ABBEYCONSULTANTS

Energy Statement

Former Masonic Hall and Old Telephone Exchange site, Elmsleigh Road, Staines

Client: Inland Homes

Report No: PA-ES-ER-IH-20-02

Report Date: September 2020

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1. ASSESSMENT INFORMATION

Project Name	Elmsleigh Road
Project Address	Former Masonic Hall and Old Telephone Exchange site, Elmsleigh Road, Staines
Developer	Inland Homes
Developer Address	Inland Homes, Burnham Yard, London End, Beaconsfield, Bucks Hp9 2jh
Architect	Assael Architecture
Architect's Address	123 Upper Richmond Road, London, SW15 2TL
Project Description	Demolition of the Former Masonic Hall and redevelopment of the site to provide 206 dwellings comprising two buildings of 13 and 15 storeys in height, provided together with car and cycle parking, hard and soft landscaping and other associated works.

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01	MF	04/09/20	Initial Issue
02	MF	23/09/20	Minor amendments
03			

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2. EXECUTIVE SUMMARY

This report considers the predicted energy and CO_2 demand for the proposed development at Elmsleigh Road located in Spelthorne Borough Council.

The report complies with the requirements at both national and local level, as set out in the National Planning Policy Framework (2019) and the Spelthorne Borough Council Core Strategy and Policies Development Plan Document (2009).

The proposed site will be built under Part L 2013 (with 2016 amendments) of the Building Regulations and in line with Spelthorne's Policy CC1 target to achieve a minimum 10% CO_2 reduction over the baseline using the current SAP12 carbon factors.

The development will reduce regulated CO_2 emissions by integrating a range of passive design and energy efficiency measures throughout the building. These measures include improving building fabric standards beyond the requirements of Part L of the Building Regulations. These measures enable the proposed scheme to go beyond Target Emission Rates (TER) and Target Fabric Energy Efficiency (TFEE) minimum standards via energy efficiency measures alone.

Following reduction of the energy demand through fabric and energy efficiency improvements, communal Air Source Heat Pumps (ASHP) are to be located on the roofs of each block to supply hot water and space heating to all residential spaces.

The regulated energy CO_2 savings expressed in terms of actual and percentage reduction after each stage of the energy hierarchy for the residential parts of the development are provided in the following tables.

The ASHP along with energy efficiency improvements save 39 tonnes of CO_2 per year which represents a 17.89% saving over a baseline unit. This exceeds the requirements of Spelthorne's emerging policy DS2.
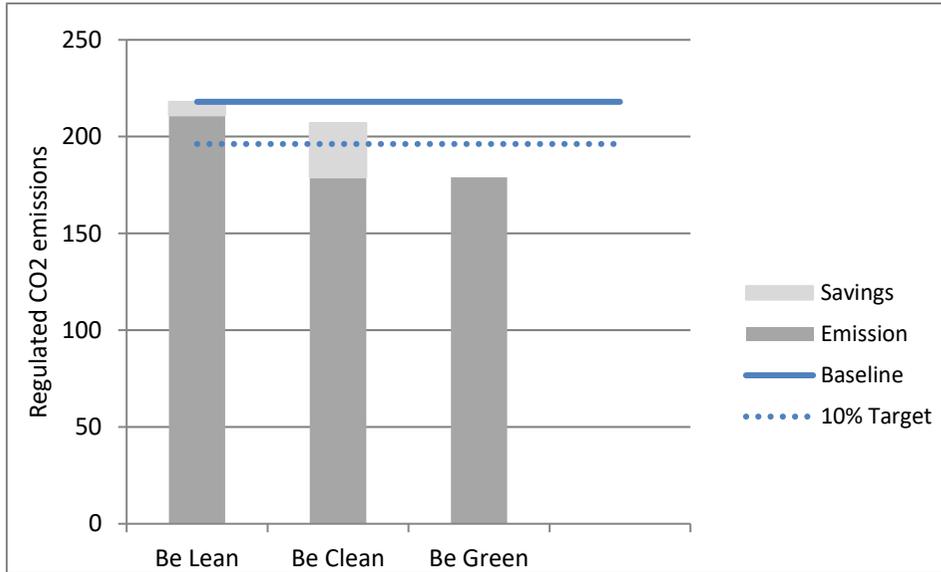
Total energy demand savings including unregulated energy are also expressed after each stage of the energy hierarchy for the residential parts of the development. The introduction ASHP provide a saving of 527 MWh per year which represents a 39% saving in total energy demand. This exceeds the 10% requirement of Spelthorne's existing Policy CC1.

Residential Units Carbon Emissions

Element	CO2 - Regulated (tonnes/year)	CO2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Residential Baseline	218.00	247	465
Be Lean	211.00	247	458
After Heat Network	211.00	247	458
Be Green	179.00	247	426

Element	Savings CO2 - Regulated (tonnes/year)	Total Savings (tonnes/year)	% Saving
Residential Baseline	0	0	0
Be Lean	7.00	7.00	3.21
After Heat Network	32.00	39.00	17.89
Be Green	0	39.00	17.89

The overall reduction in regulated carbon emission to the residential units can be illustrated graphically as below.

Residential Units Energy Usage and Savings

Element	Energy - Regulated (MWh/year)	Energy - Un-Regulated (MWh/year)	Total (MWh/year)
Residential Baseline	871	476	1,347
Be Lean	824	476	1,300
After Heat Network	344	476	820
Be Green	344	476	820

Element	Savings Energy - (MWh/year)	Total Savings (MWh/year)	% Saving
Residential Baseline	0	0	0
Be Lean	47	47	3.5
After Heat Network	480	527	39
Be Green	0	527	39

The overall reduction in energy usage to the residential units can be illustrated graphically as below.

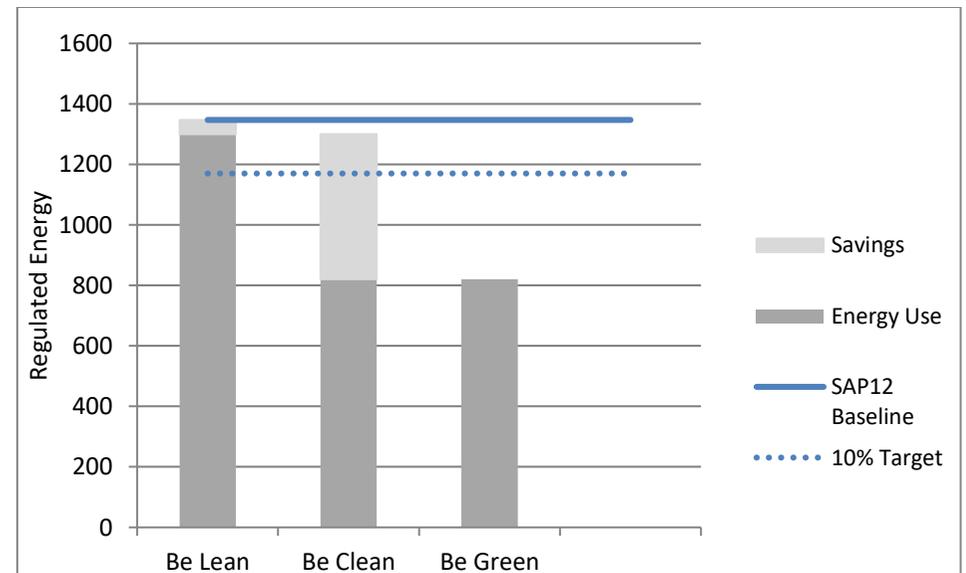The proposed strategy has first reduced energy demand through fabric and energy efficiency measures. The overall Part L Fabric Energy Efficiency (FEE) performance has been reviewed for the 'be lean' position and compared to the baseline stage of the energy hierarchy. The improvement has been shown to be circa 11.13%.

