Outline Application

NW Bicester Planning Application 1

Energy Statement

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Energy Statement

Application 1: Land to the North of the Railway Line and A4095 Lords Lane and West of B4100 Banbury Road, surrounding Lords Farm and Hawkwell Farm, Bicester, Oxfordshire

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NW Bicester

Energy Statement

Strategic Review - Energy

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1 Introduction

This Energy Statement has been prepared by Hyder Consulting Ltd in support of the outline planning **Application 1** of the North West (NW) Bicester development.

The proposed energy strategy has been guided by the following key principles:

- To meet all relevant local and national planning policy
- To be an exemplar in sustainability (whilst maintaining technical and financial viability)
- To adopt a fabric first approach to ensure that carbon emission reductions are secured for the lifetime of the development
- To mitigate adverse impacts on the surrounding environment.
- To be flexible so as to provide longevity to any proposed strategy within an evolving climate.
- To ensure the successful integration with the rest of the NW Bicester development.

The NW Bicester development is intended to provide a new form of sustainable community within Cherwell District, and to extend the benefits of this community to the existing town of Bicester. The first part of the NW Bicester development was the Exemplar Site development located in the northwest part which is currently under construction.

The statement provides a summary of the relevant planning policy and Building Regulations requirements to which Application 1 will be constructed. The statement then establishes a baseline assessment of the predicted energy demands and associated carbon emissions (based upon current Building Regulations 2013) before investigating the potential means of achieving the developments energy reduction and carbon emission targets.

Whilst this Energy Statement is specifically relevant to Application 1, it needs to be considered in the context of the energy strategy for the wider NW Bicester Development.

2 Preferred Strategic Approach

This statement, prepared on behalf of A2Dominion, progresses the options outlined within the Masterplan Energy Strategy (ref: Report No. 5022-UA005241-UE21R-01) relative to this Application. The masterplan and related documents set out the spatial vision to provide up to 6000 new homes at NW Bicester and were prepared in accordance with Planning Policy Statement: Eco-Towns A Supplement to Planning Policy Statement 1 (July 2009).

The Masterplan Energy Strategy identified various combined technology approaches to achieve the true zero carbon target - defined in the PPS1 Eco towns supplement as "*over a year the net carbon dioxide emissions from all energy use within the buildings on the eco-town development as a whole are zero or below*" (Policy ET7.1). The Masterplan Energy Strategy recognised that whilst certain technologies may go a considerable way to meeting demands and creating carbon savings; no one technology can fulfil the site's total energy demand and carbon reduction target. Therefore a combined technology solution will be required.

The strategic options considered within the Masterplan Energy Strategy were focused on achieving true zero carbon through predominantly on-site technology rather than any significant reliance on off-site/off-set allowable solutions. However, whilst a preferred approach was identified it was recognised that further optimisation of the available technical solutions would continue as detailed design progresses; such as refinement of available roof area for PV, selection and sizing of CHP engines and associated thermal store to optimise delivery of the thermal demand carbon emission reductions. The preferred strategic approach to enable the true zero carbon target to be met for the NW Bicester development was identified as follows:

- Enhanced fabric energy efficiency standards,
- Site wide District Heat Network (DHN) – providing all thermal demand across the site; linked to Energy Centres,
- On-site Energy Centres – that include Low Zero Carbon (LZC) technologies that will meet thermal demands and provide sufficient carbon emissions reduction to meet zero carbon target; in combination with,
- Roof mounted PV – optimised relative to layout and building design.

The approach was selected because:

- Technically it can achieve the true zero carbon target (i.e. delivering carbon emission savings relative to both regulated and unregulated emissions).
- Ability to be delivered entirely on-site and therefore not have any reliance on any third party agreements.
- Experience of delivering a similar solution, utilising DHN and Energy Centre with LZC, on the first phase Exemplar site of NW Bicester.
- Ability to deliver homes that maintain a traditional design approach.
- Inclusion of a DHN within the preferred option enables future proofing relative to new technology (which can be plugged into the energy centres) and/or potential connection to waste heat from the Ardley Energy from Waste (EfW) facility.

3 Development Overview

The proposals, within a total site area of 154.82 hectares, can be summarised as follows:

- Retention of the existing storage building adjacent to Bucknall Road;
- Provision of up to 2,600 new homes (Use Class C3) across 66.97 hectares of net residential land, to include up to 250 homes to be provided on an 'Extra Care' basis (Use Class C3);
- 1.02 hectares of land to accommodate commercial uses (falling within Use Classes A1-A5, B1 and B2) within a new local centre;
- 0.47 hectares of land to accommodate social and community facilities (Use Class D1) including a community hall;
- 2.22 hectares of land to accommodate a new two form entry primary school and playing fields;
- 0.88 hectares of land to accommodate an extension to the primary school approved as part of the Exemplar (LPA reference 10/01780/HYBRID);
- Provision of 67.26 hectares of green infrastructure (circa 45% of the total site area) excluding school playing fields but including 4 hectares to be offered to the Council as a burial ground, 2 hectares of allotments and 1 hectare of community farm;
- 0.2 hectares of land to accommodate an energy centre where on-site energy will be generated through low carbon technology such as a biomass boiler and/ or biomass or gas Combined Heat and Power plant ('CHP');
- Quantum and tenure split of affordable homes to be determined through viability assessment;
- New homes to be constructed to achieve a minimum of Code for Sustainable Homes Level 5;
- All residential units to be designed to Lifetime Homes standards;
- Commercial buildings constructed to achieve BREEAM 'excellent';
- Development as a whole to be 'true' zero carbon (taking in to account regulated and unregulated energy as defined in the PPS1 Supplement) to be achieved through a range of measures including high performance building fabric, reduced energy consumption, renewable and low carbon energy generation;
- Water Treatment Works to be provided on-site subject to technical considerations;
- Retention of the majority of existing trees and hedgerows and provision of strategic landscaping;
- Adoption of a range of measures to encourage a net gain in biodiversity;
- New roads, cycle routes and pedestrian footpaths including the partial realignment of Bucknell Road with routes designed to give priority to buses, cyclists and pedestrians.

3.1 Development Schedule

The following tables provide a summary of the anticipated development schedule of the site which have been used as the basis for energy demand and carbon emission calculation throughout this report.

Table 3.1 Proposed Residential Units

Dwelling Type	Total Units	Unit Area (m^2)	Total Unit Area (m^2)	No. of Occupants "N" SAP box 42
1 Bed Apartment	320	62.66	20,051	1.87
2 Beds House (Mid Terrace)	1,060	83.00	87,980	2.64
3 Beds House (Semi Detached)	827	97.54	80,666	2.76
4 Beds House (End Terrace)	281	113.34	31,849	2.85
5 Beds House (Detached)	109	150.00	16,350	2.89
Total	**2600**		**236,896**	

Table 3.2: Proposed Non-Residential Units

Building Type	Total Area	GIA (m^2)
Primary School	46,400	14,700
A2 Business Hub	4,00	360
B1 Commercial business	5,000	3500
B2 Commercial business	2,300	885.5
Nursery	1,000	500
Large Community hall on two floors	2,210	1271
1 adult learning rooms	115	57.5
2 neighbourhood police rooms	185	92.5
1 early intervention centre storage rooms	45	22.5
visitor centre room	1,150	575
Retail and restaurant	2,500	1,250
Energy Production	2,000	400
Total		**23,614**

4 Planning Policy Requirements and Targets

4.1 Introduction

This section provides a summary of the relevant national, regional and local policy relative to energy and carbon emission reduction. Current and future Building Regulations and the Government's approach to delivering zero carbon homes are also summarised. This is intended as an overview of the key policy and regulatory requirements that need to be met and considered as part of the scheme.

In addition, the aspirations of the client are highlighted to provide a concise and consolidated view of the targets that the scheme seeks to meet as it develops out.

The policy landscape around Climate Change has been rapidly moving with many new policies and changes to existing policy over the last number of years which will influence the way in which the energy strategy for the scheme may come forward. It is also safe to suggest that policy will continue to evolve over the period in which the development progresses; and therefore maintaining flexibility in any strategy is crucial to facilitating continued sustainable development.

4.2 National Planning and Policy Requirements

The Climate Change Act (2008)

The Climate Change Act 2008 introduced a legally binding target to reduce the UK's greenhouse gas (GHG) emissions to at least 80 per cent below 1990 levels by 2050. It also provides for a Committee on Climate Change (CCC) which sets out carbon budgets binding on the Government for 5 year periods.

In Budget 2009 the first three carbon budgets were announced which set out a binding 34% CO_2 reduction by 2020 and the Government has now proposed that the fourth carbon budget will be a 50% CO_2 reduction by 2025. The CCC also produces annual reports to monitor progress in meeting these carbon budgets. As a result of the Climate Change Act, a raft of policy at national and local level has been developed aimed at reducing carbon emissions.

The levels of the first three carbon budgets were set in fiscal budget 2009 at the "interim" level recommended by the CCC prior to global agreement on emissions reductions. The carbon budgets require a reduction in greenhouse gas emissions of 34%, against 1990 levels, by 2020. The fourth carbon budget level was set in June 2011. The carbon budget for the 2023–2027 budgetary period is 1,950,000,000 tonnes of carbon dioxide equivalent.

UK Low Carbon Transition Plan (2009)

The previous Government launched the UK Low Carbon Transition Plan on 15th July 2009. The Plan includes the Renewable Energy Strategy (white paper) and Low Carbon Industrial Strategy. The UK Low Carbon Transition Plan is a Government white paper that sets out policies required to ensure that the UK meets its legally binding commitment to reduce carbon emissions by 34% by 2020. Policies contained in the documents include:

- Getting 40% of our electrical energy from low and zero carbon sources by 2020
- Rolling out smart meters in every home by 2020

National Planning Policy Framework

The National Planning Policy Framework was published on 27 March 2012 and sets out the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

As of 27th March 2013 (12 months from the day of publication), Annex 1 of the NPPF confirms that due weight should be given to relevant policies in existing plans according to their degree of consistency with the NPPF (the closer the policies in the plan to the policies in the Framework, the greater the weight that may be given). It also confirms that, from the day of publication, decision-takers may also give weight to relevant policies in emerging plans according to:

- the stage of preparation of the emerging plan (the more advanced the preparation, the greater the weight that may be given);
- the extent to which there are unresolved objections to relevant policies (the less significant the unresolved objections, the greater the weight that may be given); and
- the degree of consistency of the relevant policies in the emerging plan to the policies in the NPPF (the closer the policies in the emerging plan to the policies in the NPPF, the greater the weight that may be given).

The NPPF was designed to make the planning system more user friendly and transparent. The framework's primary objective is sustainable development, focussing on the 3 pillars of sustainability: planning for prosperity (Economic), planning for people (Social) and planning for places (Environmental).

At the heart of the NPPF is a presumption in favour of sustainable development. The NPPF identifies 12 principles that should be at the core of land use planning; these include:

- "support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change, and encourage the reuse of existing resources, including conversion of existing buildings, and encourage the use of renewable resources (for example, by the development of renewable energy)".

Further guidance within the NPPF is given under the heading "Meeting the challenge of climate change, flooding and coastal change"; including:

- supporting the delivery of renewable and low carbon energy infrastructure; and
- reduce greenhouse gas emissions

4.3 Planning Policy Statement 1 Eco town supplement

NW Bicester (NWB) is identified in the supplement to PPS1 entitled 'The Planning Policy Statement: Eco-Towns A Supplement to Planning Policy Statement 1' (July 2009) as one of four locations for an Eco Town. The principle of the development is supported by Cherwell District Council ('the Council') and the land to the north west of Bicester ('the Site') is identified in the emerging Local Plan as the area within which a development following eco-town principles and the standards in PPS1 Supplement could be developed.

It is anticipated that the current Government will cancel the current PPS Supplement in due course. Notwithstanding, the requirements of the Supplement to PPS1 will be carried over by Cherwell (subject to review and amendments as necessary) into the Local Plan. The Council has already set out its policy position in respect of NWB in the emerging Local Plan and granted planning permission for the Exemplar Phase of NWB for 393 new homes, local facilities and land for a primary school.

The PPS 1 Eco-town supplement defines zero carbon under paragraph ET 7.1 as:

"*over a year the net carbon dioxide emissions from all energy use within the buildings on the eco-town development as a whole are zero or below*".

Paragraph ET 7.2 of PPS 1 Eco-town provides further clarification and states

"*This standard will take effect in accordance with a phased programme to be submitted with the planning application. It excludes embodied carbon and emissions from transport but includes all buildings – not just houses but also commercial and public sector buildings which are built as part of the eco-town development. The calculation of net emissions will take account of:*

a) emissions associated with the use of locally produced energy

b) emissions associated with production of energy imported from centralised energy networks, taking account of the carbon intensity of those imports as set out in the Government's Standard Assessment Procedure, and

c) *emissions displaced by exports of locally produced energy to centralised energy networks where that energy is produced from a plant (1) whose primary purpose is to support the needs of the eco town and (2) has a production capacity reasonably related to the overall energy requirement of the eco town.*"

The Town and Country Planning Association (TCPA) guidance for the development of energy efficient and zero carbon strategies for eco-towns, December 2009, encourage eco-towns to follow best practice to achieve zero carbon as Exemplar developments.

4.4 Building Regulations (Part L)

As part of the British Governments commitment to cutting carbon emissions by 80%, compared to 1990 levels (by 2050) the government is escalating Building Regulations requirements to reduce carbon emissions within the built environment. The government's proposed trajectory for Building Regulations Part L1A (Conservation of fuel and power in new dwellings) was outlined within Building a Greener Future: A Policy Statement (2007). This outlines the reductions in 'regulated' carbon emissions compared to a Building Regulations (2006) baseline outline in table 3.1 below:

Table 4.1 Carbon reduction improvement compared to Building Regulations 2006

Building type	Part L 2010	Part L 2013	Part L 2016	Part L 2018	Part L 2019
Domestic	25%	30%	Zero Carbon	Zero Carbon	Zero Carbon
Non – domestic	25%	32%	Further improvement	Zero Carbon	Zero Carbon

The latest Building Regulations (2013) came into effect on the 6th April 2014. As outlined above the principal aim for Part L 2013 is to:

- Provide a meaningful step towards the UK Government commitment to zero carbon standards for homes by 2016
- Drive innovation in the right direction
- Aid learning to deliver zero carbon homes.

The methodology for demonstrating compliance combines the carbon emission measure ($kgCO_2$/ m^2/year) calculated for the dwelling, with a 'new' requirement to consider the fabric energy efficiency (FEE) (kWh/m^2/year) of the building envelope. The process of demonstrating compliance uses the calculated carbon emission rate for the building in question and compares this to a target carbon emission rate, also calculated specifically for that building. In Part L terminology, the Dwelling Emission Rate (DER) must be less than the Target Emission Rate (TER). This approach is familiar from Part L 2010.

However, all residential dwellings in NW Bicester will come forward beyond 2016. Likewise, most non-residential (commercial and community etc.) buildings are expected to come forward post 2019. Therefore, the vast majority of buildings will need to achieve Zero Carbon, as defined by the Zero Carbon Homes policy, which represents the exemplar standard for the energy performance of dwellings.

Given the relatively minor reduction between 2010 and 2013 (6% for domestic and 9% non-domestic) the anticipated jump to zero carbon represents a major step change and will almost certainly require additional updates to Part L and how it is implemented. The traditional approach of building regulations is to assess the performance of a building considering only the energy use of the building and only those technologies attached to it and so directly affecting its carbon performance. If this approach were taken to zero carbon buildings it would rely on, extremely expensive, small scale renewable electricity generation. Inevitably this would mean that around half would not be able to meet the target and many of those that could meet the target would be economically unviable.

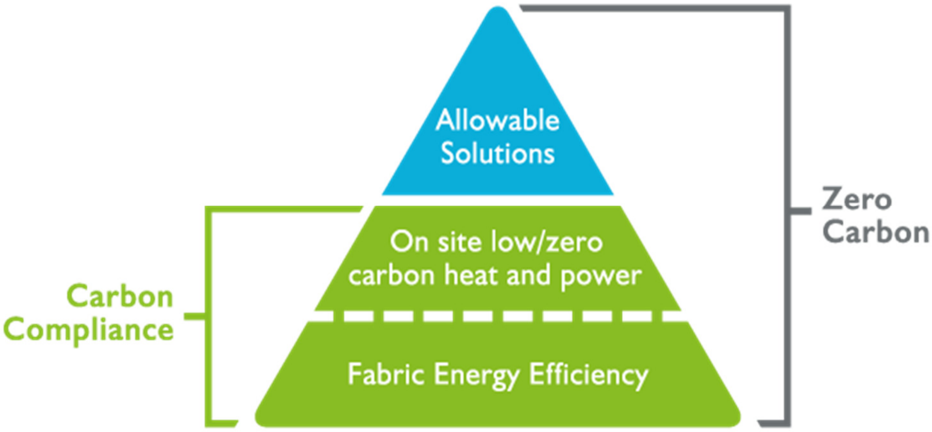
4.5 Achieving Zero Carbon

It was announced in the 2011 Budget 'The Plan for Growth' document, that a 'Zero Carbon Home' requires a 100% reduction in regulated energy (heating, hot water and fixed electrical items – pumps, fans, lights) over Building Regulations 2006. Therefore, emissions from cooking or from appliances such as computers and televisions are excluded from the definition.

The Government's commitment to achieving Zero Carbon Homes is based on the following hierarchical approach to achieving zero carbon targets:

1. Mandatory Fabric Energy Efficiency (FEE) Level – To ensure energy efficiency by energy efficient building design.
2. Mandatory onsite Carbon Compliance Level – To ensure energy efficiency by energy efficient building design and to reduce carbon emissions through on-site low carbon and renewable energy technologies and near-site heat networks.
3. Mitigate the remaining carbon emissions through use of 'Allowable Solutions'.

Figure 4.1: Showing approach to achieving Zero Carbon homes.



In February 2011 recommendations for national minimum standards of Carbon Compliance – the onsite reductions of emissions – were developed by a Zero Carbon Hub led Task Group. The Task Group found that the proposal from July 2009, to tighten the Carbon Compliance standard by 70% (equivalent to 6 kg CO_2(eq)/m^2/year), may not be achievable in all cases. In addition, it was felt that the previous method of calculating carbon compliance level was confusing and now suggest that an absolute limit in terms of CO_2 emissions per m^2 floor area per annum be the measure used. These are provided in Table 3.2 below.

Table 4.2: Proposed approach to achieving Zero Carbon homes

Built Form	Fabric Standard (kWh/m^2/yr)	Carbon Compliance (kgCO_2/m^2/yr)
Detached houses	46	10
Semi-detached houses	46	11
End of terrace	46	11
Mid terrace	39	11
Apartment block	39	14

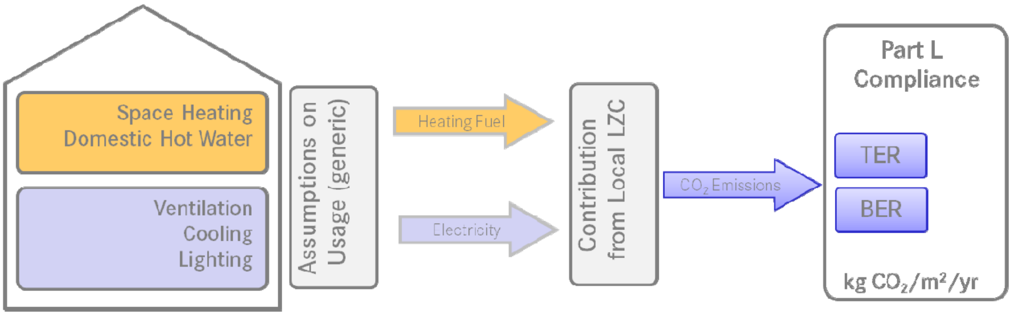
In addition, the task group are set to review and establish the Carbon Compliance limit for higher apartment blocks but the work is still ongoing.

The equivalent definition of 'Zero Carbon' for non-domestic buildings has not progressed to the same level as that of dwellings. However it is expected that a similar framework (energy efficiency, on-site carbon compliance and allowable solutions) will be developed to ensure 'Zero Carbon' is achieved by 2019 (2018 for public sector buildings) for non-domestic buildings.

4.5.1 True Zero Carbon

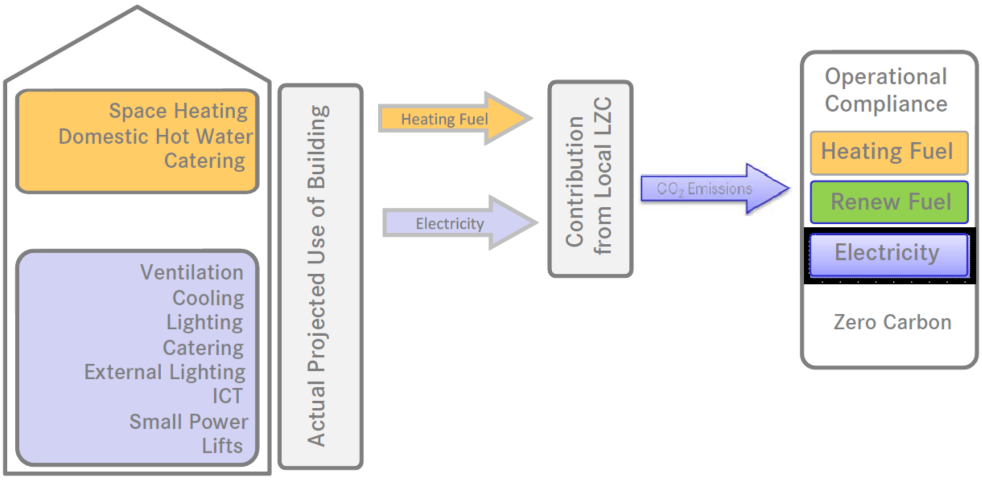
To reach True Zero Carbon, further consideration is needed regarding the operational carbon performance of the development over and above that described above in the standard regulatory approaches of building regulations. This approach recognises that the regulatory view of carbon and energy performance in buildings (see below) only represents a proportion of the actual "in use" energy consumption and carbon emissions.

Figure 4.2: The "regulated carbon emissions" arising from Part L of the building regulations



In addition to the regulatory considerations above, the operation of buildings will include other energy consuming elements and may also be used in a different manner to the standard assumptions made in respect of regulatory compliance – as presented below.

Figure 4.3: The actual “in use” picture of carbon emissions from a typical building



4.5.2 Allowable Solutions

Allowable solutions have been introduced to offer flexibility and options to offset remaining emissions (beyond carbon compliance), when other on-site options are not considered technically and commercially feasible. Therefore, allowable solutions are likely to become central to the overall policy of ensuring that achieving zero carbon is affordable and can be achieved.

However, the Government has not yet defined the scope or price of allowable solutions. It is also unclear as to how allowable solutions may be delivered. The Zero Carbon Hub (Allowable Solutions for Tomorrows New Homes, June 2011)) announced its proposals for a framework for allowable solutions. This was further refined within the Zero Carbon Strategies for Tomorrow’s New Homes report released in February 2013.

According to these proposals, the initial choice for developers will be either:

1. To pay into a carbon fund (Type 1 Allowable Solution). Here the payments from developers would be accumulated and the fund manager will take responsibility for investing in suitable Allowable Solutions projects - a wide range of carbon-saving projects could qualify as Allowable Solutions. It is expected that Local Planning Authorities will have the option to set up carbon funds and may establish local priorities for particular Allowable Solutions.

2. To invest in carbon-saving projects associated directly with their own developments (Type 2 Allowable Solution).

The range of potential Allowable Solutions can be split into the following options:

1. On-site allowable options – This might include measures such as smart appliances, site-based heat storage, electricity storage, waste management systems, LED street lights, flexible demand systems, etc

2. Near-site allowable options - This might include measures such as retrofitting low/zero carbon technologies to communal buildings, creation of local sustainable energy projects/infrastructure such as district heating or wind turbines, communal waste management, local energy storage, electric vehicle charging, etc.

3. Off-site allowable options - This might include measures such as investing in energy from waste plants, low carbon electricity generation, district heating pipe-work, low carbon cooling, energy storage, flexible demand projects to counterbalance intermittent renewable energy provision, etc.

Allowable solutions will have been designed to deliver the residual carbon emissions equal to that emitted by any new development. It is understood that the developers would pay an allowable solutions provider to deliver the required reductions. Recent DCLG consultation document discusses potential price cap strategy; of which some options would encourage competition between allowable solution providers ensuring that money is invested in the most cost-effective solutions. At present, a price cap has not been defined, however the DCLG consultation document proposes costs of between £36/tCO2 to £90/tCO2; which can make considerable difference to the total cost of achieving zero carbon and the final energy strategy for the development.

Based on the available information, it can be concluded that allowable solutions may be an important part in achieving a developments zero carbon target. Again, the extent to which allowable solutions may be implemented within the development will be determined in the detail design stage of the development, since it will then be possible to establish more accurate energy demands for the buildings.

At this stage, the option to consider the future incorporation of “Allowable Solutions” in the resulting energy strategy is inconsistent with the overall strategy and client aspiration to achieve True Zero Carbon through onsite solutions. It is therefore considered inappropriate for this stage in the design of the development.

4.6 Local Policy

The existing Cherwell Local Plan (1996) saved polices do not specifically consider energy and carbon emissions. The emerging Cherwell Local Plan 2006 – 2031, that was submitted to the Secretary of State for Examination in Public on 31st January 2014, includes policies on energy and carbon emissions however these are not yet adopted.

4.7 Code for Sustainable Homes

To strengthen the sustainability requirements of new dwellings, the Government launched the Code for Sustainable Homes (CSH or ‘the Code’) in 2006 to operate in parallel to the Building Regulations for energy use for new residential development (Approved Document Part L1A).

CSH sets out the national standard for sustainable design and construction of new homes. The Code includes sections under a number of different sustainability issues which includes; energy use in a home, materials used in the construction and the effect on biodiversity. The Code also addresses issues such as water use within each dwelling, surface water and flooding, health and wellbeing and pollution issues. This document only considers the energy/carbon aspect of the Code.

As discussed above, Part L of the Building Regulations (Conservation of fuel and power) will progressively become more stringent and will eventually require all new dwellings built from 2016 onwards to achieve ”zero carbon” status.

The Code for Sustainable Homes (CSH) was introduced as a voluntary measure to provide a comprehensive assessment of the sustainability of a new home and replaced the Eco-Homes methodology. In terms of carbon emissions CSH Level 5 equals a 100% improvement over 2010 Building Regulations (this would equate to circa 20% improvement from 2013 Building Regulations) approximately. The original programme was for all new homes to meet ‘Zero carbon’ from 2016. The Code Level relates to; compliance with mandatory minimum standards for waste, material, and surface water run-off as well as energy and potable water consumption.

In meeting True Zero Carbon the NW Bicester Development will surpass the energy requirements of CSH Level 5.

4.8 BREEAM

BREEAM (Building Research Establishment’s Environmental Assessment Method) is a standard assessment method established by the Building Research Establishment (BRE), used to assess the environmental impact of non-domestic buildings. Overall BREEAM is similar to the Code and covers a range of issues and credits which are awarded where a building achieves a benchmark performance. Like the Code, BREEAM is a voluntary standard although central government and some planning authorities require compliance.

The BRE periodically updates BREEAM and the latest version of BREEAM New Construction came into force in May 2014. The latest version imposes more demanding standards and energy/carbon requirements than the previous standard. Because BRE have applied previous best practice carbon standards before the government has fully decided how to address the future carbon performance of nondomestic buildings, it is likely that the requirements will need to be changed again in the future to align with Part L (2013 and 2016) requirements.

BREEAM (2014) has the following mandatory energy requirements:

- Excellent: Energy Performance Ratio for New Construction of 0.375
- Outstanding: Energy Performance Ratio for New Construction of 0.60

4.9 Summary of Policy Requirements

The various policy and regulations requirements are summarised in table 3.4 below:

Table 4.4: Summary of Application 1 Energy Requirements

Policy	Document	Requirement
Policy Bicester 1 – NW Bicester Eco-Town	Emerging Cherwell Local Plan 2006-2031	True Zero Carbon CSH Level 5 BREEAM Excellent
CSH Level 5 – Ene 1 Dwelling Emission Rate	CSH 2010 Technical Note	100% improvement on 2010 Building Regulations
BREEAM Excellent	BREEAM New Construction 2014	Energy Performance Ratio (EPR_{NC}) of 0.375 (6 credits) or higher.
Building Regulations	Building Regulations 2016 (anticipated)	Zero Carbon from regulated energy

5 Methodology

The carbon dioxide emissions have been calculated by utilising the Building Regulations standards for domestic units; for non-domestic units an estimation has been made using the available benchmarks:

- Residential units: The Government's Standard Assessment Procedure (SAP) for Energy Rating of Dwellings.
- Non-domestic units: Chartered Institute of Building Services Engineers (CIBSE) Energy Benchmark TM 46 - 2008

5.1 Residential Emissions Calculation Methodology

The Target Emissions Rates (TER) for residential units of the proposed development were taken from the SAP (The Government's Standard Assessment Procedure for Energy Rating of Dwellings) assessment performed by using the Stroma FSAP software version 2012.

A sample set of dwellings were selected with the intention of demonstrating the potential energy demands of the proposed residential units. The following dwelling types have been modelled, with the range of dwelling geometries for each type to cater for the worst case:

- Town Centre 1 Bed Apartment (Ground Floor)
- 2 Beds House (Mid Terrace)
- 3 Beds House (Semi Detached)
- 4 Beds House (End Terrace)
- 5 Beds House (Detached)

The above dwellings have been modelled by using SAP software to estimate the TER emissions and energy demands which are covered by Part L of the Building Regulations, known as regulated emissions including space heating, hot water, ventilation, lighting, pumps and fans.

