x	14.2	x	0.55	x	0.65	=	20.16	(75)
Northeast	0.9x	0.77	x	3.08	x	9.21	x	0.55	x	0.65	=	7.03	(75)
Northeast	0.9x	0.54	x	3.29	x	9.21	x	0.55	x	0.65	=	5.27	(75)
Northeast	0.9x	0.77	x	2.67	x	9.21	x	0.55	x	0.65	=	6.1	(75)
Northeast	0.9x	0.54	x	8.17	x	9.21	x	0.55	x	0.65	=	13.08	(75)
Southwest	0.9x	0.77	x	5.71	x	36.79		0.55	x	0.65	=	52.05	(79)
Southwest	0.9x	0.77	x	1.13	x	36.79		0.55	x	0.65	=	10.3	(79)
Southwest	0.9x	0.77	x	7.2	x	36.79		0.55	x	0.65	=	65.63	(79)
Southwest	0.9x	0.77	x	5.71	x	62.67		0.55	x	0.65	=	88.66	(79)
Southwest	0.9x	0.77	x	1.13	x	62.67		0.55	x	0.65	=	17.55	(79)
Southwest	0.9x	0.77	x	7.2	x	62.67		0.55	x	0.65	=	111.8	(79)
Southwest	0.9x	0.77	x	5.71	x	85.75		0.55	x	0.65	=	121.31	(79)
Southwest	0.9x	0.77	x	1.13	x	85.75		0.55	x	0.65	=	24.01	(79)
Southwest	0.9x	0.77	x	7.2	x	85.75		0.55	x	0.65	=	152.96	(79)
Southwest	0.9x	0.77	x	5.71	x	106.25		0.55	x	0.65	=	150.31	(79)
Southwest	0.9x	0.77	x	1.13	x	106.25		0.55	x	0.65	=	29.75	(79)
Southwest	0.9x	0.77	x	7.2	x	106.25		0.55	x	0.65	=	189.53	(79)
Southwest	0.9x	0.77	x	5.71	x	119.01		0.55	x	0.65	=	168.36	(79)
Southwest	0.9x	0.77	x	1.13	x	119.01		0.55	x	0.65	=	33.32	(79)
Southwest	0.9x	0.77	x	7.2	x	119.01		0.55	x	0.65	=	212.29	(79)
Southwest	0.9x	0.77	x	5.71	x	118.15		0.55	x	0.65	=	167.14	(79)
Southwest	0.9x	0.77	x	1.13	x	118.15		0.55	x	0.65	=	33.08	(79)
Southwest	0.9x	0.77	x	7.2	x	118.15		0.55	x	0.65	=	210.75	(79)
Southwest	0.9x	0.77	x	5.71	x	113.91		0.55	x	0.65	=	161.14	(79)
Southwest	0.9x	0.77	x	1.13	x	113.91		0.55	x	0.65	=	31.89	(79)
Southwest	0.9x	0.77	x	7.2	x	113.91		0.55	x	0.65	=	203.19	(79)
Southwest	0.9x	0.77	x	5.71	x	104.39		0.55	x	0.65	=	147.67	(79)
Southwest	0.9x	0.77	x	1.13	x	104.39		0.55	x	0.65	=	29.22	(79)
Southwest	0.9x	0.77	x	7.2	x	104.39		0.55	x	0.65	=	186.21	(79)
Southwest	0.9x	0.77	x	5.71	x	92.85		0.55	x	0.65	=	131.35	(79)
Southwest	0.9x	0.77	x	1.13	x	92.85		0.55	x	0.65	=	25.99	(79)
Southwest	0.9x	0.77	x	7.2	x	92.85		0.55	x	0.65	=	165.63	(79)
Southwest	0.9x	0.77	x	5.71	x	69.27		0.55	x	0.65	=	97.99	(79)
Southwest	0.9x	0.77	x	1.13	x	69.27		0.55	x	0.65	=	19.39	(79)
Southwest	0.9x	0.77	x	7.2	x	69.27		0.55	x	0.65	=	123.56	(79)
Southwest	0.9x	0.77	x	5.71	x	44.07		0.55	x	0.65	=	62.34	(79)
Southwest	0.9x	0.77	x	1.13	x	44.07		0.55	x	0.65	=	12.34	(79)

DER WorkSheet: New dwelling created by change of use

Southwest0.9x	0.77	x	7.2	x	44.07		0.55	x	0.65	=	78.61	(79)
Southwest0.9x	0.77	x	5.71	x	31.49		0.55	x	0.65	=	44.54	(79)
Southwest0.9x	0.77	x	1.13	x	31.49		0.55	x	0.65	=	8.82	(79)
Southwest0.9x	0.77	x	7.2	x	31.49		0.55	x	0.65	=	56.17	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	166.53	296.46	439.63	601.72	726	743.64	707.42	611.2	495.21	336.82	201.79	141	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	844.31	971.49	1092.6	1218.67	1305.03	1268.98	1210.92	1121.9	1025.32	921.74	828.24	799.88	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	1	0.99	0.96	0.9	0.93	0.98	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.68	18.84	19.14	19.62	20.08	20.52	20.76	20.72	20.35	19.78	19.19	18.71	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.4	19.41	19.42	19.47	19.48	19.53	19.53	19.54	19.51	19.48	19.46	19.44	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.98	0.92	0.77	0.82	0.96	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.37	16.61	17.06	17.79	18.46	19.11	19.41	19.37	18.88	18.03	17.16	16.44	(90)

fLA = Living area ÷ (4) = 0.15 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	16.72	16.94	17.37	18.06	18.7	19.32	19.61	19.57	19.1	18.29	17.46	16.78	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	16.57	16.79	17.22	17.91	18.55	19.17	19.46	19.42	18.95	18.14	17.31	16.63	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.99	0.96	0.9	0.76	0.81	0.95	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	843.05	968.99	1086.93	1203.28	1258.73	1140.67	916.48	905.71	975.4	913.26	826.23	798.97	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	5341.39	5132.91	4590.48	3703.12	2793.41	1794.58	1123.72	1179.41	1932.44	3073.2	4230.91	5234.41	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3346.77	2798.16	2606.64	1799.88	1141.8	0	0	0	0	1607	2451.37	3299.97	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 19051.59 (98)

Space heating requirement in kWh/m²/year 83.19 (99)

DER WorkSheet: New dwelling created by change of use

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		91.9	(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)	3346.77	2798.16	2606.64	1799.88	1141.8	0	0	0	0	1607	2451.37	3299.97		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	3641.75	3044.79	2836.39	1958.52	1242.44	0	0	0	0	1748.64	2667.43	3590.82		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													20730.78	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	258.42	228.45	241.51	218.69	215.9	178.5	172.39	187.85	187.1	226.66	236.91	252.95		
Efficiency of water heater													81.8	(216)
(217)m=	91.09	91.05	90.95	90.69	90.13	81.8	81.8	81.8	81.8	90.52	90.91	91.1		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	283.69	250.9	265.54	241.15	239.54	218.22	210.75	229.64	228.73	250.4	260.6	277.66		
Total = Sum(219a)$_{1...12}$ =													2956.83	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			20730.78	
Water heating fuel used			2956.83	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			698.14	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	4477.85	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	638.68	(264)
Space and water heating	(261) + (262) + (263) + (264) =				5116.52	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)

DER WorkSheet: New dwelling created by change of use

Electricity for lighting	(232) x	0.519	=	362.33 (268)
Total CO2, kg/year		sum of (265)…(271) =		5494.43 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		23.99 (273)
EI rating (section 14)				73 (274)

APPENDIX VIII – BE-GREEN DER WORKSHEETS (REFURB)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.23

Property Address: Flat 1 - Existing Be-Green - 3B6P - GF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	178	(1a) x	2.9	(2a) =	516.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	178	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	516.2	(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							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

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			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.06	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.81	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.75	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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 created by change of use

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.95	0.93	0.92	0.82	0.8	0.71	0.71	0.69	0.75	0.8	0.84	0.88

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.95	0.94	0.92	0.84	0.82	0.75	0.75	0.74	0.78	0.82	0.85	0.89	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.95	0.94	0.92	0.84	0.82	0.75	0.75	0.74	0.78	0.82	0.85	0.89	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			10.698	x1/[1/(1.8)+ 0.04]		=	17.96			(27)
Windows Type 2			3.14	x1/[1/(1.8)+ 0.04]		=	5.27			(27)
Windows Type 3			3.61	x1/[1/(1.8)+ 0.04]		=	6.06			(27)
Floor			178.51	x	0.25	=	44.6275			(28)
Walls	134.39	17.45	116.94	x	0.35	=	40.93			(29)
Roof	51.42	0	51.42	x	0.16	=	8.23			(30)
Total area of elements, m²			364.32							(31)
Party wall			54.81	x	0	=	0			(32)
Party ceiling			127.04							(32b)

** 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) = 123.08 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 34562.19 (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 54.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 177.73 (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=	162.54	159.54	156.59	142.76	140.17	128.12	128.12	125.89	132.76	140.17	145.41	150.88	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	340.27	337.26	334.32	320.49	317.9	305.85	305.85	303.62	310.49	317.9	323.13	328.61	

Average = Sum(39)1…12 /12= 320.47 (39)

DER WorkSheet: New dwelling created by change of use

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.91	1.89	1.88	1.8	1.79	1.72	1.72	1.71	1.74	1.79	1.82	1.85

Average = Sum(40)$_{1...12}$ /12= 1.8 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31

(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.97 (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) + 36 104.81 (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=	115.29	111.1	106.91	102.72	98.52	94.33	94.33	98.52	102.72	106.91	111.1	115.29

Total = Sum(44)$_{1...12}$ = 1257.76 (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=	170.98	149.54	154.31	134.53	129.09	111.39	103.22	118.45	119.86	139.69	152.48	165.58