Element	TFEE (kWH/m²/year)	DFEE (kWH/m²/year)	Improvement (%)
Residential Development Total	41.59	36.96	11.13

Summary

The proposed energy strategy achieves and meets the following requirements:

— Complies with Part L 2013 building regulations (with 2016 amendments)

— Includes improved optimal building fabric improvements, energy efficient design of building services.

— Utilises Air Source Heat Pumps which are classed as renewable energy as per paragraph 6.18 of Spelthorne Guidance Note for the 10% Renewable Energy Requirement.

— Achieves in excess of 17% savings in regulated energy CO_2 emissions on-site using fabric and low carbon technology which exceeds the proposed carbon savings of Spelthorne's emerging Policy DS2.

— Achieves in excess of 39% savings in total energy demand using fabric and renewable technology which exceeds the proposed energy savings of Policy CC1.
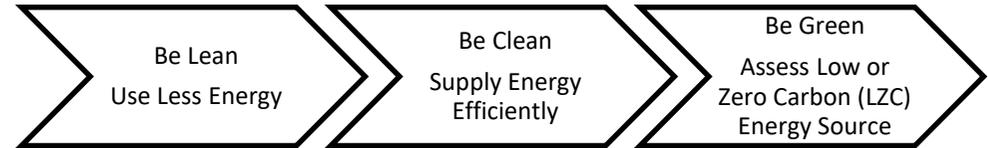
3. INTRODUCTION

This document has been prepared by Abbey Consultants (Southern) Ltd, a specialist environmental and energy consultancy on behalf of Inland Homes in support of a full planning application for the development at Elmsleigh Road located in Spelthorne Borough Council .

The proposed application is described as: Demolition of the Former Masonic Hall and redevelopment of the site to provide 206 dwellings comprising two buildings of 13 and 15 storeys in height, provided together with car and cycle parking, hard and soft landscaping and other associated works..

The following report establishes a baseline assessment of the energy demands and associated CO_2 emissions for the residential units. The accepted Energy Hierarchy approach of Be Lean, Be Clean and Be Green is then followed to enable the maximum viable reductions in Regulated CO_2 emissions to be achieved.

Be Lean	Be Clean	Be Green
Use Less Energy	Supply Energy Efficiently	Assess Low or Zero Carbon (LZC) Energy Source

The report takes into consideration the layout, use and requirements for the development to recommend a strategy that integrates the most suitable technologies available that are commercially viable, whilst also achieving compliance with all policies applicable to this development.

Figure 1: Site Plan at Ground Floor

Figure 2: Site Plan at First Floor

4. PLANNING POLICY

An effective planning system is required to contribute to achieving sustainable development.

Sustainable development is defined as having the following three overarching objectives which are interdependent and need to be pursued in mutually supportive ways: an economic objective, a social objective, and an environmental objective.

1. Economic objective – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;

2. Social objective – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and

3. Environmental objective – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

4.1 NATIONAL PLANNING POLICY FRAMEWORK (NPPF) 2019

The NPPF 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.

Chapter 14 Meeting the challenge of climate change, flooding and coastal change

The following paragraphs set out the Government's position in response to reducing carbon emissions:

Paragraph 150: New development should be planned for in ways that:

a. avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and
b. can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

Paragraph 151. To help increase the use and supply of renewable and low carbon energy and heat, plans should:

a. provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);
b. consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
c. identify opportunities for development to draw its energy supply from decentralised, renewable, or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

Paragraph 153: In determining planning applications, local planning authorities should expect new development to:

a. comply with adopted Local Plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
b. take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

Paragraph 154: When determining planning applications for renewable and low carbon development, local planning authorities should:

a. not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

4.2 PLANNING UPDATE MARCH 2015

Housing Standard Review

Following the technical Housing Standards Review, Government issued a Ministerial Statement in March 2015 withdrawing all national standards that applied to residential development. This had the impact of cancelling the Code for Sustainable Homes and BREEAM as it pertains to residential development, aside from the management of legacy cases.

Zero Carbon Homes: supporting small builders

The government highlighted their commitment to implementing the zero carbon homes standard in 2016 and in addition to the future strengthening of minimum on-site energy performance requirements introduced in the Infrastructure Act 2015 the powers needed to enable off-site carbon abatement measures (Allowable Solutions) to contribute to achieving the zero carbon standards. However they recognised achieving the zero carbon standards would be a challenge for home builders and in particular smaller home builders and consulted on how an exemption for small sites could operate.

It was decided there would be an exemption for small housing sites of 10 units or fewer, which are most commonly developed by small scale home builders and can be more expensive to develop irrespective of the size of the builder, from the allowable solutions element of the zero carbon homes target. All new homes will be required to meet the strengthened on-site energy performance standard but those building on small sites will not be required to support any further off-site carbon abatement measures.

Housing standards: streamlining the system

It was agreed that all new homes need to be high quality, accessible and sustainable. To achieve this, the government created a new approach for the setting of technical standards for new housing. This rationalises the many differing existing standards into a simpler, streamlined system which it is hoped would reduce burdens and help bring forward much needed new homes.

The new system comprises new additional optional Building Regulations on water and access, and a new national space standard (hereafter referred to as "the new national technical standards"). This system complements the existing set of Building Regulations.

Plan making

From the date the Deregulation Bill 2015 is given Royal Assent, local planning authorities and qualifying bodies preparing neighbourhood plans should not set in their emerging Local Plans, neighbourhood plans, or supplementary planning documents, any additional local technical standards or requirements relating to the construction, internal layout or performance of new dwellings. This includes any policy requiring any level of the Code for Sustainable Homes to be achieved by new development; the government has now withdrawn the code, aside from the management of legacy cases.

Local planning authorities and qualifying bodies preparing neighbourhood plans are to consider their existing plan policies on technical housing standards or requirements and update them as appropriate, for example through a partial Local Plan review, or a full neighbourhood plan replacement in due course. Local planning authorities may also need to review their local information requirements to ensure that technical detail that is no longer necessary is not requested to support planning applications.

The optional new national technical standards should only be required through any new Local Plan policies if they address a clearly evidenced need, and where their impact on viability has been considered, in accordance with the National Planning Policy Framework and Planning Guidance. Neighbourhood plans should not be used to apply the new national technical standards.