The unregulated emissions i.e. appliances and cooking have been estimated by utilising the SAP methodology formula below.

A. **Calculate the non-regulated carbon emissions (appliances & cooking) by:**

   i. **For elec oven, elec hob:**

   $\{275 + (55 \times N) + 207.8 \times (N \times TFA)^{0.4714}\} \times 0.527$

   ii. **For elec oven, gas hob:**

   $\{137.5 + (27.5 \times N) + 207.8 \times (N \times TFA)^{0.4714}\} \times 0.527 + \{280.5 + (48.15 \times N)\} \times 0.227$

   iii. **For gas oven, gas hob:**

   $\{481 + (96.3 \times N)\} \times 0.227 + \{207.8 \times (N \times TFA)^{0.4714}\} \times 0.527$

   Where N = number of occupants, defined in SAP2009 (Table 1b) by:

The emissions have been calculated based upon an assumption that all houses will use electric appliances in order to reduce infrastructure costs associated with gas pipework. The above formula has been taken from Carbon Compliance Zero Carbon Hub's document, Modelling 2016 using SAP 2009 Technical Guide.

5.2 Non-Residential Emissions Calculation Methodology

The Chartered Institute of Building Services Engineers (CIBSE) describes the statutory building energy benchmarks prepared to complement the Operational Rating procedure developed by the Department of Communities and Local Government (CLG) for Display Energy Certificates (EPC) for use in England, Wales and Northern Ireland.

CIBSE carried out various studies and develops the benchmark proposals based upon CIBSE Guide F and Energy Consumption guide ECG19. There are currently 29 benchmark categories listed under this document, which also sets the energy consumption benchmarks of a typical building type. The benchmarks are expressed in terms of delivered energy used per unit of floor area, (i.e. kWh/m^2) for both electrical and fossil fuel of energy use. This generally covers lighting, heating, cooling, appliances, standard IT and small tea rooms/spaces.

The following non-domestic units have been used to estimate the energy demands on the basis of their gross internal area,

- A1 - Shops - Retail shops etc.
- A2 – Business Hubs
- A3 - Food & Drink - Restaurants/ Café
- B1 - Business Office/ Light Industrial
- B2 to B8 - Commercial
- D2 - Assembly & Leisure
- Schools & education establishments
- Public Buildings

The above building classification has been used to estimate the target emissions under Building Regulations 2013. At this outline stage this is the best practice approach which can be adopted to demonstrate the carbon emissions and proposed improvements. These predicted energy demands and emissions have been used for estimation purposes, however, it is recognised that more detailed energy modelling will be undertaken at later design stage when building detailed designs have been formalised.

6 Baseline Energy Demand and Carbon Emission

In order to establish the approximate baseline energy demand (both thermal and electrical) for the development, an energy model has been produced. The assessment of the energy performance of the proposed design solution is based on the energy consumption of 'notional' domestic and non-domestic buildings on site which are compliant with Part L 2013 Building Regulations.

The residential energy demand was calculated using information regarding regulated energy consumption abstracted from a series of sample Standard Assessment Procedure (SAP) reports developed to provide typical residential dwelling types to develop preliminary energy benchmarks for domestic buildings. The assumptions on which the SAP calculations have been undertaken are as follows:

- Roof sizes are estimated as the exact roof dimensions are not available;
- Quantities and dimensions of openings (windows and doors) for each dwelling type are estimated;
- The differing types of openings and their dimensions are assumed to be the same for all dwelling types;
- Cooling is assumed not to be provided to any of the dwellings;
- Natural ventilation
- All internal and external lighting used throughout the dwellings is energy efficient.

A conservative approach has been adopted in the assumptions made for the purposes of the SAP calculations. This approach gives a degree of comfort since neither the worst case or best-case scenario is used and therefore incorporates an element of flexibility.

The energy consumption for space heating, hot water and electricity for lighting, pumps and fans per m^2 have been determined and derived from sample SAPs for each typical dwelling (see Appendix B). The average energy consumption for space heating, hot water and electricity for lighting per m^2 was calculated which is used as an energy benchmark for the energy demand assessment of each dwelling type.

Given that this is an outline planning application, there is still some uncertainty about the energy needs of the future occupants of non-domestic buildings. Without knowing the occupants or precise uses of the proposed units, it is difficult to accurately predict the energy demand. As such, standard benchmarks taken from CIBSE publication TM46 2008 and Guide F have been used to estimate as far as possible non-domestic energy use but there are a couple of issues with this approach. Firstly, there are multiple benchmarks for B1-B2 uses with wide differences between chilled and standard units and, secondly, the benchmarks are intended to be representative of the UK building stock as a whole and so tend to estimate higher heat demand than would typically be required for new buildings. This approach will tend to overestimate the overall energy demand.

Therefore, the non-domestic energy benchmarks, which reflect Part L 2013 Building Regulations and have been determined by assuming that the CIBSE TM46 and GUIDE F energy benchmarks, are reflective of energy consumption of 2006 Part L compliant buildings and so have been reduced by 10% to obtain the energy demand for non-domestic buildings.

These benchmarks were used in the energy model to determine the baseline energy demand.

The following tables provide a summary of the energy demand and carbon emission relative to anticipated accommodation schedule of Application 1 of the NW Bicester development. The tables provide the baseline energy demand and carbon emission values based upon meeting Building Regulations 2013.

Table 6.1 Residential - Baseline Energy Demand and Carbon Emission (Building Regulations 2013)

Residential Buildings	BR2013 Building Demand	BR2013 Building Emissions
Total Regulated Electricity	1,228,290.70 kWh	637,483 kgCO2
Total Regulated Fossil Gas	14,141,912.46 kWh	3,054,653 kgCO2
Sub Total Regulated	**15,370,203.16 kWh**	**3,692,136 kgCO2**
Total Un-regulated Electricity	8,144,414 kWh	4,226,951 kgCO2
Total Un-regulated Gas	-	-
Sub Total Un-regulated	**8,144,414 kWh**	**4,226,951 kgCO2**
TOTAL	**23,514,617 kWh**	**7,919,087 kgCO2**

Table 6.2 Non - Residential - Baseline Energy Demand and Carbon Emission (Building Regulations 2013)

Non – Residential Buildings	BR2013 Building Demand	BR2013 Building Emissions
Total Regulated Electricity	729,448 kWh	378,584 kgCO2
Total Regulated Gas	1,654,981 kWh	357,476 kgCO2
Sub Total Regulated	**2,384,429 kWh**	**736,059 kgCO2**
Total Un-regulated Electricity	801,591 kWh	416,026 kgCO2
Total Un-regulated Gas	937,125 kWh	202,419 kgCO2
Sub Total Un-regulated	**1,738,716 kWh**	**618,445 kgCO2**
TOTAL	**4,123,145 kWh**	**1,354,504 kgCO2**

The below table provides a summary of the total energy demand and carbon emission for Application 1 of the proposed NW Bicester Development.

Table 6.3 All Buildings - Baseline Energy Demand and Carbon Emission (Building Regulations 2013)

All Buildings	BR2013 Building Demand	BR2013 Building Emissions
Total Regulated Electricity	1,957,739 kWh	1,016,066 kgCO2
Total Regulated Gas	15,796,893 kWh	3,412,129 kgCO2
Sub Total Regulated	**17,754,632 kWh**	**4,428,195 kgCO2**
Total Un-regulated Electricity	8,946,005 kWh	4,642,977 kgCO2
Total Un-regulated Gas	937,125 kWh	202,419 kgCO2
Sub Total Un-regulated	**9,883,130 kWh**	**4,845,396 kgCO2**
TOTAL	**27,637,762 kWh**	**9,273,591 kgCO2**

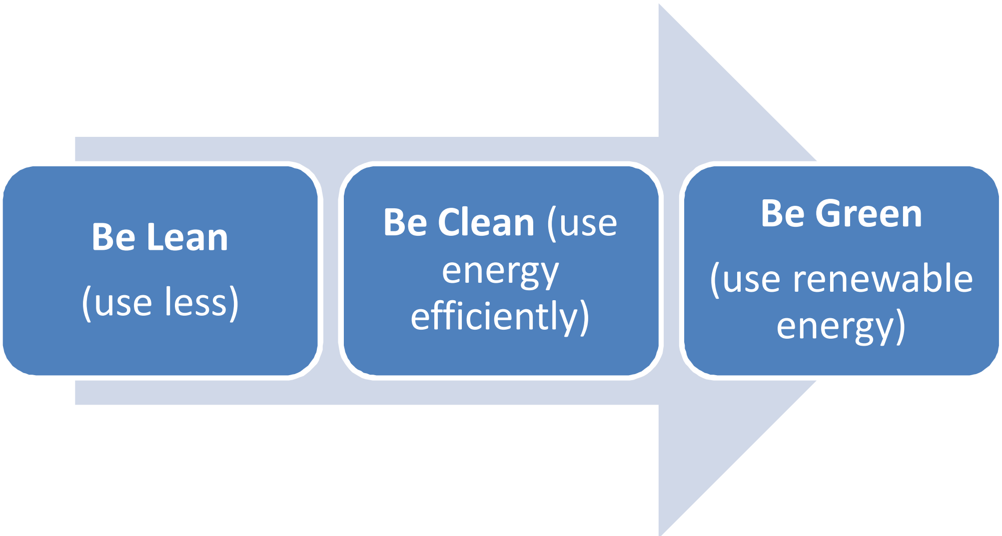
7 Strategic Approach and Carbon Reduction Targets

This report considers the strategic energy approach that may be adopted at the site to meet policy and regulatory requirements as well as client aspirations. The strategies considered follow the energy hierarchy outlined below:

1. **Be Lean:** Use less energy. Minimise energy demand through efficient design and the incorporation of passive measures;

2. **Be Clean:** Supply energy efficiently. Reduce energy consumption through use of low-carbon technology; and

3. **Be Green:** Use renewable energy systems.



The first principle stresses the primacy of seeking to reduce energy consumption. Within the built environment this comprises adopting energy efficiency measures in both the design and construction of new buildings. The second principle addresses the 'clean' supply of energy issue. This will require 'decarbonising' and improving efficiency in the generation and distribution of energy. The third principle comprises the use of 'green' energy systems. These are renewable sources of energy with low or zero carbon emissions and include, amongst others, solar generated heat and power, wind energy and biomass.

7.1 Energy Efficiency Measures (Be Lean)

7.1.1 Approach

The 'Be Lean' approach seeks to minimise energy use through demand reduction and passive measures, such as maximising insulation and use of natural ventilation, which minimise the use of energy and utilise energy more effectively (e.g. energy efficient lighting). The NW Bicester development will adopt appropriate future proofed building standards to ensure energy efficiency is the first priority in achieving its carbon reduction and sustainability objectives.

A range of measures to reduce carbon emissions and increase resilience to climate change can be incorporated into building design; some of these are outlined below.

Table 7.1 Building Energy Efficiency Measures

Passive Design	Technology
Air tightness	"A" rated appliances
Insulation	Automatic controls and monitoring
Reduce thermal bridging	Energy management systems
Solar shading	Energy efficient lighting
Use of natural daylight	High performance glazing
Natural ventilation	Energy efficient systems
Passive solar orientation	

Passive design is the process of best employing the conventional elements of construction to reduce energy consumption and to maximise the use of the natural elements such as daylight, sunlight and natural ventilation. The simplest and most effective method of achieving carbon reduction is often initially through the passive measures proposed above (and in section 7.2 below).

The development is proposed to be designed to utilise natural daylight in all the habitable spaces for the health and wellbeing of the building occupants. All the domestic units will incorporate suitable window sizes relative to living spaces and bedrooms. This will allow the development to achieve good daylighting standards as well as controlling solar gains. The careful choice of glazing and window U values will maintain the solar gain and also minimise the solar intensity to reduce potential overheating impact.

The development is also intended to incorporate high efficiency lighting throughout. The proposed target is to provide 100% of all light fittings as low energy lighting, and will accommodate the compact fluorescent or fluorescent luminaires only.

Real time energy monitors will be provided to each building to enable residents and occupiers to understand and adapt their energy use;. These monitors may be combined with systems that also enable real time passenger information in relation to public transport serving the development.

7.2 Fabric Energy Efficiency Standards (FEES)

The FEES of a building is a performance standard to measure the heating and cooling demands of the building and is measured in $kWh/m^2/year$. As mentioned previously the baseline has been considered to demonstrate compliance with current 2013 Building Regulations. However, due to the anticipated build out period for this development, it is reasonable to consider how the development may be future proofed relative to the 2016 Building Regulations and zero carbon building requirements. As such appropriate FEES criteria have been adopted in accordance with the FEES targets identified in Table 4.2 (see Appendix C).

The heat loss of building elements is dependent upon their U-value. The lower the U-value the better the level of insulation which will improve the thermal performance of the building and help to reduce the CO_2 emissions due to reduced space heating demands. The proposed residential units will incorporate high levels of insulation and high efficiency glazing.

Another cause of heat loss is air infiltration / permeability. In 'leaky' buildings the heat loss can occur through wind, internal / external pressure difference, stack effect etc. However, the careful design of appropriate air tightness can significantly reduce heat loss and save energy. The table below provides the breakdown of proposed U values and air tightness to attain the FEES targets.

Table 7.2 Proposed U Value and Air Tightness

Property Type	Floor (W/m2.K)	Wall (W/m2.K)	Roof (W/m2.K)	Window (W/m2.K)	Door (W/m2.K)	Air perm (m3/h.m2)
1 Bed Apartment	0.15	0.20	-	1.2	1.1	5.0
2 Beds House	0.15	0.20	0.11	1.2	1.1	5.0
3 Beds House	0.15	0.20	0.11	1.2	1.1	5.0
4 Beds House	0.15	0.18	0.10	1.2	1.1	4.5
5 Beds House	0.15	0.18	0.10	1.2	1.1	4.5

Attaining these U Values and air tightness will be a significant improvement upon existing Building Regulations, and will enable the following FEES to be achieved for each dwelling type. This will future proof the build quality of this development and enable true zero carbon targets to be achieved.

Table 7.3 Fabric Energy Efficiency Standard (FEES) results for each building type

Property Type	FEES ($kWh/m^2/yr$)	ZCH FEES ($kWh/m^2/yr$)
1 Bed Apartment	38.5	39
2 Beds House	38.6	39
3 Beds House	41.78	46
4 Beds House	40.09	46
5 Beds House	44.6	46

Climate Change Adaptation

The balance between ensuring good insulation and air tightness to minimise heat loss in the winter months and potential overheating in the summer months need to be carefully considered.

Adopting the ZCH recommended FEE standards ensures a highly efficient fabric capable of reducing the need for heating in the winter months through the minimisation of heat loss and protects the building against future temperature increases, and potential cooling requirements, through appropriate air tightness and ventilation standards.

7.3 Reduced Energy Demand and Carbon Emissions

The standards described in this section have been incorporated within the design and result in energy demand reduction of regulated energy and carbon emissions savings. The table below gives the breakdown of energy consumption and carbon emissions for space heating, hot water, lighting, pumps and fans (regulated energy) for domestic buildings and non-domestic units.

Table 7.4 All Buildings – Enhanced FEE Energy Demand and Carbon Emissions

All Buildings	Enhanced FEE Demand	Enhanced FEE Emissions
Total Regulated Electricity	1,960,497 kWh	1,017,498 kgCO2
Total Regulated Gas	14,203,671 kWh	3,067,993 kgCO2
Sub Total Regulated	**16,164,167 kWh**	**4,085,491 kgCO2**
B'Regs 2013 Baseline	**17,754,632 kWh**	**4,396,947 kgCO2**
Total Un-regulated Electricity	8,946,005 kWh	4,642,977 kgCO2
Total Un-regulated Gas	937,125 kWh	202,419 kgCO2
Sub Total Un-regulated	**9,883,130 kWh**	**4,845,396 kgCO2**
TOTAL	**26,047,297 kWh**	**8,930,886 kgCO2**
B'Regs 2013 Baseline	**27,637,762 kWh**	**9,273,591 kgCO2**
B'Regs 2010 (+6%)		**9,865,522 kgCO2**
B'Regs 2006 (+25%)		**13,154,029 kgCO2**

By adopting enhanced fabric efficiency standards in all residential dwellings, the total energy demand across the site is reduced by **6%**. This reduces the sites carbon emission by 3.7% over Building Regulations (2013) and 32% over Building Regulations (2006).

8 Low and Zero Carbon Technology (Be Clean and Be Green)

8.1 Introduction

After the initial savings through energy efficiency measures, the next step in a sustainable energy strategy is the consideration of ‘onsite’ low carbon (be clean) and renewable energy (be green); referred to as low and zero carbon (LZC) technology.

Utilising energy generated locally (onsite) reduces energy lost through transmission and distribution, and can often take advantage of more advanced generating technologies that combine to provide energy more efficiently. Local generation, or decentralised generation, is produced on a smaller scale nearer to the point of consumption and can offer a number of benefits, including:

- Using generated energy more efficiently by reducing distribution losses
- Contributing to security of energy supply by increasing local energy production
- Increasing reliability of supply providing the opportunity to operate ‘on or off grid’
- Reducing carbon emissions through more efficient use of fossil fuels and greater use of locally generated renewable energy
- Provides the opportunity to create stronger links between energy production and consumption.
- Can be linked to fund complementary programmes of work, such as retrofitting microgeneration equipment in existing housing stock.
- Provides a visible message of commitment to sustainable energy

Zero carbon or renewable energy comes from harnessing natural energy flows from the sun, wind, or rain. Many such as solar, wind and hydro, directly produce energy and do no emit any carbon dioxide in the process. Others such as biomass, use solar energy to grow renewable plant material that can subsequently be used for energy. Examples here are wood, straw, etc. However, biomass use still generates carbon dioxide when it is burnt. The difference being that this carbon is only that taken from the atmosphere when the plant grew. This is unlike carbon emissions from fossil fuels that are essentially new to the atmosphere, causing increases in atmospheric carbon dioxide levels and climate change. Therefore, when used to replace fossil fuels, biomass leads to a net reduction in carbon emissions; particularly where local supply chains can provide a sustainable supply of biomass.

Of the available renewable energy technologies, some are ‘intermittent’ in nature, such as solar and wind. Others such as biomass, ground source heat pumps and anaerobic digestion can service baseload duties.

The table below identifies the energy generation technologies and approaches considered.

Table 8.1 LZC Technologies

Macro Solutions (typically district scale or larger)	Micro Solutions (typically building related)
Anaerobic Digestion CHP	Air source heat pumps
Biomass heat, biomass power (CHP)	Ground source heat pumps
Energy from Waste CHP	Solar Thermal (building mounted)
Gas CHP	Solar Photovoltaic (building mounted)
Large scale PV array	Wind energy (building mounted)
Large scale wind energy	

8.2 Preferred Approach

As discussed in section 2, the preferred approach to delivering the energy and carbon reduction consists of the following:

- Enhanced fabric energy efficiency
- Site wide District Heat Network – providing all thermal demand across the site
- LZC technology sited within an Energy Centre providing hot water to the DHN and power.
- Thermal demand regulated by inclusion of thermal stores
- Percentage of residential and non-residential roof space to be used for Solar PV (orientated in southerly direction)

8.2.1 District Heat Network and Thermal Stores

A District Heat Network (DHN) is a network of insulated pipes used to deliver heat, in the form of hot water or steam, from the point of generation to the end user. They provide the means to transport heat efficiently provided distances do not become too far. A DHN enables heat to be delivered to point of use from a centralised location.

DHN tend to be installed in areas of medium to high density living and work better where there is a constant thermal demand; which is often achieved in mixed use developments, such as NW Bicester, where there is both day time and night time heat demand.

Inclusion of a thermal store(s) is proposed for Application 1 to regulate the heat demand. This will enable the hot water generated by the Gas CHP and boilers to be buffered, stored and released into the distribution network as needed.

8.2.2 LZC Technology: Gas CHP

It is proposed to utilise Gas Combined Heat and Power (CHP) engines as the lead engine(s) within the Energy Centre; as this integrates the production of usable heat and power (electricity), in one single, highly efficient process. CHP generates electricity and produce usable heat at the same time. Gas-fired reciprocating engines have intake, compression, power, and exhaust cycles. In the intake phase, as the piston moves down in its cylinder, the intake valve opens, and the upper portion of the cylinder fills with fuel and air. When the piston returns upward in the compression cycle, the spark plug emits a spark to ignite the fuel-air mixture. This controlled reaction, or "burn," forces the piston down, thereby turning the crank shaft and producing power. Reciprocating engines can be used in a variety of applications because of their small size, low unit cost, and useful thermal output. They offer low capital cost, easy start-up, proven reliability, good load-following characteristics, and heat recovery potential.

The proposed Gas CHP for Application 1 has been sized to meet 90% of the thermal demand, allowing for maintenance and downtime. The CHP will be sized to avoid significant heat dumping. The remaining thermal demands (10%) will be met by highly efficient conventional gas boilers.

This solution also contributes to meeting the electrical needs of the development at the same time, however further LZC technology will be required to meet the True Zero Carbon target.

8.2.3 Solar PV

It is proposed that the remaining carbon reductions required to achieve the True Zero Carbon Target will be achieved through the provision of roof mounted Solar PV.

Solar- Photovoltaic (PV) systems convert energy from the photons within sunlight into electricity through the aid of photocells; made of semi-conductor material, usually Germanium or Silicon. PV systems are suitable for any type of building but they require significant unshaded south facing space as even a small shadow may significantly reduce output.

The maximum total annual solar radiation is usually at an orientation due south and at a tilt from the horizontal equal to the latitude of the site minus approximately 20 degrees. The latitude of Bicester is 51.9 degrees. Therefore 32 degrees is the optimal tilt in Bicester, south facing.

8.3 Reduced Energy Demand and Carbon Emissions

Following the FEES enhancements the remaining carbon reductions required for Application 1 are 8,930,886 kgCO_2.

According to the CIBSE CHP calculation method a GAS CHP driven DHN to meet 90% of the thermal demands will reduce the carbon emissions as follows:

Table 8.2 CIBSE Method Calculations

Without CHP

Electricity Demand (P)	10,906,502	*kWh*
Electricity Emissions (P X Pf - electric emissions)	5,660,474	*kgCO2*
Thermal Demand (H)	14,203,671	*kWh*
Thermal Emissions (H X Hf - gas emissions)	3,067,993	*kgCO2*
Total Emissions without CHP	**8,728,467**	***kgCO2***
	8,728	**tonnes**

With CHP

Electricity Demand (P)	10,906,502	*kWh*
Thermal Demand (H)	14,203,671	*kWh*
Heat Generation from CHP (H_{CHP})	13,626,716	*kWh*
($H-H_{CHP}$) Heat (Demand - Generation)	576,955	*kWh*
[$(H-H_{CHP})/\eta_{boiler} \times E_{f,boiler}$]	124,622.183	*kgCO2*
F_{CHP} - Gas Fuel to run CHP	15,093,758	*kWh*
($F_{CHP} \times E_{f,CHP}$) - Gas fuel X fuel factor	3,260,252	*kgCO2*
Electricity Generated from CHP (P_{CHP})	12,334,549	*kWh*
($P-P_{CHP}$) Elect. (Demand - Generation)	- 1,428,047	*kWh*
($P-P_{CHP}$)X electricity fuel factor	- 741,156	*kgCO2*
Total Emissions with CHP	**2,643,718**	**kgCO2**
	2,644	**tonnes**

The Gas CHP will therefore reduce the carbon emissions by approximately **6,084,750 $KgCO_2$**. This leaves a further reduction 2,846,136 $KgCO_2$ to be achieved through the provision of roof mounted solar PV.

To calculate the Solar PV requirements the following general assumptions have been made:

- Annual PV output per kWp: 850.00 kWh/year
- PV peak output: 1.41 kWp at 850 kWh
- Typical PV Area per kWp: 10.00 m^2

The following assumptions have been made for the residential aspect:

- Total Available Roof Area: 121,736 m^2 (as per SAP calculations)
- % Roof with PV installed: 35%
- Total PV area: 42,607 m^2

The following assumptions have been made for the commercial aspect:

- Total Available Roof Area: 11,132 m^2
- % Roof with PV installed: 40%
- Total PV area: 4,452 m^2

Based on these assumptions the following calculations can be made:

Table 8.2: Building Mounted Solar PV

All Buildings	Enhanced FEE Emissions
Remaining Emissions	2,846,136 kgCO2
Solar PV generation	- 2,927,243 kgCO2

Sub Total	**- 81,107 kgCO2**

The above table demonstrates that the provision of solar PV to 35% of the available residential roof space (i.e. circa half of traditional south facing roof) and 40% of the available commercial roof space would achieve an approximate reduction of 2,927,243 $KgCO_2$. This exceeds the required reduction of 2,846,136 to achieve True Zero Carbon.

9 Phasing of Gas CHP instalment

There are a number of parameters which need to be considered in order to agree upon a proposed phasing strategy for the implementation of the site wide requirement to achieve True Zero Carbon. Parameters to consider include (but not limited to) the following:

- Gas CHP engine(s)
    - Sizing
    - Efficiency
    - Capital Cost
- Build out rate
- Spatial Distribution
    - Existing 'Exemplar' energy centre
    - Location and direction of build out

9.1 Gas CHP

The energy centre for Application 1 will comprise (worst case scenario):

- To serve circa up to 2600 homes plus non-domestic
- Flue height – circa 18m (estimation based on previous modelling AQA for Exemplar site)
- Indicative CHP Engines sizes - Either:
    - 2 x E850 CHP engines;
        - Electrical Output: 853 kW
        - Electrical Efficiency: 42.8%
        - Heat Output: 891 kW
        - Thermal Efficiency: 44.7%
        - Overall efficiency (LHV): 87.5%

or

- 4 x E425 CHP engines
    - Electrical Output: 430 kW
    - Electrical Efficiency: 38.5
    - Heat Output: 468 kW
    - Thermal Efficiency: 41.8
    - Overall efficiency (LHV): 80.4%

- Plus supporting gas boilers

Please refer to appendix A for detailed datasheets for the two Gas CHP engine sizes provided above.

9.2 Build Out Rate

The DHN will be installed as the new road network is constructed, which will facilitate connection. The Energy Centre will be one of the first infrastructure elements to be constructed; however, temporary portable gas boiler units may be utilised to enable building to receive heat/hot water in the short term.

As identified above the smaller CHP engines are slightly less efficient than the larger engines but represent a lower capital cost. This would therefore enable the CHP engines to be installed more readily as the development progresses and achieve true Zero Carbon on a 'per 500 homes' basis. The larger engines would increase this to every 1000 homes.

At a construction rate of circa 250 homes a year the site would there be achieving the True Zero Carbon target every 2 years respectively. However, further optimisation may improve this ratio.

9.3 Spatial Distribution

9.3.1 Connection to existing Exemplar Energy Centre

The Application 1 area adjoins the already consented Exemplar site; within which 1 of the 3 energy centres proposed at NW Bicester is located. The 'Exemplar' site consists of 393 dwellings however the Gas CHP engine within the energy centre is capable of providing heat to up to 1100 homes. This therefore provides an 'opportunity' to connect up to 707 homes of the proposed dwellings within Application 1 to the existing energy centre.

The DHN will be constructed alongside all new infrastructure and therefore the 707 homes connected to the Exemplar Energy Centre will be capable of achieving true zero carbon as they are built out. Whether this is the first 707 homes within Application 1 to be constructed will depend upon the agreed phasing and build out schedule.

The energy centre for Application 1 will therefore need to provide sufficient heat and power for the remaining 1900 dwellings and commercial buildings.

9.3.2 Location and Direction of Build Out

As identified above; build out may occur outward from the location of the Energy Centre(s), including the already consented Exemplar site Energy Centre. The DHN will be installed as the new road network is constructed, which will facilitate connection to buildings.

10 Summary

This energy statement has been prepared to ensure that Application 1 of the NW Bicester development meets the applicant's sustainability aspirations and key development priorities, Building Regulations requirements and planning targets. The following local and national energy requirements were deemed relevant:

Policy	Document	Requirement
Policy Bicester 1 – NW Bicester Eco-Town	Emerging Cherwell Local Plan 2006-2031	True Zero Carbon CSH Level 5 BREEAM Excellent
CSH Level 5 – Ene 1 Dwelling Emission Rate	CSH 2010 Technical Note	100% improvement on 2010 Building Regulations
BREEAM Excellent	BREEAM New Construction 2014	Energy Performance Ratio (EPR_{NC}) of 0.375 (6 credits) or higher.
Building Regulations	Building Regulations 2016 (anticipated)	Zero Carbon from regulated energy

The proposed strategy follows the energy hierarchy principles outlined below:

1. **Be Lean:** Use less energy. Minimise energy demand through efficient design and the incorporation of passive measures;
2. **Be Clean:** Supply energy efficiently. Reduce energy consumption through use of low-carbon technology; and
3. **Be Green:** Use renewable energy systems.

The standards outlined within this statement surpass the FEES set by the ZCH and result in reduced energy demand and carbon emissions. The table below gives the breakdown of energy consumption and carbon emissions for space heating, hot water, lighting, pumps and fans (regulated energy) for domestic buildings and non-domestic units.