Total = Sum(45)$_{1...12}$ = 1649.12 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.65	22.43	23.15	20.18	19.36	16.71	15.48	17.77	17.98	20.95	22.87	24.84

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 305 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.63 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.88 (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) 0.88 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29

(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29

(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	37.3	33.69	37.3	36.09	37.3	36.09	37.3	37.3	36.09	37.3	36.09	37.3

(59)

DER WorkSheet: New dwelling created by change of use

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=	235.56	207.87	218.89	197.03	193.67	173.89	167.8	183.03	182.36	204.27	214.98	230.17	(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=	235.56	207.87	218.89	197.03	193.67	173.89	167.8	183.03	182.36	204.27	214.98	230.17	

Output from water heater (annual)$_{1...12}$ 2409.54 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	108.52	96.39	102.98	94.73	94.59	87.04	85.99	91.05	89.85	98.11	100.7	106.72	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	148.66	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	36.99	32.86	26.72	20.23	15.12	12.77	13.79	17.93	24.07	30.56	35.67	38.02	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	349.62	353.25	344.11	324.65	300.08	276.99	261.56	257.93	267.07	286.54	311.11	334.2	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	(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=	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	-118.93	(71)

Water heating gains (Table 5)

(72)m=	145.86	143.44	138.41	131.57	127.14	120.89	115.58	122.38	124.8	131.87	139.86	143.45	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	600.07	597.14	576.84	544.05	509.93	478.24	458.53	465.84	483.54	516.57	554.23	583.26	(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	3.14	x	11.28	x	0.55	x	0.65	=	8.78	(75)
Northeast 0.9x	0.54	x	3.61	x	11.28	x	0.55	x	0.65	=	7.08	(75)
Northeast 0.9x	0.77	x	3.14	x	22.97	x	0.55	x	0.65	=	17.87	(75)
Northeast 0.9x	0.54	x	3.61	x	22.97	x	0.55	x	0.65	=	14.41	(75)
Northeast 0.9x	0.77	x	3.14	x	41.38	x	0.55	x	0.65	=	32.19	(75)

DER WorkSheet: New dwelling created by change of use

Northeast	0.9x	0.54	x	3.61	x	41.38	x	0.55	x	0.65	=	25.95	(75)
Northeast	0.9x	0.77	x	3.14	x	67.96	x	0.55	x	0.65	=	52.86	(75)
Northeast	0.9x	0.54	x	3.61	x	67.96	x	0.55	x	0.65	=	42.62	(75)
Northeast	0.9x	0.77	x	3.14	x	91.35	x	0.55	x	0.65	=	71.06	(75)
Northeast	0.9x	0.54	x	3.61	x	91.35	x	0.55	x	0.65	=	57.29	(75)
Northeast	0.9x	0.77	x	3.14	x	97.38	x	0.55	x	0.65	=	75.76	(75)
Northeast	0.9x	0.54	x	3.61	x	97.38	x	0.55	x	0.65	=	61.08	(75)
Northeast	0.9x	0.77	x	3.14	x	91.1	x	0.55	x	0.65	=	70.87	(75)
Northeast	0.9x	0.54	x	3.61	x	91.1	x	0.55	x	0.65	=	57.14	(75)
Northeast	0.9x	0.77	x	3.14	x	72.63	x	0.55	x	0.65	=	56.5	(75)
Northeast	0.9x	0.54	x	3.61	x	72.63	x	0.55	x	0.65	=	45.55	(75)
Northeast	0.9x	0.77	x	3.14	x	50.42	x	0.55	x	0.65	=	39.22	(75)
Northeast	0.9x	0.54	x	3.61	x	50.42	x	0.55	x	0.65	=	31.62	(75)
Northeast	0.9x	0.77	x	3.14	x	28.07	x	0.55	x	0.65	=	21.83	(75)
Northeast	0.9x	0.54	x	3.61	x	28.07	x	0.55	x	0.65	=	17.6	(75)
Northeast	0.9x	0.77	x	3.14	x	14.2	x	0.55	x	0.65	=	11.04	(75)
Northeast	0.9x	0.54	x	3.61	x	14.2	x	0.55	x	0.65	=	8.9	(75)
Northeast	0.9x	0.77	x	3.14	x	9.21	x	0.55	x	0.65	=	7.17	(75)
Northeast	0.9x	0.54	x	3.61	x	9.21	x	0.55	x	0.65	=	5.78	(75)
Southwest	0.9x	0.77	x	10.7	x	36.79		0.55	x	0.65	=	97.52	(79)
Southwest	0.9x	0.77	x	10.7	x	62.67		0.55	x	0.65	=	166.11	(79)
Southwest	0.9x	0.77	x	10.7	x	85.75		0.55	x	0.65	=	227.28	(79)
Southwest	0.9x	0.77	x	10.7	x	106.25		0.55	x	0.65	=	281.61	(79)
Southwest	0.9x	0.77	x	10.7	x	119.01		0.55	x	0.65	=	315.43	(79)
Southwest	0.9x	0.77	x	10.7	x	118.15		0.55	x	0.65	=	313.15	(79)
Southwest	0.9x	0.77	x	10.7	x	113.91		0.55	x	0.65	=	301.91	(79)
Southwest	0.9x	0.77	x	10.7	x	104.39		0.55	x	0.65	=	276.68	(79)
Southwest	0.9x	0.77	x	10.7	x	92.85		0.55	x	0.65	=	246.1	(79)
Southwest	0.9x	0.77	x	10.7	x	69.27		0.55	x	0.65	=	183.59	(79)
Southwest	0.9x	0.77	x	10.7	x	44.07		0.55	x	0.65	=	116.8	(79)
Southwest	0.9x	0.77	x	10.7	x	31.49		0.55	x	0.65	=	83.46	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	113.37	198.38	285.42	377.1	443.78	449.98	429.92	378.73	316.94	223.03	136.75	96.4	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	713.44	795.52	862.26	921.14	953.71	928.22	888.44	844.57	800.48	739.59	690.98	679.66	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	1	0.99	0.97	0.91	0.93	0.98	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.74	18.85	19.15	19.59	20.05	20.5	20.75	20.71	20.35	19.79	19.19	18.74	(87)

DER WorkSheet: New dwelling created by change of use

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.39	19.4	19.42	19.47	19.48	19.53	19.53	19.54	19.51	19.48	19.46	19.44	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.98	0.93	0.79	0.83	0.96	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.39	16.62	17.06	17.76	18.41	19.08	19.39	19.36	18.88	18.03	17.18	16.47	(90)

fLA = Living area ÷ (4) = 0.28 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.05	17.24	17.64	18.27	18.87	19.47	19.77	19.74	19.29	18.53	17.75	17.11	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.05	17.24	17.64	18.27	18.87	19.47	19.77	19.74	19.29	18.53	17.75	17.11	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.97	0.93	0.82	0.85	0.96	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	712.21	793.37	858.09	911.73	929.04	860.02	728.7	720.72	767.98	733.18	689.13	678.74	(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=	4338.73	4162.72	3725.47	3004.55	2280.48	1490.99	970.29	1014.15	1611.37	2519.87	3440.51	4241.28	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	2698.13	2264.2	2133.33	1506.83	1005.47	0	0	0	0	1329.3	1980.99	2650.53	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 15568.79 (98)

Space heating requirement in kWh/m²/year 87.47 (99)

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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		387.54	(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)													
	2698.13	2264.2	2133.33	1506.83	1005.47	0	0	0	0	1329.3	1980.99	2650.53	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	696.22	584.25	550.48	388.82	259.45	0	0	0	0	343.01	511.17	683.94	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 4017.36 (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 created by change of use

Water heating

Output from water heater (calculated above)

235.56	207.87	218.89	197.03	193.67	173.89	167.8	183.03	182.36	204.27	214.98	230.17

Efficiency of water heater 300.39 (216)

(217)m=	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	78.42	69.2	72.87	65.59	64.47	57.89	55.86	60.93	60.71	68	71.57	76.62

Total = Sum(219a)$_{1...12}$ = 802.14 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4017.36	
Water heating fuel used			802.14	
Electricity for pumps, fans and electric keep-hot				
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		0	(231)
Electricity for lighting			653.31	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	2085.01	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	416.31	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2501.32	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	0	(267)
Electricity for lighting	(232)	x	0.519	=	339.07	(268)
Total CO2, kg/year			sum of (265)…(271) =		2840.39	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		15.96	(273)
EI rating (section 14)					83	(274)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 2 - Existing Be-Green - 4B8P - GF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	227.6	(1a) x	2.9	(2a) =	660.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	227.6	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	660.04	(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							5	x 10 =	50	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50	÷ (5) =	0.08	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.83	(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) =	0.7	(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

DER WorkSheet: New dwelling created by change of use

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.89	0.88	0.86	0.77	0.75	0.67	0.67	0.65	0.7	0.75	0.79	0.82

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=	0.9	0.88	0.87	0.8	0.78	0.72	0.72	0.71	0.75	0.78	0.81	0.84	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.9	0.88	0.87	0.8	0.78	0.72	0.72	0.71	0.75	0.78	0.81	0.84	(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	
Windows Type 1			3.77	x1/[1/(1.8)+ 0.04]	=	6.33			(27)
Windows Type 2			3.77	x1/[1/(1.8)+ 0.04]	=	6.33			(27)
Windows Type 3			3.77	x1/[1/(1.8)+ 0.04]	=	6.33			(27)
Windows Type 4			4.94	x1/[1/(1.8)+ 0.04]	=	8.29			(27)
Floor			227.5	x 0.25	=	56.875			(28)
Walls Type1	94.68	16.25	78.43	x 0.35	=	27.45			(29)
Walls Type2	53.48	0	53.48	x 0.31	=	16.42			(29)
Roof	104.54	0	104.54	x 0.16	=	16.73			(30)
Total area of elements, m²			480.2						(31)
Party wall			83.58	x 0	=	0			(32)
Party ceiling			122.96						(32b)