For the specific issue of energy performance, local planning authorities will continue to be able to set and apply policies in their Local Plans which require compliance with energy performance standards that exceed the energy requirements of Building Regulations until commencement of amendments to the Planning and Energy Act 2008 in the Deregulation Bill 2015.

This is expected to happen alongside the introduction of zero carbon homes policy in late 2016. The government has stated that, from then, the energy performance requirements in Building Regulations will be set at a level equivalent to the (outgoing) Code for Sustainable Homes Level 4. Until the amendment is commenced, it is expected local planning authorities to take this statement of the government's intention into account in applying existing policies and not set conditions with requirements above a Code level 4 equivalent. This statement does not modify the National Planning Policy Framework policy allowing the connection of new housing development to low carbon infrastructure such as district heating networks.

Decision taking, transition and compliance:

Where there is an existing plan policy which references the Code for Sustainable Homes, it was decided authorities may continue to apply a requirement for a water efficiency standard equivalent to the new national technical standard, or in the case of energy a standard consistent with Code Level 4.

4.3   LOCAL POLICY

Spelthorne Borough Council

Core Strategy and Policies Development Plan Document

Adopted 26 February 2009

Policy EN1: Design of New Development

The Council will require a high standard in the design and layout of new development. Proposals for new development should demonstrate that they will:

a.   create buildings and places that are attractive with their own distinct identity; they should respect and make a positive contribution to the street scene and the character of the area in which they are situated, paying due regard to the scale, height, proportions, building lines, layout, materials and other characteristics of adjoining buildings and land,

b.   achieve a satisfactory relationship to adjoining properties avoiding significant harmful impact in terms of loss of privacy, daylight or sunlight, or overbearing effect due to bulk and proximity or outlook,

c.   be designed in an inclusive way to be accessible to all members of the community regardless of any disability and to encourage sustainable means of travel,

d.   incorporate landscaping to enhance the setting of the development, including the retention of any trees of amenity value and other significant landscape features that are of merit, and provide for suitable boundary treatment,

e.   create a safe and secure environment in which the opportunities for crime are minimized,

f.   incorporate measures to minimise energy consumption, conserve water resources and provide for renewable energy generation in accordance with Policy CC1,

g.   incorporate provision for the storage of waste and recyclable materials and make provision for sustainable drainage systems (SUDS).

Section 11 Climate Change and Transport

Paragrapgh 11.5: The strategy promotes energy conservation in new development and also greater use of renewable energy to replace the use of traditional fossil fuels from non-renewable sources. Implementation will be through the application of a policy setting out minimum requirements (Policy CC1).

Strategic Policy SP7: Climate Change and Transport

The Council will seek to minimise the impact of climate change. It will reduce the impact of development in contributing to climate change by:

a.   promoting the inclusion of provision for renewable energy, energy conservation and waste management facilities in both new and existing developments,

b.   ensuring development is located in a way that reduces the need to travel and encourages alternatives to car use, and its design and layout takes account of climate change,

c.   supporting initiatives, including travel plans, to encourage non car-based travel,

d.   promoting the efficient use and conservation of water resources,

e.   promoting measures to reduce flooding and the risks from flooding,

f.   supporting measures to enhance and manage Staines' role as a public transport interchange.

Policy CC1: Renewable Energy, Energy Conservation and Sustainable Construction

The Council will support the provision of renewable energy, energy efficiency and promote sustainable development generally by:

a.   requiring residential development of one or more dwellings and other development involving new building or extensions exceeding 100m2 to:

I.   optimise design, layout and orientation of development to minimise energy use,

II.   include measures to provide at least 10% of the development's energy demand from on-site renewable energy sources unless it can be shown that it would seriously threaten the viability of the development.

b.   encouraging the installation of renewable energy equipment to supply existing buildings,

c.   encouraging appropriate freestanding renewable energy schemes,

d. encouraging high standards of sustainable construction including the use of recycled construction material,

e. encouraging developments to attain high energy efficiency and minimum impact on the environment to at least Code for Sustainable Homes – 3 star or BREEAM 'very good' standard.

Emerging Policy

Spelthorne Local Plan

Preferred Options Consultation Policies

November 2019

Policy DS2: Sustainable Design and Renewable/Low Carbon Energy

Generation

1. Sustainable design and construction will be integral to new development in Spelthorne borough. All planning applications must include evidence that the below will be addressed:

a) Maximising energy efficiency and integrating the use of renewable and low carbon energy (demonstrated though an energy statement);

b) Maximise opportunities for passive solar gain and passive cooling through the orientation and layout of development;

c)Incorporate sustainable construction and demolition techniques that provide for the efficient use of minerals including a proportion of recycled or secondary aggregates, and encourage the re-use of construction and demolition waste at source or its separation and collection for recycling.

d) In residential development (including replacements, conversions and subdivisions) achieve water efficiency of 110 litres per person per day and where feasible provide rainwater harvesting techniques;

e) Flexibility and adaptability, allowing future modification of use or layout, facilitating future refurbishment and retrofitting;

f) Incorporate active electrical vehicle charging points in accordance with the latest guidance issued by Surrey County Council;

g) Where CHP distribution networks already exist (or are proposed), new developments are required to connect to them or be connection-ready, unless it can be clearly demonstrated that utilising a different energy supply would be more sustainable or connection is not feasible;

h) Incorporate measures for the secure storage of cycles and storage of waste including recyclable waste;

i) Protect existing biodiversity and include opportunities to achieve net gains in biodiversity as well as greening of the urban environment;

2. Applications for all development will need to be accompanied by a Sustainable Construction Checklist.

3. Proposals for zero carbon development are strongly supported and the development of renewable, low and zero carbon and decentralised energy, including (C) CHP distribution networks, is strongly supported and encouraged.

4. All new buildings on greenfield sites are required to reduce carbon emissions by 20 per cent below the relevant Target Emission Rate (TER) set out in the Building Regulations 2010 (as amended) (Part L).This should be achieved through the provision of appropriate renewable and low carbon energy technologies in the locality of the development and improvements to the energy performance of the building.

5. Applications for major development are expected to include information setting out how the energy hierarchy has been applied and how sustainable design and construction practice will be incorporated. Smaller developments(including refurbishment, conversion and extensions to existing buildings)should include information proportionate to the scale of the development proposed.

5. DEVELOPMENT APPROACH

The proposed energy strategy follows the accepted Energy Hierarchy of Be Lean, Be Clean and Be Green to enable the maximum viable reductions in regulated and total CO_2 emissions over the baseline.
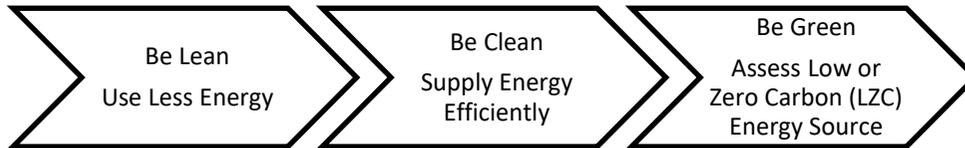
The proposed energy supply solutions aim to match energy profiles of the development ensuring effective use. The proposed solutions consider viability and flexibility of the scheme from both a technical and economic point of view by identifying best combination of energy efficiency measures as well as decentralised and renewable energy supply solutions.