All Buildings	Enhanced FEE Demand	Enhanced FEE Emissions
Total Regulated Electricity	1,960,497 kWh	1,017,498 kgCO2
Total Regulated Gas	14,203,671 kWh	3,067,993 kgCO2
Sub Total Regulated	**16,164,167 kWh**	**4,085,491 kgCO2**
B'Regs 2013 Baseline	**17,754,632 kWh**	**4,396,947 kgCO2**
Total Un-regulated Electricity	8,946,005 kWh	4,642,977 kgCO2
Total Un-regulated Gas	937,125 kWh	202,419 kgCO2
Sub Total Un-regulated	**9,883,130 kWh**	**4,845,396 kgCO2**
TOTAL	**26,047,297 kWh**	**8,930,886 kgCO2**

B'Regs 2013 Baseline	27,637,762 kWh	9,273,591 kgCO2

By adopting enhanced fabric efficiency standards in all residential dwellings, the total energy demand across the site is reduced by circa **6%**. This reduces the sites carbon emission by 3.7% over Building Regulations (2013).

Following the FEES enhancements the remaining carbon reductions required for Application 1 are 8,930,886 kgCO_2.

Installing a GAS CHP driven DHN to meet 90% of the thermal demands will reduce the carbon emissions by approximately **6,084,750 KgCO_2**. This leaves a further reduction of 2,846,136 KgCO_2 to be achieved through the provision of roof mounted solar PV.

The provision of solar PV to 35% of the available residential roof space (i.e. circa half of traditional south facing roof) and 40% of the available commercial roof space would achieve an approximate reduction of 2,927,243 KgCO_2. This exceeds the required reduction of 2,846,136 to achieve True Zero Carbon.

10.1 Summary of requirements and response

The strategy outlined within this statement achieves the True Zero Carbon target through predominantly on-site technology rather than any significant reliance on off-site/off-set allowable solutions. However, whilst a preferred approach is identified it is recognised that further optimisation of the available technical solutions will continue as detailed design progresses; such as refinement of available roof area for PV, selection and sizing of CHP engines and associated thermal store to optimise delivery of the thermal demand carbon emission reductions.

The table below provides a summary of the development requirements and the current proposals to address them.

Policy	Requirement	Application 1 Proposals
Policy Bicester 1 – NW Bicester Eco-Town	True Zero Carbon CSH Level 5 BREEAM Excellent	True Zero Carbon CSH Level 5 BREEAM Excellent
CSH Level 5 – Ene 1 Dwelling Emission Rate	100% improvement on 2010 Building Regulations	100% improvement on 2010 Building Regulations
BREEAM Excellent	Energy Performance Ratio (EPR_{NC}) of 0.375 (6 credits) or higher.	Energy Performance Ratio (EPR_{NC}) of 0.375 (6 credits) or higher.
Building Regulations	Zero Carbon from regulated energy	Zero Carbon from regulated energy

Appendices

Appendix A: Gas CHP Datasheets

Technical Datasheet

E850 250NOx L33 Natural Gas CHP Unit

ENER-G

Energy Balance and Part Load Data @ 0.95PF		Units	100%	75%	50%
Electrical Output	(+/-3%)	kW	853	640	426
Electrical Efficiency (Net)	(+/-5%)	%	41.5%	40.3%	38.2%
Heat Output	(+/-10%)	kW	931	733	530
Thermal Efficiency (Net)	(+/-8%)	%	45.3%	46.2%	47.5%
Fuel Input (Net)	(+/-5%)	kW	2053	1588	1116
Total Efficiency (Net)	(+/-8%)	%	86.9%	86.4%	85.7%
Heat Output from Jacket Water	(+/-8%)	kW	462	341	236
Heat Output from Exhaust Gas @ Outlet Temp.	(+/-8%)	kW	469	392	294
Aftercooler Heat Output	(+/-8%)	kW	51	41	30
Radiated Heat Output	(+/-8%)	kW	37	28	20
Combustion Air Flow (30 C, 100 kPa, 30% RH)	(+/-5%)	m^3/h	3937	2968	2032
Fuel Mass Flow (ρ = 0.75kg/Nm³)	(+/-5%)	kg/h	154.0	119.1	83.7
Fuel Volume Flow (LHV = 10kWh/Nm³)	(+/-5%)	Nm3/h	205.3	158.8	111.6
Exhaust Mass Flow (Wet)	(+/-5%)	kg/h	4737	3574	2449
Exhaust Volume Flow @ Outlet Temp.	(+/-5%)	m^3/h	5276	3981	2728

Engine Details

Manufacturer		MTU
Model		AoE 8V4000L33
Fuel Type		Natural Gas
Min. Methane Number		80
Cylinders		8
Aspiration		Turbocharged
Speed	rpm	1500
Aftercooler		Yes

Hot Water Details

Max. Water In/Out Temp.	°C	78/89°C
Max. Water Flow Rate*	l/s	20.77
Max. Glycol Content	%	30
Connection Size	mm	100
Flange Type		PN16
Pressure Loss**	kPa	TBC
Max. Test Pressure	Bar	9.75

* Assuming Cp = 4.21 kJ/kg·K and ρ = 968.55 kg/m³

** Pressure loss figures stated are at max. water flow rate. Internal unit only.

Exhaust Details

Connection Size	mm	450
Flange Type		PN10
Outlet Temp.	°C	120
Max. Allowable Backpressure	Pa	TBC

Ventilation Details

Ventilation Rate***	m^3/s	5.37
Max. Air Inlet Temp.	°C	35
Max. Air Outlet Temp.	°C	50
Enclosure Pressure Drop	Pa	TBC

*** Vent rate is stated at max. air outlet temp, 100kPa

Aftercooler Details

Max. Water Inlet Temp.	°C	40
Water Flow Rate	l/s	6.11
Connection Size	mm	65
Flange Type		PN16
Pressure Loss	kPa	70
Max. Test Pressure	Bar	6
Ethylene Glycol Content	%	40

Generator Details

Manufacturer		Stamford
Model		PE734C-312
Type		Synchronous
Rating	kVA	1445
Voltage	V	400
Phase	Ph	3
Frequency	Hz	50
Protection Class		IP23
Rated Power Factor	PF	0.8
Xd Dir. Axis Synchronous		2.76
X'd Dir. Axis Transient		0.17
X"d Dir. Axis Sub-Transient		0.12
T" Sub-Transient Time Const.		0.01
T'do O.C Field Time Const.		2.23
CHP Protection Device	A/Ph	TBC
Indicative Client Protection Device	A/Ph	TBC
Current Per Phase @ 0.8PF	A	1528
Current Per Phase @ 0.95PF	A	1296
Efficiency @ 0.8PF	%	96.2%
Efficiency @ 0.95PF	%	96.9%
Indicative Main Cable Size [a] †	mm^2	TBC
Indicative Earth Cable Size [b] †	mm^2	TBC

[a] 4-Core XLPE/SWA/PVC to BS5467, Max 50 meters.

[b] 1-Core 6491B to BS7211, Max 50 meters.

† Sizes and lengths based on IET 17TH Edition BS7671, Installation method 31.

Fuel Details

Connection Size	mm	80
Flange Type		PN16
Min/Max. Supply Pressure	mbar	120/300

Emissions @ 5% O2

NOx	mg/Nm^3	250
CO	mg/Nm^3	1000
NOx (With Catalyst)	mg/Nm^3	N/A
CO (With Catalyst)	mg/Nm^3	TBC

Weight Details

Enclosure (Dry)	STD/PREM.	kg	TBC/TBC
Container (Dry)	STD/PREM.	kg	TBC/TBC

Noise Data

Enclosure SPL @ 1m	SN/LN	dB(A)	70/65
Container SPL @ 1m	SN/LN	dB(A)	75/65

NB: Output figures are based on operation at ISO 3046 conditions with the exception of exhaust output, which is quoted to 120°C, figures are stated from manufacturer's declared performance figures subject to the manufacturer's tolerances and subject to change without notice. Values for de-rated units are estimates only. Energy balance data assumes perfect combustion. All information detailed is for guidance only and is subject to change without notice due to our commitment to continuous improvement - all values should be confirmed with ENER-G Combined Power Ltd on a project specific basis.

Technical Datasheet

E425 Natural Gas CHP Unit

ENER-G

Energy Balance and Part Load Data @ 0.95PF		Units	100%	75%	50%
Electrical Output	(+/-3%)	kW	430	323	215
Electrical Efficiency (Net)	(+/-5%)	%	38.5%	37.4%	34.1%
Heat Output	(+/-10%)	kW	468	394	320
Thermal Efficiency (Net)	(+/-8%)	%	41.8%	45.7%	50.7%
Fuel Input (Net)	(+/-5%)	kW	1119	862	630
Total Efficiency (Net)	(+/-8%)	%	80.3%	83.1%	84.9%
Heat Output from Jacket Water	(+/-8%)	kW	189	161	136
Heat Output from Exhaust Gas @ Outlet Temp.	(+/-8%)	kW	279	233	184
Aftercooler Heat Output	(+/-8%)	kW	67	35	14
Radiated Heat Output	(+/-8%)	kW	66	43	33
Combustion Air Flow (30 C, 100 kPa, 30% RH)	(+/-5%)	m^3/h	2048	1578	1154
Fuel Mass Flow (ρ = 0.75kg/Nm³)	(+/-5%)	kg/h	83.9	64.6	47.3
Fuel Volume Flow (LHV = 10kWh/Nm³)	(+/-5%)	Nm3/h	111.9	86.2	63.0
Exhaust Mass Flow (Wet)	(+/-5%)	kg/h	2473	1905	1393
Exhaust Volume Flow @ Outlet Temp.	(+/-5%)	m^3/h	2754	2122	1552

Engine Details

Manufacturer		Perkins
Model		4008-30 TRS1
Fuel Type		Natural Gas
Min. Methane Number		75
Cylinders		8
Aspiration		Turbocharged
Speed	rpm	1500
Aftercooler		Yes

Hot Water Details

Max. Water In/Out Temp.	°C	80/90°C
Max. Water Flow Rate*	l/s	11.48
Max. Glycol Content	%	30
Connection Size	mm	80
Flange Type		PN16
Pressure Loss**	kPa	33.7
Max. Test Pressure	Bar	9.75

* Assuming Cp = 4.21 kJ/kg·K and ρ = 968.55 kg/m³

** Pressure loss figures stated are at max. water flow rate. Internal unit only.

Exhaust Details

Connection Size	mm	250
Flange Type		PN10
Outlet Temp.	°C	120
Max. Allowable Backpressure	Pa	4250

Ventilation Details

Connection Size	mm	900
Ventilation Rate***	m^3/s	5.48
Max. Air Inlet Temp.	°C	30
Max. Air Outlet Temp.	°C	45
Enclosure Pressure Drop	Pa	240

*** Vent rate is stated at max. air outlet temp, 100kPa

Aftercooler Details

Max. Water Inlet Temp.	°C	45
Water Flow Rate	l/s	8.30
Connection Size	mm	65
Flange Type		PN16
Pressure Loss	kPa	75
Max. Test Pressure	Bar	3.5
Ethylene Glycol Content	%	50

Generator Details

Manufacturer		Stamford
Model		HCI544E-311
Type		Synchronous
Rating	kVA	610
Voltage	V	400
Phase	Ph	3
Frequency	Hz	50
Protection Class		IP23
Rated Power Factor	PF	0.8
Xd Dir. Axis Synchronous		2.88
X'd Dir. Axis Transient		0.15
X"d Dir. Axis Sub-Transient		0.11
T" Sub-Transient Time Const.		0.012
T'do O.C Field Time Const.		2.5
CHP Protection Device	A/Ph	800
Indicative Client Protection Device	A/Ph	800 (Adjustable)
Current Per Phase @ 0.8PF	A	768
Current Per Phase @ 0.95PF	A	654
Efficiency @ 0.8PF	%	95.3%
Efficiency @ 0.95PF	%	96.3%
Indicative Main Cable Size [a] †	mm^2	TBC
Indicative Earth Cable Size [b] †	mm^2	TBC

[a] 4-Core XLPE/SWA/PVC to BS5467, Max 50 meters.

[b] 1-Core 6491B to BS7211, Max 50 meters.

† Sizes and lengths based on IET 17TH Edition BS7671, Installation method 31.

Fuel Details

Connection Size	mm	65
Flange Type		PN16
Min/Max. Supply Pressure	mbar	20/50

Emissions @ 5% O2

NOx	mg/Nm^3	480
CO	mg/Nm^3	791
NOx (With Catalyst)	mg/Nm^3	N/A
CO (With Catalyst)	mg/Nm^3	N/A

Weight Details

Enclosure (Dry) STD/PREM.	kg	10500/12500
Container (Dry) STD/PREM.	kg	TBC/TBC

Noise Data

Enclosure SPL @ 1m SN/LN	dB(A)	70/65
Container SPL @ 1m SN/LN	dB(A)	75/65

NB: Output figures are based on operation at ISO 3046 conditions with the exception of exhaust output, which is quoted to 120°C, figures are stated from manufacturer's declared performance figures subject to the manufacturer's tolerances and subject to change without notice. Values for de-rated units are estimates only. Energy balance data assumes perfect combustion. All information detailed is for guidance only and is subject to change without notice due to our commitment to continuous improvement - all values should be confirmed with ENER-G Combined Power Ltd on a project specific basis.

Appendix B: SAP Worksheets – Building Regulations Baseline

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.0.28

Property Address: 1 Bed 2013 Baseline

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.66	(1a) x	2.39	(2a) =	149.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.66	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		149.76	(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)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.2	(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		5.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.48	(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) =	0.4	(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

SAP WorkSheet: New dwelling design stage

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

0.52	0.5	0.49	0.44	0.43	0.38	0.38	0.37	0.4	0.43	0.45	0.47

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=	0.63	0.63	0.62	0.6	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(24d)

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

(25)m=	0.63	0.63	0.62	0.6	0.59	0.57	0.57	0.57	0.58	0.59	0.6	0.61	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.2	=	2.4			(26)
Windows Type 1			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 2			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 3			0.96	x1/[1/(1.4)+ 0.04]		=	1.27			(27)
Floor			62.66	x	0.2	=	12.532			(28)
Walls	60	10.13	49.87	x	0.24	=	11.97			(29)
Total area of elements, m²			122.66							(31)
Party wall			13	x	0	=	0			(32)
Party ceiling			62.66							(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) =	37.68	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	9854.9	(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		6.13	(36)

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

Total fabric heat loss	(33) + (36) =	43.81	(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=	31.27	31.01	30.76	29.59	29.37	28.35	28.35	28.16	28.74	29.37	29.82	30.28	(38)

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

(39)m=	75.08	74.82	74.58	73.4	73.18	72.16	72.16	71.97	72.55	73.18	73.63	74.09	

Average = Sum(39)$_{1\ldots12}$ /12= 73.4 (39)

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

(40)m=	1.2	1.19	1.19	1.17	1.17	1.15	1.15	1.15	1.16	1.17	1.18	1.18

Average = Sum(40)$_{1...12}$ /12= 1.17 (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 2.06 (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 83.03 (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=	91.33	88.01	84.69	81.36	78.04	74.72	74.72	78.04	81.36	84.69	88.01	91.33	
											Total = Sum(44)$_{1...12}$ =	996.3	(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=	135.44	118.45	122.23	106.57	102.25	88.24	81.76	93.83	94.95	110.65	120.78	131.16	
											Total = Sum(45)$_{1...12}$ =	1306.31	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.32	17.77	18.34	15.98	15.34	13.24	12.26	14.07	14.24	16.6	18.12	19.67	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 120 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

SAP WorkSheet: New dwelling design stage

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

(61)m=	22.94	20.53	22.42	21.35	21.81	20.82	21.33	21.64	21.11	22.17	21.85	22.84	(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=	158.37	138.98	144.65	127.92	124.06	109.05	103.09	115.47	116.05	132.82	142.64	154	(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=	158.37	138.98	144.65	127.92	124.06	109.05	103.09	115.47	116.05	132.82	142.64	154	

Output from water heater (annual)$_{1...12}$ 1567.11 (64)

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

(65)m=	50.77	44.52	46.25	40.77	39.45	34.54	32.52	36.61	36.85	42.33	45.62	49.32	(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=	123.35	123.35	123.35	123.35	123.35	123.35	123.35	123.35	123.35	123.35	123.35	123.35	(66)

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

(67)m=	42.42	37.68	30.64	23.2	17.34	14.64	15.82	20.56	27.6	35.04	40.9	43.6	(67)

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

(68)m=	268.07	270.85	263.84	248.91	230.08	212.37	200.54	197.76	204.77	219.7	238.53	256.24	(68)

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

(69)m=	49.39	49.39	49.39	49.39	49.39	49.39	49.39	49.39	49.39	49.39	49.39	49.39	(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=	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	(71)

Water heating gains (Table 5)

(72)m=	68.24	66.25	62.16	56.63	53.03	47.98	43.71	49.2	51.18	56.9	63.37	66.29	(72)

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

(73)m=	472.23	468.28	450.15	422.25	393.95	368.5	353.58	361.04	377.05	405.15	436.31	459.64	(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	2.39	x	10.63	x	0.76	x	0.8	=	10.71	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.8	=	20.46	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.8	=	34.77	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.8	=	55.85	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.8	=	75.24	(74)

North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.8	=	80.55	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.8	=	75.2	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.8	=	59.66	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.8	=	41.81	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.8	=	24.36	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.8	=	13.21	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.8	=	8.93	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.8	=	94.16	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.8	=	154.21	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.8	=	196.44	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.8	=	222.01	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.8	=	231.35	(78)
South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.8	=	222.65	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.8	=	217.54	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.8	=	211.26	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.8	=	205.2	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.8	=	166.33	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.8	=	111.61	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.8	=	81.36	(78)

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

(83)m=	112.81	190.21	256.8	315.19	352.34	350.02	337.32	309.22	276.77	209.13	134.73	96.82	(83)

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

(84)m=	585.04	658.49	706.95	737.44	746.29	718.52	690.9	670.25	653.83	614.27	571.03	556.46	(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	0.95	0.9	0.79	0.62	0.45	0.49	0.71	0.91	0.97	0.99	(86)

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

(87)m=	19.99	20.16	20.39	20.66	20.87	20.97	20.99	20.99	20.94	20.7	20.3	19.97	(87)

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

(88)m=	19.92	19.92	19.93	19.94	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.93	(88)

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

(89)m=	0.98	0.97	0.94	0.87	0.73	0.53	0.35	0.38	0.62	0.87	0.97	0.99	(89)

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

(90)m=	18.62	18.86	19.19	19.57	19.82	19.94	19.96	19.96	19.91	19.62	19.08	18.59	(90)

fLA = Living area ÷ (4) = | 0.64 | (91)

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

(92)m=	19.5	19.69	19.96	20.27	20.49	20.6	20.62	20.62	20.57	20.31	19.86	19.47	(92)

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

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(93)m=	19.35	19.54	19.81	20.12	20.34	20.45	20.47	20.47	20.42	20.16	19.71	19.32	(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	0.94	0.87	0.76	0.57	0.4	0.43	0.66	0.88	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	573.28	635.38	662.2	644.82	564.72	409.48	277.47	290.29	432.18	541.42	549.96	547.33	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1129.79	1095.72	992.51	823.46	632.22	422.06	279.23	292.83	458.55	699.49	928.48	1120.06	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	414.04	309.35	245.75	128.62	50.22	0	0	0	0	117.61	272.53	426.11	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1964.23 (98)

Space heating requirement in kWh/m²/year 31.35 (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		92.9	(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)													
	414.04	309.35	245.75	128.62	50.22	0	0	0	0	117.61	272.53	426.11	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	445.69	332.99	264.53	138.45	54.06	0	0	0	0	126.59	293.36	458.67	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2114.35 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] + (214) m } 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)

	158.37	138.98	144.65	127.92	124.06	109.05	103.09	115.47	116.05	132.82	142.64	154	

Efficiency of water heater 87.3 (216)

(217)m=	89.17	89.08	88.92	88.58	88.03	87.3	87.3	87.3	87.3	88.5	88.99	89.19	(217)

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

(219)m=	177.62	156.02	162.68	144.4	140.93	124.92	118.09	132.26	132.94	150.07	160.29	172.66

Total = Sum(219a)$_{1...12}$ = 1772.88 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2114.35

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Water heating fuel used				1772.88	
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				299.68	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	73.5794	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	61.7	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	39.53	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			304.7	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.19	(257)
SAP rating (Section 12)		83.42	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	456.7	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	382.94	(264)
Space and water heating	(261) + (262) + (263) + (264) =			839.64	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	155.53	(268)
Total CO2, kg/year		sum of (265)…(271) =		1034.1	(272)
CO2 emissions per m²		(272) ÷ (4) =		16.5	(273)
EI rating (section 14)				87	(274)

13a. Primary Energy

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	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x		1.22	=	2579.51	(261)
Space heating (secondary)	(215) x		3.07	=	0	(263)
Energy for water heating	(219) x		1.22	=	2162.91	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4742.41	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		3.07	=	230.25	(267)
Electricity for lighting	(232) x		0	=	920.02	(268)
'Total Primary Energy		sum of (265)…(271) =			5892.69	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =			94.04	(273)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.0.28

Property Address: 2 Bed 2013 Baseline

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	41.5	(1a)	x	2.5	(2a)	=	103.75	(3a)
First floor	41.5	(1b)	x	2.5	(2b)	=	103.75	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	207.5	(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)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (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		6	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.44	(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) =	0.38	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.48	0.47	0.46	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.44

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.2	=	2.4			(26)
Windows Type 1			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 2			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 3			0.96	x1/[1/(1.4)+ 0.04]		=	1.27			(27)
Floor			41.5	x	0.2	=	8.3			(28)
Walls	83.18	10.13	73.05	x	0.24	=	17.53			(29)
Roof	41.5	0	41.5	x	0.16	=	6.64			(30)
Total area of elements, m²			166.18							(31)
Party wall			45	x	0	=	0			(32)
Internal floor			41.5							(32d)

** 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) = 45.65 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17244.75 (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 8.31 (36)

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

Total fabric heat loss	(33) + (36) =	53.96	(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=	42.19	41.88	41.57	40.15	39.89	38.65	38.65	38.42	39.13	39.89	40.43	40.99	(38)

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

(39)m=	96.15	95.84	95.53	94.11	93.85	92.61	92.61	92.38	93.09	93.85	94.39	94.95	

Average = Sum(39)$_{1...12}$ /12= 94.11 (39)

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

(40)m=	1.16	1.15	1.15	1.13	1.13	1.12	1.12	1.11	1.12	1.13	1.14	1.14	

Average = Sum(40)$_{1...12}$ /12= 1.13 (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 2.52 (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 98.93 (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=	108.83	104.87	100.91	96.95	93	89.04	89.04	93	96.95	100.91	104.87	108.83	

Total = Sum(44)$_{1...12}$ = 1187.19 (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=	161.39	141.15	145.65	126.98	121.84	105.14	97.43	111.8	113.14	131.85	143.92	156.29	

Total = Sum(45)$_{1...12}$ = 1556.59 (45)

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

(46)m=	24.21	21.17	21.85	19.05	18.28	15.77	14.61	16.77	16.97	19.78	21.59	23.44	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer’s declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

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

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

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

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

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

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

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

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

(61)m=	23.91	21.48	23.5	22.29	22.67	21.53	21.99	22.43	21.94	23.15	22.82	23.78	(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=	185.29	162.62	169.16	149.27	144.52	126.67	119.42	134.23	135.08	155	166.75	180.07	(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=	185.29	162.62	169.16	149.27	144.52	126.67	119.42	134.23	135.08	155	166.75	180.07

Output from water heater (annual)$_{1...12}$ — 1828.07 (64)

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

(65)m=	59.64	52.3	54.31	47.79	46.18	40.34	37.89	42.78	43.1	49.63	53.56	57.91	(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=	151.04	151.04	151.04	151.04	151.04	151.04	151.04	151.04	151.04	151.04	151.04	151.04	(66)

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

(67)m=	56.67	50.34	40.94	30.99	23.17	19.56	21.13	27.47	36.87	46.82	54.64	58.25	(67)

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

(68)m=	336.71	340.2	331.4	312.65	288.99	266.75	251.9	248.4	257.21	275.95	299.61	321.85	(68)

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

(69)m=	52.62	52.62	52.62	52.62	52.62	52.62	52.62	52.62	52.62	52.62	52.62	52.62	(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=	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	(71)

Water heating gains (Table 5)

(72)m=	80.16	77.83	72.99	66.38	62.07	56.03	50.93	57.5	59.87	66.7	74.39	77.84	(72)

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

(73)m=	579.51	574.34	551.29	515.99	480.2	448.31	429.93	439.34	459.91	495.44	534.61	563.91	(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	2.39	x	10.63	x	0.76	x	0.8	=	10.71	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.8	=	20.46	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.8	=	34.77	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.8	=	55.85	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.8	=	75.24	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.8	=	80.55	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.8	=	75.2	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.8	=	59.66	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.8	=	41.81	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.8	=	24.36	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.8	=	13.21	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.8	=	8.93	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.8	=	94.16	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.8	=	154.21	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.8	=	196.44	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.8	=	222.01	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.8	=	231.35	(78)
South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.8	=	222.65	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.8	=	217.54	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.8	=	211.26	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.8	=	205.2	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.8	=	166.33	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.8	=	111.61	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.8	=	81.36	(78)

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

(83)m=	112.81	190.21	256.8	315.19	352.34	350.02	337.32	309.22	276.77	209.13	134.73	96.82	(83)

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

(84)m=	692.32	764.55	808.1	831.19	832.54	798.33	767.25	748.56	736.69	704.57	669.34	660.73	(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=	0.99	0.98	0.97	0.94	0.86	0.69	0.52	0.55	0.77	0.94	0.98	0.99	(86)

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

(87)m=	19.96	20.11	20.32	20.59	20.82	20.96	20.99	20.99	20.92	20.64	20.26	19.94	(87)

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

(88)m=	19.95	19.96	19.96	19.97	19.98	19.99	19.99	19.99	19.98	19.98	19.97	19.97	(88)

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

(89)m=	0.99	0.98	0.96	0.91	0.81	0.6	0.41	0.44	0.69	0.91	0.98	0.99	(89)

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

(90)m=	18.6	18.81	19.12	19.5	19.8	19.96	19.98	19.99	19.92	19.58	19.04	18.57	(90)

fLA = Living area ÷ (4) = 0.36 (91)

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

(92)m=	19.09	19.28	19.55	19.9	20.17	20.32	20.35	20.35	20.28	19.97	19.48	19.06	(92)

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

(93)m=	18.94	19.13	19.4	19.75	20.02	20.17	20.2	20.2	20.13	19.82	19.33	18.91	(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=	0.99	0.98	0.96	0.91	0.81	0.62	0.43	0.46	0.71	0.91	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	682.01	745.44	771.81	755.05	672.52	495.04	330.69	347.11	520.62	640.17	650.93	652.67	(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=	1407.51	1363.52	1232.5	1020.82	780.56	515.71	333.26	350.85	561.52	864.87	1154.36	1396.92	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	539.78	415.35	342.75	191.35	80.38	0	0	0	0	167.17	362.47	553.72	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2652.97 (98)

Space heating requirement in kWh/m²/year 31.96 (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		92.9	(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)													
	539.78	415.35	342.75	191.35	80.38	0	0	0	0	167.17	362.47	553.72	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	581.03	447.09	368.95	205.98	86.52	0	0	0	0	179.95	390.17	596.04	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2855.73 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] + (214) m } 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)

185.29	162.62	169.16	149.27	144.52	126.67	119.42	134.23	135.08	155	166.75	180.07

Efficiency of water heater 87.3 (216)

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(217)m=	89.22	89.15	89.02	88.74	88.21	87.3	87.3	87.3	87.3	88.63	89.06	89.25	(217)

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

(219)m=	207.68	182.41	190.01	168.21	163.83	145.1	136.79	153.76	154.73	174.88	187.22	201.76

Total = Sum(219a)$_{1...12}$ = 2066.38 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2855.73	
Water heating fuel used			2066.38	
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			400.36	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	99.3793	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	71.91	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	52.81	(250)
Additional standing charges (Table 12)				120	(251)

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

Total energy cost (245)...(247) + (250)…(254) = 353.99 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.16	(257)
SAP rating (Section 12)		83.8	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	616.84	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	446.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1063.18	(265)

Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	207.79	(268)
Total CO2, kg/year		sum of (265)…(271) =		1309.89	(272)
CO2 emissions per m²		(272) ÷ (4) =		15.78	(273)
EI rating (section 14)				86	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3483.99	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2520.99	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6004.97	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1229.1	(268)
'Total Primary Energy		sum of (265)…(271) =		7464.32	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		89.93	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.0.28

Property Address: 3 Bed 2013 Baseline

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	48.77	(1a)	x	2.5	(2a)	=	121.92	(3a)
First floor	48.77	(1b)	x	2.5	(2b)	=	121.92	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	97.54	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	243.85	(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) =	0.12	(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		6	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.42	(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) =	0.36	(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

0.46	0.45	0.44	0.4	0.39	0.34	0.34	0.33	0.36	0.39	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.2	=	2.52			(26)
Windows Type 1			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 2			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 3			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 4			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 5			3.15	x1/[1/(1.4)+ 0.04]		=	4.18			(27)
Floor			48.77	x	0.2	=	9.754001			(28)
Walls	125	19.13	105.87	x	0.24	=	25.41			(29)
Roof	48.77	0	48.77	x	0.16	=	7.8			(30)
Total area of elements, m²			222.54							(31)
Party wall			25	x	0	=	0			(32)
Internal floor			48.77							(32d)