** 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) = 144.76 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 42649.44 (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 72.03 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 216.79 (37)

DER WorkSheet: New dwelling created by change of use

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=	196.13	192.74	189.42	173.83	170.91	157.33	157.33	154.81	162.56	170.91	176.81	182.98	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	412.91	409.53	406.21	390.61	387.7	374.12	374.12	371.6	379.35	387.7	393.6	399.77	

Average = Sum(39)$_{1…12}$ /12= 390.6 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.81	1.8	1.78	1.72	1.7	1.64	1.64	1.63	1.67	1.7	1.73	1.76	

Average = Sum(40)$_{1…12}$ /12= 1.72 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 106.35 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	116.98	112.73	108.47	104.22	99.97	95.71	95.71	99.97	104.22	108.47	112.73	116.98	

Total = Sum(44)$_{1…12}$ = 1276.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	173.48	151.73	156.57	136.5	130.98	113.02	104.73	120.18	121.62	141.73	154.71	168.01	

Total = Sum(45)$_{1…12}$ = 1673.27 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.02	22.76	23.49	20.48	19.65	16.95	15.71	18.03	18.24	21.26	23.21	25.2	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 305 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.63 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.88 (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) 0.88 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(56)

DER WorkSheet: New dwelling created by change of use

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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	37.3	33.69	37.3	36.09	37.3	36.09	37.3	37.3	36.09	37.3	36.09	37.3	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	238.07	210.06	221.15	199	195.56	175.52	169.32	184.77	184.12	206.32	217.21	232.59	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	238.07	210.06	221.15	199	195.56	175.52	169.32	184.77	184.12	206.32	217.21	232.59

Output from water heater (annual)$_{1...12}$ | 2433.69 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	109.35	97.12	103.73	95.39	95.22	87.58	86.49	91.63	90.44	98.79	101.44	107.53	(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=	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	151.89	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	45.54	40.45	32.9	24.9	18.62	15.72	16.98	22.07	29.63	37.62	43.91	46.81	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	396.58	400.69	390.32	368.24	340.38	314.18	296.69	292.57	302.94	325.02	352.89	379.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	38.19	(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=	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	-121.51	(71)

Water heating gains (Table 5)

(72)m=	146.98	144.52	139.42	132.48	127.98	121.64	116.25	123.16	125.61	132.79	140.89	144.53	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	657.66	654.23	631.2	594.2	555.54	520.11	498.49	506.37	526.74	563.99	606.25	638.98	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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Northeast	0.9x	0.54	x	4.94	x	11.28	x	0.55	x	0.65	=	9.68	(75)
Northeast	0.9x	0.54	x	4.94	x	22.97	x	0.55	x	0.65	=	19.71	(75)
Northeast	0.9x	0.54	x	4.94	x	41.38	x	0.55	x	0.65	=	35.52	(75)
Northeast	0.9x	0.54	x	4.94	x	67.96	x	0.55	x	0.65	=	58.33	(75)
Northeast	0.9x	0.54	x	4.94	x	91.35	x	0.55	x	0.65	=	78.4	(75)
Northeast	0.9x	0.54	x	4.94	x	97.38	x	0.55	x	0.65	=	83.59	(75)
Northeast	0.9x	0.54	x	4.94	x	91.1	x	0.55	x	0.65	=	78.19	(75)
Northeast	0.9x	0.54	x	4.94	x	72.63	x	0.55	x	0.65	=	62.34	(75)
Northeast	0.9x	0.54	x	4.94	x	50.42	x	0.55	x	0.65	=	43.28	(75)
Northeast	0.9x	0.54	x	4.94	x	28.07	x	0.55	x	0.65	=	24.09	(75)
Northeast	0.9x	0.54	x	4.94	x	14.2	x	0.55	x	0.65	=	12.19	(75)
Northeast	0.9x	0.54	x	4.94	x	9.21	x	0.55	x	0.65	=	7.91	(75)
South	0.9x	0.54	x	3.77	x	46.75	x	0.55	x	0.65	=	30.62	(78)
South	0.9x	0.54	x	3.77	x	76.57	x	0.55	x	0.65	=	50.15	(78)
South	0.9x	0.54	x	3.77	x	97.53	x	0.55	x	0.65	=	63.89	(78)
South	0.9x	0.54	x	3.77	x	110.23	x	0.55	x	0.65	=	72.21	(78)
South	0.9x	0.54	x	3.77	x	114.87	x	0.55	x	0.65	=	75.24	(78)
South	0.9x	0.54	x	3.77	x	110.55	x	0.55	x	0.65	=	72.41	(78)
South	0.9x	0.54	x	3.77	x	108.01	x	0.55	x	0.65	=	70.75	(78)
South	0.9x	0.54	x	3.77	x	104.89	x	0.55	x	0.65	=	68.71	(78)
South	0.9x	0.54	x	3.77	x	101.89	x	0.55	x	0.65	=	66.74	(78)
South	0.9x	0.54	x	3.77	x	82.59	x	0.55	x	0.65	=	54.1	(78)
South	0.9x	0.54	x	3.77	x	55.42	x	0.55	x	0.65	=	36.3	(78)
South	0.9x	0.54	x	3.77	x	40.4	x	0.55	x	0.65	=	26.46	(78)
Southwest	0.9x	0.54	x	3.77	x	36.79		0.55	x	0.65	=	24.1	(79)
Southwest	0.9x	0.54	x	3.77	x	62.67		0.55	x	0.65	=	41.05	(79)
Southwest	0.9x	0.54	x	3.77	x	85.75		0.55	x	0.65	=	56.17	(79)
Southwest	0.9x	0.54	x	3.77	x	106.25		0.55	x	0.65	=	69.6	(79)
Southwest	0.9x	0.54	x	3.77	x	119.01		0.55	x	0.65	=	77.95	(79)
Southwest	0.9x	0.54	x	3.77	x	118.15		0.55	x	0.65	=	77.39	(79)
Southwest	0.9x	0.54	x	3.77	x	113.91		0.55	x	0.65	=	74.61	(79)
Southwest	0.9x	0.54	x	3.77	x	104.39		0.55	x	0.65	=	68.38	(79)
Southwest	0.9x	0.54	x	3.77	x	92.85		0.55	x	0.65	=	60.82	(79)
Southwest	0.9x	0.54	x	3.77	x	69.27		0.55	x	0.65	=	45.37	(79)
Southwest	0.9x	0.54	x	3.77	x	44.07		0.55	x	0.65	=	28.87	(79)
Southwest	0.9x	0.54	x	3.77	x	31.49		0.55	x	0.65	=	20.63	(79)
West	0.9x	0.54	x	3.77	x	19.64	x	0.55	x	0.65	=	12.86	(80)
West	0.9x	0.54	x	3.77	x	38.42	x	0.55	x	0.65	=	25.17	(80)
West	0.9x	0.54	x	3.77	x	63.27	x	0.55	x	0.65	=	41.45	(80)
West	0.9x	0.54	x	3.77	x	92.28	x	0.55	x	0.65	=	60.45	(80)
West	0.9x	0.54	x	3.77	x	113.09	x	0.55	x	0.65	=	74.08	(80)

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West	0.9x	0.54	x	3.77	x	115.77	x	0.55	x	0.65	=	75.83	(80)
West	0.9x	0.54	x	3.77	x	110.22	x	0.55	x	0.65	=	72.2	(80)
West	0.9x	0.54	x	3.77	x	94.68	x	0.55	x	0.65	=	62.01	(80)
West	0.9x	0.54	x	3.77	x	73.59	x	0.55	x	0.65	=	48.2	(80)
West	0.9x	0.54	x	3.77	x	45.59	x	0.55	x	0.65	=	29.86	(80)
West	0.9x	0.54	x	3.77	x	24.49	x	0.55	x	0.65	=	16.04	(80)
West	0.9x	0.54	x	3.77	x	16.15	x	0.55	x	0.65	=	10.58	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	77.27	136.08	197.02	260.57	305.68	309.22	295.75	261.44	219.04	153.42	93.39	65.57	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	734.93	790.31	828.22	854.77	861.22	829.33	794.24	767.8	745.78	717.41	699.65	704.56	(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	1	1	1	1	0.99	0.97	0.97	0.99	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.17	18.86	19.13	19.54	19.97	20.41	20.67	20.64	20.29	19.76	19.2	18.77	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.46	19.47	19.48	19.53	19.54	19.58	19.58	19.59	19.56	19.54	19.52	19.5	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	1	0.99	0.97	0.9	0.92	0.99	1	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.48	16.67	17.07	17.72	18.34	19	19.36	19.33	18.83	18.03	17.23	16.55	(90)

fLA = Living area ÷ (4) = 0.22 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.08	17.16	17.53	18.13	18.7	19.31	19.65	19.62	19.15	18.42	17.67	17.05	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.08	17.16	17.53	18.13	18.7	19.31	19.65	19.62	19.15	18.42	17.67	17.05	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	1	0.99	0.97	0.91	0.93	0.98	1	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	734.36	789.41	826.65	851.58	852.96	803.95	721.03	710.9	732.75	714.82	698.82	704.11	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	5278.24	5021.35	4481.66	3604.53	2715.74	1762.77	1142.09	1195.94	1916.64	3030.22	4160.65	5137.26	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3380.65	2843.86	2719.33	1982.12	1385.91	0	0	0	0	1722.65	2492.52	3298.26	

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	Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	19825.3	(98)
Space heating requirement in kWh/m²/year		87.11	(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		383.02	(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)	3380.65	2843.86	2719.33	1982.12	1385.91	0	0	0	0	1722.65	2492.52	3298.26		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	882.64	742.49	709.98	517.5	361.84	0	0	0	0	449.76	650.76	861.13		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													5176.11	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	238.07	210.06	221.15	199	195.56	175.52	169.32	184.77	184.12	206.32	217.21	232.59		
Efficiency of water heater													300.39	(216)
(217)m=	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	79.25	69.93	73.62	66.25	65.1	58.43	56.37	61.51	61.29	68.68	72.31	77.43		
Total = Sum(219a)$_{1...12}$ =													810.18	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5176.11	
Water heating fuel used			810.18	
Electricity for pumps, fans and electric keep-hot				
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		0	(231)
Electricity for lighting			804.3	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	2686.4	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	420.48	(264)