Using these principles, Inland Homes aim to deliver the following objectives:

- Comply with the relevant regulatory requirements.
- To propose to reduce energy consumption and carbon dioxide emissions through passive and energy efficiency measures.
- Investigate the feasibility of connecting into an existing district heat network and where this is not available investigate the feasibility of providing a communal CHP Plant to serve the base heating and hot water requirements for the development.
- To propose to reduce energy consumption and carbon dioxide emissions further through the use of on-site renewable or LZC energy technologies.

5.1 CARBON FIGURES

The following carbon factors have been used in this assessment.

Table 1: Carbon factors

Fuel Type	SAP 2012 kgCO2/kWh
Natural Gas	0.216
Grid Electricity	0.519

6. BASELINE ENERGY CALCULATIONS

A baseline total energy demand has been established for the proposed development. Reductions in demand due to energy conservation measures are considered and form the basis of the renewable energy strategy which follows.

Floor plans for the development have been used in conjunction with an outline accommodation schedule and building specifications to prepare preliminary SAP Calculations on a sample of unit types.

SAP calculations have been carried out to Approved Document Part L1A 2013. The relevant energy loads have been collated from the full SAP calculation sheets and entered into a spread sheet that can be found in the appendices, which calculates the total energy and CO_2 demand.

Regulated Energy Demand is calculated from the energy associated with space heating, hot water and fixed electrical demands (for lights, fans and pumps).

Unregulated energy is the annual electrical energy demand from appliances and would be calculated using the methodology as suggested by SAP2012. SAP calculations are extended to allow for CO_2 emissions associated with appliances and cooking, and to allow for site-wide electricity generation technologies.

Total Energy Demand for the development is calculated from the regulated energy demand figures given above and an additional energy demand associated with unregulated energy.

Total Energy Demand is used in the final analysis to determine the contribution which renewable energy technology makes to total energy requirements for the development once energy conservation measures have been considered.

Energy savings are measured in terms of a reduction in CO_2 emissions and kWh, which are calculated from their association with a particular fuel source. CO_2 Conversion Factors have been taken from Table 2, Building Regulations Part L1A 2013:

6.1 RESIDENTIAL UNITS

Stroma's FSAP 2012 has been used to evaluate the CO_2 emissions on a representative sample of the residential dwellings. Using the mix of the development, the energy usage and CO_2 emissions for each dwelling are extrapolated on a weighted basis to evaluate the predicted energy and CO_2 performance for all the residential units.

FSAP has also used to estimate the unregulated energy use for appliances and cooking.

The following table provides the mix used to determine baseline CO_2 demand for the residential units.

Table 2: Residential mix

Dwelling Ref	Type of Unit	TFA	No of Types
P.1.1	Flat	50.40	2
P.1.2	Flat	53.00	1
P.1.3	Flat	50.40	54
P.2.1	Flat	71.90	55
R.1.1	Flat	50.40	2
R.1.2	Flat	53.00	1
R.1.3	Flat	50.40	28
R.2.2	Flat	71.90	2
R.2.3	Flat	71.90	26
S.1.3	Flat	50.40	17
S.2.1	Flat	71.90	18
Totals		12,559	206

6.2 CALCULATION OF BASELINE ENERGY AND CO2 EMISSIONS

Thermal insulation levels and air tightness standards for the baseline case are assumed to just meet the requirements Part L1A 2013 of Building Regulations. Specification as detailed below.

Table 3: Baseline design specification 2013

Element	Baseline Design Specification
Ground Floor	0.13 W/m2K
Exposed Floor	0.13 W/m2K
External Wall	0.18 W/m2K
Party Wall	0.00 W/m2K
Roof – insulated at ceiling	0.13 W/m2K
Roof – insulated at slope	0.13 W/m2K
Roof – flat	0.13 W/m2K
Glazing U-Value	1.40 W/m2K
Door U-Value	1.20 W/m2K
Design Air Permeability	5.00
Space Heating	Mains Gas 88.6% efficient
Heating Controls	Heating System controls
Domestic Hot water	Mains Gas
Ventilation	Natural ventilation with intermittent fans
Low Energy Lighting	100%
Thermal Bridging	Appendix R values

Using the above specification, the baseline energy and carbon figures for the site are as detailed in the table below.

Table 4: Predicted Energy Demand and Carbon Emissions: Part L1A 2013 Baseline Unit (TER)

Element Part L1A 2013	Space Heating Demand	Hot Water demand	Pumps and fans	Lighting	Totals
Energy : Baseline (kWh p.a)	379,179	452,675	15,450	57,954	**905,258**
CO$_2$ Associated with total Energy Demand (kgCO2 p.a./a)	81,903	97,778	8,019	30,078	**217,778**

7. PASSIVE DESIGN AND ENERGY EFFICIENT MEASURES - BE LEAN
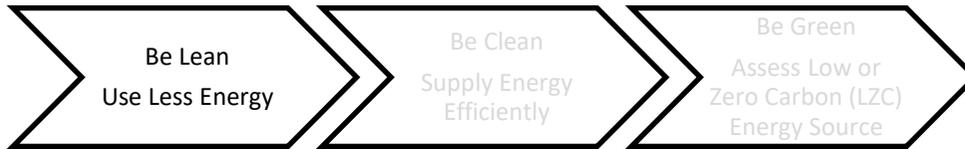
In accordance with the Accepted Energy Hierarchy, the energy demands of the development should be reduced as much as practically viable. The desire is to achieve Part L 2013 Building Regulations compliance before low carbon or renewable measures are introduced.

The non-residential units will be built to a shell only standard. The works will therefore cover fabric, sub and superstructure, including external walls, windows, doors (external) and structural floors. The future tenants may vary the proposed energy efficiency measures/specifications modelled for the purposes of this report for their own specific requirements and needs.

A range of measures to reduce CO_2 emissions and increase resilience to climate change are proposed in the building design including good building fabric standards as well as energy efficient M&E systems and lighting.

7.1 PASSIVE DESIGN - RESIDENTIAL

Natural ventilation has been considered but is judged to be inappropriate due to the high energy efficiency requirements and CO_2 reduction target, and a mechanical ventilation strategy to supply fresh are is deemed to more suitable.

Openable windows and balcony doors are proposed and provide purge ventilation as part of the overheating strategy. The ventilation strategy will be reviewed and developed as the design progresses to ensure compliance with all the relevant regulations and standards and should certain dwellings be affected by noise issues and cannot open their windows enhanced mechanical ventilation will be introduced to reduce the risk of overheating. It is assumed in this scenario windows can still be opened albeit intermittently for purge ventilation.

The building incorporates passive design measures such as balconies which help to provide shading. The proposed glazed areas have been designed to maximise daylight and optimise solar gains. The glazing specification will be reviewed to ensure that they provide a balance between solar control and solar gain.