** 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) = 68.06 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 21016.99 (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	11.13	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)		
Total fabric heat loss (33) + (36) =	79.19	(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=	48.69	48.36	48.04	46.53	46.25	44.93	44.93	44.69	45.44	46.25	46.82	47.42		(38)
Heat transfer coefficient, W/K (39)m = (37) + (38)m														
(39)m=	127.88	127.55	127.23	125.72	125.44	124.12	124.12	123.88	124.63	125.44	126.01	126.61		
										Average = Sum(39)$_{1…12}$ /12=			125.72	(39)
Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)														
(40)m=	1.31	1.31	1.3	1.29	1.29	1.27	1.27	1.27	1.28	1.29	1.29	1.3		
										Average = Sum(40)$_{1…12}$ /12=			1.29	(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	2.72	(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	103.89	(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=	114.28	110.12	105.97	101.81	97.66	93.5	93.5	97.66	101.81	105.97	110.12	114.28		
										Total = Sum(44)$_{1…12}$ =			1246.68	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)														
(45)m=	169.47	148.22	152.95	133.35	127.95	110.41	102.31	117.4	118.81	138.46	151.14	164.12		
										Total = Sum(45)$_{1…12}$ =			1634.59	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	25.42	22.23	22.94	20	19.19	16.56	15.35	17.61	17.82	20.77	22.67	24.62		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	150	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)		
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)		
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day):	0	(48)
Temperature factor from Table 2b	0	(49)
Energy lost from water storage, kWh/year (48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If community heating see section 4.3		
Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b	0	(53)

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

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

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

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

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

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

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

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

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

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

(61)m=	25.39	22.85	25.1	24.03	24.6	23.5	24.08	24.42	23.77	24.84	24.34	25.3	(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=	194.86	171.07	178.05	157.38	152.55	133.91	126.4	141.82	142.58	163.3	175.48	189.42	(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=	194.86	171.07	178.05	157.38	152.55	133.91	126.4	141.82	142.58	163.3	175.48	189.42	

Output from water heater (annual)$_{1...12}$ | 1926.82 | (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=	62.7	55	57.13	50.34	48.69	42.59	40.04	45.14	45.45	52.25	56.34	60.9	(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=	162.94	162.94	162.94	162.94	162.94	162.94	162.94	162.94	162.94	162.94	162.94	162.94	(66)

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

(67)m=	56.64	50.31	40.91	30.97	23.15	19.55	21.12	27.45	36.85	46.79	54.61	58.21	(67)

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

(68)m=	376.55	380.46	370.61	349.65	323.19	298.32	281.71	277.8	287.64	308.61	335.07	359.94	(68)

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

(69)m=	54.01	54.01	54.01	54.01	54.01	54.01	54.01	54.01	54.01	54.01	54.01	54.01	(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=	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	(71)

Water heating gains (Table 5)

(72)m=	84.27	81.84	76.79	69.92	65.45	59.15	53.82	60.67	63.12	70.23	78.25	81.85	(72)

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

(73)m=	628.78	623.93	599.64	561.87	523.11	488.33	467.96	477.25	498.93	536.94	579.25	611.32	(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	2.39	x	10.63	x	0.76	x	0.8	=	21.42	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.76	x	0.8	=	12.9	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.8	=	40.93	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.76	x	0.8	=	24.66	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.8	=	69.54	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.76	x	0.8	=	41.9	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.8	=	111.71	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.76	x	0.8	=	67.3	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.8	=	150.48	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.76	x	0.8	=	90.67	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.8	=	161.09	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.76	x	0.8	=	97.06	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.8	=	150.4	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.76	x	0.8	=	90.62	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.8	=	119.32	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.76	x	0.8	=	71.89	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.8	=	83.62	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.76	x	0.8	=	50.38	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.8	=	48.72	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.76	x	0.8	=	29.35	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.8	=	26.42	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.76	x	0.8	=	15.92	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.8	=	17.85	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.76	x	0.8	=	10.76	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.8	=	94.16	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.76	x	0.8	=	28.37	(78)
South	0.9x	0.77	x	3.15	x	46.75	x	0.76	x	0.8	=	62.05	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.8	=	154.21	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.76	x	0.8	=	46.46	(78)
South	0.9x	0.77	x	3.15	x	76.57	x	0.76	x	0.8	=	101.62	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.8	=	196.44	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.76	x	0.8	=	59.18	(78)
South	0.9x	0.77	x	3.15	x	97.53	x	0.76	x	0.8	=	129.45	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.8	=	222.01	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.76	x	0.8	=	66.88	(78)
South	0.9x	0.77	x	3.15	x	110.23	x	0.76	x	0.8	=	146.31	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.8	=	231.35	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.76	x	0.8	=	69.7	(78)
South	0.9x	0.77	x	3.15	x	114.87	x	0.76	x	0.8	=	152.46	(78)

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South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.8	=	222.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.76	x	0.8	=	67.07	(78)
South	0.9x	0.77	x	3.15	x	110.55	x	0.76	x	0.8	=	146.72	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.8	=	217.54	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.76	x	0.8	=	65.53	(78)
South	0.9x	0.77	x	3.15	x	108.01	x	0.76	x	0.8	=	143.36	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.8	=	211.26	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.76	x	0.8	=	63.64	(78)
South	0.9x	0.77	x	3.15	x	104.89	x	0.76	x	0.8	=	139.22	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.8	=	205.2	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.76	x	0.8	=	61.82	(78)
South	0.9x	0.77	x	3.15	x	101.89	x	0.76	x	0.8	=	135.23	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.8	=	166.33	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.76	x	0.8	=	50.11	(78)
South	0.9x	0.77	x	3.15	x	82.59	x	0.76	x	0.8	=	109.61	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.8	=	111.61	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.76	x	0.8	=	33.62	(78)
South	0.9x	0.77	x	3.15	x	55.42	x	0.76	x	0.8	=	73.55	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.8	=	81.36	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.76	x	0.8	=	24.51	(78)
South	0.9x	0.77	x	3.15	x	40.4	x	0.76	x	0.8	=	53.62	(78)

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

(83)m=	218.9	367.88	496.51	614.22	694.65	694.59	667.45	605.34	536.24	404.12	261.12	188.1	(83)

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

(84)m=	847.68	991.8	1096.14	1176.09	1217.77	1182.93	1135.41	1082.59	1035.17	941.06	840.37	799.42	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.91	0.8	0.63	0.47	0.51	0.74	0.93	0.98	0.99	(86)

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

(87)m=	19.79	19.99	20.26	20.58	20.82	20.96	20.99	20.99	20.91	20.59	20.13	19.75	(87)

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

(88)m=	19.83	19.83	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.84	(88)

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

(89)m=	0.99	0.97	0.95	0.88	0.74	0.54	0.35	0.39	0.65	0.9	0.97	0.99	(89)

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

(90)m=	18.26	18.55	18.93	19.38	19.69	19.84	19.86	19.86	19.79	19.41	18.77	18.21	(90)

fLA = Living area ÷ (4) = 0.31 (91)

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

(92)m=	18.73	18.99	19.34	19.75	20.04	20.18	20.21	20.21	20.14	19.78	19.19	18.68	(92)

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

(93)m=	18.58	18.84	19.19	19.6	19.89	20.03	20.06	20.06	19.99	19.63	19.04	18.53	(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=	0.98	0.97	0.94	0.87	0.75	0.55	0.38	0.41	0.66	0.89	0.97	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	833.44	959.57	1027.75	1024.96	907.6	651.79	426.23	448.3	682.9	835.85	813.56	788.71		(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=	1825.99	1778.26	1614.66	1344.75	1027.14	674.02	429.12	452.92	733.79	1132.33	1503.92	1814.8		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	738.46	550.16	436.66	230.25	88.94	0	0	0	0	220.58	497.06	763.41		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													3525.53	(98)
Space heating requirement in kWh/m²/year													36.14	(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		92.9	(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)														
	738.46	550.16	436.66	230.25	88.94	0	0	0	0	220.58	497.06	763.41		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)														(211)
	794.9	592.21	470.03	247.85	95.73	0	0	0	0	237.44	535.05	821.76		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3794.97	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } 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)														
	194.86	171.07	178.05	157.38	152.55	133.91	126.4	141.82	142.58	163.3	175.48	189.42		
Efficiency of water heater													87.3	(216)
(217)m=	89.34	89.27	89.13	88.83	88.24	87.3	87.3	87.3	87.3	88.78	89.21	89.37		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	218.1	191.63	199.76	177.17	172.88	153.39	144.78	162.46	163.32	183.95	196.71	211.95		
Total = Sum(219a)$_{1...12}$ =													2176.11	(219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			3794.97	
Water heating fuel used			2176.11	
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			400.11	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211)	x	3.48	x 0.01 =	132.0649	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.48	x 0.01 =	75.73	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	9.89	(249)

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

Energy for lighting	(232)		13.19	x 0.01 =	52.77	(250)
Additional standing charges (Table 12)					120	(251)

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

Total energy cost	(245)...(247) + (250)…(254) =	390.46	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.15	(257)
SAP rating (Section 12)		83.95	(258)

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

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating (main system 1)	(211)	x	0.216	=	819.71	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	470.04	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1289.75	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	207.66	(268)
Total CO_2, kg/year			sum of (265)…(271) =		1536.33	(272)
CO_2 emissions per m²			(272) ÷ (4) =		15.75	(273)

EI rating (section 14)				86	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	4629.86	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2654.85	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7284.71	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1228.34	(268)
'Total Primary Energy		sum of (265)…(271) =		8743.3	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		89.64	(273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.0.28

Property Address: 4 Bed 2013 Baseline

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.67	(1a)	x	2.5	(2a)	=	141.68	(3a)
First floor	56.67	(1b)	x	2.5	(2b)	=	141.68	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	113.34	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	283.35	(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) =	0.11	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.36	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(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

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

0.39	0.38	0.37	0.33	0.33	0.29	0.29	0.28	0.3	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)m^2 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 (m^2)	Openings m^2	Net Area A ,m^2		U-value W/m2K		A X U (W/K)	k-value kJ/m^2·K	A X k kJ/K	
Doors			2	x	1.2	=	2.4			(26)
Windows Type 1			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 2			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 3			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 4			0.96	x1/[1/(1.4)+ 0.04]		=	1.27			(27)
Windows Type 5			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 6			3.15	x1/[1/(1.4)+ 0.04]		=	4.18			(27)
Floor			56.67	x	0.15	=	8.5005			(28)
Walls	113.52	20	93.52	x	0.2	=	18.7			(29)
Roof	56.67	0	56.67	x	0.11	=	6.23			(30)
Total area of elements, m^2			226.86							(31)
Party wall			50	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	59.7	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	13871.48	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m^{2}K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 11.34 | (36)

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

Total fabric heat loss (33) + (36) = | 71.04 | (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=	53.71	53.44	53.18	51.93	51.7	50.61	50.61	50.41	51.04	51.7	52.17	52.66	(38)

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

(39)m=	124.75	124.48	124.22	122.98	122.74	121.66	121.66	121.45	122.08	122.74	123.21	123.71

Average = Sum(39)$_{1…12}$ /12= | 122.97 | (39)

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

(40)m=	1.1	1.1	1.1	1.08	1.08	1.07	1.07	1.07	1.08	1.08	1.09	1.09

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

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.83 | (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 | 106.84 | (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=	117.52	113.25	108.97	104.7	100.43	96.15	96.15	100.43	104.7	108.97	113.25	117.52

Total = Sum(44)$_{1…12}$ = | 1282.05 | (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=	174.28	152.43	157.29	137.13	131.58	113.54	105.21	120.74	122.18	142.39	155.43	168.78

Total = Sum(45)$_{1…12}$ = | 1680.97 | (45)

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

(46)m=	26.14	22.86	23.59	20.57	19.74	17.03	15.78	18.11	18.33	21.36	23.31	25.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 180 | (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): | 1.51 | (48)

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

Energy lost from water storage, kWh/year (48) x (49) = | 0.82 | (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) 0.82 (55)

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

(56)m=	25.28	22.83	25.28	24.46	25.28	24.46	25.28	25.28	24.46	25.28	24.46	25.28	(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=	25.28	22.83	25.28	24.46	25.28	24.46	25.28	25.28	24.46	25.28	24.46	25.28	(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=	222.82	196.27	205.83	184.1	180.12	160.52	153.75	169.27	169.15	190.93	202.4	217.32	(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=	222.82	196.27	205.83	184.1	180.12	160.52	153.75	169.27	169.15	190.93	202.4	217.32	

Output from water heater (annual)1…12 2252.49 (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=	96.78	85.76	91.13	83.17	82.58	75.33	73.82	78.98	78.2	86.18	89.26	94.95	(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=	170.01	170.01	170.01	170.01	170.01	170.01	170.01	170.01	170.01	170.01	170.01	170.01	(66)

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

(67)m=	64.34	57.15	46.47	35.18	26.3	22.2	23.99	31.19	41.86	53.15	62.03	66.13	(67)

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

(68)m=	412.35	416.63	405.84	382.89	353.91	326.68	308.48	304.2	314.99	337.94	366.92	394.15	(68)

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

(69)m=	54.83	54.83	54.83	54.83	54.83	54.83	54.83	54.83	54.83	54.83	54.83	54.83	(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=	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	(71)

Water heating gains (Table 5)

(72)m=	130.08	127.61	122.49	115.52	111	104.63	99.21	106.15	108.62	115.83	123.97	127.62	(72)

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

(73)m=	721.27	715.89	689.31	648.1	605.71	568.01	546.19	556.05	579.96	621.42	667.42	702.41	(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	2.39	x	10.63	x	0.76	x	0.7	=	18.74	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.76	x	0.7	=	11.29	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.7	=	35.81	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.76	x	0.7	=	21.58	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.7	=	60.85	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.76	x	0.7	=	36.66	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.7	=	97.74	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.76	x	0.7	=	58.89	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.7	=	131.67	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.76	x	0.7	=	79.33	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.7	=	140.96	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.76	x	0.7	=	84.93	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.7	=	131.6	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.76	x	0.7	=	79.29	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.7	=	104.41	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.76	x	0.7	=	62.91	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.7	=	73.16	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.76	x	0.7	=	44.08	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.7	=	42.63	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.76	x	0.7	=	25.68	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.7	=	23.12	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.76	x	0.7	=	13.93	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.7	=	15.62	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.76	x	0.7	=	9.41	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.7	=	41.19	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.76	x	0.7	=	49.64	(78)
South	0.9x	0.77	x	3.15	x	46.75	x	0.76	x	0.7	=	54.29	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.7	=	67.47	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.76	x	0.7	=	81.3	(78)
South	0.9x	0.77	x	3.15	x	76.57	x	0.76	x	0.7	=	88.92	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.7	=	85.94	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.76	x	0.7	=	103.56	(78)
South	0.9x	0.77	x	3.15	x	97.53	x	0.76	x	0.7	=	113.27	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.7	=	97.13	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.76	x	0.7	=	117.05	(78)
South	0.9x	0.77	x	3.15	x	110.23	x	0.76	x	0.7	=	128.02	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.7	=	101.22	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.76	x	0.7	=	121.97	(78)
South	0.9x	0.77	x	3.15	x	114.87	x	0.76	x	0.7	=	133.4	(78)

South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.7	=	97.41	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.76	x	0.7	=	117.38	(78)
South	0.9x	0.77	x	3.15	x	110.55	x	0.76	x	0.7	=	128.38	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.7	=	95.17	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.76	x	0.7	=	114.69	(78)
South	0.9x	0.77	x	3.15	x	108.01	x	0.76	x	0.7	=	125.44	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.7	=	92.43	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.76	x	0.7	=	111.38	(78)
South	0.9x	0.77	x	3.15	x	104.89	x	0.76	x	0.7	=	121.82	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.7	=	89.78	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.76	x	0.7	=	108.18	(78)
South	0.9x	0.77	x	3.15	x	101.89	x	0.76	x	0.7	=	118.32	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.7	=	72.77	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.76	x	0.7	=	87.69	(78)
South	0.9x	0.77	x	3.15	x	82.59	x	0.76	x	0.7	=	95.91	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.7	=	48.83	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.76	x	0.7	=	58.84	(78)
South	0.9x	0.77	x	3.15	x	55.42	x	0.76	x	0.7	=	64.36	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.7	=	35.6	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.76	x	0.7	=	42.89	(78)
South	0.9x	0.77	x	3.15	x	40.4	x	0.76	x	0.7	=	46.92	(78)

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

(83)m=	189.06	322.27	445.07	564.15	647.64	651	624.21	559.95	485.61	356.95	226.41	161.87	(83)

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

(84)m=	910.33	1038.16	1134.38	1212.25	1253.36	1219.01	1170.4	1116	1065.58	978.37	893.83	864.28	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.91	0.8	0.62	0.45	0.49	0.73	0.93	0.98	0.99	(86)

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

(87)m=	20.01	20.18	20.41	20.68	20.88	20.98	21	20.99	20.94	20.69	20.3	19.98	(87)

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

(88)m=	20	20	20	20.01	20.01	20.02	20.02	20.02	20.02	20.01	20.01	20.01	(88)

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

(89)m=	0.99	0.98	0.95	0.89	0.74	0.53	0.35	0.39	0.65	0.9	0.98	0.99	(89)

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

(90)m=	18.71	18.94	19.27	19.65	19.91	20.01	20.02	20.02	19.98	19.68	19.13	18.66	(90)

fLA = Living area ÷ (4) = | 0.4 | (91)

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

(92)m=	19.22	19.43	19.72	20.06	20.29	20.39	20.41	20.41	20.36	20.08	19.6	19.18	(92)

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

(93)m=	19.07	19.28	19.57	19.91	20.14	20.24	20.26	20.26	20.21	19.93	19.45	19.03	(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	0.95	0.88	0.75	0.55	0.38	0.42	0.66	0.9	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	898.5	1011.89	1075.62	1070.54	941.9	671.92	443.46	465.82	708.4	879.46	870.5	855.38	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1843.2	1790.59	1624.17	1354.17	1036.4	686.49	445.05	468.54	746.25	1145.33	1521.21	1835.08	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	702.86	523.29	408.12	204.22	70.31	0	0	0	0	197.81	468.51	728.9	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3304.01 (98)

Space heating requirement in kWh/m²/year 29.15 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)													
	702.86	523.29	408.12	204.22	70.31	0	0	0	0	197.81	468.51	728.9	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	778.36	579.5	451.96	226.15	77.86	0	0	0	0	219.05	518.83	807.2	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3658.92 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] + (214) m } 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)

	222.82	196.27	205.83	184.1	180.12	160.52	153.75	169.27	169.15	190.93	202.4	217.32	
Efficiency of water heater												79.6	(216)
(217)m=	87.47	87.11	86.41	84.89	82.34	79.6	79.6	79.6	79.6	84.71	86.78	87.6	(217)

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

(219)m=	254.74	225.32	238.21	216.87	218.75	201.65	193.16	212.66	212.5	225.39	233.23	248.1

Total = Sum(219a)$_{1...12}$ = 2680.59 (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			3658.92	
Water heating fuel used			2680.59	
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			454.5	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	127.3305	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	93.28	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	59.95	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			410.46	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.09	(257)
SAP rating (Section 12)		84.81	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	790.33	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	579.01	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1369.34	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	235.89	(268)
Total CO2, kg/year		sum of (265)…(271) =		1644.15	(272)
CO2 emissions per m²		(272) ÷ (4) =		14.51	(273)

EI rating (section 14)				86	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.22	=	4463.89	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	3270.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7734.21	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1395.31	(268)
'Total Primary Energy		sum of (265)…(271) =		9359.77	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		82.58	(273)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.0.28

Property Address: 5 Bed 2013 Baseline

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	75	(1a)	x	2.7	(2a)	=	202.5	(3a)
First floor	75	(1b)	x	2.41	(2b)	=	180.75	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	150	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	383.25	(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) =	0.1	(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)	0.35	(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) =	0.3	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.38	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	0.55	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	0.55	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	
Doors			2.1	x	1.2	=	2.52			(26)
Windows Type 1			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 2			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 3			0.96	x1/[1/(1.4)+ 0.04]		=	1.27			(27)
Windows Type 4			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 5			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 6			3.78	x1/[1/(1.4)+ 0.04]		=	5.01			(27)
Windows Type 7			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Floor			75	x	0.15	=	11.25			(28)
Walls	180	31.24	148.76	x	0.2	=	29.75			(29)
Roof	75	0	75	x	0.11	=	8.25			(30)
Total area of elements, m²			330							(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) =	90.4	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	37189.4	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 16.5 | (36)

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

Total fabric heat loss — (33) + (36) = | 106.9 | (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=	72.56	72.2	71.85	70.18	69.86	68.41	68.41	68.14	68.98	69.86	70.5	71.15	(38)

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

(39)m=	179.46	179.11	178.75	177.08	176.77	175.31	175.31	175.05	175.88	176.77	177.4	178.06	

Average = $Sum(39)_{1...12}$ /12= | 177.08 | (39)

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

(40)m=	1.2	1.19	1.19	1.18	1.18	1.17	1.17	1.17	1.17	1.18	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 | 2.93 | (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 | 109.36 | (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=	120.29	115.92	111.54	107.17	102.79	98.42	98.42	102.79	107.17	111.54	115.92	120.29

Total = $Sum(44)_{1...12}$ = | 1312.26 | (44)

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

(45)m=	178.39	156.02	161	140.36	134.68	116.22	107.69	123.58	125.06	145.74	159.09	172.76

Total = $Sum(45)_{1...12}$ = | 1720.58 | (45)

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

(46)m=	26.76	23.4	24.15	21.05	20.2	17.43	16.15	18.54	18.76	21.86	23.86	25.91	(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): | 1.8 | (48)

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

Energy lost from water storage, kWh/year — (48) x (49) = | 0.97 | (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)		0.97	(55)

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

(56)m=	30.13	27.22	30.13	29.16	30.13	29.16	30.13	30.13	29.16	30.13	29.16	30.13	(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=	30.13	27.22	30.13	29.16	30.13	29.16	30.13	30.13	29.16	30.13	29.16	30.13	(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=	231.78	204.25	214.39	192.03	188.07	167.89	161.09	176.97	176.73	199.14	210.76	226.15	(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)
WWHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G10)

Output from water heater

(64)m=	231.78	204.25	214.39	192.03	188.07	167.89	161.09	176.97	176.73	199.14	210.76	226.15	

Output from water heater (annual)$_{1...12}$ — 2349.26 (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=	102.03	90.46	96.25	88.01	87.5	79.98	78.52	83.81	82.92	91.17	94.23	100.16	(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=	176.05	176.05	176.05	176.05	176.05	176.05	176.05	176.05	176.05	176.05	176.05	176.05	(66)

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

(67)m=	72.17	64.1	52.13	39.47	29.5	24.91	26.91	34.98	46.95	59.62	69.58	74.18	(67)

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

(68)m=	478.39	483.36	470.85	444.22	410.6	379	357.89	352.93	365.44	392.07	425.69	457.28	(68)

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

(69)m=	55.54	55.54	55.54	55.54	55.54	55.54	55.54	55.54	55.54	55.54	55.54	55.54	(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=	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	(71)

Water heating gains (Table 5)

(72)m=	137.14	134.61	129.36	122.23	117.6	111.08	105.54	112.64	115.16	122.55	130.88	134.62	(72)

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

(73)m=	804.93	799.29	769.57	723.14	674.93	632.22	607.57	617.78	644.78	691.46	743.38	783.31	(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	2.39	x	10.63	x	0.76	x	0.7	=	28.11	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.76	x	0.7	=	11.29	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.7	=	53.72	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.76	x	0.7	=	21.58	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.7	=	91.28	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.76	x	0.7	=	36.66	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.7	=	146.62	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.76	x	0.7	=	58.89	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.7	=	197.5	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.76	x	0.7	=	79.33	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.7	=	211.43	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.76	x	0.7	=	84.93	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.7	=	197.4	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.76	x	0.7	=	79.29	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.7	=	156.61	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.76	x	0.7	=	62.91	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.7	=	109.75	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.76	x	0.7	=	44.08	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.7	=	63.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.76	x	0.7	=	25.68	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.7	=	34.68	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.76	x	0.7	=	13.93	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.7	=	23.43	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.76	x	0.7	=	9.41	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.7	=	123.58	(78)
South	0.9x	0.77	x	3.78	x	46.75	x	0.76	x	0.7	=	65.15	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.76	x	0.7	=	24.82	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.7	=	202.4	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.76	x	0.7	=	106.7	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.76	x	0.7	=	40.65	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.7	=	257.82	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.76	x	0.7	=	135.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.76	x	0.7	=	51.78	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.7	=	291.39	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.76	x	0.7	=	153.62	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.76	x	0.7	=	58.52	(78)

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South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.7	=	303.65	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.76	x	0.7	=	160.08	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.76	x	0.7	=	60.98	(78)
South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.7	=	292.22	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.76	x	0.7	=	154.06	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.76	x	0.7	=	58.69	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.7	=	285.52	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.76	x	0.7	=	150.52	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.76	x	0.7	=	57.34	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.7	=	277.28	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.76	x	0.7	=	146.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.76	x	0.7	=	55.69	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.7	=	269.33	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.76	x	0.7	=	141.99	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.76	x	0.7	=	54.09	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.7	=	218.31	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.76	x	0.7	=	115.09	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.76	x	0.7	=	43.84	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.7	=	146.49	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.76	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.76	x	0.7	=	29.42	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.7	=	106.79	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.76	x	0.7	=	56.3	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.76	x	0.7	=	21.45	(78)

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

(83)m=	301.47	519.95	729.76	936.99	1080.91	1087.3	1042.33	932.53	801	579.48	362.23	257.27	(83)

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

(84)m=	1106.4	1319.25	1499.33	1660.13	1755.84	1719.52	1649.91	1550.31	1445.79	1270.94	1105.61	1040.58	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.92	0.8	0.62	0.46	0.51	0.75	0.94	0.99	1	(86)

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

(87)m=	19.82	20.02	20.29	20.61	20.85	20.97	20.99	20.99	20.92	20.6	20.15	19.78	(87)

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

(88)m=	19.92	19.92	19.93	19.94	19.94	19.94	19.94	19.95	19.94	19.94	19.93	19.93	(88)

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

(89)m=	0.99	0.98	0.96	0.89	0.75	0.53	0.35	0.4	0.67	0.92	0.98	1	(89)

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

(90)m=	18.37	18.66	19.05	19.5	19.8	19.93	19.94	19.94	19.88	19.5	18.85	18.32		(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	18.86	19.11	19.47	19.87	20.15	20.27	20.29	20.29	20.23	19.87	19.28	18.81	(92)

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

(93)m=	18.71	18.96	19.32	19.72	20	20.12	20.14	20.14	20.08	19.72	19.13	18.66	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.88	0.75	0.55	0.37	0.42	0.68	0.91	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1096.22	1291.81	1428.11	1468.88	1315.65	942.98	618.05	649.73	981.83	1160.5	1084.16	1033.2	(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=	2585.35	2518.45	2290.84	1916.6	1467.72	968.24	621.19	655.05	1051.74	1611.36	2134.61	2574.65	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1107.91	824.31	641.87	322.36	113.14	0	0	0	0	335.45	756.32	1146.84	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5248.2 (98)

Space heating requirement in kWh/m²/year 34.99 (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		90.3	(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)													
	1107.91	824.31	641.87	322.36	113.14	0	0	0	0	335.45	756.32	1146.84	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	1226.92	912.85	710.82	356.98	125.3	0	0	0	0	371.48	837.56	1270.03	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 5811.96 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] + (214) m } 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)

231.78	204.25	214.39	192.03	188.07	167.89	161.09	176.97	176.73	199.14	210.76	226.15

Efficiency of water heater 79.6 (216)

SAP WorkSheet: New dwelling design stage

(217)m=	88.25	87.95	87.36	85.98	83.31	79.6	79.6	79.6	79.6	85.99	87.73	88.34	(217)

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

(219)m=	262.65	232.22	245.41	223.33	225.76	210.92	202.37	222.33	222.02	231.57	240.24	255.99

Total = Sum(219a)$_{1…12}$ = 2774.81 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			5811.96	
Water heating fuel used			2774.81	
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			509.85	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	202.2561	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	96.56	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	67.25	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			495.96	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.07	(257)
SAP rating (Section 12)		85.1	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1255.38	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	599.36	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1854.74	(265)

Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	264.61	(268)
Total CO2, kg/year		sum of (265)…(271) =		2158.28	(272)
CO2 emissions per m²		(272) ÷ (4) =		14.39	(273)
EI rating (section 14)				85	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	7090.59	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	3385.27	(264)
Space and water heating	(261) + (262) + (263) + (264) =			10475.86	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1565.23	(268)
‘Total Primary Energy		sum of (265)…(271) =		12271.34	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		81.81	(273)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.0.28

Property Address: 1 Bed 2013 Baseline

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.66	(1a) x	2.39	(2a) =	149.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.66	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	149.76	(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							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *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		5.5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.41	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

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

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.2	=	2.4			(26)
Windows Type 1			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 2			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 3			0.96	x1/[1/(1.4)+ 0.04]		=	1.27			(27)
Floor			62.66	x	0.2	=	12.532			(28)
Walls	60	10.13	49.87	x	0.24	=	11.97			(29)
Total area of elements, m²			122.66							(31)
Party wall			13	x	0	=	0			(32)
Party ceiling			62.66							(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) = 37.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 9854.9 (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 6.13 (36)

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

Total fabric heat loss (33) + (36) = 43.81 (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=	29.55	29.37	29.18	28.31	28.15	27.4	27.4	27.26	27.69	28.15	28.48	28.82	(38)

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

(39)m=	73.37	73.18	72.99	72.12	71.96	71.21	71.21	71.07	71.5	71.96	72.29	72.63	

Average = Sum(39)$_{1…12}$ /12= 72.13 (39)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