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Space and water heating	(261) + (262) + (263) + (264) =			3106.88	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0	(267)
Electricity for lighting	(232) x	0.519	=	417.43	(268)
Total CO2, kg/year		sum of (265)…(271) =		3524.32	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.48	(273)
EI rating (section 14)				83	(274)

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 7 - Existing Be-Green - 3B6P - MF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	250.9	(1a) x	4.4	(2a) =	1103.96	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	250.9	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	1103.96	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.04	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.79	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.73	(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

0.93	0.91	0.89	0.8	0.78	0.69	0.69	0.67	0.73	0.78	0.82	0.85

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=	0.93	0.91	0.9	0.82	0.81	0.74	0.74	0.73	0.76	0.81	0.83	0.87	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.93	0.91	0.9	0.82	0.81	0.74	0.74	0.73	0.76	0.81	0.83	0.87	(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	
Windows Type 1			14.91	x1/[1/(1.8)+ 0.04]		=	25.04			(27)
Windows Type 2			29.57	x1/[1/(1.8)+ 0.04]		=	49.65			(27)
Windows Type 3			10.836	x1/[1/(1.8)+ 0.04]		=	18.19			(27)
Windows Type 4			4.81	x1/[1/(1.8)+ 0.04]		=	8.08			(27)
Windows Type 5			7.72	x1/[1/(1.8)+ 0.04]		=	12.96			(27)
Windows Type 6			7.32	x1/[1/(1.8)+ 0.04]		=	12.29			(27)
Walls Type1	337.79	75.17	262.62	x	0.35	=	91.92			(29)
Walls Type2	58.52	0	58.52	x	0.31	=	17.97			(29)
Total area of elements, m²			396.31							(31)
Party wall			11.35	x	0	=	0			(32)
Party floor			251.47							(32a)
Party ceiling			251.47							(32b)

** 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) = 236.1 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 40593.68 (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 59.45 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

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Total fabric heat loss (33) + (36) = 295.54 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	338.77	332.69	326.73	298.73	293.49	269.1	269.1	264.59	278.5	293.49	304.09	315.17	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	634.31	628.23	622.27	594.27	589.03	564.65	564.65	560.13	574.04	589.03	599.63	610.71	

Average = $Sum(39)_{1...12}$ /12= 594.25 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	2.53	2.5	2.48	2.37	2.35	2.25	2.25	2.23	2.29	2.35	2.39	2.43	

Average = $Sum(40)_{1...12}$ /12= 2.37 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.07 (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) + 36 107.07 (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=	117.77	113.49	109.21	104.93	100.64	96.36	96.36	100.64	104.93	109.21	113.49	117.77

Total = $Sum(44)_{1...12}$ = 1284.81 (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=	174.66	152.75	157.63	137.43	131.86	113.79	105.44	120.99	122.44	142.69	155.76	169.14

Total = $Sum(45)_{1...12}$ = 1684.59 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.2	22.91	23.64	20.61	19.78	17.07	15.82	18.15	18.37	21.4	23.36	25.37	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 305 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.63 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.88 (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) 0.88 (55)

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Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	37.3	33.69	37.3	36.09	37.3	36.09	37.3	37.3	36.09	37.3	36.09	37.3	(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=	239.24	211.09	222.21	199.93	196.45	176.29	170.02	185.58	184.94	207.28	218.26	233.73	(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=	239.24	211.09	222.21	199.93	196.45	176.29	170.02	185.58	184.94	207.28	218.26	233.73	

Output from water heater (annual)$_{1...12}$ | 2445.01 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	109.74	97.46	104.08	95.69	95.51	87.83	86.73	91.9	90.71	99.11	101.79	107.91	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	37.19	33.03	26.86	20.34	15.2	12.83	13.87	18.03	24.2	30.72	35.86	38.22	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	417.17	421.5	410.59	387.36	358.05	330.5	312.09	307.76	318.67	341.89	371.21	398.76	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	38.34	(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=	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	-122.72	(71)

Water heating gains (Table 5)

(72)m=	147.5	145.03	139.89	132.91	128.38	121.99	116.57	123.52	125.99	133.22	141.38	145.04	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	670.88	668.58	646.36	609.63	570.65	534.35	511.55	518.33	537.88	574.85	617.46	651.04	(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	0.54	x	10.84	x	11.28	x	0.55	x	0.65	=	21.24	(75)
Northeast 0.9x	0.77	x	4.81	x	11.28	x	0.55	x	0.65	=	13.45	(75)
Northeast 0.9x	0.77	x	7.72	x	11.28	x	0.55	x	0.65	=	21.58	(75)
Northeast 0.9x	0.77	x	7.32	x	11.28	x	0.55	x	0.65	=	20.46	(75)
Northeast 0.9x	0.54	x	10.84	x	22.97	x	0.55	x	0.65	=	43.24	(75)
Northeast 0.9x	0.77	x	4.81	x	22.97	x	0.55	x	0.65	=	27.37	(75)
Northeast 0.9x	0.77	x	7.72	x	22.97	x	0.55	x	0.65	=	43.93	(75)
Northeast 0.9x	0.77	x	7.32	x	22.97	x	0.55	x	0.65	=	41.65	(75)
Northeast 0.9x	0.54	x	10.84	x	41.38	x	0.55	x	0.65	=	77.9	(75)
Northeast 0.9x	0.77	x	4.81	x	41.38	x	0.55	x	0.65	=	49.31	(75)
Northeast 0.9x	0.77	x	7.72	x	41.38	x	0.55	x	0.65	=	79.14	(75)
Northeast 0.9x	0.77	x	7.32	x	41.38	x	0.55	x	0.65	=	75.04	(75)
Northeast 0.9x	0.54	x	10.84	x	67.96	x	0.55	x	0.65	=	127.94	(75)
Northeast 0.9x	0.77	x	4.81	x	67.96	x	0.55	x	0.65	=	80.98	(75)
Northeast 0.9x	0.77	x	7.72	x	67.96	x	0.55	x	0.65	=	129.97	(75)
Northeast 0.9x	0.77	x	7.32	x	67.96	x	0.55	x	0.65	=	123.24	(75)
Northeast 0.9x	0.54	x	10.84	x	91.35	x	0.55	x	0.65	=	171.98	(75)
Northeast 0.9x	0.77	x	4.81	x	91.35	x	0.55	x	0.65	=	108.85	(75)
Northeast 0.9x	0.77	x	7.72	x	91.35	x	0.55	x	0.65	=	174.71	(75)
Northeast 0.9x	0.77	x	7.32	x	91.35	x	0.55	x	0.65	=	165.66	(75)
Northeast 0.9x	0.54	x	10.84	x	97.38	x	0.55	x	0.65	=	183.35	(75)
Northeast 0.9x	0.77	x	4.81	x	97.38	x	0.55	x	0.65	=	116.05	(75)
Northeast 0.9x	0.77	x	7.72	x	97.38	x	0.55	x	0.65	=	186.26	(75)
Northeast 0.9x	0.77	x	7.32	x	97.38	x	0.55	x	0.65	=	176.61	(75)
Northeast 0.9x	0.54	x	10.84	x	91.1	x	0.55	x	0.65	=	171.52	(75)
Northeast 0.9x	0.77	x	4.81	x	91.1	x	0.55	x	0.65	=	108.56	(75)
Northeast 0.9x	0.77	x	7.72	x	91.1	x	0.55	x	0.65	=	174.24	(75)
Northeast 0.9x	0.77	x	7.32	x	91.1	x	0.55	x	0.65	=	165.21	(75)
Northeast 0.9x	0.54	x	10.84	x	72.63	x	0.55	x	0.65	=	136.73	(75)
Northeast 0.9x	0.77	x	4.81	x	72.63	x	0.55	x	0.65	=	86.55	(75)
Northeast 0.9x	0.77	x	7.72	x	72.63	x	0.55	x	0.65	=	138.91	(75)
Northeast 0.9x	0.77	x	7.32	x	72.63	x	0.55	x	0.65	=	131.71	(75)
Northeast 0.9x	0.54	x	10.84	x	50.42	x	0.55	x	0.65	=	94.93	(75)
Northeast 0.9x	0.77	x	4.81	x	50.42	x	0.55	x	0.65	=	60.08	(75)
Northeast 0.9x	0.77	x	7.72	x	50.42	x	0.55	x	0.65	=	96.44	(75)
Northeast 0.9x	0.77	x	7.32	x	50.42	x	0.55	x	0.65	=	91.44	(75)
Northeast 0.9x	0.54	x	10.84	x	28.07	x	0.55	x	0.65	=	52.84	(75)
Northeast 0.9x	0.77	x	4.81	x	28.07	x	0.55	x	0.65	=	33.45	(75)
Northeast 0.9x	0.77	x	7.72	x	28.07	x	0.55	x	0.65	=	53.68	(75)