7.2 BUILDING FABRIC - RESIDENTIAL

To reduce demand for space heating, emphasis has been placed on providing a very high standard of fabric and reducing heat loss through the building envelope. Approved Document Part L1A 2013 sets out the limiting fabric parameters for each of the building elements. Each stated value represents the area-weighted average U-value. The following Table details the proposed U-values to be used in the described exposed element within the fabric of the development along with anticipated percentage improvements over the maximum allowable average weighted U-values in Part L1A 2013.

To further minimise heat loss through the building envelope, air leakage will be made a priority. The airtightness of the dwellings will be set to a level of 4.65m3/h/m2.

Table 5: Proposed U Values - Apartments

Element	Baseline Design Specification W/m²k	Maximum Allowable SAP 2012 W/m²k	Proposed Design Stage Specification W/m²k
Ground Floor	0.13	0.25	0.12
Exposed Floor	0.13	0.25	0.12
External Wall	0.18	0.30	0.18
Communal Walls	0.18	0.30	0.18
Party Wall	0.00	0.20	0.00
Roof – flat	0.13	0.20	0.13
Glazing U-Value	1.40	2.00	1.20
Glazing G-Value	0.50	NA	0.45
Door U-Value	1.20	2.00	1.20

Table 6: Proposed DAP and Target PSI Values

Element	Baseline Design Specification	Maximum Allowable SAP 2012	Proposed Design Stage Specification
Air Permeability	5.00	10.00	4.65
PSI Values	Appendix R	0.15	0.11

Table 7: Predicted Energy Demand and Carbon Emissions: Be Lean

Element Part L1A 2013	Space Heating Demand	Hot Water demand	Pumps and fans	Lighting	Totals
Energy : Be Lean (kWh p.a)	357,104	440,547	16,826	57,022	**871,499**
CO_2 Associated with total Energy Demand (kgCO2 p.a./a)	77,134	95,184	8,731	29,595	**210,644**

Table 8: CO_2 Savings: Be Lean

Element	CO2 - Regulated (tonnes/year)	CO2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Residential Baseline	218	247	**465**
After energy demand reductions	211	247	**458**
Saving	**7**	**0**	**7**
Improvement	**3%**	**0%**	**2%**

FEES

Using the specification detailed the overall Part L Fabric Energy Efficiency (FEE) performance has been reviewed for and compared to the baseline stage of the energy hierarchy. The improved building fabric proposed by Inland Homes have improved upon Building Regulations by 11.13%. The results are shown in the following table.

Table 9: Residential FEE Performance

Element	TFEE (kWH/m^2/year)	DFEE (kWH/m^2/year)	Improvement (%)
Residential Development Total	41.59	36.96	11.13

8. BE CLEAN SUPPLY ENERGY EFFICIENTLY

```
[ Be Lean          ]  [ Be Clean          ]  [ Be Green          ]
[ Use Less Energy   ]  [ Supply Energy     ]  [ Assess Low or     ]
                       [ Efficiently       ]  [ Zero Carbon (LZC) ]
                                              [ Energy Source     ]
```
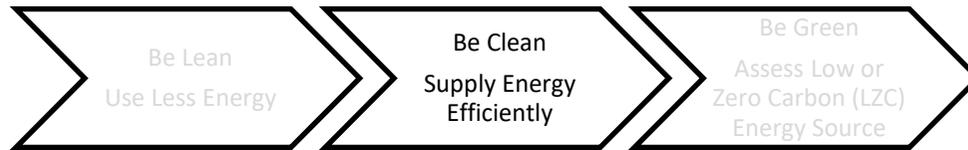
CHP

Decentralised energy refers to energy that is generated off the main grid. This may include micro-renewables, heating and cooling. It can also refer to energy from waste plants, combined heat and power, district heating and cooling, as well as geothermal, biomass or solar energy. Decentralised Energy schemes can serve a single building or a whole community, even being built out across entire cities.

The heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

1. Connect to local or existing planned heat networks

    a. Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)

    b. Use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network)

    c. Use ultra-low NOx gas boilers

2. CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements of policy Sl1 (A)

3. Where a heat network is planned but not yet in existence the development should be designed for connection at a later date.

There are many benefits of decentralised heat generation and Combined Heat and Power (CHP) in terms of cost and CO_2 emissions savings. However, technology such as this is more significant for larger developments, ideally complimented with some non-residential use of heat and electricity. The proposed development size of 206 dwellings is at the low end of what the industry tends to view as viable for such systems. The development is for residential dwellings only and this will result in 'peaky' thermal demands with little anchor load to enable efficient operation of gas fired CHP. This option also risks the potential to increase costs to residents.

The site is neither sufficiently dense nor large enough to warrant investment from 3rd party managing agents or Energy Supply Companies (ESCos). The proposed development would need to be run by an independent agent/company and there would be very little if any interest among existing ESCos in servicing such a small-scale system. Even if it was possible, the cost of managing fuel procurement, customer billing, operation and maintenance would lead to disproportionally and unnecessary high service charges to residents compared to the provision of heat from individual gas boilers.

9. Be Green: Renewables or LZC Technology

```
Be Lean          Be Clean            Be Green
Use Less Energy  Supply Energy       Assess Low or
                 Efficiently         Zero Carbon (LZC)
                                     Energy Source
```

The following low and zero carbon technologies have been considered for this scheme:

- Air Source Heat Pump (ASHP)
- Photovoltaic Panels (PV)
- Ground Source Heat Pump (GSHP)
- Wind Turbines
- Biomass Boiler
- Solar Thermal

The assessment shows that ASHPs are considered the most suitable renewable energy option for the residential elements of the development.

All other renewable energy technology options are summarised in the appendices and have been deemed as not appropriate for this development.

The ASHPs along with pumps, thermal store and pressure equipment are to be located at roof level as indicated in the following figure.