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

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

Average = Sum(40)$_{1…12}$ /12= 1.15 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.06 (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 — 83.03 (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=	91.33	88.01	84.69	81.36	78.04	74.72	74.72	78.04	81.36	84.69	88.01	91.33	
										Total = Sum(44)$_{1…12}$ =		996.3	(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=	135.44	118.45	122.23	106.57	102.25	88.24	81.76	93.83	94.95	110.65	120.78	131.16	
										Total = Sum(45)$_{1…12}$ =		1306.31	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 120 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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

Enter (50) or (54) in (55) — 0 (55)

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

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

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

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

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

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

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

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

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

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=	115.12	100.69	103.9	90.58	86.91	75	69.5	79.75	80.7	94.05	102.67	111.49	(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=	115.12	100.69	103.9	90.58	86.91	75	69.5	79.75	80.7	94.05	102.67	111.49	

Output from water heater (annual) 1…12 | 1110.36 | (64)

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

(65)m=	28.78	25.17	25.97	22.65	21.73	18.75	17.37	19.94	20.18	23.51	25.67	27.87	(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=	102.79	102.79	102.79	102.79	102.79	102.79	102.79	102.79	102.79	102.79	102.79	102.79	(66)

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

(67)m=	16.97	15.07	12.26	9.28	6.94	5.86	6.33	8.23	11.04	14.02	16.36	17.44	(67)

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

(68)m=	179.6	181.47	176.77	166.77	154.15	142.29	134.36	132.5	137.2	147.2	159.82	171.68	(68)

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

(69)m=	33.28	33.28	33.28	33.28	33.28	33.28	33.28	33.28	33.28	33.28	33.28	33.28	(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=	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	(71)

Water heating gains (Table 5)

(72)m=	38.68	37.46	34.91	31.45	29.21	26.04	23.35	26.8	28.02	31.6	35.65	37.46	(72)

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

(73)m=	289.09	287.83	277.78	261.34	244.13	228.02	217.88	221.36	230.1	246.65	265.66	280.42	(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	2.39	x	10.63	x	0.76	x	0.8	=	10.71	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.8	=	20.46	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.8	=	34.77	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.8	=	55.85	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.8	=	75.24	(74)

North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.8	=	80.55	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.8	=	75.2	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.8	=	59.66	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.8	=	41.81	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.8	=	24.36	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.8	=	13.21	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.8	=	8.93	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.8	=	94.16	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.8	=	154.21	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.8	=	196.44	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.8	=	222.01	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.8	=	231.35	(78)
South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.8	=	222.65	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.8	=	217.54	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.8	=	211.26	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.8	=	205.2	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.8	=	166.33	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.8	=	111.61	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.8	=	81.36	(78)

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

(83)m=	112.81	190.21	256.8	315.19	352.34	350.02	337.32	309.22	276.77	209.13	134.73	96.82	(83)

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

(84)m=	401.91	478.05	534.58	576.54	596.47	578.04	555.2	530.58	506.87	455.78	400.39	377.24	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.88	0.72	0.55	0.59	0.82	0.97	0.99	1	(86)

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

(87)m=	19.77	19.95	20.2	20.52	20.78	20.94	20.99	20.98	20.89	20.54	20.09	19.74	(87)

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

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

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

(89)m=	1	0.99	0.98	0.94	0.83	0.63	0.43	0.47	0.75	0.95	0.99	1	(89)

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

(90)m=	18.83	19.01	19.26	19.57	19.81	19.95	19.97	19.97	19.91	19.6	19.16	18.8	(90)

fLA = Living area ÷ (4) = 0.64 (91)

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

(92)m=	19.43	19.61	19.86	20.18	20.43	20.58	20.62	20.62	20.53	20.2	19.75	19.4	(92)

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

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(93)m=	19.43	19.61	19.86	20.18	20.43	20.58	20.62	20.62	20.53	20.2	19.75	19.4	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.86	0.69	0.51	0.55	0.79	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	400.22	473.27	522.12	542.4	510.1	397.75	281.32	292.24	401.34	434.95	396.79	376.07	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1109.92	1076.38	975.36	813.23	628.4	426.01	286.23	299.64	459.87	690.77	914.81	1104.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	528.02	405.29	337.21	194.99	88.01	0	0	0	0	190.33	372.98	541.59	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2658.42 (98)

Space heating requirement in kWh/m²/year 42.43 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	669.38	526.96	540.15	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.88	0.94	0.92	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	589.19	493.55	497.91	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	752.68	724.5	697.05	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	117.71	171.82	148.16	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 437.7 (104)

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

Intermittency factor (Table 10b)

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

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

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

(107)m=	0	0	0	0	0	29.43	42.96	37.04	0	0	0	0

Total = Sum(107)$_{6...8}$ = 109.42 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.75 (108)

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

Fabric Energy Efficiency — (99) + (108) = 44.17 (109)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.0.28

Property Address: 2 Bed 2013 Baseline

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	41.5	(1a)	x	2.5	(2a)	=	103.75	(3a)
First floor	41.5	(1b)	x	2.5	(2b)	=	103.75	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	207.5	(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)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (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 *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		6	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.44	(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) =	0.38	(21)

Infiltration rate modified for monthly wind speed

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

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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

0.48	0.47	0.46	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.44

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.2	=	2.4			(26)
Windows Type 1			2.39		x1/[1/(1.4)+ 0.04]	=	3.17			(27)
Windows Type 2			2.39		x1/[1/(1.4)+ 0.04]	=	3.17			(27)
Windows Type 3			0.96		x1/[1/(1.4)+ 0.04]	=	1.27			(27)
Floor			41.5	x	0.2	=	8.3			(28)
Walls	83.18	10.13	73.05	x	0.24	=	17.53			(29)
Roof	41.5	0	41.5	x	0.16	=	6.64			(30)
Total area of elements, m²			166.18							(31)
Party wall			45	x	0	=	0			(32)
Internal floor			41.5							(32d)

** 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) = 45.65 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17244.75 (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 8.31 (36)

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

Total fabric heat loss (33) + (36) = 53.96 (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=	42.19	41.88	41.57	40.15	39.89	38.65	38.65	38.42	39.13	39.89	40.43	40.99	(38)

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

(39)m=	96.15	95.84	95.53	94.11	93.85	92.61	92.61	92.38	93.09	93.85	94.39	94.95	

Average = $Sum(39)_{1...12}$ /12= 94.11 (39)

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

(40)m=	1.16	1.15	1.15	1.13	1.13	1.12	1.12	1.11	1.12	1.13	1.14	1.14	

Average = $Sum(40)_{1...12}$ /12= 1.13 (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 2.52 (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 98.93 (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=	108.83	104.87	100.91	96.95	93	89.04	89.04	93	96.95	100.91	104.87	108.83	

Total = $Sum(44)_{1...12}$ = 1187.19 (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=	161.39	141.15	145.65	126.98	121.84	105.14	97.43	111.8	113.14	131.85	143.92	156.29	

Total = $Sum(45)_{1...12}$ = 1556.59 (45)

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

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

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

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

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

(62)m=	137.18	119.98	123.8	107.94	103.57	89.37	82.82	95.03	96.17	112.07	122.34	132.85	(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=	137.18	119.98	123.8	107.94	103.57	89.37	82.82	95.03	96.17	112.07	122.34	132.85	

Output from water heater (annual)1…12 — 1323.1 (64)

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

(65)m=	34.29	29.99	30.95	26.98	25.89	22.34	20.7	23.76	24.04	28.02	30.58	33.21	(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=	125.86	125.86	125.86	125.86	125.86	125.86	125.86	125.86	125.86	125.86	125.86	125.86	(66)

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

(67)m=	22.67	20.14	16.38	12.4	9.27	7.82	8.45	10.99	14.75	18.73	21.86	23.3	(67)

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

(68)m=	225.6	227.94	222.04	209.48	193.63	178.73	168.77	166.43	172.33	184.89	200.74	215.64	(68)

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

(69)m=	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	(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=	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	(71)

Water heating gains (Table 5)

(72)m=	46.09	44.63	41.6	37.48	34.8	31.03	27.83	31.93	33.39	37.66	42.48	44.64	(72)

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

(73)m=	355.12	353.46	340.77	320.11	298.45	278.34	265.81	270.11	281.23	302.03	325.84	344.34	(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	2.39	x	10.63	x	0.76	x	0.8	=	10.71	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.8	=	20.46	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.8	=	34.77	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.8	=	55.85	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.8	=	75.24	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.8	=	80.55	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.8	=	75.2	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.8	=	59.66	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.8	=	41.81	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.8	=	24.36	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.8	=	13.21	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.8	=	8.93	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.8	=	94.16	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.8	=	154.21	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.8	=	196.44	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.8	=	222.01	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.8	=	231.35	(78)
South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.8	=	222.65	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.8	=	217.54	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.8	=	211.26	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.8	=	205.2	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.8	=	166.33	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.8	=	111.61	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.8	=	81.36	(78)

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

(83)m=	112.81	190.21	256.8	315.19	352.34	350.02	337.32	309.22	276.77	209.13	134.73	96.82	(83)

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

(84)m=	467.93	543.68	597.57	635.31	650.79	628.36	603.13	579.33	558	511.16	460.56	441.16	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.93	0.81	0.64	0.69	0.89	0.98	1	1	(86)

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

(87)m=	19.71	19.87	20.1	20.41	20.7	20.91	20.98	20.97	20.83	20.46	20.03	19.69	(87)

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

(88)m=	19.95	19.96	19.96	19.97	19.98	19.99	19.99	19.99	19.98	19.98	19.97	19.97	(88)

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

(89)m=	1	1	0.99	0.97	0.9	0.73	0.51	0.56	0.83	0.97	1	1	(89)

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

(90)m=	18.78	18.94	19.17	19.49	19.76	19.94	19.98	19.98	19.89	19.54	19.11	18.77	(90)

fLA = Living area ÷ (4) = 0.36 (91)

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

(92)m=	19.12	19.27	19.51	19.82	20.1	20.29	20.34	20.34	20.23	19.87	19.45	19.1	(92)

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

(93)m=	19.12	19.27	19.51	19.82	20.1	20.29	20.34	20.34	20.23	19.87	19.45	19.1	(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	0.96	0.9	0.76	0.56	0.61	0.85	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	466.71	540.53	589.63	613.07	588.7	474.98	337.75	350.78	472.07	496.59	458.03	440.33	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1424.69	1377.52	1242.78	1027.87	788.14	526.9	346.53	363.8	570.52	870.32	1165.23	1414.95	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	712.74	562.46	485.94	298.65	148.38	0	0	0	0	278.05	509.18	725.12	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3720.53 (98)

Space heating requirement in kWh/m²/year 44.83 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	870.5	685.29	702.09	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.89	0.87	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	710.77	612.65	614.12	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	829.43	798.1	772.2	0	0	0	0	(103)

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

(104)m=	0	0	0	0	0	85.44	137.97	117.61	0	0	0	0

Total = Sum(104)$_{6...8}$ = 341.02 (104)

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

Intermittency factor (Table 10b)

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

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

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

(107)m=	0	0	0	0	0	21.36	34.49	29.4	0	0	0	0

Total = Sum(107)$_{6...8}$ = 85.25 (107)

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Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.03	(108)
8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)			
Fabric Energy Efficiency	(99) + (108) =	45.85	(109)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.0.28

Property Address: 3 Bed 2013 Baseline

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	48.77	(1a) x	2.5	(2a) =	121.92	(3a)
First floor	48.77	(1b) x	2.5	(2b) =	121.92	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	97.54	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	243.85	(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) =	0.12	(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		6	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.42	(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) =	0.36	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.46	0.45	0.44	0.4	0.39	0.34	0.34	0.33	0.36	0.39	0.4	0.42

Calculate effective air change rate for the applicable case

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.2	=	2.52			(26)
Windows Type 1			2.39		x1/[1/(1.4)+ 0.04]	=	3.17			(27)
Windows Type 2			2.39		x1/[1/(1.4)+ 0.04]	=	3.17			(27)
Windows Type 3			1.44		x1/[1/(1.4)+ 0.04]	=	1.91			(27)
Windows Type 4			1.44		x1/[1/(1.4)+ 0.04]	=	1.91			(27)
Windows Type 5			3.15		x1/[1/(1.4)+ 0.04]	=	4.18			(27)
Floor			48.77	x	0.2	=	9.754001			(28)
Walls	125	19.13	105.87	x	0.24	=	25.41			(29)
Roof	48.77	0	48.77	x	0.16	=	7.8			(30)
Total area of elements, m²			222.54							(31)
Party wall			25	x	0	=	0			(32)
Internal floor			48.77							(32d)

** 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) =	68.06	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	21016.99	(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

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 11.13 | (36)

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

Total fabric heat loss (33) + (36) = | 79.19 | (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=	48.69	48.36	48.04	46.53	46.25	44.93	44.93	44.69	45.44	46.25	46.82	47.42	(38)

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

(39)m=	127.88	127.55	127.23	125.72	125.44	124.12	124.12	123.88	124.63	125.44	126.01	126.61	

Average = $Sum(39)_{1...12}$ /12= | 125.72 | (39)

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

(40)m=	1.31	1.31	1.3	1.29	1.29	1.27	1.27	1.27	1.28	1.29	1.29	1.3	

Average = $Sum(40)_{1...12}$ /12= | 1.29 | (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 | 2.72 | (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 | 103.89 | (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=	114.28	110.12	105.97	101.81	97.66	93.5	93.5	97.66	101.81	105.97	110.12	114.28	

Total = $Sum(44)_{1...12}$ = | 1246.68 | (44)

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

(45)m=	169.47	148.22	152.95	133.35	127.95	110.41	102.31	117.4	118.81	138.46	151.14	164.12	

Total = $Sum(45)_{1...12}$ = | 1634.59 | (45)

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

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

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b | 0 | (49)

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

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

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

If community heating see section 4.3

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(62)m=	144.05	125.99	130.01	113.34	108.76	93.85	86.96	99.79	100.99	117.69	128.47	139.51	(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=	144.05	125.99	130.01	113.34	108.76	93.85	86.96	99.79	100.99	117.69	128.47	139.51

Output from water heater (annual)$_{1...12}$ 1389.41 (64)

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

(65)m=	36.01	31.5	32.5	28.34	27.19	23.46	21.74	24.95	25.25	29.42	32.12	34.88	(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=	135.78	135.78	135.78	135.78	135.78	135.78	135.78	135.78	135.78	135.78	135.78	135.78	(66)

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

(67)m=	22.66	20.12	16.36	12.39	9.26	7.82	8.45	10.98	14.74	18.71	21.84	23.29	(67)

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

(68)m=	252.29	254.91	248.31	234.27	216.54	199.87	188.74	186.12	192.72	206.77	224.5	241.16	(68)

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

(69)m=	36.58	36.58	36.58	36.58	36.58	36.58	36.58	36.58	36.58	36.58	36.58	36.58	(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=	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	(71)

Water heating gains (Table 5)

(72)m=	48.4	46.87	43.69	39.36	36.54	32.59	29.22	33.53	35.06	39.55	44.61	46.88	(72)

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

(73)m=	387.08	385.64	372.1	349.75	326.08	304.01	290.15	294.37	306.26	328.76	354.68	375.06	(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	2.39	x	10.63	x	0.76	x	0.8	=	21.42	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.76	x	0.8	=	12.9	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.8	=	40.93	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.76	x	0.8	=	24.66	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.8	=	69.54	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.76	x	0.8	=	41.9	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.8	=	111.71	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.76	x	0.8	=	67.3	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.8	=	150.48	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.76	x	0.8	=	90.67	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.8	=	161.09	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.76	x	0.8	=	97.06	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.8	=	150.4	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.76	x	0.8	=	90.62	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.8	=	119.32	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.76	x	0.8	=	71.89	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.8	=	83.62	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.76	x	0.8	=	50.38	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.8	=	48.72	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.76	x	0.8	=	29.35	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.8	=	26.42	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.76	x	0.8	=	15.92	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.8	=	17.85	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.76	x	0.8	=	10.76	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.8	=	94.16	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.76	x	0.8	=	28.37	(78)
South	0.9x	0.77	x	3.15	x	46.75	x	0.76	x	0.8	=	62.05	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.8	=	154.21	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.76	x	0.8	=	46.46	(78)
South	0.9x	0.77	x	3.15	x	76.57	x	0.76	x	0.8	=	101.62	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.8	=	196.44	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.76	x	0.8	=	59.18	(78)
South	0.9x	0.77	x	3.15	x	97.53	x	0.76	x	0.8	=	129.45	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.8	=	222.01	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.76	x	0.8	=	66.88	(78)
South	0.9x	0.77	x	3.15	x	110.23	x	0.76	x	0.8	=	146.31	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.8	=	231.35	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.76	x	0.8	=	69.7	(78)
South	0.9x	0.77	x	3.15	x	114.87	x	0.76	x	0.8	=	152.46	(78)

South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.8	=	222.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.76	x	0.8	=	67.07	(78)
South	0.9x	0.77	x	3.15	x	110.55	x	0.76	x	0.8	=	146.72	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.8	=	217.54	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.76	x	0.8	=	65.53	(78)
South	0.9x	0.77	x	3.15	x	108.01	x	0.76	x	0.8	=	143.36	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.8	=	211.26	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.76	x	0.8	=	63.64	(78)
South	0.9x	0.77	x	3.15	x	104.89	x	0.76	x	0.8	=	139.22	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.8	=	205.2	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.76	x	0.8	=	61.82	(78)
South	0.9x	0.77	x	3.15	x	101.89	x	0.76	x	0.8	=	135.23	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.8	=	166.33	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.76	x	0.8	=	50.11	(78)
South	0.9x	0.77	x	3.15	x	82.59	x	0.76	x	0.8	=	109.61	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.8	=	111.61	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.76	x	0.8	=	33.62	(78)
South	0.9x	0.77	x	3.15	x	55.42	x	0.76	x	0.8	=	73.55	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.8	=	81.36	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.76	x	0.8	=	24.51	(78)
South	0.9x	0.77	x	3.15	x	40.4	x	0.76	x	0.8	=	53.62	(78)

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

(83)m=	218.9	367.88	496.51	614.22	694.65	694.59	667.45	605.34	536.24	404.12	261.12	188.1	(83)

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

(84)m=	605.98	753.51	868.6	963.96	1020.73	998.61	957.6	899.71	842.5	732.88	615.8	563.16	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.72	0.55	0.6	0.83	0.97	0.99	1	(86)

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

(87)m=	19.57	19.78	20.07	20.43	20.74	20.93	20.98	20.97	20.85	20.44	19.93	19.53	(87)

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

(88)m=	19.83	19.83	19.84	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.85	19.84	(88)

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

(89)m=	1	0.99	0.98	0.93	0.82	0.62	0.42	0.47	0.75	0.95	0.99	1	(89)

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

(90)m=	18.54	18.75	19.04	19.4	19.68	19.83	19.86	19.86	19.78	19.42	18.91	18.51	(90)

fLA = Living area ÷ (4) = 0.31 (91)

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

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(92)m=	18.86	19.07	19.36	19.72	20.01	20.17	20.2	20.2	20.11	19.73	19.23	18.83	(92)

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

(93)m=	18.86	19.07	19.36	19.72	20.01	20.17	20.2	20.2	20.11	19.73	19.23	18.83	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.97	0.93	0.83	0.65	0.46	0.51	0.77	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	603.44	745.15	845.07	896.29	846.9	646.9	440.3	459.48	649.14	696.02	610.08	561.47	(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=	1861.41	1807.02	1636.06	1360.04	1041.84	690.99	447.36	470.86	748.73	1145.47	1528	1851.84	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	935.93	713.58	588.5	333.9	145.04	0	0	0	0	334.39	660.91	960.04	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 4672.27 (98)

Space heating requirement in kWh/m²/year 47.9 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	1166.7	918.47	941.46	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.86	0.92	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	998.46	842.33	842.98	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1270.64	1220.5	1154.65	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	195.97	281.36	231.88	0	0	0	0	

Total = $Sum(104)_{6...8}$ = 709.21 (104)

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

Intermittency factor (Table 10b)

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

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

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

(107)m=	0	0	0	0	0	48.99	70.34	57.97	0	0	0	0

Total = $Sum(107)_{6...8}$ = 177.3 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.82 (108)

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

Fabric Energy Efficiency (99) + (108) = 49.72 (109)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.0.28

Property Address: 4 Bed 2013 Baseline

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.67	(1a)	x	2.5	(2a)	=	141.68	(3a)
First floor	56.67	(1b)	x	2.5	(2b)	=	141.68	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	113.34	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	283.35	(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

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.42	0.42	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	
Doors			2	x	1.2	=	2.4			(26)
Windows Type 1			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 2			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 3			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 4			0.96	x1/[1/(1.4)+ 0.04]		=	1.27			(27)
Windows Type 5			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 6			3.15	x1/[1/(1.4)+ 0.04]		=	4.18			(27)
Floor			56.67	x	0.15	=	8.5005			(28)
Walls	113.52	20	93.52	x	0.2	=	18.7			(29)
Roof	56.67	0	56.67	x	0.11	=	6.23			(30)
Total area of elements, m²			226.86							(31)
Party wall			50	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 59.7 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13871.48 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		11.34	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)			
Total fabric heat loss	(33) + (36) =	71.04	(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=	55.15	54.83	54.5	53.01	52.73	51.42	51.42	51.18	51.92	52.73	53.3	53.89	(38)

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

(39)m=	126.19	125.88	125.55	124.05	123.77	122.46	122.46	122.22	122.97	123.77	124.34	124.93	

Average = $Sum(39)_{1...12}$ /12= 124.05 (39)

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

(40)m=	1.11	1.11	1.11	1.09	1.09	1.08	1.08	1.08	1.08	1.09	1.1	1.1	

Average = $Sum(40)_{1...12}$ /12= 1.09 (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 2.83 (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) + 36 106.84 (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=	117.52	113.25	108.97	104.7	100.43	96.15	96.15	100.43	104.7	108.97	113.25	117.52

Total = $Sum(44)_{1...12}$ = 1282.05 (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=	174.28	152.43	157.29	137.13	131.58	113.54	105.21	120.74	122.18	142.39	155.43	168.78

Total = $Sum(45)_{1...12}$ = 1680.97 (45)

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

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

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		180	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)			
Water storage loss:			
a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)

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

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

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

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

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

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

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

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

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

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

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

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

(62)m=	148.14	129.56	133.7	116.56	111.84	96.51	89.43	102.62	103.85	121.03	132.11	143.46	(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=	148.14	129.56	133.7	116.56	111.84	96.51	89.43	102.62	103.85	121.03	132.11	143.46	

Output from water heater (annual)$_{1...12}$ — 1428.82 (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=	37.03	32.39	33.42	29.14	27.96	24.13	22.36	25.66	25.96	30.26	33.03	35.87	(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=	141.68	141.68	141.68	141.68	141.68	141.68	141.68	141.68	141.68	141.68	141.68	141.68	(66)

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

(67)m=	25.74	22.86	18.59	14.07	10.52	8.88	9.6	12.47	16.74	21.26	24.81	26.45	(67)

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

(68)m=	276.27	279.14	271.91	256.53	237.12	218.87	206.68	203.82	211.04	226.42	245.84	264.08	(68)

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

(69)m=	37.17	37.17	37.17	37.17	37.17	37.17	37.17	37.17	37.17	37.17	37.17	37.17	(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=	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	(71)

Water heating gains (Table 5)

(72)m=	49.78	48.2	44.93	40.47	37.58	33.51	30.05	34.48	36.06	40.67	45.87	48.21	(72)

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

(73)m=	417.29	415.7	400.93	376.58	350.72	326.77	311.83	316.28	329.35	353.85	382.02	404.24	(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	2.39	x	10.63	x	0.76	x	0.7	=	18.74	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.76	x	0.7	=	11.29	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.7	=	35.81	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.76	x	0.7	=	21.58	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.7	=	60.85	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.76	x	0.7	=	36.66	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.7	=	97.74	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.76	x	0.7	=	58.89	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.7	=	131.67	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.76	x	0.7	=	79.33	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.7	=	140.96	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.76	x	0.7	=	84.93	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.7	=	131.6	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.76	x	0.7	=	79.29	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.7	=	104.41	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.76	x	0.7	=	62.91	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.7	=	73.16	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.76	x	0.7	=	44.08	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.7	=	42.63	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.76	x	0.7	=	25.68	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.7	=	23.12	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.76	x	0.7	=	13.93	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.7	=	15.62	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.76	x	0.7	=	9.41	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.7	=	41.19	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.76	x	0.7	=	49.64	(78)
South	0.9x	0.77	x	3.15	x	46.75	x	0.76	x	0.7	=	54.29	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.7	=	67.47	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.76	x	0.7	=	81.3	(78)
South	0.9x	0.77	x	3.15	x	76.57	x	0.76	x	0.7	=	88.92	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.7	=	85.94	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.76	x	0.7	=	103.56	(78)
South	0.9x	0.77	x	3.15	x	97.53	x	0.76	x	0.7	=	113.27	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.7	=	97.13	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.76	x	0.7	=	117.05	(78)
South	0.9x	0.77	x	3.15	x	110.23	x	0.76	x	0.7	=	128.02	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.7	=	101.22	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.76	x	0.7	=	121.97	(78)
South	0.9x	0.77	x	3.15	x	114.87	x	0.76	x	0.7	=	133.4	(78)

South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.7	=	97.41	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.76	x	0.7	=	117.38	(78)
South	0.9x	0.77	x	3.15	x	110.55	x	0.76	x	0.7	=	128.38	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.7	=	95.17	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.76	x	0.7	=	114.69	(78)
South	0.9x	0.77	x	3.15	x	108.01	x	0.76	x	0.7	=	125.44	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.7	=	92.43	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.76	x	0.7	=	111.38	(78)
South	0.9x	0.77	x	3.15	x	104.89	x	0.76	x	0.7	=	121.82	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.7	=	89.78	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.76	x	0.7	=	108.18	(78)
South	0.9x	0.77	x	3.15	x	101.89	x	0.76	x	0.7	=	118.32	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.7	=	72.77	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.76	x	0.7	=	87.69	(78)
South	0.9x	0.77	x	3.15	x	82.59	x	0.76	x	0.7	=	95.91	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.7	=	48.83	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.76	x	0.7	=	58.84	(78)
South	0.9x	0.77	x	3.15	x	55.42	x	0.76	x	0.7	=	64.36	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.7	=	35.6	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.76	x	0.7	=	42.89	(78)
South	0.9x	0.77	x	3.15	x	40.4	x	0.76	x	0.7	=	46.92	(78)

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

(83)m=	189.06	322.27	445.07	564.15	647.64	651	624.21	559.95	485.61	356.95	226.41	161.87	(83)

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

(84)m=	606.35	737.97	846.01	940.73	998.37	977.77	936.04	876.23	814.96	710.8	608.43	566.12	(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	0.99	0.97	0.89	0.74	0.56	0.62	0.86	0.98	1	1	(86)

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

(87)m=	19.75	19.92	20.18	20.5	20.78	20.95	20.99	20.98	20.87	20.51	20.06	19.72	(87)

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

(88)m=	19.99	19.99	19.99	20.01	20.01	20.02	20.02	20.02	20.01	20.01	20	20	(88)

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

(89)m=	1	1	0.99	0.95	0.85	0.65	0.44	0.5	0.79	0.97	1	1	(89)

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

(90)m=	18.84	19.02	19.28	19.6	19.86	19.99	20.01	20.01	19.94	19.61	19.17	18.82	(90)

fLA = Living area ÷ (4) = 0.4 (91)

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

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(92)m=	19.2	19.38	19.63	19.96	20.23	20.37	20.4	20.4	20.31	19.96	19.52	19.18	(92)

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

(93)m=	19.2	19.38	19.63	19.96	20.23	20.37	20.4	20.4	20.31	19.96	19.52	19.18	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.86	0.68	0.49	0.55	0.81	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	605.14	733.84	832.81	895.3	860.59	666.15	459.6	478.6	661.83	688.55	605.57	565.32	(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=	1880.56	1822.45	1649.06	1372.05	1055.21	706.68	465.51	488.67	763.92	1159.12	1544.68	1871.21	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	948.92	731.55	607.3	343.26	144.8	0	0	0	0	350.1	676.16	971.58	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4773.66 (98)

Space heating requirement in kWh/m²/year 42.12 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	1151.16	906.23	928.88	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.87	0.93	0.91	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	1007.03	846.15	847.6	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1254.81	1203.62	1135.87	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	178.4	265.96	214.47	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 658.83 (104)

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

Intermittency factor (Table 10b)

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

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

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

(107)m=	0	0	0	0	0	44.6	66.49	53.62	0	0	0	0

Total = Sum(107)$_{6...8}$ = 164.71 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.45 (108)

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

Fabric Energy Efficiency (99) + (108) = 43.57 (109)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.0.28

Property Address: 5 Bed 2013 Baseline

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	75	(1a)	x	2.7	(2a)	=	202.5	(3a)
First floor	75	(1b)	x	2.41	(2b)	=	180.75	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	150	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	383.25	(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) =	0.1	(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)	0.35	(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) =	0.3	(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

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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

0.38	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	0.55	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	0.55	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	
Doors			2.1	x	1.2	=	2.52			(26)
Windows Type 1			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 2			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 3			0.96	x1/[1/(1.4)+ 0.04]		=	1.27			(27)
Windows Type 4			2.39	x1/[1/(1.4)+ 0.04]		=	3.17			(27)
Windows Type 5			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 6			3.78	x1/[1/(1.4)+ 0.04]		=	5.01			(27)
Windows Type 7			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Floor			75	x	0.15	=	11.25			(28)
Walls	180	31.24	148.76	x	0.2	=	29.75			(29)
Roof	75	0	75	x	0.11	=	8.25			(30)
Total area of elements, m²			330							(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) = 90.4 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 37189.4 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 16.5 | (36)