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Northeast 0.9x	0.77	x	7.32	x	28.07	x	0.55	x	0.65	=	50.9	(75)
Northeast 0.9x	0.54	x	10.84	x	14.2	x	0.55	x	0.65	=	26.73	(75)
Northeast 0.9x	0.77	x	4.81	x	14.2	x	0.55	x	0.65	=	16.92	(75)
Northeast 0.9x	0.77	x	7.72	x	14.2	x	0.55	x	0.65	=	27.15	(75)
Northeast 0.9x	0.77	x	7.32	x	14.2	x	0.55	x	0.65	=	25.75	(75)
Northeast 0.9x	0.54	x	10.84	x	9.21	x	0.55	x	0.65	=	17.35	(75)
Northeast 0.9x	0.77	x	4.81	x	9.21	x	0.55	x	0.65	=	10.98	(75)
Northeast 0.9x	0.77	x	7.72	x	9.21	x	0.55	x	0.65	=	17.62	(75)
Northeast 0.9x	0.77	x	7.32	x	9.21	x	0.55	x	0.65	=	16.71	(75)
Southwest0.9x	0.77	x	14.91	x	36.79		0.55	x	0.65	=	135.91	(79)
Southwest0.9x	0.77	x	29.57	x	36.79		0.55	x	0.65	=	269.55	(79)
Southwest0.9x	0.77	x	14.91	x	62.67		0.55	x	0.65	=	231.51	(79)
Southwest0.9x	0.77	x	29.57	x	62.67		0.55	x	0.65	=	459.14	(79)
Southwest0.9x	0.77	x	14.91	x	85.75		0.55	x	0.65	=	316.76	(79)
Southwest0.9x	0.77	x	29.57	x	85.75		0.55	x	0.65	=	628.21	(79)
Southwest0.9x	0.77	x	14.91	x	106.25		0.55	x	0.65	=	392.48	(79)
Southwest0.9x	0.77	x	29.57	x	106.25		0.55	x	0.65	=	778.39	(79)
Southwest0.9x	0.77	x	14.91	x	119.01		0.55	x	0.65	=	439.62	(79)
Southwest0.9x	0.77	x	29.57	x	119.01		0.55	x	0.65	=	871.86	(79)
Southwest0.9x	0.77	x	14.91	x	118.15		0.55	x	0.65	=	436.44	(79)
Southwest0.9x	0.77	x	29.57	x	118.15		0.55	x	0.65	=	865.55	(79)
Southwest0.9x	0.77	x	14.91	x	113.91		0.55	x	0.65	=	420.77	(79)
Southwest0.9x	0.77	x	29.57	x	113.91		0.55	x	0.65	=	834.49	(79)
Southwest0.9x	0.77	x	14.91	x	104.39		0.55	x	0.65	=	385.61	(79)
Southwest0.9x	0.77	x	29.57	x	104.39		0.55	x	0.65	=	764.75	(79)
Southwest0.9x	0.77	x	14.91	x	92.85		0.55	x	0.65	=	342.99	(79)
Southwest0.9x	0.77	x	29.57	x	92.85		0.55	x	0.65	=	680.22	(79)
Southwest0.9x	0.77	x	14.91	x	69.27		0.55	x	0.65	=	255.87	(79)
Southwest0.9x	0.77	x	29.57	x	69.27		0.55	x	0.65	=	507.45	(79)
Southwest0.9x	0.77	x	14.91	x	44.07		0.55	x	0.65	=	162.79	(79)
Southwest0.9x	0.77	x	29.57	x	44.07		0.55	x	0.65	=	322.86	(79)
Southwest0.9x	0.77	x	14.91	x	31.49		0.55	x	0.65	=	116.31	(79)
Southwest0.9x	0.77	x	29.57	x	31.49		0.55	x	0.65	=	230.68	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	482.19	846.84	1226.37	1633.01	1932.67	1964.25	1874.79	1644.26	1366.1	954.19	582.19	409.65	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	1153.07	1515.41	1872.74	2242.64	2503.32	2498.6	2386.34	2162.59	1903.97	1529.04	1199.66	1060.7	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	1	0.99	0.98	0.94	0.87	0.77	0.82	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.65	19.33	18.85	19.45	20.05	20.56	20.8	20.75	20.32	19.58	18.8	19.2	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19	19.02	19.03	19.1	19.11	19.17	19.17	19.18	19.15	19.11	19.09	19.06	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.97	0.91	0.77	0.55	0.62	0.88	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.31	15.78	16.41	17.35	18.17	18.87	19.11	19.08	18.59	17.53	16.41	15.5	(90)

fLA = Living area ÷ (4) = | 0.17 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.71	16.38	16.82	17.71	18.49	19.15	19.39	19.37	18.89	17.88	16.81	16.13	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.71	16.38	16.82	17.71	18.49	19.15	19.39	19.37	18.89	17.88	16.81	16.13	(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	0.76	0.58	0.65	0.87	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1150.2	1501.33	1833.64	2134.09	2227.7	1909.34	1391.86	1401.39	1654.1	1482.32	1190.44	1057.31	(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=	9138.86	7214.12	6422.32	5234.71	3998.63	2570.9	1577.17	1661.5	2748.4	4287.12	5823.79	7283.18	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	5943.57	3838.99	3413.98	2232.45	1317.58	0	0	0	0	2086.77	3336.01	4632.04	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 26801.39 | (98)

Space heating requirement in kWh/m²/year | 106.82 | (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		350.65	(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)													
	5943.57	3838.99	3413.98	2232.45	1317.58	0	0	0	0	2086.77	3336.01	4632.04	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1695.02	1094.83	973.62	636.66	375.75	0	0	0	0	595.12	951.38	1320.99	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | 7643.37 | (211)

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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)

239.24	211.09	222.21	199.93	196.45	176.29	170.02	185.58	184.94	207.28	218.26	233.73

Efficiency of water heater 300.39 (216)

(217)m=	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	79.64	70.27	73.98	66.56	65.4	58.69	56.6	61.78	61.57	69	72.66	77.81

Total = Sum(219a)$_{1...12}$ = 813.95 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		7643.37	
Water heating fuel used		813.95	
Electricity for pumps, fans and electric keep-hot			
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	0	(231)
Electricity for lighting		656.8	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	3966.91	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	422.44	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4389.35	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	0	(267)
Electricity for lighting	(232)	x	0.519	=	340.88	(268)
Total CO2, kg/year			sum of (265)…(271) =		4730.23	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		18.85	(273)
EI rating (section 14)					79	(274)

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User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.23

Property Address: Flat 16 - Existing Be-Green - 3B4P - MF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	270	(1a) x	3.28	(2a) =	885.6	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	270	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	885.6	(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							3	x 10 =	30	(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) =	30 ÷ (5) =	0.03	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.78	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.73	(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

0.92	0.91	0.89	0.8	0.78	0.69	0.69	0.67	0.73	0.78	0.82	0.85

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=	0.93	0.91	0.89	0.82	0.8	0.74	0.74	0.72	0.76	0.8	0.83	0.86	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.93	0.91	0.89	0.82	0.8	0.74	0.74	0.72	0.76	0.8	0.83	0.86	(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	
Windows Type 1			22.26	x1/[1/(1.8)+ 0.04]		=	37.38			(27)
Windows Type 2			2.47	x1/[1/(1.8)+ 0.04]		=	4.15			(27)
Windows Type 3			2.47	x1/[1/(1.8)+ 0.04]		=	4.15			(27)
Windows Type 4			3.861	x1/[1/(1.8)+ 0.04]		=	6.48			(27)
Windows Type 5			7.356	x1/[1/(1.8)+ 0.04]		=	12.35			(27)
Windows Type 6			10.782	x1/[1/(1.8)+ 0.04]		=	18.1			(27)
Windows Type 7			4.904	x1/[1/(1.8)+ 0.04]		=	8.23			(27)
Walls Type1	258.53	54.1	204.43	x	0.35	=	71.55			(29)
Walls Type2	40.28	0	40.28	x	0.31	=	12.37			(29)
Total area of elements, m²			298.81							(31)
Party wall			17.06	x	0	=	0			(32)
Party floor			271.8							(32a)
Party ceiling			271.8							(32b)

** 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) = 174.76 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 36922.87 (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 44.82 (36)

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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 219.58 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	271.01	266.16	261.41	239.08	234.9	215.46	215.46	211.86	222.95	234.9	243.35	252.19	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	490.59	485.74	480.99	458.66	454.49	435.04	435.04	431.44	442.53	454.49	462.94	471.77	

Average = $Sum(39)_{1...12}$ /12= 458.64 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.82	1.8	1.78	1.7	1.68	1.61	1.61	1.6	1.64	1.68	1.71	1.75	

Average = $Sum(40)_{1...12}$ /12= 1.7 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.09 (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) + 36 107.66 (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=	118.42	114.12	109.81	105.5	101.2	96.89	96.89	101.2	105.5	109.81	114.12	118.42	

Total = $Sum(44)_{1...12}$ = 1291.89 (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=	175.62	153.6	158.5	138.18	132.59	114.41	106.02	121.66	123.11	143.48	156.62	170.08	

Total = $Sum(45)_{1...12}$ = 1693.87 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.34	23.04	23.77	20.73	19.89	17.16	15.9	18.25	18.47	21.52	23.49	25.51	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 305 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.63 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.88 (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) 0.88 (55)

DER WorkSheet: New dwelling created by change of use

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	37.3	33.69	37.3	36.09	37.3	36.09	37.3	37.3	36.09	37.3	36.09	37.3	(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=	240.2	211.93	223.08	200.68	197.17	176.91	170.61	186.25	185.62	208.06	219.12	234.66	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	240.2	211.93	223.08	200.68	197.17	176.91	170.61	186.25	185.62	208.06	219.12	234.66	

Output from water heater (annual)1…12 | 2454.29 | (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=	110.06	97.74	104.37	95.95	95.75	88.04	86.92	92.12	90.94	99.37	102.08	108.22	(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=	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	154.65	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	39.55	35.12	28.56	21.63	16.17	13.65	14.75	19.17	25.73	32.67	38.13	40.64	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	433.49	437.99	426.65	402.52	372.06	343.43	324.3	319.8	331.14	355.27	385.73	414.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	38.46	(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=	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	-123.72	(71)

Water heating gains (Table 5)

(72)m=	147.93	145.44	140.28	133.26	128.7	122.28	116.83	123.82	126.3	133.57	141.77	145.45	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	690.36	687.95	664.89	626.8	586.32	548.75	525.27	532.18	552.56	590.9	635.03	669.86	(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 created by change of use