Figure 3: Indicative positions of ASHP

Figure 4: Indicative ASHP Enclosure
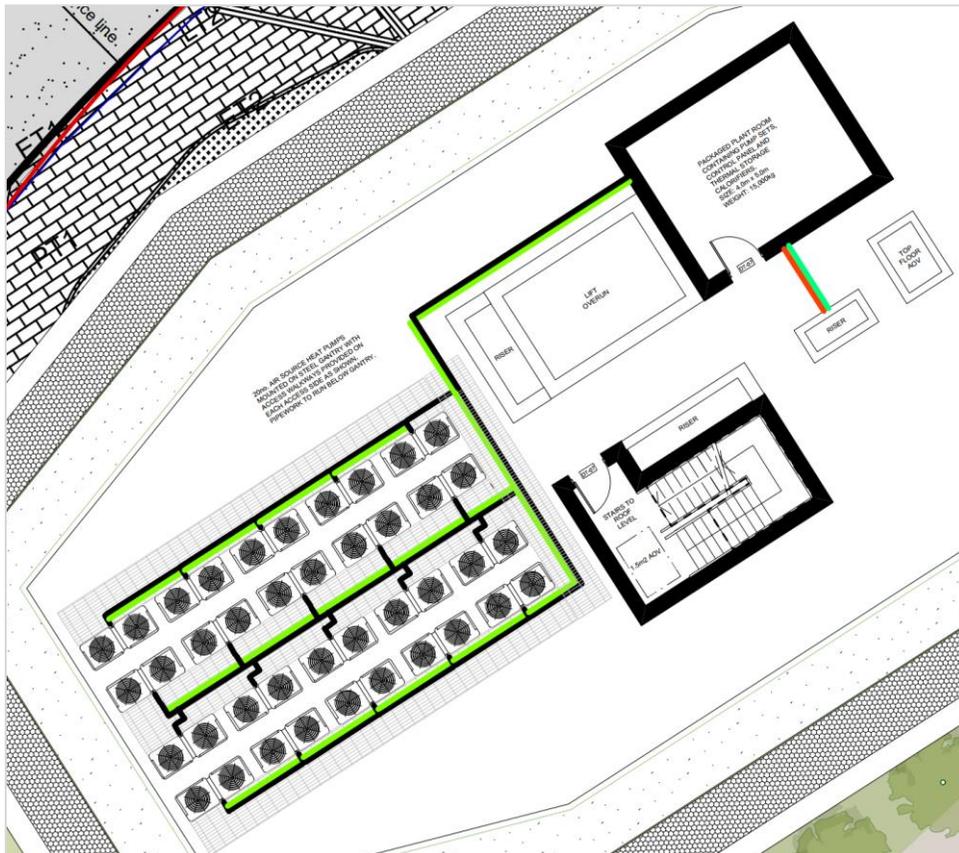
The efficiency of ASHPs is better at lower water delivery temperatures. Full design has not been carried out at this stage but it is assumed the systems will be designed to supply hot water at circa 65°C during winter months with a return design temperature of circa 35°C.

The system can be designed to reduce the delivery temperature to 60°C during warmer periods of the year with a return design temperature of 30°C. This will ensure an efficient operation of the system and will comply with the NHBC hot water supply requirements. This design proposal will be reviewed and developed further during the detailed design stage.

Pipework from ASHPs will be distributed via internal risers to the plant room. The thermal stores will be used to smooth the heat load such that the quantity of heat pumps is optimised. This arrangement should further reduce maintenance and replacement costs to the system and provide resilience.

Due to the high temperature that the system is to be run at the Seasonal Coefficient of Performance (SCOP) is estimated to be circa 2.80 rather than the 3.19 that Mitsubishi technical data sheet suggests are possible when run at a lower temperature of 35 °C.

The site-wide heating network will comply with the minimum performance standards as set out in the Enhanced Capital Allowances (ECA) product criteria. The ASHPs will also comply with other relevant standards as outlined in the Microgeneration Certification Scheme Heat Pump Product Certification Requirements. The ASHPs will be specified in accordance with the following standards:

− Energy efficient system with high seasonal heat supply efficiencies;

− High efficiency motors, variable speed pumps and energy efficient compressors for circulation of refrigerant in the cooling system;

− Enhanced insulation of distribution pipework and valves; and

− Appropriate controls, temperature and time zoning; and

− Low noise emissions.

The introduction of the ASHP provides the following carbon savings:

Table 10: Predicted Energy Demand and Carbon Emissions: Be Green

Element Part L1A 2013	Space Heating Demand	Hot Water demand	Pumps and fans	Lighting	Totals
Energy : Be Lean (kWh p.a)	121,160	149,471	16,823	57,022	**344,476**
CO_2 Associated with total Energy Demand (kgCO2 p.a./a)	62,882	77,576	8,731	29,595	**178,784**

Table 11: CO_2 Savings: Be Green

Element	CO2 - Regulated (tonnes/year)	CO2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Residential Be Lean	211	247	**458**
After LZT	179	247	**426**
Saving	**32**	0	32
Improvement	**15%**	**0%**	**7%**

10. CONCLUSIONS

The energy strategy has followed the accepted Energy Hierarchy Be Lean, Be Clean and Be Green. The energy strategy proposed for the development can be summarised as below.

The ASHP along with energy efficiency improvements save 39 tonnes of CO_2 per year which represents a 17.89% saving over a baseline unit. This exceeds the requirements of Spelthorne's emerging policy DS2.

Total energy demand savings including unregulated energy are also expressed after each stage of the energy hierarchy for the residential parts of the development. The introduction ASHP provide a saving of 527 MWh per year which represents a 39% saving in total energy demand. This exceeds the 10% requirement of Spelthorne's existing Policy CC1.

Table 12: Proposed Energy strategy - Residential Units

Element	Measure
Passive	Optimised design to enable controlled solar gain and improved direct and indirect natural lighting. Incorporation of balconies into the design to provide shading.
Fabric	Building fabric U values have been enhanced over and above those detailed with Part LA2013
Heat Network	Site-wide heating network to supply hot water and space heating to all residential units.
Heating	ASHP to supply heat to site wide heating network
Hot Water	ASHP to supply hot water to site wide network
Cooling	None

Element	Measure
Ventilation	Mechanical ventilation System 3 Low DAP
Lighting	Energy efficient LED Lighting where applicable

10.1 TOTAL RESIDENTIAL CO_2 SAVINGS

The summary of the overall reduction in residential CO_2 emissions after each stage of the energy hierarchy is summarised in the table below.

Table 13: Summary Residential CO_2 Savings

Element	CO_2 - Regulated (tonnes/year)	CO_2 - Un-Regulated (tonnes/year)	Total (tonnes/year)
Residential Baseline	218.00	247	465
Be Lean	211.00	247	458
After Heat Network	211.00	247	458
Be Green	179.00	247	426

The CO_2 savings attributed to Regulated energy only are summarised with the relative percentage improvements shown in the table below.

Table 14: Summary Residential CO_2 percentage savings

Element	Savings CO2 - Regulated (tonnes/year)	Total Savings (tonnes/year)	% Saving
Residential Baseline	0	0	0
Be Lean	7.00	7.00	3.21
After Heat Network	32.00	39.00	17.89
Be Green	0	39.00	17.89

The overall reduction in regulated carbon emission to the residential units can be illustrated graphically as below.

10.2 TOTAL RESIDENTIAL ENERGY SAVINGS

The summary of the overall reduction in residential energy demand after each stage of the energy hierarchy is summarised in the table below.

Table 15: Summary Residential energy Savings

Element	Energy - Regulated (MWh/year)	Energy - Un-Regulated (MWh/year)	Total (MWh/year)
Residential Baseline	871	476	1,347
Be Lean	824	476	1,300
After Heat Network	344	476	820
Be Green	344	476	820

The energy savings attributed to both regulated and un-regulated energy are summarised with the relative percentage improvements shown in the table below.

Table 16: Summary Residential energy percentage savings

Element	Savings Energy - (MWh/year)	Total Savings (MWh/year)	% Saving
Residential Baseline	0	0	0
Be Lean	47	47	3.5
After Heat Network	480	527	39
Be Green	0	527	39

The overall reduction in energy usage to the residential units can be illustrated graphically as below.