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

Total fabric heat loss (33) + (36) = | 106.9 | (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=	72.56	72.2	71.85	70.18	69.86	68.41	68.41	68.14	68.98	69.86	70.5	71.15	(38)

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

(39)m=	179.46	179.11	178.75	177.08	176.77	175.31	175.31	175.05	175.88	176.77	177.4	178.06	

Average = Sum(39)$_{1...12}$ /12= | 177.08 | (39)

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

(40)m=	1.2	1.19	1.19	1.18	1.18	1.17	1.17	1.17	1.17	1.18	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 | 2.93 | (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 | 109.36 | (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=	120.29	115.92	111.54	107.17	102.79	98.42	98.42	102.79	107.17	111.54	115.92	120.29

Total = Sum(44)$_{1...12}$ = | 1312.26 | (44)

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

(45)m=	178.39	156.02	161	140.36	134.68	116.22	107.69	123.58	125.06	145.74	159.09	172.76

Total = Sum(45)$_{1...12}$ = | 1720.58 | (45)

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

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

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 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) = | 0 | (50)

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

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

If community heating see section 4.3

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(62)m=	151.63	132.62	136.85	119.31	114.48	98.79	91.54	105.04	106.3	123.88	135.22	146.84	(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)
WWHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G10)

Output from water heater

(64)m=	151.63	132.62	136.85	119.31	114.48	98.79	91.54	105.04	106.3	123.88	135.22	146.84	

Output from water heater (annual)$_{1…12}$ | 1462.49 | (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=	37.91	33.15	34.21	29.83	28.62	24.7	22.88	26.26	26.57	30.97	33.81	36.71	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	146.71	146.71	146.71	146.71	146.71	146.71	146.71	146.71	146.71	146.71	146.71	146.71	(66)

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

(67)m=	28.87	25.64	20.85	15.79	11.8	9.96	10.77	13.99	18.78	23.85	27.83	29.67	(67)

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

(68)m=	320.52	323.85	315.47	297.62	275.1	253.93	239.79	236.46	244.84	262.69	285.21	306.38	(68)

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

(69)m=	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	(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=	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	(71)

Water heating gains (Table 5)

(72)m=	50.95	49.34	45.98	41.43	38.47	34.3	30.76	35.3	36.91	41.63	46.95	49.34	(72)

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

(73)m=	467.36	465.84	449.32	421.85	392.38	365.21	348.33	352.77	367.55	395.17	427.01	452.41	(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	2.39	x	10.63	x	0.76	x	0.7	=	28.11	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.76	x	0.7	=	11.29	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.7	=	53.72	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.76	x	0.7	=	21.58	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.7	=	91.28	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.76	x	0.7	=	36.66	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.7	=	146.62	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.76	x	0.7	=	58.89	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.7	=	197.5	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.76	x	0.7	=	79.33	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.7	=	211.43	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.76	x	0.7	=	84.93	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.7	=	197.4	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.76	x	0.7	=	79.29	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.7	=	156.61	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.76	x	0.7	=	62.91	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.7	=	109.75	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.76	x	0.7	=	44.08	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.7	=	63.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.76	x	0.7	=	25.68	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.7	=	34.68	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.76	x	0.7	=	13.93	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.7	=	23.43	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.76	x	0.7	=	9.41	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.7	=	123.58	(78)
South	0.9x	0.77	x	3.78	x	46.75	x	0.76	x	0.7	=	65.15	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.76	x	0.7	=	24.82	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.7	=	202.4	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.76	x	0.7	=	106.7	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.76	x	0.7	=	40.65	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.7	=	257.82	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.76	x	0.7	=	135.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.76	x	0.7	=	51.78	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.7	=	291.39	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.76	x	0.7	=	153.62	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.76	x	0.7	=	58.52	(78)

South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.7	=	303.65	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.76	x	0.7	=	160.08	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.76	x	0.7	=	60.98	(78)
South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.7	=	292.22	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.76	x	0.7	=	154.06	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.76	x	0.7	=	58.69	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.7	=	285.52	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.76	x	0.7	=	150.52	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.76	x	0.7	=	57.34	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.7	=	277.28	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.76	x	0.7	=	146.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.76	x	0.7	=	55.69	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.7	=	269.33	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.76	x	0.7	=	141.99	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.76	x	0.7	=	54.09	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.7	=	218.31	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.76	x	0.7	=	115.09	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.76	x	0.7	=	43.84	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.7	=	146.49	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.76	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.76	x	0.7	=	29.42	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.7	=	106.79	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.76	x	0.7	=	56.3	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.76	x	0.7	=	21.45	(78)

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

(83)m=	301.47	519.95	729.76	936.99	1080.91	1087.3	1042.33	932.53	801	579.48	362.23	257.27	(83)

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

(84)m=	768.83	985.79	1179.08	1358.84	1473.29	1452.51	1390.66	1285.29	1168.55	974.65	789.25	709.68	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.87	0.71	0.54	0.6	0.85	0.98	1	1	(86)

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

(87)m=	19.62	19.82	20.11	20.48	20.78	20.94	20.99	20.98	20.86	20.45	19.96	19.58	(87)

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

(88)m=	19.92	19.92	19.93	19.94	19.94	19.94	19.94	19.95	19.94	19.94	19.93	19.93	(88)

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

(89)m=	1	1	0.98	0.94	0.83	0.62	0.42	0.48	0.77	0.97	1	1	(89)

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

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(90)m=	18.66	18.86	19.16	19.52	19.79	19.92	19.94	19.94	19.87	19.5	19.01	18.63	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	18.98	19.18	19.48	19.84	20.12	20.26	20.29	20.29	20.2	19.81	19.32	18.95	(92)

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

(93)m=	18.98	19.18	19.48	19.84	20.12	20.26	20.29	20.29	20.2	19.81	19.32	18.95	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.84	0.65	0.46	0.52	0.79	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	767.44	979.97	1157.38	1277.99	1230.79	939.48	639.15	666.55	928.18	941.91	785.77	708.83	(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=	2634.13	2557.91	2319.38	1936.63	1488.07	992.43	647.03	680.48	1072.39	1628.78	2168.3	2625.72	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1388.81	1060.37	864.53	474.22	191.42	0	0	0	0	511.03	995.42	1426.16	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6911.96 (98)

Space heating requirement in kWh/m²/year 46.08 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	1647.95	1297.32	1330.37	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.87	0.93	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	1436.02	1205.6	1202.78	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1823.3	1748.1	1627.4	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	278.84	403.62	315.92	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 998.38 (104)

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

Intermittency factor (Table 10b)

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

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

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

(107)m=	0	0	0	0	0	69.71	100.9	78.98	0	0	0	0

Total = Sum(107)$_{6...8}$ = 249.59 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.66 (108)

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8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)			
Fabric Energy Efficiency	(99) + (108) =	47.74	(109)

Appendix C: SAP Worksheets – Enhanced Fabric Energy Efficiency Standards

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.0.28

Property Address: 1 Bed Enhanced Fabric

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.66	(1a) x	2.39	(2a) =	149.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.66	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		149.76	(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) =	0.2	(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)	0.45	(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) =	0.38	(21)

Infiltration rate modified for monthly wind speed

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

SAP WorkSheet: New dwelling design stage

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

0.49	0.48	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.1	=	2.2			(26)
Windows Type 1			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 2			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 3			0.96	x1/[1/(1.2)+ 0.04]		=	1.1			(27)
Floor			62.66	x	0.15	=	9.399			(28)
Walls	60	10.13	49.87	x	0.2	=	9.97			(29)
Total area of elements, m²			122.66							(31)
Party wall			13	x	0	=	0			(32)
Party ceiling			62.66							(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) = 30.88 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 9854.9 (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 6.13 (36)

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

Total fabric heat loss (33) + (36) = 37.02 (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=	30.6	30.37	30.14	29.09	28.9	27.98	27.98	27.81	28.33	28.9	29.29	29.71	(38)

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

(39)m=	67.61	67.38	67.16	66.11	65.91	64.99	64.99	64.82	65.35	65.91	66.31	66.73	

Average = Sum(39)$_{1…12}$ /12= 66.11 (39)

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

(40)m=	1.08	1.08	1.07	1.06	1.05	1.04	1.04	1.03	1.04	1.05	1.06	1.06

Average = Sum(40)$_{1…12}$ /12= 1.06 (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 2.06 (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 83.03 (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=	91.33	88.01	84.69	81.36	78.04	74.72	74.72	78.04	81.36	84.69	88.01	91.33

Total = Sum(44)$_{1…12}$ = 996.3 (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=	135.44	118.45	122.23	106.57	102.25	88.24	81.76	93.83	94.95	110.65	120.78	131.16

Total = Sum(45)$_{1…12}$ = 1306.31 (45)

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

(46)m=	20.32	17.77	18.34	15.98	15.34	13.24	12.26	14.07	14.24	16.6	18.12	19.67	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 120 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	22.94	20.53	22.42	21.35	21.81	20.82	21.33	21.64	21.11	22.17	21.85	22.84	(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=	158.37	138.98	144.65	127.92	124.06	109.05	103.09	115.47	116.05	132.82	142.64	154	(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=	158.37	138.98	144.65	127.92	124.06	109.05	103.09	115.47	116.05	132.82	142.64	154	

Output from water heater (annual)$_{1...12}$ 1567.11 (64)

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

(65)m=	50.77	44.52	46.25	40.77	39.45	34.54	32.52	36.61	36.85	42.33	45.62	49.32	(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=	123.35	123.35	123.35	123.35	123.35	123.35	123.35	123.35	123.35	123.35	123.35	123.35	(66)

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

(67)m=	43.67	38.78	31.54	23.88	17.85	15.07	16.28	21.16	28.41	36.07	42.1	44.88	(67)

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

(68)m=	268.07	270.85	263.84	248.91	230.08	212.37	200.54	197.76	204.77	219.7	238.53	256.24	(68)

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

(69)m=	49.39	49.39	49.39	49.39	49.39	49.39	49.39	49.39	49.39	49.39	49.39	49.39	(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=	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	(71)

Water heating gains (Table 5)

(72)m=	68.24	66.25	62.16	56.63	53.03	47.98	43.71	49.2	51.18	56.9	63.37	66.29	(72)

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

(73)m=	473.47	469.38	451.05	422.93	394.46	368.92	354.04	361.64	377.86	406.17	437.51	460.92	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	2.39	x	10.63	x	0.76	x	0.7	=	9.37	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.7	=	17.91	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.7	=	30.43	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.7	=	48.87	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.7	=	65.83	(74)

North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.7	=	70.48	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.7	=	65.8	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.7	=	52.2	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.7	=	36.58	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.7	=	21.31	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.7	=	11.56	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.7	=	7.81	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.7	=	82.39	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.7	=	134.93	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.7	=	171.88	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.7	=	194.26	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.7	=	202.43	(78)
South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.7	=	194.82	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.7	=	190.35	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.7	=	184.85	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.7	=	179.55	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.7	=	145.54	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.7	=	97.66	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.7	=	71.19	(78)

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

(83)m=	98.71	166.44	224.7	275.8	308.3	306.27	295.16	270.57	242.18	182.99	117.89	84.72	(83)

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

(84)m=	572.18	635.82	675.75	698.72	702.76	675.19	649.2	632.2	620.04	589.16	555.39	545.64	(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	0.95	0.89	0.78	0.6	0.44	0.47	0.69	0.9	0.97	0.99	(86)

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

(87)m=	20.14	20.29	20.5	20.73	20.9	20.98	21	21	20.96	20.76	20.42	20.11	(87)

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

(88)m=	20.02	20.02	20.02	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.03	(88)

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

(89)m=	0.98	0.97	0.94	0.86	0.73	0.52	0.34	0.37	0.61	0.87	0.96	0.99	(89)

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

(90)m=	18.9	19.12	19.41	19.74	19.95	20.04	20.05	20.05	20.02	19.79	19.32	18.87	(90)

fLA = Living area ÷ (4) = 0.64 (91)

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

(92)m=	19.69	19.87	20.1	20.38	20.56	20.64	20.66	20.66	20.62	20.41	20.02	19.67	(92)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	19.54	19.72	19.95	20.23	20.41	20.49	20.51	20.51	20.47	20.26	19.87	19.52		(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	0.94	0.87	0.75	0.56	0.39	0.42	0.64	0.87	0.96	0.98		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	560.57	613.44	632.5	608.66	525.45	375.27	252.86	264.77	399.37	515.28	534.12	536.58		(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=	1030.71	998.62	903.55	748.68	573.95	382.91	253.81	266.11	416.37	636.78	846.7	1021.98		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	349.78	258.84	201.66	100.82	36.09	0	0	0	0	90.4	225.06	361.14		
									Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =				1623.79	(98)
Space heating requirement in kWh/m²/year													25.91	(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		92.9	(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)														
	349.78	258.84	201.66	100.82	36.09	0	0	0	0	90.4	225.06	361.14		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)														(211)
	376.52	278.62	217.07	108.52	38.84	0	0	0	0	97.3	242.26	388.74		
									Total (kWh/year) =Sum(211)$_{1...5,10...12}$=				1747.89	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } 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)														
	158.37	138.98	144.65	127.92	124.06	109.05	103.09	115.47	116.05	132.82	142.64	154		
Efficiency of water heater													87.3	(216)
(217)m=	89.07	88.97	88.8	88.43	87.87	87.3	87.3	87.3	87.3	88.33	88.87	89.11		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	177.8	156.2	162.91	144.66	141.19	124.92	118.09	132.26	132.94	150.36	160.5	172.83		
									Total = Sum(219a)$_{1...12}$ =				1774.65	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1747.89

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Water heating fuel used			1774.65	
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			308.46	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	60.8265	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	61.76	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	40.69	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			293.16	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.14	(257)
SAP rating (Section 12)		84.05	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	377.54	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	383.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			760.87	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	160.09	(268)
Total CO2, kg/year		sum of (265)…(271) =		959.88	(272)
CO2 emissions per m²		(272) ÷ (4) =		15.32	(273)
EI rating (section 14)				88	(274)

13a. Primary Energy

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	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	2132.42	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	2165.07	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4297.49	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	946.97	(268)
'Total Primary Energy			sum of (265)…(271) =		5474.71	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		87.37	(273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.0.28

Property Address: 2 Bed Enhanced Fabric

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	41.5	(1a)	x	2.5	(2a)	=	103.75	(3a)
First floor	41.5	(1b)	x	2.5	(2b)	=	103.75	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	207.5	(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) =	0.14	(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) =	0.34	(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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	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	
Doors			2	x	1.1	=	2.2			(26)
Windows Type 1			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 2			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 3			0.96	x1/[1/(1.2)+ 0.04]		=	1.1			(27)
Floor			41.5	x	0.15	=	6.225			(28)
Walls	83.18	10.13	73.05	x	0.2	=	14.61			(29)
Roof	41.5	0	41.5	x	0.11	=	4.56			(30)
Total area of elements, m²			166.18							(31)
Party wall			45	x	0	=	0			(32)
Internal floor			41.5							(32d)

** 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) = 36.91 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17244.75 (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 8.31 (36)

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

Total fabric heat loss (33) + (36) = 45.22 (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=	40.5	40.26	40.02	38.89	38.69	37.72	37.72	37.53	38.09	38.69	39.11	39.56	(38)

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

(39)m=	85.71	85.47	85.23	84.11	83.91	82.93	82.93	82.75	83.3	83.91	84.33	84.78	

Average = Sum(39)$_{1…12}$ /12= 84.11 (39)

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

(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)$_{1…12}$ /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 2.52 (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 98.93 (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=	108.83	104.87	100.91	96.95	93	89.04	89.04	93	96.95	100.91	104.87	108.83	

Total = Sum(44)$_{1…12}$ = 1187.19 (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=	161.39	141.15	145.65	126.98	121.84	105.14	97.43	111.8	113.14	131.85	143.92	156.29	

Total = Sum(45)$_{1…12}$ = 1556.59 (45)

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

(46)m=	24.21	21.17	21.85	19.05	18.28	15.77	14.61	16.77	16.97	19.78	21.59	23.44	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	23.91	21.48	23.5	22.29	22.67	21.53	21.99	22.43	21.94	23.15	22.82	23.78	(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=	185.29	162.62	169.16	149.27	144.52	126.67	119.42	134.23	135.08	155	166.75	180.07	(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=	185.29	162.62	169.16	149.27	144.52	126.67	119.42	134.23	135.08	155	166.75	180.07	

Output from water heater (annual)1…12 1828.07 (64)

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

(65)m=	59.64	52.3	54.31	47.79	46.18	40.34	37.89	42.78	43.1	49.63	53.56	57.91	(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=	151.04	151.04	151.04	151.04	151.04	151.04	151.04	151.04	151.04	151.04	151.04	151.04	(66)

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

(67)m=	56.67	50.34	40.94	30.99	23.17	19.56	21.13	27.47	36.87	46.82	54.64	58.25	(67)

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

(68)m=	336.71	340.2	331.4	312.65	288.99	266.75	251.9	248.4	257.21	275.95	299.61	321.85	(68)

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

(69)m=	52.62	52.62	52.62	52.62	52.62	52.62	52.62	52.62	52.62	52.62	52.62	52.62	(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=	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	(71)

Water heating gains (Table 5)

(72)m=	80.16	77.83	72.99	66.38	62.07	56.03	50.93	57.5	59.87	66.7	74.39	77.84	(72)

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

(73)m=	579.51	574.34	551.29	515.99	480.2	448.31	429.93	439.34	459.91	495.44	534.61	563.91	(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	2.39	x	10.63	x	0.76	x	0.8	=	10.71	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.8	=	20.46	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.8	=	34.77	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.8	=	55.85	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.8	=	75.24	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.8	=	80.55	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.8	=	75.2	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.8	=	59.66	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.8	=	41.81	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.8	=	24.36	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.8	=	13.21	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.8	=	8.93	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.8	=	94.16	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.8	=	154.21	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.8	=	196.44	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.8	=	222.01	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.8	=	231.35	(78)
South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.8	=	222.65	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.8	=	217.54	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.8	=	211.26	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.8	=	205.2	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.8	=	166.33	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.8	=	111.61	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.8	=	81.36	(78)

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

(83)m=	112.81	190.21	256.8	315.19	352.34	350.02	337.32	309.22	276.77	209.13	134.73	96.82	(83)

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

(84)m=	692.32	764.55	808.1	831.19	832.54	798.33	767.25	748.56	736.69	704.57	669.34	660.73	(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=	0.99	0.98	0.96	0.92	0.82	0.64	0.47	0.5	0.73	0.92	0.98	0.99	(86)

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

(87)m=	20.14	20.28	20.47	20.71	20.89	20.98	21	21	20.95	20.74	20.4	20.11	(87)

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

(88)m=	20.06	20.06	20.06	20.07	20.07	20.08	20.08	20.09	20.08	20.07	20.07	20.07	(88)

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

(89)m=	0.99	0.98	0.95	0.89	0.77	0.56	0.38	0.41	0.65	0.89	0.97	0.99	(89)

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

(90)m=	18.93	19.13	19.41	19.74	19.97	20.07	20.08	20.08	20.05	19.79	19.32	18.89	(90)

fLA = Living area ÷ (4) = 0.36 (91)

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

(92)m=	19.36	19.54	19.79	20.09	20.3	20.4	20.41	20.41	20.38	20.14	19.71	19.33	(92)

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

(93)m=	19.21	19.39	19.64	19.94	20.15	20.25	20.26	20.26	20.23	19.99	19.56	19.18	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.89	0.77	0.57	0.39	0.42	0.66	0.89	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	681.11	742.99	765.75	740.17	643.13	458.48	302.76	318.14	488.35	627.77	648.46	652.07	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1278.38	1238.82	1120.18	928.45	708.92	468.4	303.79	319.67	510.25	787.58	1050.79	1270.17	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	444.37	333.2	263.7	135.56	48.94	0	0	0	0	118.9	289.68	459.86	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2094.2 (98)

Space heating requirement in kWh/m²/year 25.23 (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		92.9	(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)													
	444.37	333.2	263.7	135.56	48.94	0	0	0	0	118.9	289.68	459.86	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	478.33	358.66	283.85	145.92	52.68	0	0	0	0	127.98	311.82	495.01	

Total (kWh/year) =$Sum(211)_{1...5,10...12}$= 2254.26 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] + (214) m } 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)

185.29	162.62	169.16	149.27	144.52	126.67	119.42	134.23	135.08	155	166.75	180.07

Efficiency of water heater 87.3 (216)

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(217)m=	89.12	89.03	88.87	88.52	87.94	87.3	87.3	87.3	87.3	88.41	88.93	89.15	(217)

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

(219)m=	207.92	182.66	190.35	168.63	164.33	145.1	136.79	153.76	154.73	175.32	187.5	201.98	

	Total = Sum(219a)$_{1...12}$ =	2069.06	(219)
Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2254.26	
Water heating fuel used		2069.06	
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		400.36	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	78.4481	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	72	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	52.81	(250)
Additional standing charges (Table 12)				120	(251)

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

Total energy cost	(245)...(247) + (250)…(254) =	333.15	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.09	(257)
SAP rating (Section 12)		84.75	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	486.92	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	446.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =			933.84	(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	=	207.79	(268)
Total CO2, kg/year		sum of (265)…(271) =		1180.55	(272)
CO2 emissions per m²		(272) ÷ (4) =		14.22	(273)
EI rating (section 14)				88	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	2750.19	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2524.25	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5274.45	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1229.1	(268)
'Total Primary Energy		sum of (265)…(271) =		6733.8	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		81.13	(273)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.0.28

Property Address: 3 Bed Enhanced Fabric

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	48.77	(1a) x	2.5	(2a) =	121.92	(3a)
First floor	48.77	(1b) x	2.5	(2b) =	121.92	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	97.54	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	243.85	(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)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.12	(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)	0.37	(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) =	0.32	(21)

Infiltration rate modified for monthly wind speed

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.4	0.4	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.36	0.37

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.1	=	2.31			(26)
Windows Type 1			2.39		x1/[1/(1.2)+ 0.04]	=	2.74			(27)
Windows Type 2			2.39		x1/[1/(1.2)+ 0.04]	=	2.74			(27)
Windows Type 3			1.44		x1/[1/(1.2)+ 0.04]	=	1.65			(27)
Windows Type 4			1.44		x1/[1/(1.2)+ 0.04]	=	1.65			(27)
Windows Type 5			3.15		x1/[1/(1.2)+ 0.04]	=	3.61			(27)
Floor			48.77	x	0.15	=	7.3155			(28)
Walls	125	19.13	105.87	x	0.2	=	21.17			(29)
Roof	48.77	0	48.77	x	0.11	=	5.36			(30)
Total area of elements, m²			222.54							(31)
Party wall			45	x	0	=	0			(32)
Internal floor			48.77							(32d)

** 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) = 55.66 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 22416.99 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 11.13 | (36)

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

Total fabric heat loss (33) + (36) = | 66.79 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	46.81	46.55	46.3	45.13	44.91	43.88	43.88	43.7	44.27	44.91	45.35	45.82	(38)

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

(39)m=	113.6	113.34	113.09	111.92	111.7	110.67	110.67	110.49	111.07	111.7	112.14	112.61	

Average = $Sum(39)_{1...12}$ /12= | 111.92 | (39)

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

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

Average = $Sum(40)_{1...12}$ /12= | 1.15 | (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.72 | (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 | 103.89 | (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=	114.28	110.12	105.97	101.81	97.66	93.5	93.5	97.66	101.81	105.97	110.12	114.28

Total = $Sum(44)_{1...12}$ = | 1246.68 | (44)

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

(45)m=	169.47	148.22	152.95	133.35	127.95	110.41	102.31	117.4	118.81	138.46	151.14	164.12

Total = $Sum(45)_{1...12}$ = | 1634.59 | (45)

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

(46)m=	25.42	22.23	22.94	20	19.19	16.56	15.35	17.61	17.82	20.77	22.67	24.62	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b | 0 | (49)

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

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

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

If community heating see section 4.3

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

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

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

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

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

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

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

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

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

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

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

(61)m=	25.39	22.85	25.1	24.03	24.6	23.5	24.08	24.42	23.77	24.84	24.34	25.3	(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=	194.86	171.07	178.05	157.38	152.55	133.91	126.4	141.82	142.58	163.3	175.48	189.42	(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=	194.86	171.07	178.05	157.38	152.55	133.91	126.4	141.82	142.58	163.3	175.48	189.42	

Output from water heater (annual)$_{1...12}$ | 1926.82 | (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=	62.7	55	57.13	50.34	48.69	42.59	40.04	45.14	45.45	52.25	56.34	60.9	(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=	162.94	162.94	162.94	162.94	162.94	162.94	162.94	162.94	162.94	162.94	162.94	162.94	(66)

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

(67)m=	56.64	50.31	40.91	30.97	23.15	19.55	21.12	27.45	36.85	46.79	54.61	58.21	(67)

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

(68)m=	376.55	380.46	370.61	349.65	323.19	298.32	281.71	277.8	287.64	308.61	335.07	359.94	(68)

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

(69)m=	54.01	54.01	54.01	54.01	54.01	54.01	54.01	54.01	54.01	54.01	54.01	54.01	(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=	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	(71)

Water heating gains (Table 5)

(72)m=	84.27	81.84	76.79	69.92	65.45	59.15	53.82	60.67	63.12	70.23	78.25	81.85	(72)

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

(73)m=	628.78	623.93	599.64	561.87	523.11	488.33	467.96	477.25	498.93	536.94	579.25	611.32	(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	2.39	x	10.63	x	0.76	x	0.8	=	21.42	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.76	x	0.8	=	12.9	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.8	=	40.93	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.76	x	0.8	=	24.66	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.8	=	69.54	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.76	x	0.8	=	41.9	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.8	=	111.71	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.76	x	0.8	=	67.3	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.8	=	150.48	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.76	x	0.8	=	90.67	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.8	=	161.09	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.76	x	0.8	=	97.06	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.8	=	150.4	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.76	x	0.8	=	90.62	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.8	=	119.32	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.76	x	0.8	=	71.89	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.8	=	83.62	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.76	x	0.8	=	50.38	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.8	=	48.72	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.76	x	0.8	=	29.35	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.8	=	26.42	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.76	x	0.8	=	15.92	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.8	=	17.85	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.76	x	0.8	=	10.76	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.8	=	94.16	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.76	x	0.8	=	28.37	(78)
South	0.9x	0.77	x	3.15	x	46.75	x	0.76	x	0.8	=	62.05	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.8	=	154.21	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.76	x	0.8	=	46.46	(78)
South	0.9x	0.77	x	3.15	x	76.57	x	0.76	x	0.8	=	101.62	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.8	=	196.44	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.76	x	0.8	=	59.18	(78)
South	0.9x	0.77	x	3.15	x	97.53	x	0.76	x	0.8	=	129.45	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.8	=	222.01	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.76	x	0.8	=	66.88	(78)
South	0.9x	0.77	x	3.15	x	110.23	x	0.76	x	0.8	=	146.31	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.8	=	231.35	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.76	x	0.8	=	69.7	(78)
South	0.9x	0.77	x	3.15	x	114.87	x	0.76	x	0.8	=	152.46	(78)

South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.8	=	222.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.76	x	0.8	=	67.07	(78)
South	0.9x	0.77	x	3.15	x	110.55	x	0.76	x	0.8	=	146.72	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.8	=	217.54	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.76	x	0.8	=	65.53	(78)
South	0.9x	0.77	x	3.15	x	108.01	x	0.76	x	0.8	=	143.36	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.8	=	211.26	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.76	x	0.8	=	63.64	(78)
South	0.9x	0.77	x	3.15	x	104.89	x	0.76	x	0.8	=	139.22	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.8	=	205.2	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.76	x	0.8	=	61.82	(78)
South	0.9x	0.77	x	3.15	x	101.89	x	0.76	x	0.8	=	135.23	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.8	=	166.33	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.76	x	0.8	=	50.11	(78)
South	0.9x	0.77	x	3.15	x	82.59	x	0.76	x	0.8	=	109.61	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.8	=	111.61	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.76	x	0.8	=	33.62	(78)
South	0.9x	0.77	x	3.15	x	55.42	x	0.76	x	0.8	=	73.55	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.8	=	81.36	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.76	x	0.8	=	24.51	(78)
South	0.9x	0.77	x	3.15	x	40.4	x	0.76	x	0.8	=	53.62	(78)

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

(83)m=	218.9	367.88	496.51	614.22	694.65	694.59	667.45	605.34	536.24	404.12	261.12	188.1	(83)

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

(84)m=	847.68	991.8	1096.14	1176.09	1217.77	1182.93	1135.41	1082.59	1035.17	941.06	840.37	799.42	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.89	0.76	0.58	0.43	0.46	0.69	0.91	0.98	0.99	(86)

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

(87)m=	19.98	20.18	20.43	20.7	20.89	20.98	21	20.99	20.95	20.7	20.29	19.94	(87)

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

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

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

(89)m=	0.99	0.97	0.94	0.86	0.7	0.49	0.33	0.36	0.61	0.88	0.97	0.99	(89)

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

(90)m=	18.62	18.9	19.26	19.63	19.87	19.96	19.97	19.97	19.93	19.65	19.08	18.57	(90)

fLA = Living area ÷ (4) = 0.31 (91)