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	3.86	x	11.28	x	0.55	x	0.65	=	10.79	(75)
Northeast	0.9x	0.54	x	7.36	x	11.28	x	0.55	x	0.65	=	14.42	(75)
Northeast	0.9x	0.77	x	10.78	x	11.28	x	0.55	x	0.65	=	30.14	(75)
Northeast	0.9x	0.54	x	4.9	x	11.28	x	0.55	x	0.65	=	9.61	(75)
Northeast	0.9x	0.77	x	3.86	x	22.97	x	0.55	x	0.65	=	21.97	(75)
Northeast	0.9x	0.54	x	7.36	x	22.97	x	0.55	x	0.65	=	29.35	(75)
Northeast	0.9x	0.77	x	10.78	x	22.97	x	0.55	x	0.65	=	61.35	(75)
Northeast	0.9x	0.54	x	4.9	x	22.97	x	0.55	x	0.65	=	19.57	(75)
Northeast	0.9x	0.77	x	3.86	x	41.38	x	0.55	x	0.65	=	39.58	(75)
Northeast	0.9x	0.54	x	7.36	x	41.38	x	0.55	x	0.65	=	52.88	(75)
Northeast	0.9x	0.77	x	10.78	x	41.38	x	0.55	x	0.65	=	110.53	(75)
Northeast	0.9x	0.54	x	4.9	x	41.38	x	0.55	x	0.65	=	35.26	(75)
Northeast	0.9x	0.77	x	3.86	x	67.96	x	0.55	x	0.65	=	65	(75)
Northeast	0.9x	0.54	x	7.36	x	67.96	x	0.55	x	0.65	=	86.85	(75)
Northeast	0.9x	0.77	x	10.78	x	67.96	x	0.55	x	0.65	=	181.52	(75)
Northeast	0.9x	0.54	x	4.9	x	67.96	x	0.55	x	0.65	=	57.9	(75)
Northeast	0.9x	0.77	x	3.86	x	91.35	x	0.55	x	0.65	=	87.38	(75)
Northeast	0.9x	0.54	x	7.36	x	91.35	x	0.55	x	0.65	=	116.75	(75)
Northeast	0.9x	0.77	x	10.78	x	91.35	x	0.55	x	0.65	=	244	(75)
Northeast	0.9x	0.54	x	4.9	x	91.35	x	0.55	x	0.65	=	77.83	(75)
Northeast	0.9x	0.77	x	3.86	x	97.38	x	0.55	x	0.65	=	93.15	(75)
Northeast	0.9x	0.54	x	7.36	x	97.38	x	0.55	x	0.65	=	124.46	(75)
Northeast	0.9x	0.77	x	10.78	x	97.38	x	0.55	x	0.65	=	260.13	(75)
Northeast	0.9x	0.54	x	4.9	x	97.38	x	0.55	x	0.65	=	82.98	(75)
Northeast	0.9x	0.77	x	3.86	x	91.1	x	0.55	x	0.65	=	87.14	(75)
Northeast	0.9x	0.54	x	7.36	x	91.1	x	0.55	x	0.65	=	116.43	(75)
Northeast	0.9x	0.77	x	10.78	x	91.1	x	0.55	x	0.65	=	243.35	(75)
Northeast	0.9x	0.54	x	4.9	x	91.1	x	0.55	x	0.65	=	77.62	(75)
Northeast	0.9x	0.77	x	3.86	x	72.63	x	0.55	x	0.65	=	69.47	(75)
Northeast	0.9x	0.54	x	7.36	x	72.63	x	0.55	x	0.65	=	92.82	(75)
Northeast	0.9x	0.77	x	10.78	x	72.63	x	0.55	x	0.65	=	194	(75)
Northeast	0.9x	0.54	x	4.9	x	72.63	x	0.55	x	0.65	=	61.88	(75)
Northeast	0.9x	0.77	x	3.86	x	50.42	x	0.55	x	0.65	=	48.23	(75)
Northeast	0.9x	0.54	x	7.36	x	50.42	x	0.55	x	0.65	=	64.44	(75)
Northeast	0.9x	0.77	x	10.78	x	50.42	x	0.55	x	0.65	=	134.68	(75)
Northeast	0.9x	0.54	x	4.9	x	50.42	x	0.55	x	0.65	=	42.96	(75)
Northeast	0.9x	0.77	x	3.86	x	28.07	x	0.55	x	0.65	=	26.85	(75)
Northeast	0.9x	0.54	x	7.36	x	28.07	x	0.55	x	0.65	=	35.87	(75)
Northeast	0.9x	0.77	x	10.78	x	28.07	x	0.55	x	0.65	=	74.97	(75)

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Northeast	0.9x	0.54	x	4.9	x	28.07	x	0.55	x	0.65	=	23.91	(75)
Northeast	0.9x	0.77	x	3.86	x	14.2	x	0.55	x	0.65	=	13.58	(75)
Northeast	0.9x	0.54	x	7.36	x	14.2	x	0.55	x	0.65	=	18.14	(75)
Northeast	0.9x	0.77	x	10.78	x	14.2	x	0.55	x	0.65	=	37.92	(75)
Northeast	0.9x	0.54	x	4.9	x	14.2	x	0.55	x	0.65	=	12.1	(75)
Northeast	0.9x	0.77	x	3.86	x	9.21	x	0.55	x	0.65	=	8.81	(75)
Northeast	0.9x	0.54	x	7.36	x	9.21	x	0.55	x	0.65	=	11.78	(75)
Northeast	0.9x	0.77	x	10.78	x	9.21	x	0.55	x	0.65	=	24.61	(75)
Northeast	0.9x	0.54	x	4.9	x	9.21	x	0.55	x	0.65	=	7.85	(75)
South	0.9x	0.77	x	2.47	x	46.75	x	0.55	x	0.65	=	28.61	(78)
South	0.9x	0.77	x	2.47	x	76.57	x	0.55	x	0.65	=	46.85	(78)
South	0.9x	0.77	x	2.47	x	97.53	x	0.55	x	0.65	=	59.68	(78)
South	0.9x	0.77	x	2.47	x	110.23	x	0.55	x	0.65	=	67.46	(78)
South	0.9x	0.77	x	2.47	x	114.87	x	0.55	x	0.65	=	70.29	(78)
South	0.9x	0.77	x	2.47	x	110.55	x	0.55	x	0.65	=	67.65	(78)
South	0.9x	0.77	x	2.47	x	108.01	x	0.55	x	0.65	=	66.1	(78)
South	0.9x	0.77	x	2.47	x	104.89	x	0.55	x	0.65	=	64.19	(78)
South	0.9x	0.77	x	2.47	x	101.89	x	0.55	x	0.65	=	62.35	(78)
South	0.9x	0.77	x	2.47	x	82.59	x	0.55	x	0.65	=	50.54	(78)
South	0.9x	0.77	x	2.47	x	55.42	x	0.55	x	0.65	=	33.91	(78)
South	0.9x	0.77	x	2.47	x	40.4	x	0.55	x	0.65	=	24.72	(78)
Southwest	0.9x	0.77	x	22.26	x	36.79		0.55	x	0.65	=	202.91	(79)
Southwest	0.9x	0.77	x	22.26	x	62.67		0.55	x	0.65	=	345.64	(79)
Southwest	0.9x	0.77	x	22.26	x	85.75		0.55	x	0.65	=	472.91	(79)
Southwest	0.9x	0.77	x	22.26	x	106.25		0.55	x	0.65	=	585.96	(79)
Southwest	0.9x	0.77	x	22.26	x	119.01		0.55	x	0.65	=	656.33	(79)
Southwest	0.9x	0.77	x	22.26	x	118.15		0.55	x	0.65	=	651.58	(79)
Southwest	0.9x	0.77	x	22.26	x	113.91		0.55	x	0.65	=	628.19	(79)
Southwest	0.9x	0.77	x	22.26	x	104.39		0.55	x	0.65	=	575.7	(79)
Southwest	0.9x	0.77	x	22.26	x	92.85		0.55	x	0.65	=	512.07	(79)
Southwest	0.9x	0.77	x	22.26	x	69.27		0.55	x	0.65	=	382	(79)
Southwest	0.9x	0.77	x	22.26	x	44.07		0.55	x	0.65	=	243.04	(79)
Southwest	0.9x	0.77	x	22.26	x	31.49		0.55	x	0.65	=	173.65	(79)
West	0.9x	0.77	x	2.47	x	19.64	x	0.55	x	0.65	=	12.02	(80)
West	0.9x	0.77	x	2.47	x	38.42	x	0.55	x	0.65	=	23.51	(80)
West	0.9x	0.77	x	2.47	x	63.27	x	0.55	x	0.65	=	38.72	(80)
West	0.9x	0.77	x	2.47	x	92.28	x	0.55	x	0.65	=	56.47	(80)
West	0.9x	0.77	x	2.47	x	113.09	x	0.55	x	0.65	=	69.21	(80)
West	0.9x	0.77	x	2.47	x	115.77	x	0.55	x	0.65	=	70.84	(80)
West	0.9x	0.77	x	2.47	x	110.22	x	0.55	x	0.65	=	67.45	(80)
West	0.9x	0.77	x	2.47	x	94.68	x	0.55	x	0.65	=	57.94	(80)