Summary

The proposed energy strategy achieves and meets the following requirements:

− Complies with Part L 2013 building regulations (with 2016 amendments)

− Includes improved optimal building fabric improvements, energy efficient design of building services.

− Utilises Air Source Heat Pumps which are classed as renewable energy as per paragraph 6.18 of Spelthorne Guidance Note for the 10% Renewable Energy Requirement.

− Achieves in excess of 17% savings in regulated energy CO_2 emissions on-site using fabric and low carbon technology which exceeds the proposed carbon savings of Spelthorne's emerging Policy DS2.

− Achieves in excess of 39% savings in total energy demand using fabric and renewable technology which exceeds the proposed energy savings of Policy CC1.

Appendix A - Summary of Energy and CO₂ Demand From SAP calculations

Baseline

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK — Calculated TER 2012 (kgCO2/m2)	TER Worksheet TER 2012 (kgCO2/m2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - TER WORKSHEET — Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.) — Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)
	TER Worksheet (Row 4)			TER Worksheet (Row 273)		TER Worksheet (Row 211)		TER Worksheet (Row 219)		TER Worksheet (Row 232)	TER Worksheet (Row 231)	N / A						
1F - 2Bed -	71.72	1	71.72	18.8	18.8	2996.01	Natural Gas	2303.66	Natural Gas	321.47	75		647	498	167	39		1,350
1F - 2Bed -	71.72	3	215.16	17.6	17.6	2587.11	Natural Gas	2311.99	Natural Gas	321.47	75		559	499	167	39		1,264
1F - 2Bed -	71.72	4	286.88	18.1	18.1	2747.78	Natural Gas	2308.56	Natural Gas	321.47	75		594	499	167	39		1,298
1F - 1Bed -	50.25	2	100.5	20.6	20.6	1989.01	Natural Gas	2054.26	Natural Gas	240.1	75		430	444	125	39		1,037
1F - 1Bed -	50.35	3	151.05	23.4	23.4	2643.79	Natural Gas	2041.9	Natural Gas	240.6	75		571	441	125	39		1,176
1F - 1Bed -	52.77	1	52.77	22.5	22.5	2646.87	Natural Gas	2074.81	Natural Gas	245.34	75		572	448	127	39		1,186
MF - 2Bed	71.72	22	1577.84	15.8	15.8	1982.09	Natural Gas	2326.34	Natural Gas	321.47	75		428	502	167	39		1,136
MF - 2Bed	71.72	22	1577.84	14.8	14.8	1609.19	Natural Gas	2338.38	Natural Gas	321.47	75		348	505	167	39		1,058
MF - 2Bed	71.72	22	1577.84	15.2	15.2	1753.05	Natural Gas	2333.47	Natural Gas	321.47	75		379	504	167	39		1,088
MF - 2Bed	71.72	22	1577.84	16.3	16.3	2150.54	Natural Gas	2321.62	Natural Gas	321.47	75		465	501	167	39		1,172
MF - 1Bed	50.25	44	2211	17.3	17.3	1199.31	Natural Gas	2078.66	Natural Gas	240.1	75		259	449	125	39		872
MF - 1Bed	50.35	44	2215.4	19.8	19.8	1795	Natural Gas	2060.14	Natural Gas	240.6	75		388	445	125	39		997
TF - 2Bed -	71.72	2	143.44	19.7	19.7	3279.95	Natural Gas	2298.94	Natural Gas	321.47	75		708	497	167	39		1,411
TF - 2Bed -	71.72	2	143.44	18.4	18.5	2866.09	Natural Gas	2306.39	Natural Gas	321.47	75		619	498	167	39		1,323
TF - 2Bed -	71.72	2	143.44	18.9	18.9	3029.22	Natural Gas	2303.29	Natural Gas	321.47	75		654	498	167	39		1,358
TF - 2Bed -	71.72	2	143.44	20.2	20.2	3458.78	Natural Gas	2296.06	Natural Gas	321.47	75		747	496	167	39		1,449
TF - 1Bed -	50.25	4	201	21.7	21.7	2239.42	Natural Gas	2048.61	Natural Gas	240.1	75		484	443	125	39		1,090
TF - 1Bed -	50.35	4	201.4	24.9	24.9	3003	Natural Gas	2036.3	Natural Gas	240.6	75		649	440	125	39		1,252
Sum	12,592	206	12,592	17.3	-	379,179	N/A	452,675	N/A	57,954	15,450	0	81,903	97,778	30,078	8,019	0	217,777

| Be Lean | | | | | | | | | | | | | SAP 2012 CO2 PERFORMANCE | | | | | |

DOMESTIC ENERGY CONSUMPTION AND CO₂ ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK		REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - TER WORKSHEET							REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)					
				Calculated TER 2012 (kgCO2 / m2)	TER Worksheet TER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)
	TER Worksheet (Row 4)				TER Worksheet (Row 273)	TER Worksheet (Row 211)		TER Worksheet (Row 219)		TER Worksheet (Row 232)	TER Worksheet (Row 231)	N / A						
1F - 2Bed -	71.72	1	71.72	18.0	18.0	2721.01	Natural Gas	2258.72	Natural Gas	317.29	99.77		588	488	165	52		1,292
1F - 2Bed -	71.72	3	215.16	17.0	17.0	2395.55	Natural Gas	2258.72	Natural Gas	317.29	96.68		517	488	165	50		1,220
1F - 2Bed -	71.72	4	286.88	17.4	17.4	2522.71	Natural Gas	2258.72	Natural Gas	317.29	97.88		545	488	165	51		1,248
1F - 1Bed -	50.25	2	100.5	20.1	20.1	1917.12	Natural Gas	2015.17	Natural Gas	235.22	74.46		414	435	122	39		1,010
1F - 1Bed -	50.35	3	151.05	22.6	22.6	2499.67	Natural Gas	2016.39	Natural Gas	235.69	80.07		540	436	122	42		1,139
1F - 1Bed -	52.77	1	52.77	21.7	21.7	2486	Natural Gas	2045.86	Natural Gas	243.1	82.01		537	442	126	43		1,148
MF - 2Bed	71.72	22	1577.84	15.3	15.3	1830.72	Natural Gas	2258.72	Natural Gas	317.29	91.31		395	488	165	47		1,095
MF - 2Bed	71.72	22	1577.84	14.5	14.5	1568.26	Natural Gas	2258.72	Natural Gas	317.29	88.82		339	488	165	46		1,037
MF - 2Bed	71.72	22	1577.84	14.8	14.8	1669.49	Natural Gas	2258.72	Natural Gas	317.29	89.78		361	488	165	47		1,060
MF - 2Bed	71.72	22	1577.84	15.6	15.6	1950.24	Natural Gas	2258.72	Natural Gas	317.29	92.45		421	488	165	48		1,122
MF - 1Bed	50.25	44	2211	17.1	17.1	1241.67	Natural Gas	2015.17	Natural Gas	235.22	68.04		268	435	122	35		861
MF - 1Bed	50.35	44	2215.4	19.3	19.3	1735.25	Natural Gas	2016.39	Natural Gas	235.69	72.81		375	436	122	38		970
TF - 2Bed -	71.72	2	143.44	17.8	17.8	2644.66	Natural Gas	2258.72	Natural Gas	317.29	99.04		571	488	165	51		1,275
TF - 2Bed -	71.72	2	143.44	17.0	17.0	2396.37	Natural Gas	2258.72	Natural Gas	317.29	96.68		518	488	165	50		1,220
TF - 2Bed -	71.72	2	143.44	17.3	17.3	2493.48	Natural Gas	2258.72	Natural Gas	317.29	97.61		539	488	165	51		1,242
TF - 2Bed -	71.72	2	143.44	18.1	18.1	2754.44	Natural Gas	2258.72	Natural Gas	317.29	100.08		595	488	165	52		1,299
TF - 1Bed -	50.25	4	201	20.2	20.2	1945.57	Natural Gas	2015.17	Natural Gas	235.22	74.73		420	435	122	39		1,016
TF - 1Bed -	50.35	4	201.4	22.1	22.1	2382.41	Natural Gas	2016.39	Natural Gas	235.69	78.96		515	436	122	41		1,113
Sum	12,592	206	12,592	16.7	-	357,104	N/A	440,547	N/A	57,022	16,823	0	77,134	95,158	29,595	8,731	0	210,619