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

(92)m=	19.04	19.3	19.62	19.96	20.18	20.27	20.29	20.29	20.25	19.97	19.45	18.99	(92)

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

(93)m=	18.89	19.15	19.47	19.81	20.03	20.12	20.14	20.14	20.1	19.82	19.3	18.84	(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	0.93	0.85	0.71	0.51	0.34	0.38	0.62	0.87	0.96	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	832.68	956.2	1017.66	999.2	860.35	600.81	390.24	410.95	638.7	818.63	810.87	788.31	(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=	1657.73	1614.77	1466.38	1221.28	930.86	611.26	391.41	412.84	666.05	1030.42	1368.26	1649	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	613.84	442.56	333.84	159.9	52.45	0	0	0	0	157.57	401.32	640.35	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2801.85 (98)

Space heating requirement in kWh/m²/year 28.73 (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		92.9	(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)														
	613.84	442.56	333.84	159.9	52.45	0	0	0	0	157.57	401.32	640.35		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)														(211)
	660.76	476.39	359.36	172.12	56.46	0	0	0	0	169.61	431.99	689.29		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3015.98	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } 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)														
	194.86	171.07	178.05	157.38	152.55	133.91	126.4	141.82	142.58	163.3	175.48	189.42		
Efficiency of water heater													87.3	(216)
(217)m=	89.26	89.16	88.98	88.59	87.95	87.3	87.3	87.3	87.3	88.56	89.09	89.29		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	218.31	191.87	200.1	177.64	173.45	153.39	144.78	162.46	163.32	184.4	196.96	212.13		
Total = Sum(219a)$_{1...12}$ =													2178.82	(219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			3015.98	
Water heating fuel used			2178.82	
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			400.11	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	104.9562	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	75.82	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	52.77	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			363.45	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.07	(257)
SAP rating (Section 12)		85.06	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	651.45	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	470.63	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1122.08	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	207.66	(268)
Total CO2, kg/year		sum of (265)…(271) =		1368.66	(272)
CO2 emissions per m²		(272) ÷ (4) =		14.03	(273)

EI rating (section 14)				87	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3679.5	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2658.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6337.66	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1228.34	(268)
‘Total Primary Energy		sum of (265)…(271) =		7796.25	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		79.93	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.0.28

Property Address: 4 Bed Enhanced Fabric

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	56.67	(1a)	x	2.5	(2a)	=	141.68	(3a)
First floor	56.67	(1b)	x	2.5	(2b)	=	141.68	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	113.34	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	283.35	(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		4.5	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.28	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.36	0.35	0.34	0.31	0.3	0.27	0.27	0.26	0.28	0.3	0.32	0.33

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	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	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	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	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	
Doors			2	x	1.1	=	2.2			(26)
Windows Type 1			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 2			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 3			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Windows Type 4			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Windows Type 5			0.96	x1/[1/(1.2)+ 0.04]		=	1.1			(27)
Windows Type 6			3.15	x1/[1/(1.2)+ 0.04]		=	3.61			(27)
Floor			56.67	x	0.15	=	8.5005			(28)
Walls	113.52	20	93.52	x	0.18	=	16.83			(29)
Roof	56.67	0	56.67	x	0.1	=	5.67			(30)
Total area of elements, m²			226.86							(31)
Party wall			50	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 53.81 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13871.48 (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) = 0.15 x (31)

Total fabric heat loss | (33) + (36) = | 65.15 | (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=	52.77	52.53	52.31	51.23	51.03	50.09	50.09	49.92	50.46	51.03	51.44	51.86	(38)

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

(39)m=	117.92	117.69	117.46	116.39	116.18	115.25	115.25	115.08	115.61	116.18	116.59	117.01	

Average = Sum(39)$_{1…12}$ /12= | 116.38 | (39)

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

(40)m=	1.04	1.04	1.04	1.03	1.03	1.02	1.02	1.02	1.02	1.03	1.03	1.03	

Average = Sum(40)$_{1…12}$ /12= | 1.03 | (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 | 2.83 | (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 | 106.84 | (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=	117.52	113.25	108.97	104.7	100.43	96.15	96.15	100.43	104.7	108.97	113.25	117.52	

Total = Sum(44)$_{1…12}$ = | 1282.05 | (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=	174.28	152.43	157.29	137.13	131.58	113.54	105.21	120.74	122.18	142.39	155.43	168.78	

Total = Sum(45)$_{1…12}$ = | 1680.97 | (45)

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

(46)m=	26.14	22.86	23.59	20.57	19.74	17.03	15.78	18.11	18.33	21.36	23.31	25.32	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 180 | (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): | 1.51 | (48)

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

Energy lost from water storage, kWh/year | (48) x (49) = | 0.82 | (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)		0.82	(55)

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

(56)m=	25.28	22.83	25.28	24.46	25.28	24.46	25.28	25.28	24.46	25.28	24.46	25.28	(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=	25.28	22.83	25.28	24.46	25.28	24.46	25.28	25.28	24.46	25.28	24.46	25.28	(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=	222.82	196.27	205.83	184.1	180.12	160.52	153.75	169.27	169.15	190.93	202.4	217.32	(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=	222.82	196.27	205.83	184.1	180.12	160.52	153.75	169.27	169.15	190.93	202.4	217.32	

Output from water heater (annual)$_{1…12}$ — 2252.49 (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=	96.78	85.76	91.13	83.17	82.58	75.33	73.82	78.98	78.2	86.18	89.26	94.95	(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=	170.01	170.01	170.01	170.01	170.01	170.01	170.01	170.01	170.01	170.01	170.01	170.01	(66)

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

(67)m=	64.34	57.15	46.47	35.18	26.3	22.2	23.99	31.19	41.86	53.15	62.03	66.13	(67)

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

(68)m=	412.35	416.63	405.84	382.89	353.91	326.68	308.48	304.2	314.99	337.94	366.92	394.15	(68)

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

(69)m=	54.83	54.83	54.83	54.83	54.83	54.83	54.83	54.83	54.83	54.83	54.83	54.83	(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=	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	(71)

Water heating gains (Table 5)

(72)m=	130.08	127.61	122.49	115.52	111	104.63	99.21	106.15	108.62	115.83	123.97	127.62	(72)

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

(73)m=	721.27	715.89	689.31	648.1	605.71	568.01	546.19	556.05	579.96	621.42	667.42	702.41	(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	2.39	x	10.63	x	0.76	x	0.7	=	18.74	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.76	x	0.7	=	11.29	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.7	=	35.81	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.76	x	0.7	=	21.58	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.7	=	60.85	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.76	x	0.7	=	36.66	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.7	=	97.74	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.76	x	0.7	=	58.89	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.7	=	131.67	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.76	x	0.7	=	79.33	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.7	=	140.96	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.76	x	0.7	=	84.93	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.7	=	131.6	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.76	x	0.7	=	79.29	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.7	=	104.41	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.76	x	0.7	=	62.91	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.7	=	73.16	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.76	x	0.7	=	44.08	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.7	=	42.63	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.76	x	0.7	=	25.68	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.7	=	23.12	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.76	x	0.7	=	13.93	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.7	=	15.62	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.76	x	0.7	=	9.41	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.7	=	41.19	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.76	x	0.7	=	49.64	(78)
South	0.9x	0.77	x	3.15	x	46.75	x	0.76	x	0.7	=	54.29	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.7	=	67.47	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.76	x	0.7	=	81.3	(78)
South	0.9x	0.77	x	3.15	x	76.57	x	0.76	x	0.7	=	88.92	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.7	=	85.94	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.76	x	0.7	=	103.56	(78)
South	0.9x	0.77	x	3.15	x	97.53	x	0.76	x	0.7	=	113.27	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.7	=	97.13	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.76	x	0.7	=	117.05	(78)
South	0.9x	0.77	x	3.15	x	110.23	x	0.76	x	0.7	=	128.02	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.7	=	101.22	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.76	x	0.7	=	121.97	(78)
South	0.9x	0.77	x	3.15	x	114.87	x	0.76	x	0.7	=	133.4	(78)

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South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.7	=	97.41	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.76	x	0.7	=	117.38	(78)
South	0.9x	0.77	x	3.15	x	110.55	x	0.76	x	0.7	=	128.38	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.7	=	95.17	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.76	x	0.7	=	114.69	(78)
South	0.9x	0.77	x	3.15	x	108.01	x	0.76	x	0.7	=	125.44	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.7	=	92.43	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.76	x	0.7	=	111.38	(78)
South	0.9x	0.77	x	3.15	x	104.89	x	0.76	x	0.7	=	121.82	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.7	=	89.78	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.76	x	0.7	=	108.18	(78)
South	0.9x	0.77	x	3.15	x	101.89	x	0.76	x	0.7	=	118.32	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.7	=	72.77	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.76	x	0.7	=	87.69	(78)
South	0.9x	0.77	x	3.15	x	82.59	x	0.76	x	0.7	=	95.91	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.7	=	48.83	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.76	x	0.7	=	58.84	(78)
South	0.9x	0.77	x	3.15	x	55.42	x	0.76	x	0.7	=	64.36	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.7	=	35.6	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.76	x	0.7	=	42.89	(78)
South	0.9x	0.77	x	3.15	x	40.4	x	0.76	x	0.7	=	46.92	(78)

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

(83)m=	189.06	322.27	445.07	564.15	647.64	651	624.21	559.95	485.61	356.95	226.41	161.87	(83)

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

(84)m=	910.33	1038.16	1134.38	1212.25	1253.36	1219.01	1170.4	1116	1065.58	978.37	893.83	864.28	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.9	0.78	0.59	0.43	0.47	0.7	0.92	0.98	0.99	(86)

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

(87)m=	20.1	20.26	20.48	20.73	20.91	20.98	21	21	20.96	20.74	20.37	20.06	(87)

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

(88)m=	20.05	20.05	20.05	20.06	20.06	20.07	20.07	20.07	20.07	20.06	20.06	20.06	(88)

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

(89)m=	0.99	0.98	0.95	0.87	0.72	0.51	0.34	0.38	0.63	0.89	0.98	0.99	(89)

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

(90)m=	18.87	19.1	19.41	19.76	19.98	20.06	20.07	20.07	20.04	19.78	19.27	18.82	(90)

fLA = Living area ÷ (4) = 0.4 (91)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(92)m=	19.35	19.56	19.84	20.15	20.35	20.43	20.44	20.44	20.4	20.16	19.71	19.31	(92)

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

(93)m=	19.2	19.41	19.69	20	20.2	20.28	20.29	20.29	20.25	20.01	19.56	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	0.97	0.94	0.87	0.73	0.53	0.36	0.4	0.64	0.89	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	897.95	1010.13	1070.63	1056.96	916.2	644.49	424.04	445.62	684.32	870.16	868.98	855.03	(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=	1757.57	1707.69	1549.1	1291.73	987.48	654.22	424.96	447.33	711.44	1093.37	1452.23	1750.8	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	639.56	468.76	355.98	169.03	53.03	0	0	0	0	166.06	419.93	666.45	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2938.8 (98)

Space heating requirement in kWh/m²/year 25.93 (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		90.3	(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)													
	639.56	468.76	355.98	169.03	53.03	0	0	0	0	166.06	419.93	666.45	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	708.26	519.11	394.22	187.19	58.72	0	0	0	0	183.9	465.04	738.04	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3254.49 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] + (214) m } 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)

	222.82	196.27	205.83	184.1	180.12	160.52	153.75	169.27	169.15	190.93	202.4	217.32	
Efficiency of water heater												79.6	(216)
(217)m=	87.27	86.85	86.06	84.39	81.8	79.6	79.6	79.6	79.6	84.24	86.52	87.41	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	255.33	225.98	239.17	218.17	220.18	201.65	193.16	212.66	212.5	226.63	233.94	248.62	

Total = Sum(219a)$_{1...12}$ = 2687.99 (219)

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			3254.49	
Water heating fuel used			2687.99	
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			454.5	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	113.2563	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	93.54	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	59.95	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			396.64	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.05	(257)
SAP rating (Section 12)		85.32	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	702.97	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	580.6	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1283.57	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	235.89	(268)
Total CO2, kg/year		sum of (265)…(271) =		1558.38	(272)
CO2 emissions per m²		(272) ÷ (4) =		13.75	(273)

EI rating (section 14)				87	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3970.48	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	3279.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7249.82	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1395.31	(268)
‘Total Primary Energy		sum of (265)…(271) =		8875.38	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		78.31	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.0.28

Property Address: 5 Bed Enhanced FAbric

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	75	(1a)	x	2.7	(2a)	=	202.5	(3a)
First floor	75	(1b)	x	2.41	(2b)	=	180.75	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	150	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	383.25	(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) =	0.1	(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		4.5	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.28	(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

0.36	0.35	0.34	0.31	0.3	0.27	0.27	0.26	0.28	0.3	0.32	0.33

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	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	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	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	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	
Doors			2.1	x	1.1	=	2.31			(26)
Windows Type 1			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 2			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 3			3.78	x1/[1/(1.2)+ 0.04]		=	4.33			(27)
Windows Type 4			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 5			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Windows Type 6			0.96	x1/[1/(1.2)+ 0.04]		=	1.1			(27)
Windows Type 7			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Floor			75	x	0.15	=	11.25			(28)
Walls	180	31.24	148.76	x	0.18	=	26.78			(29)
Roof	75	0	75	x	0.1	=	7.5			(30)
Total area of elements, m²			330							(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) = 81.2 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 37189.4 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: High 450 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 16.5 | (36)

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

Total fabric heat loss (33) + (36) = | 97.7 | (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=	71.29	70.98	70.67	69.23	68.97	67.71	67.71	67.47	68.19	68.97	69.51	70.08	(38)

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

(39)m=	169	168.68	168.38	166.93	166.67	165.42	165.42	165.18	165.9	166.67	167.21	167.78	

Average = Sum(39)1…12 /12= | 166.94 | (39)

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

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

Average = Sum(40)1…12 /12= | 1.11 | (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 | 2.93 | (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 | 109.36 | (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=	120.29	115.92	111.54	107.17	102.79	98.42	98.42	102.79	107.17	111.54	115.92	120.29

Total = Sum(44)1…12 = | 1312.26 | (44)

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

(45)m=	178.39	156.02	161	140.36	134.68	116.22	107.69	123.58	125.06	145.74	159.09	172.76

Total = Sum(45)1…12 = | 1720.58 | (45)

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

(46)m=	26.76	23.4	24.15	21.05	20.2	17.43	16.15	18.54	18.76	21.86	23.86	25.91	(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): | 1.8 | (48)

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

Energy lost from water storage, kWh/year (48) x (49) = | 0.97 | (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)		0.97	(55)

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

(56)m=	30.13	27.22	30.13	29.16	30.13	29.16	30.13	30.13	29.16	30.13	29.16	30.13	(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=	30.13	27.22	30.13	29.16	30.13	29.16	30.13	30.13	29.16	30.13	29.16	30.13	(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=	231.78	204.25	214.39	192.03	188.07	167.89	161.09	176.97	176.73	199.14	210.76	226.15	(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=	231.78	204.25	214.39	192.03	188.07	167.89	161.09	176.97	176.73	199.14	210.76	226.15	

Output from water heater (annual)$_{1...12}$ 2349.26 (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=	102.03	90.46	96.25	88.01	87.5	79.98	78.52	83.81	82.92	91.17	94.23	100.16	(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=	176.05	176.05	176.05	176.05	176.05	176.05	176.05	176.05	176.05	176.05	176.05	176.05	(66)

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

(67)m=	72.17	64.1	52.13	39.47	29.5	24.91	26.91	34.98	46.95	59.62	69.58	74.18	(67)

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

(68)m=	478.39	483.36	470.85	444.22	410.6	379	357.89	352.93	365.44	392.07	425.69	457.28	(68)

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

(69)m=	55.54	55.54	55.54	55.54	55.54	55.54	55.54	55.54	55.54	55.54	55.54	55.54	(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=	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	(71)

Water heating gains (Table 5)

(72)m=	137.14	134.61	129.36	122.23	117.6	111.08	105.54	112.64	115.16	122.55	130.88	134.62	(72)

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

(73)m=	804.93	799.29	769.57	723.14	674.93	632.22	607.57	617.78	644.78	691.46	743.38	783.31	(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	2.39	x	10.63	x	0.76	x	0.7	=	28.11	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.76	x	0.7	=	11.29	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.7	=	53.72	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.76	x	0.7	=	21.58	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.7	=	91.28	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.76	x	0.7	=	36.66	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.7	=	146.62	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.76	x	0.7	=	58.89	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.7	=	197.5	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.76	x	0.7	=	79.33	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.7	=	211.43	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.76	x	0.7	=	84.93	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.7	=	197.4	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.76	x	0.7	=	79.29	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.7	=	156.61	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.76	x	0.7	=	62.91	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.7	=	109.75	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.76	x	0.7	=	44.08	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.7	=	63.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.76	x	0.7	=	25.68	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.7	=	34.68	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.76	x	0.7	=	13.93	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.7	=	23.43	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.76	x	0.7	=	9.41	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.7	=	123.58	(78)
South	0.9x	0.77	x	3.78	x	46.75	x	0.76	x	0.7	=	65.15	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.76	x	0.7	=	24.82	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.7	=	202.4	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.76	x	0.7	=	106.7	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.76	x	0.7	=	40.65	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.7	=	257.82	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.76	x	0.7	=	135.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.76	x	0.7	=	51.78	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.7	=	291.39	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.76	x	0.7	=	153.62	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.76	x	0.7	=	58.52	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.7	=	303.65	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.76	x	0.7	=	160.08	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.76	x	0.7	=	60.98	(78)

South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.7	=	292.22	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.76	x	0.7	=	154.06	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.76	x	0.7	=	58.69	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.7	=	285.52	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.76	x	0.7	=	150.52	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.76	x	0.7	=	57.34	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.7	=	277.28	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.76	x	0.7	=	146.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.76	x	0.7	=	55.69	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.7	=	269.33	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.76	x	0.7	=	141.99	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.76	x	0.7	=	54.09	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.7	=	218.31	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.76	x	0.7	=	115.09	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.76	x	0.7	=	43.84	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.7	=	146.49	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.76	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.76	x	0.7	=	29.42	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.7	=	106.79	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.76	x	0.7	=	56.3	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.76	x	0.7	=	21.45	(78)

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

(83)m=	301.47	519.95	729.76	936.99	1080.91	1087.3	1042.33	932.53	801	579.48	362.23	257.27	(83)

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

(84)m=	1106.4	1319.25	1499.33	1660.13	1755.84	1719.52	1649.91	1550.31	1445.79	1270.94	1105.61	1040.58	(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	0.96	0.83	0.61	0.44	0.49	0.77	0.98	1	1	(86)

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

(87)m=	20.34	20.46	20.63	20.84	20.96	21	21	21	20.99	20.81	20.53	20.32	(87)

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

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

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

(89)m=	1	1	0.99	0.94	0.76	0.52	0.34	0.38	0.67	0.96	1	1	(89)

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

(90)m=	19.11	19.29	19.54	19.82	19.97	20	20	20	19.99	19.8	19.4	19.08	(90)

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

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

(92)m=	19.52	19.68	19.9	20.16	20.3	20.33	20.33	20.33	20.32	20.14	19.77	19.49	(92)

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

(93)m=	19.37	19.53	19.75	20.01	20.15	20.18	20.18	20.18	20.17	19.99	19.62	19.34	(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	0.94	0.77	0.54	0.36	0.4	0.69	0.96	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	1105.84	1316.08	1481.63	1555.71	1359.54	921.15	592.48	624.77	992.82	1223.53	1103.29	1040.27	(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=	2546.73	2467.87	2231.67	1854.74	1408.35	923.17	592.56	624.88	1007.24	1564.47	2094.15	2540.43	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1072.02	774	558.03	215.3	36.31	0	0	0	0	253.66	713.42	1116.12	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4738.86 (98)

Space heating requirement in kWh/m²/year 31.59 (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		90.3	(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)													
	1072.02	774	558.03	215.3	36.31	0	0	0	0	253.66	713.42	1116.12	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	1187.18	857.14	617.97	238.43	40.21	0	0	0	0	280.9	790.06	1236.01	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 5247.91 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] + (214) m } 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)

	231.78	204.25	214.39	192.03	188.07	167.89	161.09	176.97	176.73	199.14	210.76	226.15	
Efficiency of water heater												79.6	(216)
(217)m=	88.19	87.83	87.05	84.92	81.16	79.6	79.6	79.6	79.6	85.26	87.61	88.3	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	262.81	232.53	246.28	226.14	231.74	210.92	202.37	222.33	222.02	233.56	240.55	256.12

Total = Sum(219a)$_{1...12}$ = 2787.38 (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			5247.91	
Water heating fuel used			2787.38	
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			509.85	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	182.6271	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	97	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	67.25	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			476.77	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.03	(257)
SAP rating (Section 12)		85.67	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1133.55	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	602.08	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1735.62	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	264.61	(268)
Total CO2, kg/year		sum of (265)…(271) =		2039.16	(272)
CO2 emissions per m²		(272) ÷ (4) =		13.59	(273)

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EI rating (section 14)				86	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	6402.44	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	3400.61	(264)
Space and water heating	(261) + (262) + (263) + (264) =			9803.05	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1565.23	(268)
'Total Primary Energy		sum of (265)…(271) =		11598.53	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		77.32	(273)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.0.28

Property Address: 1 Bed Enhanced Fabric

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	62.66	(1a) x	2.39	(2a) =	149.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62.66	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	149.76	(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							2	x 10 =	20	(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) =	20	÷ (5) =	0.13	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

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

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

Infiltration rate modified for monthly wind speed

	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

Dwelling Fabric Energy Efficiency 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	0.38

Calculate effective air change rate for the applicable case

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.1	=	2.2			(26)
Windows Type 1			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 2			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 3			0.96	x1/[1/(1.2)+ 0.04]		=	1.1			(27)
Floor			62.66	x	0.15	=	9.399			(28)
Walls	60	10.13	49.87	x	0.2	=	9.97			(29)
Total area of elements, m²			122.66							(31)
Party wall			13	x	0	=	0			(32)
Party ceiling			62.66							(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) =	30.88	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	9854.9	(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	6.13	(36)

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

Total fabric heat loss	(33) + (36) =	37.02	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.98	28.81	28.65	27.89	27.74	27.08	27.08	26.96	27.33	27.74	28.04	28.33	(38)

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

(39)m=	66	65.83	65.67	64.9	64.76	64.1	64.1	63.97	64.35	64.76	65.05	65.35	

Average = Sum(39)$_{1…12}$ /12= 64.9 (39)

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

(40)m=	1.05	1.05	1.05	1.04	1.03	1.02	1.02	1.02	1.03	1.03	1.04	1.04

Average = $Sum(40)_{1…12}$ /12= 1.04 (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 2.06 (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 83.03 (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=	91.33	88.01	84.69	81.36	78.04	74.72	74.72	78.04	81.36	84.69	88.01	91.33	
											Total = $Sum(44)_{1…12}$ =	996.3	(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=	135.44	118.45	122.23	106.57	102.25	88.24	81.76	93.83	94.95	110.65	120.78	131.16	
											Total = $Sum(45)_{1…12}$ =	1306.31	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 120 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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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=	115.12	100.69	103.9	90.58	86.91	75	69.5	79.75	80.7	94.05	102.67	111.49	(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=	115.12	100.69	103.9	90.58	86.91	75	69.5	79.75	80.7	94.05	102.67	111.49	

Output from water heater (annual)1…12 — 1110.36 (64)

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

(65)m=	28.78	25.17	25.97	22.65	21.73	18.75	17.37	19.94	20.18	23.51	25.67	27.87	(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=	102.79	102.79	102.79	102.79	102.79	102.79	102.79	102.79	102.79	102.79	102.79	102.79	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	17.47	15.51	12.62	9.55	7.14	6.03	6.51	8.47	11.36	14.43	16.84	17.95	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	179.6	181.47	176.77	166.77	154.15	142.29	134.36	132.5	137.2	147.2	159.82	171.68	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	33.28	33.28	33.28	33.28	33.28	33.28	33.28	33.28	33.28	33.28	33.28	33.28	(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=	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	-82.23	(71)
Water heating gains (Table 5)													
(72)m=	38.68	37.46	34.91	31.45	29.21	26.04	23.35	26.8	28.02	31.6	35.65	37.46	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	289.59	288.28	278.14	261.61	244.33	228.2	218.07	221.6	230.42	247.06	266.14	280.93	(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	2.39	x	10.63	x	0.76	x	0.7	=	9.37	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.7	=	17.91	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.7	=	30.43	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.7	=	48.87	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.7	=	65.83	(74)

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North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.7	=	70.48	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.7	=	65.8	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.7	=	52.2	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.7	=	36.58	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.7	=	21.31	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.7	=	11.56	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.7	=	7.81	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.7	=	82.39	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.7	=	134.93	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.7	=	171.88	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.7	=	194.26	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.7	=	202.43	(78)
South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.7	=	194.82	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.7	=	190.35	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.7	=	184.85	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.7	=	179.55	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.7	=	145.54	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.7	=	97.66	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.7	=	71.19	(78)

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

(83)m=	98.71	166.44	224.7	275.8	308.3	306.27	295.16	270.57	242.18	182.99	117.89	84.72	(83)

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

(84)m=	388.3	454.71	502.84	537.41	552.63	534.46	513.22	492.17	472.6	430.05	384.03	365.65	(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=	1	0.99	0.98	0.96	0.88	0.72	0.54	0.58	0.82	0.97	0.99	1	(86)

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

(87)m=	19.91	20.07	20.3	20.58	20.82	20.96	20.99	20.99	20.91	20.61	20.2	19.88	(87)

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

(88)m=	20.04	20.04	20.04	20.05	20.06	20.06	20.06	20.07	20.06	20.06	20.05	20.05	(88)

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

(89)m=	1	0.99	0.98	0.94	0.84	0.63	0.43	0.47	0.75	0.95	0.99	1	(89)

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

(90)m=	19.05	19.21	19.44	19.72	19.93	20.05	20.06	20.06	20.01	19.74	19.35	19.02	(90)

fLA = Living area ÷ (4) = | 0.64 | (91)

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

(92)m=	19.6	19.76	19.99	20.27	20.5	20.63	20.66	20.65	20.59	20.29	19.89	19.57	(92)

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

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(93)m=	19.6	19.76	19.99	20.27	20.5	20.63	20.66	20.65	20.59	20.29	19.89	19.57	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.86	0.69	0.5	0.54	0.79	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	386.9	450.8	492.43	507.85	474.38	366.16	256.97	267.49	373.07	411.39	380.96	364.7	(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=	1009.53	978.19	885.85	738.07	569.97	386.4	260	272.15	417.47	627.8	832.11	1004.37	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	463.23	354.4	292.7	165.76	71.12	0	0	0	0	161.01	324.83	475.92	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 2308.98 (98)

Space heating requirement in kWh/m²/year 36.85 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	602.51	474.32	486.2	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.9	0.95	0.94	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	544.37	452.12	457.71	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	701.97	675.67	652.48	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	113.47	166.32	144.91	0	0	0	0	

Total = Sum(104)6..8 = 424.7 (104)

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

Intermittency factor (Table 10b)

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

Total = Sum(104)6..8 = 0 (106)

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

(107)m=	0	0	0	0	0	28.37	41.58	36.23	0	0	0	0

Total = Sum(107)6..8 = 106.18 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.69 (108)

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

Fabric Energy Efficiency (99) + (108) = 38.54 (109)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.0.28

Property Address: 2 Bed Enhanced Fabric

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	41.5	(1a)	x	2.5	(2a)	=	103.75	(3a)
First floor	41.5	(1b)	x	2.5	(2b)	=	103.75	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	207.5	(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) =	0.14	(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) =	0.34	(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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	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	
Doors			2	x	1.1	=	2.2			(26)
Windows Type 1			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 2			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 3			0.96	x1/[1/(1.2)+ 0.04]		=	1.1			(27)
Floor			41.5	x	0.15	=	6.225			(28)
Walls	83.18	10.13	73.05	x	0.2	=	14.61			(29)
Roof	41.5	0	41.5	x	0.11	=	4.56			(30)
Total area of elements, m²			166.18							(31)
Party wall			45	x	0	=	0			(32)
Internal floor			41.5							(32d)

** 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) =	36.91	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	17244.75	(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	8.31	(36)

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

Total fabric heat loss (33) + (36) = 45.22 (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=	40.5	40.26	40.02	38.89	38.69	37.72	37.72	37.53	38.09	38.69	39.11	39.56	(38)

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

(39)m=	85.71	85.47	85.23	84.11	83.91	82.93	82.93	82.75	83.3	83.91	84.33	84.78	

Average = $\text{Sum}(39)_{1\ldots12}$ /12= 84.11 (39)

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

(40)m=	1.03	1.03	1.03	1.01	1.01	1	1	1	1	1.01	1.02	1.02	

Average = $\text{Sum}(40)_{1\ldots12}$ /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 2.52 (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 98.93 (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=	108.83	104.87	100.91	96.95	93	89.04	89.04	93	96.95	100.91	104.87	108.83	

Total = $\text{Sum}(44)_{1\ldots12}$ = 1187.19 (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=	161.39	141.15	145.65	126.98	121.84	105.14	97.43	111.8	113.14	131.85	143.92	156.29	

Total = $\text{Sum}(45)_{1\ldots12}$ = 1556.59 (45)

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

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

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

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

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

(62)m=	137.18	119.98	123.8	107.94	103.57	89.37	82.82	95.03	96.17	112.07	122.34	132.85	(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=	137.18	119.98	123.8	107.94	103.57	89.37	82.82	95.03	96.17	112.07	122.34	132.85	