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West	0.9x	0.77	x	2.47	x	73.59	x	0.55	x	0.65	=	45.03	(80)
West	0.9x	0.77	x	2.47	x	45.59	x	0.55	x	0.65	=	27.9	(80)
West	0.9x	0.77	x	2.47	x	24.49	x	0.55	x	0.65	=	14.99	(80)
West	0.9x	0.77	x	2.47	x	16.15	x	0.55	x	0.65	=	9.88	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	308.51	548.24	809.57	1101.17	1321.79	1350.8	1286.29	1116	909.76	622.04	373.68	261.31	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	998.87	1236.19	1474.46	1727.97	1908.11	1899.55	1811.56	1648.18	1462.32	1212.94	1008.71	931.17	(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	1	0.99	0.97	0.91	0.82	0.86	0.97	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.74	18.95	19.29	19.78	20.25	20.67	20.86	20.82	20.47	19.89	19.27	18.95	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.46	19.47	19.48	19.54	19.55	19.61	19.61	19.61	19.58	19.55	19.53	19.51	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.95	0.85	0.65	0.72	0.94	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.91	16.81	17.3	18.07	18.74	19.34	19.54	19.52	19.09	18.22	17.34	16.62	(90)

fLA = Living area ÷ (4) = | 0.16 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.36	17.15	17.61	18.34	18.98	19.55	19.75	19.73	19.31	18.49	17.64	16.98	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.36	17.15	17.61	18.34	18.98	19.55	19.75	19.73	19.31	18.49	17.64	16.98	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.98	0.94	0.84	0.67	0.74	0.93	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	997.71	1232.62	1464.07	1693.62	1797.44	1597.85	1218.61	1215.52	1356.77	1199.06	1006.37	930.31	(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=	6406.03	5948.67	5345.71	4329.52	3307.85	2151.78	1371.25	1435.33	2304.94	3583.62	4880.6	6031.58	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	4023.79	3169.19	2887.94	1897.85	1123.75	0	0	0	0	1774.12	2789.45	3795.35	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 21461.42 | (98)

Space heating requirement in kWh/m²/year | 79.49 | (99)

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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		379.78	(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)	4023.79	3169.19	2887.94	1897.85	1123.75	0	0	0	0	1774.12	2789.45	3795.35		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	1059.51	834.48	760.43	499.72	295.89	0	0	0	0	467.14	734.49	999.36		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													5651.03	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	240.2	211.93	223.08	200.68	197.17	176.91	170.61	186.25	185.62	208.06	219.12	234.66		
Efficiency of water heater													300.39	(216)
(217)m=	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	79.96	70.55	74.26	66.81	65.64	58.9	56.79	62	61.79	69.26	72.94	78.12		
Total = Sum(219a)$_{1...12}$ =													817.04	(219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			5651.03	
Water heating fuel used			817.04	
Electricity for pumps, fans and electric keep-hot				
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		0	(231)
Electricity for lighting			698.38	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	2932.89	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	424.04	(264)
Space and water heating	(261) + (262) + (263) + (264) =				3356.93	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	0	(267)
Electricity for lighting	(232)	x	0.519	=	362.46	(268)

DER WorkSheet: New dwelling created by change of use

Total CO_2, kg/year	sum of (265)…(271) =	3719.38	(272)
Dwelling CO_2 Emission Rate	(272) ÷ (4) =	13.78	(273)
EI rating (section 14)		84	(274)

envision

DER WorkSheet: New dwelling created by change of use

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.23

Property Address: Flat 24 Existing Be-Green - 3B4P - TF

Address : Branch Hill House, Branch Hill, LONDON, NW3 7LS

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	229	(1a) x	2.76	(2a) =	632.04	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	229	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	632.04	(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) =	0.06	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		15	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.81	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.75	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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

0.96	0.94	0.92	0.83	0.81	0.71	0.71	0.7	0.75	0.81	0.85	0.88

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.96	0.94	0.92	0.84	0.83	0.76	0.76	0.74	0.78	0.83	0.86	0.89	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.96	0.94	0.92	0.84	0.83	0.76	0.76	0.74	0.78	0.83	0.86	0.89	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			5.71	x1/[1/(1.8)+ 0.04]	=	9.59			(27)
Windows Type 2			1.13	x1/[1/(1.8)+ 0.04]	=	1.9			(27)
Windows Type 3			7.2	x1/[1/(1.8)+ 0.04]	=	12.09			(27)
Windows Type 4			3.08	x1/[1/(1.8)+ 0.04]	=	5.17			(27)
Windows Type 5			3.29	x1/[1/(1.8)+ 0.04]	=	5.52			(27)
Windows Type 6			2.67	x1/[1/(1.8)+ 0.04]	=	4.48			(27)
Windows Type 7			8.172	x1/[1/(1.8)+ 0.04]	=	13.72			(27)
Walls Type1	220.77	31.25	189.52	x 0.35	=	66.33			(29)
Walls Type2	31.6	0	31.6	x 0.31	=	9.7			(29)
Roof	222.14	0	222.14	x 0.16	=	35.54			(30)
Total area of elements, m²			474.51						(31)
Party wall			14.63	x 0	=	0			(32)
Party floor			222.14						(32a)

** 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) = 164.05 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27021.66 (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 71.18 (36)

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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 235.23 (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=	200.23	196.51	192.85	175.7	172.49	157.55	157.55	154.79	163.31	172.49	178.98	185.77	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	435.46	431.73	428.08	410.93	407.72	392.78	392.78	390.01	398.54	407.72	414.21	421	

Average = $Sum(39)_{1...12}$ /12= 410.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.9	1.89	1.87	1.79	1.78	1.72	1.72	1.7	1.74	1.78	1.81	1.84	

Average = $Sum(40)_{1...12}$ /12= 1.79 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 3.04 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 106.39 (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=	117.03	112.77	108.52	104.26	100.01	95.75	95.75	100.01	104.26	108.52	112.77	117.03	

Total = $Sum(44)_{1...12}$ = 1276.69 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	173.55	151.79	156.63	136.56	131.03	113.07	104.77	120.23	121.67	141.79	154.78	168.08	

Total = $Sum(45)_{1...12}$ = 1673.95 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.03	22.77	23.5	20.48	19.65	16.96	15.72	18.03	18.25	21.27	23.22	25.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 305 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.63 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.88 (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) 0.88 (55)

DER WorkSheet: New dwelling created by change of use

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(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=	27.29	24.65	27.29	26.41	27.29	26.41	27.29	27.29	26.41	27.29	26.41	27.29	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	37.3	33.69	37.3	36.09	37.3	36.09	37.3	37.3	36.09	37.3	36.09	37.3	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	238.14	210.12	221.22	199.06	195.61	175.57	169.36	184.81	184.17	206.37	217.28	232.66	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	238.14	210.12	221.22	199.06	195.61	175.57	169.36	184.81	184.17	206.37	217.28	232.66	

Output from water heater (annual)1…12 — 2434.37 (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=	109.37	97.14	103.75	95.41	95.23	87.6	86.5	91.64	90.45	98.81	101.46	107.55	(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=	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	151.98	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	39.53	35.11	28.55	21.62	16.16	13.64	14.74	19.16	25.72	32.66	38.11	40.63	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	397.84	401.96	391.56	369.41	341.46	315.18	297.63	293.5	303.9	326.05	354.01	380.28	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	38.2	(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=	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	-121.59	(71)

Water heating gains (Table 5)

(72)m=	147.01	144.55	139.45	132.51	128	121.66	116.27	123.18	125.63	132.81	140.92	144.56	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	652.97	650.22	628.16	592.13	554.21	519.08	497.23	504.43	523.85	560.11	601.64	634.07	(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 created by change of use

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.08	x	11.28	x	0.55	x	0.65	=	8.61	(75)
Northeast 0.9x	0.54	x	3.29	x	11.28	x	0.55	x	0.65	=	6.45	(75)
Northeast 0.9x	0.77	x	2.67	x	11.28	x	0.55	x	0.65	=	7.46	(75)
Northeast 0.9x	0.54	x	8.17	x	11.28	x	0.55	x	0.65	=	16.02	(75)
Northeast 0.9x	0.77	x	3.08	x	22.97	x	0.55	x	0.65	=	17.53	(75)
Northeast 0.9x	0.54	x	3.29	x	22.97	x	0.55	x	0.65	=	13.13	(75)
Northeast 0.9x	0.77	x	2.67	x	22.97	x	0.55	x	0.65	=	15.19	(75)
Northeast 0.9x	0.54	x	8.17	x	22.97	x	0.55	x	0.65	=	32.61	(75)
Northeast 0.9x	0.77	x	3.08	x	41.38	x	0.55	x	0.65	=	31.57	(75)
Northeast 0.9x	0.54	x	3.29	x	41.38	x	0.55	x	0.65	=	23.65	(75)
Northeast 0.9x	0.77	x	2.67	x	41.38	x	0.55	x	0.65	=	27.37	(75)
Northeast 0.9x	0.54	x	8.17	x	41.38	x	0.55	x	0.65	=	58.75	(75)
Northeast 0.9x	0.77	x	3.08	x	67.96	x	0.55	x	0.65	=	51.85	(75)
Northeast 0.9x	0.54	x	3.29	x	67.96	x	0.55	x	0.65	=	38.84	(75)
Northeast 0.9x	0.77	x	2.67	x	67.96	x	0.55	x	0.65	=	44.95	(75)
Northeast 0.9x	0.54	x	8.17	x	67.96	x	0.55	x	0.65	=	96.49	(75)
Northeast 0.9x	0.77	x	3.08	x	91.35	x	0.55	x	0.65	=	69.7	(75)
Northeast 0.9x	0.54	x	3.29	x	91.35	x	0.55	x	0.65	=	52.22	(75)
Northeast 0.9x	0.77	x	2.67	x	91.35	x	0.55	x	0.65	=	60.42	(75)
Northeast 0.9x	0.54	x	8.17	x	91.35	x	0.55	x	0.65	=	129.7	(75)
Northeast 0.9x	0.77	x	3.08	x	97.38	x	0.55	x	0.65	=	74.31	(75)
Northeast 0.9x	0.54	x	3.29	x	97.38	x	0.55	x	0.65	=	55.67	(75)
Northeast 0.9x	0.77	x	2.67	x	97.38	x	0.55	x	0.65	=	64.42	(75)
Northeast 0.9x	0.54	x	8.17	x	97.38	x	0.55	x	0.65	=	138.27	(75)
Northeast 0.9x	0.77	x	3.08	x	91.1	x	0.55	x	0.65	=	69.52	(75)
Northeast 0.9x	0.54	x	3.29	x	91.1	x	0.55	x	0.65	=	52.08	(75)
Northeast 0.9x	0.77	x	2.67	x	91.1	x	0.55	x	0.65	=	60.26	(75)
Northeast 0.9x	0.54	x	8.17	x	91.1	x	0.55	x	0.65	=	129.35	(75)
Northeast 0.9x	0.77	x	3.08	x	72.63	x	0.55	x	0.65	=	55.42	(75)
Northeast 0.9x	0.54	x	3.29	x	72.63	x	0.55	x	0.65	=	41.52	(75)
Northeast 0.9x	0.77	x	2.67	x	72.63	x	0.55	x	0.65	=	48.04	(75)
Northeast 0.9x	0.54	x	8.17	x	72.63	x	0.55	x	0.65	=	103.12	(75)
Northeast 0.9x	0.77	x	3.08	x	50.42	x	0.55	x	0.65	=	38.47	(75)
Northeast 0.9x	0.54	x	3.29	x	50.42	x	0.55	x	0.65	=	28.82	(75)
Northeast 0.9x	0.77	x	2.67	x	50.42	x	0.55	x	0.65	=	33.35	(75)
Northeast 0.9x	0.54	x	8.17	x	50.42	x	0.55	x	0.65	=	71.59	(75)
Northeast 0.9x	0.77	x	3.08	x	28.07	x	0.55	x	0.65	=	21.42	(75)
Northeast 0.9x	0.54	x	3.29	x	28.07	x	0.55	x	0.65	=	16.04	(75)
Northeast 0.9x	0.77	x	2.67	x	28.07	x	0.55	x	0.65	=	18.57	(75)