Output from water heater (annual)1…12 — 1323.1 (64)

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

(65)m=	34.29	29.99	30.95	26.98	25.89	22.34	20.7	23.76	24.04	28.02	30.58	33.21	(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=	125.86	125.86	125.86	125.86	125.86	125.86	125.86	125.86	125.86	125.86	125.86	125.86	(66)

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

(67)m=	22.67	20.14	16.38	12.4	9.27	7.82	8.45	10.99	14.75	18.73	21.86	23.3	(67)

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

(68)m=	225.6	227.94	222.04	209.48	193.63	178.73	168.77	166.43	172.33	184.89	200.74	215.64	(68)

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

(69)m=	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	35.59	(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=	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	-100.69	(71)

Water heating gains (Table 5)

(72)m=	46.09	44.63	41.6	37.48	34.8	31.03	27.83	31.93	33.39	37.66	42.48	44.64	(72)

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

(73)m=	355.12	353.46	340.77	320.11	298.45	278.34	265.81	270.11	281.23	302.03	325.84	344.34	(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	2.39	x	10.63	x	0.76	x	0.8	=	10.71	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.8	=	20.46	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.8	=	34.77	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.8	=	55.85	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.8	=	75.24	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.8	=	80.55	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.8	=	75.2	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.8	=	59.66	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.8	=	41.81	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.8	=	24.36	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.8	=	13.21	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.8	=	8.93	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.8	=	94.16	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.8	=	154.21	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.8	=	196.44	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.8	=	222.01	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.8	=	231.35	(78)
South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.8	=	222.65	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.8	=	217.54	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.8	=	211.26	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.8	=	205.2	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.8	=	166.33	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.8	=	111.61	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.8	=	81.36	(78)

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

(83)m=	112.81	190.21	256.8	315.19	352.34	350.02	337.32	309.22	276.77	209.13	134.73	96.82	(83)

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

(84)m=	467.93	543.68	597.57	635.31	650.79	628.36	603.13	579.33	558	511.16	460.56	441.16	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.77	0.59	0.63	0.86	0.98	1	1	(86)

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

(87)m=	19.89	20.03	20.25	20.54	20.78	20.94	20.99	20.98	20.89	20.57	20.17	19.86	(87)

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

(88)m=	20.06	20.06	20.06	20.07	20.07	20.08	20.08	20.09	20.08	20.07	20.07	20.07	(88)

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

(89)m=	1	1	0.99	0.96	0.88	0.69	0.48	0.52	0.8	0.97	1	1	(89)

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

(90)m=	19.03	19.19	19.41	19.69	19.92	20.06	20.08	20.08	20.02	19.73	19.33	19.02	(90)

fLA = Living area ÷ (4) = 0.36 (91)

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

(92)m=	19.34	19.49	19.71	20	20.23	20.38	20.41	20.41	20.33	20.03	19.64	19.32	(92)

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

(93)m=	19.34	19.49	19.71	20	20.23	20.38	20.41	20.41	20.33	20.03	19.64	19.32	(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	0.96	0.89	0.72	0.52	0.56	0.82	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	466.76	540.47	588.91	609.39	576.21	449.59	311.94	325.41	455.67	494.4	457.98	440.37	(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=	1289.31	1247.29	1126.17	933.25	716.05	479.19	315.94	331.64	519.26	791.24	1057.22	1281.99	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	611.98	474.98	399.73	233.18	104.04	0	0	0	0	220.85	431.45	626.17	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3102.37 (98)

Space heating requirement in kWh/m²/year 37.38 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	779.58	613.71	628.89	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.87	0.94	0.92	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	681.59	574.56	579.65	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	829.43	798.1	772.2	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	106.44	166.31	143.25	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 416.01 (104)

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

Intermittency factor (Table 10b)

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

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

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

(107)m=	0	0	0	0	0	26.61	41.58	35.81	0	0	0	0

Total = Sum(107)$_{6...8}$ = 104 (107)

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Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	1.25	(108)

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

Fabric Energy Efficiency	(99) + (108) =	38.63	(109)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.0.28

Property Address: 3 Bed Enhanced Fabric

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	48.77	(1a)	x	2.5	(2a)	=	121.92	(3a)
First floor	48.77	(1b)	x	2.5	(2b)	=	121.92	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	97.54	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	243.85	(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) =	0.12	(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)	0.37	(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) =	0.32	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.4	0.4	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.36	0.37

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1.1	=	2.31			(26)
Windows Type 1			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 2			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 3			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Windows Type 4			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Windows Type 5			3.15	x1/[1/(1.2)+ 0.04]		=	3.61			(27)
Floor			48.77	x	0.15	=	7.3155			(28)
Walls	125	19.13	105.87	x	0.2	=	21.17			(29)
Roof	48.77	0	48.77	x	0.11	=	5.36			(30)
Total area of elements, m²			222.54							(31)
Party wall			45	x	0	=	0			(32)
Internal floor			48.77							(32d)

** 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) = 55.66 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 22416.99 (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 | 11.13 | (36)

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

Total fabric heat loss (33) + (36) = | 66.79 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	46.81	46.55	46.3	45.13	44.91	43.88	43.88	43.7	44.27	44.91	45.35	45.82	(38)

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

(39)m=	113.6	113.34	113.09	111.92	111.7	110.67	110.67	110.49	111.07	111.7	112.14	112.61	

Average = Sum(39)$_{1…12}$ /12= | 111.92 | (39)

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

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

Average = Sum(40)$_{1…12}$ /12= | 1.15 | (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.72 | (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 | 103.89 | (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=	114.28	110.12	105.97	101.81	97.66	93.5	93.5	97.66	101.81	105.97	110.12	114.28

Total = Sum(44)$_{1…12}$ = | 1246.68 | (44)

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

(45)m=	169.47	148.22	152.95	133.35	127.95	110.41	102.31	117.4	118.81	138.46	151.14	164.12

Total = Sum(45)$_{1…12}$ = | 1634.59 | (45)

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

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

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b | 0 | (49)

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

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

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

If community heating see section 4.3

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(62)m=	144.05	125.99	130.01	113.34	108.76	93.85	86.96	99.79	100.99	117.69	128.47	139.51	(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=	144.05	125.99	130.01	113.34	108.76	93.85	86.96	99.79	100.99	117.69	128.47	139.51

Output from water heater (annual)$_{1...12}$ 1389.41 (64)

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

(65)m=	36.01	31.5	32.5	28.34	27.19	23.46	21.74	24.95	25.25	29.42	32.12	34.88	(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=	135.78	135.78	135.78	135.78	135.78	135.78	135.78	135.78	135.78	135.78	135.78	135.78	(66)

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

(67)m=	22.66	20.12	16.36	12.39	9.26	7.82	8.45	10.98	14.74	18.71	21.84	23.29	(67)

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

(68)m=	252.29	254.91	248.31	234.27	216.54	199.87	188.74	186.12	192.72	206.77	224.5	241.16	(68)

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

(69)m=	36.58	36.58	36.58	36.58	36.58	36.58	36.58	36.58	36.58	36.58	36.58	36.58	(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=	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	-108.62	(71)

Water heating gains (Table 5)

(72)m=	48.4	46.87	43.69	39.36	36.54	32.59	29.22	33.53	35.06	39.55	44.61	46.88	(72)

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

(73)m=	387.08	385.64	372.1	349.75	326.08	304.01	290.15	294.37	306.26	328.76	354.68	375.06	(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	2.39	x	10.63	x	0.76	x	0.8	=	21.42	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.76	x	0.8	=	12.9	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.8	=	40.93	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.76	x	0.8	=	24.66	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.8	=	69.54	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.76	x	0.8	=	41.9	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.8	=	111.71	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.76	x	0.8	=	67.3	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.8	=	150.48	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.76	x	0.8	=	90.67	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.8	=	161.09	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.76	x	0.8	=	97.06	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.8	=	150.4	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.76	x	0.8	=	90.62	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.8	=	119.32	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.76	x	0.8	=	71.89	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.8	=	83.62	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.76	x	0.8	=	50.38	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.8	=	48.72	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.76	x	0.8	=	29.35	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.8	=	26.42	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.76	x	0.8	=	15.92	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.8	=	17.85	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.76	x	0.8	=	10.76	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.8	=	94.16	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.76	x	0.8	=	28.37	(78)
South	0.9x	0.77	x	3.15	x	46.75	x	0.76	x	0.8	=	62.05	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.8	=	154.21	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.76	x	0.8	=	46.46	(78)
South	0.9x	0.77	x	3.15	x	76.57	x	0.76	x	0.8	=	101.62	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.8	=	196.44	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.76	x	0.8	=	59.18	(78)
South	0.9x	0.77	x	3.15	x	97.53	x	0.76	x	0.8	=	129.45	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.8	=	222.01	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.76	x	0.8	=	66.88	(78)
South	0.9x	0.77	x	3.15	x	110.23	x	0.76	x	0.8	=	146.31	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.8	=	231.35	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.76	x	0.8	=	69.7	(78)
South	0.9x	0.77	x	3.15	x	114.87	x	0.76	x	0.8	=	152.46	(78)

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South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.8	=	222.65	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.76	x	0.8	=	67.07	(78)
South	0.9x	0.77	x	3.15	x	110.55	x	0.76	x	0.8	=	146.72	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.8	=	217.54	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.76	x	0.8	=	65.53	(78)
South	0.9x	0.77	x	3.15	x	108.01	x	0.76	x	0.8	=	143.36	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.8	=	211.26	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.76	x	0.8	=	63.64	(78)
South	0.9x	0.77	x	3.15	x	104.89	x	0.76	x	0.8	=	139.22	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.8	=	205.2	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.76	x	0.8	=	61.82	(78)
South	0.9x	0.77	x	3.15	x	101.89	x	0.76	x	0.8	=	135.23	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.8	=	166.33	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.76	x	0.8	=	50.11	(78)
South	0.9x	0.77	x	3.15	x	82.59	x	0.76	x	0.8	=	109.61	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.8	=	111.61	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.76	x	0.8	=	33.62	(78)
South	0.9x	0.77	x	3.15	x	55.42	x	0.76	x	0.8	=	73.55	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.8	=	81.36	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.76	x	0.8	=	24.51	(78)
South	0.9x	0.77	x	3.15	x	40.4	x	0.76	x	0.8	=	53.62	(78)

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

(83)m=	218.9	367.88	496.51	614.22	694.65	694.59	667.45	605.34	536.24	404.12	261.12	188.1	(83)

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

(84)m=	605.98	753.51	868.6	963.96	1020.73	998.61	957.6	899.71	842.5	732.88	615.8	563.16	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.84	0.67	0.5	0.55	0.79	0.96	0.99	1	(86)

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

(87)m=	19.76	19.97	20.24	20.57	20.83	20.96	20.99	20.99	20.91	20.56	20.09	19.72	(87)

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

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

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.92	0.79	0.58	0.39	0.44	0.71	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.82	19.03	19.3	19.62	19.85	19.96	19.97	19.97	19.92	19.62	19.16	18.79	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

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(92)m=	19.11	19.32	19.59	19.91	20.15	20.26	20.29	20.28	20.22	19.91	19.45	19.08	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.11	19.32	19.59	19.91	20.15	20.26	20.29	20.28	20.22	19.91	19.45	19.08	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.97	0.92	0.8	0.6	0.42	0.47	0.73	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	603.56	744.85	842.46	885.21	816.89	603.66	404.78	423.86	619.15	690.74	609.95	561.58	(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=	1682.4	1634.05	1480.56	1232.69	944.05	626.9	407.84	429.11	680.09	1040.02	1384.49	1675.26	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	802.66	597.55	474.75	250.19	94.6	0	0	0	0	259.87	557.67	828.58	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3865.85 (98)

Space heating requirement in kWh/m²/year 39.63 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	1040.32	818.97	839.7	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.91	0.95	0.94	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	943.25	780.07	786.8	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1270.64	1220.5	1154.65	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	235.72	327.68	273.68	0	0	0	0

Total = Sum(104)$_{6..8}$ = 837.08 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6..8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	58.93	81.92	68.42	0	0	0	0

Total = Sum(107)$_{6..8}$ = 209.27 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 2.15 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 41.78 (109)

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.0.28

Property Address: 4 Bed Enhanced Fabric

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	56.67	(1a) x	2.5	(2a) =	141.68	(3a)
First floor	56.67	(1b) x	2.5	(2b) =	141.68	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	113.34	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		283.35	(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		4.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(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

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.4	0.39	0.38	0.34	0.33	0.3	0.3	0.29	0.31	0.33	0.35	0.37

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.1	=	2.2			(26)
Windows Type 1			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 2			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 3			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Windows Type 4			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Windows Type 5			0.96	x1/[1/(1.2)+ 0.04]		=	1.1			(27)
Windows Type 6			3.15	x1/[1/(1.2)+ 0.04]		=	3.61			(27)
Floor			56.67	x	0.15	=	8.5005			(28)
Walls	113.52	20	93.52	x	0.18	=	16.83			(29)
Roof	56.67	0	56.67	x	0.1	=	5.67			(30)
Total area of elements, m²			226.86							(31)
Party wall			50	x	0	=	0			(32)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	53.81	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	13871.48	(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

Dwelling Fabric Energy Efficiency WorkSheet: New dwelling design stage

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) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 65.15 | (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=	54.12	53.83	53.55	52.23	51.99	50.84	50.84	50.63	51.29	51.99	52.48	53.01	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	119.28	118.99	118.71	117.39	117.14	115.99	115.99	115.79	116.44	117.14	117.64	118.16	

Average = $Sum(39)_{1…12}$ /12= | 117.39 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.05	1.05	1.05	1.04	1.03	1.02	1.02	1.02	1.03	1.03	1.04	1.04

Average = $Sum(40)_{1…12}$ /12= | 1.04 | (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 | 2.83 | (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 | 106.84 | (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=	117.52	113.25	108.97	104.7	100.43	96.15	96.15	100.43	104.7	108.97	113.25	117.52

Total = $Sum(44)_{1…12}$ = | 1282.05 | (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=	174.28	152.43	157.29	137.13	131.58	113.54	105.21	120.74	122.18	142.39	155.43	168.78

Total = $Sum(45)_{1…12}$ = | 1680.97 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 180 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	148.14	129.56	133.7	116.56	111.84	96.51	89.43	102.62	103.85	121.03	132.11	143.46	(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=	148.14	129.56	133.7	116.56	111.84	96.51	89.43	102.62	103.85	121.03	132.11	143.46	

Output from water heater (annual)1…12 | 1428.82 | (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=	37.03	32.39	33.42	29.14	27.96	24.13	22.36	25.66	25.96	30.26	33.03	35.87	(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=	141.68	141.68	141.68	141.68	141.68	141.68	141.68	141.68	141.68	141.68	141.68	141.68	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	25.74	22.86	18.59	14.07	10.52	8.88	9.6	12.47	16.74	21.26	24.81	26.45	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	276.27	279.14	271.91	256.53	237.12	218.87	206.68	203.82	211.04	226.42	245.84	264.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.17	37.17	37.17	37.17	37.17	37.17	37.17	37.17	37.17	37.17	37.17	37.17	(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=	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	-113.34	(71)

Water heating gains (Table 5)

(72)m=	49.78	48.2	44.93	40.47	37.58	33.51	30.05	34.48	36.06	40.67	45.87	48.21	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	417.29	415.7	400.93	376.58	350.72	326.77	311.83	316.28	329.35	353.85	382.02	404.24	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Dwelling Fabric Energy Efficiency 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	2.39	x	10.63	x	0.76	x	0.7	=	18.74	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.76	x	0.7	=	11.29	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.7	=	35.81	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.76	x	0.7	=	21.58	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.7	=	60.85	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.76	x	0.7	=	36.66	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.7	=	97.74	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.76	x	0.7	=	58.89	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.7	=	131.67	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.76	x	0.7	=	79.33	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.7	=	140.96	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.76	x	0.7	=	84.93	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.7	=	131.6	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.76	x	0.7	=	79.29	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.7	=	104.41	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.76	x	0.7	=	62.91	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.7	=	73.16	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.76	x	0.7	=	44.08	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.7	=	42.63	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.76	x	0.7	=	25.68	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.7	=	23.12	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.76	x	0.7	=	13.93	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.7	=	15.62	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.76	x	0.7	=	9.41	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.7	=	41.19	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.76	x	0.7	=	49.64	(78)
South	0.9x	0.77	x	3.15	x	46.75	x	0.76	x	0.7	=	54.29	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.7	=	67.47	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.76	x	0.7	=	81.3	(78)
South	0.9x	0.77	x	3.15	x	76.57	x	0.76	x	0.7	=	88.92	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.7	=	85.94	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.76	x	0.7	=	103.56	(78)
South	0.9x	0.77	x	3.15	x	97.53	x	0.76	x	0.7	=	113.27	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.7	=	97.13	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.76	x	0.7	=	117.05	(78)
South	0.9x	0.77	x	3.15	x	110.23	x	0.76	x	0.7	=	128.02	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.7	=	101.22	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.76	x	0.7	=	121.97	(78)
South	0.9x	0.77	x	3.15	x	114.87	x	0.76	x	0.7	=	133.4	(78)

South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.7	=	97.41	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.76	x	0.7	=	117.38	(78)
South	0.9x	0.77	x	3.15	x	110.55	x	0.76	x	0.7	=	128.38	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.7	=	95.17	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.76	x	0.7	=	114.69	(78)
South	0.9x	0.77	x	3.15	x	108.01	x	0.76	x	0.7	=	125.44	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.7	=	92.43	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.76	x	0.7	=	111.38	(78)
South	0.9x	0.77	x	3.15	x	104.89	x	0.76	x	0.7	=	121.82	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.7	=	89.78	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.76	x	0.7	=	108.18	(78)
South	0.9x	0.77	x	3.15	x	101.89	x	0.76	x	0.7	=	118.32	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.7	=	72.77	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.76	x	0.7	=	87.69	(78)
South	0.9x	0.77	x	3.15	x	82.59	x	0.76	x	0.7	=	95.91	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.7	=	48.83	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.76	x	0.7	=	58.84	(78)
South	0.9x	0.77	x	3.15	x	55.42	x	0.76	x	0.7	=	64.36	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.7	=	35.6	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.76	x	0.7	=	42.89	(78)
South	0.9x	0.77	x	3.15	x	40.4	x	0.76	x	0.7	=	46.92	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	189.06	322.27	445.07	564.15	647.64	651	624.21	559.95	485.61	356.95	226.41	161.87	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	606.35	737.97	846.01	940.73	998.37	977.77	936.04	876.23	814.96	710.8	608.43	566.12	(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	0.99	0.96	0.88	0.71	0.54	0.59	0.84	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.83	20	20.25	20.56	20.82	20.96	20.99	20.99	20.9	20.56	20.13	19.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.04	20.04	20.04	20.05	20.06	20.06	20.06	20.07	20.06	20.06	20.05	20.05	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.95	0.84	0.63	0.43	0.48	0.77	0.97	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.97	19.14	19.39	19.7	19.93	20.05	20.06	20.06	20	19.7	19.28	18.94	(90)

fLA = Living area ÷ (4) = | 0.4 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

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(92)m=	19.31	19.48	19.73	20.04	20.29	20.41	20.43	20.43	20.36	20.04	19.61	19.28	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.31	19.48	19.73	20.04	20.29	20.41	20.43	20.43	20.36	20.04	19.61	19.28	(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	0.85	0.66	0.47	0.52	0.8	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	605.2	733.76	832.13	891.35	847.42	644.45	440.59	459.76	648.3	686.92	605.57	565.38	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1790.29	1735.25	1570.82	1308.04	1005.87	673.77	444.44	466.59	728.94	1105.82	1472.25	1782.31	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	881.71	673	549.58	300.02	117.89	0	0	0	0	311.66	624.01	905.4	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4363.27 (98)

Space heating requirement in kWh/m²/year 38.5 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	1090.34	858.35	879.99	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.9	0.95	0.93	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	980.76	815.61	820.41	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1254.81	1203.62	1135.87	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	197.31	288.68	234.7	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 720.69 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	49.33	72.17	58.67	0	0	0	0

Total = Sum(107)$_{6...8}$ = 180.17 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.59 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 40.09 (109)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.0.28

Property Address: 5 Bed Enhanced FAbric

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	75	(1a)	x	2.7	(2a)	=	202.5	(3a)
First floor	75	(1b)	x	2.41	(2b)	=	180.75	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	150	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	383.25	(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) =	0.1	(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		4.5	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.28	(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

0.36	0.35	0.34	0.31	0.3	0.27	0.27	0.26	0.28	0.3	0.32	0.33

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	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	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	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	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	
Doors			2.1	x	1.1	=	2.31			(26)
Windows Type 1			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 2			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 3			3.78	x1/[1/(1.2)+ 0.04]		=	4.33			(27)
Windows Type 4			2.39	x1/[1/(1.2)+ 0.04]		=	2.74			(27)
Windows Type 5			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Windows Type 6			0.96	x1/[1/(1.2)+ 0.04]		=	1.1			(27)
Windows Type 7			1.44	x1/[1/(1.2)+ 0.04]		=	1.65			(27)
Floor			75	x	0.15	=	11.25			(28)
Walls	180	31.24	148.76	x	0.18	=	26.78			(29)
Roof	75	0	75	x	0.1	=	7.5			(30)
Total area of elements, m²			330							(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) = 81.2 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 37189.4 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: High 450 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		16.5	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)			
Total fabric heat loss	(33) + (36) =	97.7	(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=	71.29	70.98	70.67	69.23	68.97	67.71	67.71	67.47	68.19	68.97	69.51	70.08	(38)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	169	168.68	168.38	166.93	166.67	165.42	165.42	165.18	165.9	166.67	167.21	167.78	

Average = $Sum(39)_{1...12}$ /12= 166.94 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.13	1.12	1.12	1.11	1.11	1.1	1.1	1.1	1.11	1.11	1.11	1.12	

Average = $Sum(40)_{1...12}$ /12= 1.11 (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 — 2.93 (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 — 109.36 (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=	120.29	115.92	111.54	107.17	102.79	98.42	98.42	102.79	107.17	111.54	115.92	120.29

Total = $Sum(44)_{1...12}$ = 1312.26 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	178.39	156.02	161	140.36	134.68	116.22	107.69	123.58	125.06	145.74	159.09	172.76

Total = $Sum(45)_{1...12}$ = 1720.58 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		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) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)

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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 — (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	151.63	132.62	136.85	119.31	114.48	98.79	91.54	105.04	106.3	123.88	135.22	146.84	(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=	151.63	132.62	136.85	119.31	114.48	98.79	91.54	105.04	106.3	123.88	135.22	146.84	

Output from water heater (annual)$_{1...12}$ — 1462.49 — (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=	37.91	33.15	34.21	29.83	28.62	24.7	22.88	26.26	26.57	30.97	33.81	36.71	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	146.71	146.71	146.71	146.71	146.71	146.71	146.71	146.71	146.71	146.71	146.71	146.71	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	28.87	25.64	20.85	15.79	11.8	9.96	10.77	13.99	18.78	23.85	27.83	29.67	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	320.52	323.85	315.47	297.62	275.1	253.93	239.79	236.46	244.84	262.69	285.21	306.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	37.67	(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=	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	-117.37	(71)

Water heating gains (Table 5)

(72)m=	50.95	49.34	45.98	41.43	38.47	34.3	30.76	35.3	36.91	41.63	46.95	49.34	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	467.36	465.84	449.32	421.85	392.38	365.21	348.33	352.77	367.55	395.17	427.01	452.41	(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	2.39	x	10.63	x	0.76	x	0.7	=	28.11	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.76	x	0.7	=	11.29	(74)
North	0.9x	0.77	x	2.39	x	20.32	x	0.76	x	0.7	=	53.72	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.76	x	0.7	=	21.58	(74)
North	0.9x	0.77	x	2.39	x	34.53	x	0.76	x	0.7	=	91.28	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.76	x	0.7	=	36.66	(74)
North	0.9x	0.77	x	2.39	x	55.46	x	0.76	x	0.7	=	146.62	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.76	x	0.7	=	58.89	(74)
North	0.9x	0.77	x	2.39	x	74.72	x	0.76	x	0.7	=	197.5	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.76	x	0.7	=	79.33	(74)
North	0.9x	0.77	x	2.39	x	79.99	x	0.76	x	0.7	=	211.43	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.76	x	0.7	=	84.93	(74)
North	0.9x	0.77	x	2.39	x	74.68	x	0.76	x	0.7	=	197.4	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.76	x	0.7	=	79.29	(74)
North	0.9x	0.77	x	2.39	x	59.25	x	0.76	x	0.7	=	156.61	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.76	x	0.7	=	62.91	(74)
North	0.9x	0.77	x	2.39	x	41.52	x	0.76	x	0.7	=	109.75	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.76	x	0.7	=	44.08	(74)
North	0.9x	0.77	x	2.39	x	24.19	x	0.76	x	0.7	=	63.94	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.76	x	0.7	=	25.68	(74)
North	0.9x	0.77	x	2.39	x	13.12	x	0.76	x	0.7	=	34.68	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.76	x	0.7	=	13.93	(74)
North	0.9x	0.77	x	2.39	x	8.86	x	0.76	x	0.7	=	23.43	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.76	x	0.7	=	9.41	(74)
South	0.9x	0.77	x	2.39	x	46.75	x	0.76	x	0.7	=	123.58	(78)
South	0.9x	0.77	x	3.78	x	46.75	x	0.76	x	0.7	=	65.15	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.76	x	0.7	=	24.82	(78)
South	0.9x	0.77	x	2.39	x	76.57	x	0.76	x	0.7	=	202.4	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.76	x	0.7	=	106.7	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.76	x	0.7	=	40.65	(78)
South	0.9x	0.77	x	2.39	x	97.53	x	0.76	x	0.7	=	257.82	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.76	x	0.7	=	135.92	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.76	x	0.7	=	51.78	(78)
South	0.9x	0.77	x	2.39	x	110.23	x	0.76	x	0.7	=	291.39	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.76	x	0.7	=	153.62	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.76	x	0.7	=	58.52	(78)
South	0.9x	0.77	x	2.39	x	114.87	x	0.76	x	0.7	=	303.65	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.76	x	0.7	=	160.08	(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.76	x	0.7	=	60.98	(78)

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South	0.9x	0.77	x	2.39	x	110.55	x	0.76	x	0.7	=	292.22	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.76	x	0.7	=	154.06	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.76	x	0.7	=	58.69	(78)
South	0.9x	0.77	x	2.39	x	108.01	x	0.76	x	0.7	=	285.52	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.76	x	0.7	=	150.52	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.76	x	0.7	=	57.34	(78)
South	0.9x	0.77	x	2.39	x	104.89	x	0.76	x	0.7	=	277.28	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.76	x	0.7	=	146.18	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.76	x	0.7	=	55.69	(78)
South	0.9x	0.77	x	2.39	x	101.89	x	0.76	x	0.7	=	269.33	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.76	x	0.7	=	141.99	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.76	x	0.7	=	54.09	(78)
South	0.9x	0.77	x	2.39	x	82.59	x	0.76	x	0.7	=	218.31	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.76	x	0.7	=	115.09	(78)
South	0.9x	0.77	x	1.44	x	82.59	x	0.76	x	0.7	=	43.84	(78)
South	0.9x	0.77	x	2.39	x	55.42	x	0.76	x	0.7	=	146.49	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.76	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.76	x	0.7	=	29.42	(78)
South	0.9x	0.77	x	2.39	x	40.4	x	0.76	x	0.7	=	106.79	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.76	x	0.7	=	56.3	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.76	x	0.7	=	21.45	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	301.47	519.95	729.76	936.99	1080.91	1087.3	1042.33	932.53	801	579.48	362.23	257.27	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	768.83	985.79	1179.08	1358.84	1473.29	1452.51	1390.66	1285.29	1168.55	974.65	789.25	709.68	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.99	0.92	0.72	0.52	0.59	0.89	1	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.21	20.33	20.51	20.74	20.92	20.99	21	21	20.96	20.71	20.41	20.19	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.98	19.98	19.98	19.99	19.99	20	20	20	20	19.99	19.99	19.99	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.98	0.86	0.61	0.4	0.46	0.8	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.26	19.38	19.56	19.79	19.95	20	20	20	19.98	19.76	19.46	19.24	(90)

fLA = Living area ÷ (4) = | 0.33 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

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(92)m=	19.57	19.7	19.88	20.11	20.27	20.33	20.33	20.33	20.31	20.08	19.78	19.56	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.57	19.7	19.88	20.11	20.27	20.33	20.33	20.33	20.31	20.08	19.78	19.56	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	1	0.98	0.88	0.65	0.44	0.5	0.83	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	768.83	985.59	1176.72	1332.89	1297.38	938.9	617.04	648.69	970.25	968.42	789.17	709.68	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	2581.24	2496.32	2252.74	1870.73	1429.02	947.56	617.35	649.59	1029.48	1579.45	2119.94	2576.42	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1348.43	1015.21	800.56	387.25	97.94	0	0	0	0	454.61	958.15	1388.85	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6451.01 (98)

Space heating requirement in kWh/m²/year 43.01 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	1554.92	1224.08	1255.34	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.95	0.99	0.97	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	1479.97	1206.09	1221.45	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1823.3	1748.1	1627.4	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	247.2	403.26	302.03	0	0	0	0	

Total = Sum(104)$_{6..8}$ = 952.49 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6..8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	61.8	100.81	75.51	0	0	0	0

Total = Sum(107)$_{6..8}$ = 238.12 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.59 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 44.59 (109)