DER WorkSheet: New dwelling created by change of use

Northeast	0.9x	0.54	x	8.17	x	28.07	x	0.55	x	0.65	=	39.85	(75)
Northeast	0.9x	0.77	x	3.08	x	14.2	x	0.55	x	0.65	=	10.83	(75)
Northeast	0.9x	0.54	x	3.29	x	14.2	x	0.55	x	0.65	=	8.12	(75)
Northeast	0.9x	0.77	x	2.67	x	14.2	x	0.55	x	0.65	=	9.39	(75)
Northeast	0.9x	0.54	x	8.17	x	14.2	x	0.55	x	0.65	=	20.16	(75)
Northeast	0.9x	0.77	x	3.08	x	9.21	x	0.55	x	0.65	=	7.03	(75)
Northeast	0.9x	0.54	x	3.29	x	9.21	x	0.55	x	0.65	=	5.27	(75)
Northeast	0.9x	0.77	x	2.67	x	9.21	x	0.55	x	0.65	=	6.1	(75)
Northeast	0.9x	0.54	x	8.17	x	9.21	x	0.55	x	0.65	=	13.08	(75)
Southwest	0.9x	0.77	x	5.71	x	36.79		0.55	x	0.65	=	52.05	(79)
Southwest	0.9x	0.77	x	1.13	x	36.79		0.55	x	0.65	=	10.3	(79)
Southwest	0.9x	0.77	x	7.2	x	36.79		0.55	x	0.65	=	65.63	(79)
Southwest	0.9x	0.77	x	5.71	x	62.67		0.55	x	0.65	=	88.66	(79)
Southwest	0.9x	0.77	x	1.13	x	62.67		0.55	x	0.65	=	17.55	(79)
Southwest	0.9x	0.77	x	7.2	x	62.67		0.55	x	0.65	=	111.8	(79)
Southwest	0.9x	0.77	x	5.71	x	85.75		0.55	x	0.65	=	121.31	(79)
Southwest	0.9x	0.77	x	1.13	x	85.75		0.55	x	0.65	=	24.01	(79)
Southwest	0.9x	0.77	x	7.2	x	85.75		0.55	x	0.65	=	152.96	(79)
Southwest	0.9x	0.77	x	5.71	x	106.25		0.55	x	0.65	=	150.31	(79)
Southwest	0.9x	0.77	x	1.13	x	106.25		0.55	x	0.65	=	29.75	(79)
Southwest	0.9x	0.77	x	7.2	x	106.25		0.55	x	0.65	=	189.53	(79)
Southwest	0.9x	0.77	x	5.71	x	119.01		0.55	x	0.65	=	168.36	(79)
Southwest	0.9x	0.77	x	1.13	x	119.01		0.55	x	0.65	=	33.32	(79)
Southwest	0.9x	0.77	x	7.2	x	119.01		0.55	x	0.65	=	212.29	(79)
Southwest	0.9x	0.77	x	5.71	x	118.15		0.55	x	0.65	=	167.14	(79)
Southwest	0.9x	0.77	x	1.13	x	118.15		0.55	x	0.65	=	33.08	(79)
Southwest	0.9x	0.77	x	7.2	x	118.15		0.55	x	0.65	=	210.75	(79)
Southwest	0.9x	0.77	x	5.71	x	113.91		0.55	x	0.65	=	161.14	(79)
Southwest	0.9x	0.77	x	1.13	x	113.91		0.55	x	0.65	=	31.89	(79)
Southwest	0.9x	0.77	x	7.2	x	113.91		0.55	x	0.65	=	203.19	(79)
Southwest	0.9x	0.77	x	5.71	x	104.39		0.55	x	0.65	=	147.67	(79)
Southwest	0.9x	0.77	x	1.13	x	104.39		0.55	x	0.65	=	29.22	(79)
Southwest	0.9x	0.77	x	7.2	x	104.39		0.55	x	0.65	=	186.21	(79)
Southwest	0.9x	0.77	x	5.71	x	92.85		0.55	x	0.65	=	131.35	(79)
Southwest	0.9x	0.77	x	1.13	x	92.85		0.55	x	0.65	=	25.99	(79)
Southwest	0.9x	0.77	x	7.2	x	92.85		0.55	x	0.65	=	165.63	(79)
Southwest	0.9x	0.77	x	5.71	x	69.27		0.55	x	0.65	=	97.99	(79)
Southwest	0.9x	0.77	x	1.13	x	69.27		0.55	x	0.65	=	19.39	(79)
Southwest	0.9x	0.77	x	7.2	x	69.27		0.55	x	0.65	=	123.56	(79)
Southwest	0.9x	0.77	x	5.71	x	44.07		0.55	x	0.65	=	62.34	(79)
Southwest	0.9x	0.77	x	1.13	x	44.07		0.55	x	0.65	=	12.34	(79)

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Southwest0.9x	0.77	x	7.2	x	44.07	0.55	x	0.65	=	78.61	(79)
Southwest0.9x	0.77	x	5.71	x	31.49	0.55	x	0.65	=	44.54	(79)
Southwest0.9x	0.77	x	1.13	x	31.49	0.55	x	0.65	=	8.82	(79)
Southwest0.9x	0.77	x	7.2	x	31.49	0.55	x	0.65	=	56.17	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	166.53	296.46	439.63	601.72	726	743.64	707.42	611.2	495.21	336.82	201.79	141	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	819.49	946.68	1067.79	1193.85	1280.22	1262.72	1204.66	1115.64	1019.06	896.93	803.43	775.07	(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	1	1	1	0.99	0.96	0.9	0.93	0.98	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.23	18.83	19.14	19.6	20.07	20.52	20.76	20.72	20.35	19.77	19.17	18.71	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.4	19.41	19.42	19.47	19.48	19.53	19.53	19.54	19.51	19.48	19.46	19.44	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.98	0.92	0.77	0.82	0.97	1	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.36	16.59	17.05	17.78	18.45	19.11	19.41	19.37	18.88	18.01	17.15	16.43	(90)

fLA = Living area ÷ (4) = 0.15 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	16.79	16.93	17.36	18.05	18.69	19.32	19.61	19.57	19.1	18.28	17.45	16.77	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	16.79	16.93	17.36	18.05	18.69	19.32	19.61	19.57	19.1	18.28	17.45	16.77	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.99	0.97	0.91	0.78	0.83	0.96	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	818.45	944.51	1062.84	1180.36	1239.66	1146.11	939.29	922.43	974.2	889.79	801.74	774.3	(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=	5437.86	5192.3	4649.65	3758.89	2849.98	1852.78	1182.17	1237.33	1990.73	3129.45	4286.76	5292.59	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	3436.84	2854.51	2668.59	1856.54	1198.07	0	0	0	0	1666.31	2509.22	3361.6	

Total per year (kWh/year) = Sum(98)1…5,9…12 = 19551.68 (98)

Space heating requirement in kWh/m²/year 85.38 (99)

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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		382.08	(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)	3436.84	2854.51	2668.59	1856.54	1198.07	0	0	0	0	1666.31	2509.22	3361.6		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	899.52	747.1	698.44	485.91	313.57	0	0	0	0	436.12	656.73	879.83		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													5117.22	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	238.14	210.12	221.22	199.06	195.61	175.57	169.36	184.81	184.17	206.37	217.28	232.66		
Efficiency of water heater													300.39	(216)
(217)m=	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39	300.39		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	79.28	69.95	73.64	66.27	65.12	58.45	56.38	61.52	61.31	68.7	72.33	77.45		
Total = Sum(219a)$_{1...12}$ =													810.4	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5117.22	
Water heating fuel used			810.4	
Electricity for pumps, fans and electric keep-hot				
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		0	(231)
Electricity for lighting			698.14	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.519	=	2655.84	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	420.6	(264)
Space and water heating	(261) + (262) + (263) + (264) =				3076.44	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	0	(267)
Electricity for lighting	(232)	x	0.519	=	362.33	(268)

DER WorkSheet: New dwelling created by change of use

Total CO_2, kg/year	sum of (265)…(271) =	3438.77	(272)
Dwelling CO_2 Emission Rate	(272) ÷ (4) =	15.02	(273)
EI rating (section 14)		83	(274)