ABBEYCONSULTANTS

Be Green														SAP 2012 CO2 PERFORMANCE				

DOMESTIC ENERGY CONSUMPTION AND CO₂ ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK		REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - TER WORKSHEET							REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)					
				Calculated TER 2012 (kgCO2 / m2)	TER Worksheet TER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)
	TER Worksheet (Row 4)				TER Worksheet (Row 273)	TER Worksheet (Row 211)		TER Worksheet (Row 219)		TER Worksheet (Row 232)	TER Worksheet (Row 231)	N / A						
1F - 2Bed -	71.72	1	71.72	15.2	15.2	923.2	Grid Electricity	766.35	Grid Electricity	317.29	99.77		479	398	165	52		1,093
1F - 2Bed -	71.72	3	215.16	14.4	14.4	812.775	Grid Electricity	766.35	Grid Electricity	317.29	96.68		422	398	165	50		1,034
1F - 2Bed -	71.72	4	286.88	14.7	14.7	855.918	Grid Electricity	766.35	Grid Electricity	317.29	97.88		444	398	165	51		1,057
1F - 1Bed -	50.25	2	100.5	17.0	17.0	650.45	Grid Electricity	683.718	Grid Electricity	235.22	74.46		338	355	122	39		853
1F - 1Bed -	50.35	3	151.05	19.0	19.0	848.104	Grid Electricity	684.132	Grid Electricity	235.69	80.07		440	355	122	42		959
1F - 1Bed -	52.77	1	52.77	18.3	18.3	843.464	Grid Electricity	694.132	Grid Electricity	243.1	82.01		438	360	126	43		967
MF - 2Bed	71.72	22	1577.84	13.0	13.0	621.136	Grid Electricity	766.35	Grid Electricity	317.29	91.31		322	398	165	47		932
MF - 2Bed	71.72	22	1577.84	12.3	12.3	532.089	Grid Electricity	766.35	Grid Electricity	317.29	88.82		276	398	165	46		885
MF - 2Bed	71.72	22	1577.84	12.6	12.6	566.436	Grid Electricity	766.35	Grid Electricity	317.29	89.78		294	398	165	47		903
MF - 2Bed	71.72	22	1577.84	13.3	13.3	661.689	Grid Electricity	766.35	Grid Electricity	317.29	92.45		343	398	165	48		954
MF - 1Bed	50.25	44	2211	14.5	14.5	421.282	Grid Electricity	683.718	Grid Electricity	235.22	68.04		219	355	122	35		731
MF - 1Bed	50.35	44	2215.4	16.3	16.3	588.746	Grid Electricity	684.132	Grid Electricity	235.69	72.81		306	355	122	38		821
TF - 2Bed -	71.72	2	143.44	15.1	15.1	897.296	Grid Electricity	766.35	Grid Electricity	317.29	99.04		466	398	165	51		1,080
TF - 2Bed -	71.72	2	143.44	14.4	14.4	813.054	Grid Electricity	766.35	Grid Electricity	317.29	96.68		422	398	165	50		1,035
TF - 2Bed -	71.72	2	143.44	14.7	14.7	846.004	Grid Electricity	766.35	Grid Electricity	317.29	97.61		439	398	165	51		1,052
TF - 2Bed -	71.72	2	143.44	15.3	15.3	934.543	Grid Electricity	766.35	Grid Electricity	317.29	100.08		485	398	165	52		1,099
TF - 1Bed -	50.25	4	201	17.1	17.1	660.104	Grid Electricity	683.718	Grid Electricity	235.22	74.73		343	355	122	39		858
TF - 1Bed -	50.35	4	201.4	18.6	18.6	808.318	Grid Electricity	684.132	Grid Electricity	235.69	78.96		420	355	122	41		938
Sum	12,592	206	12,592	14.2	-	121,160	N/A	149,471	N/A	57,022	16,823	0	62,882	77,576	29,595	8,731	0	178,784

Appendix B - Alternative Renewable options

The following alternative options to supply low carbon and renewable energy generation have been explored and discounted based on the following reasons:

Wind Turbines

Wind turbines come in a variety of sizes and shapes. Turbines of 1 Kw can be installed to single house and large-scale turbines of 1-2 MW can be installed on a development to generate electricity to multiple dwellings and other buildings. In both instances the electricity generated can be used on site or exported to the grid. Vertical- or horizontal-axis turbines are available.

A roof-mounted 1 kW micro wind system costs up to £3,000. A 2.5 kW pole-mounted system costs between £9,900 and £19,000. A 6 kW pole-mounted system costs between £21,000 and £30,000 (taken from the Energy Saving Trust, TBC by supplier)

- Local average wind speed is a determining factor. A minimum average wind speed of 6 m/s is required.

- Noise considerations can be an issue dependent on density and build-up of the surrounding area.

- Buildings in the immediate area can disrupt wind speed and reduce performance of the system.

- Planning permission will be required along with suitable space to site the turbine, whether ground installed or roof mounted.

Wind turbines have been discounted due to concerns over reliable wind resources. The use of wind turbines is likely to present aesthetic as well as nuisance issues.

Biomass Boilers

Providing a heating system fuelled by plant-based materials such as wood, crops or food waste. Biomass boilers generate heat for space heating and domestic hot water through the combustion of biofuels, such as woodchip, wood pellets or potentially biofuel or bio diesel. Biomass is considered to be virtually zero carbon. They can be used on an individual scale or for multiple dwellings as part of a district-heating network. A back-up heat source should be provided as consistent delivery of fuel is necessary for continued operation.

Biomass is considered a technically-viable option for this development scheme as there are no apparent physical constraints on site in terms of installing biomass boilers or storing a sufficient supply.

- There are, however, concerns regarding a sustainable supply of biomass to the site.
- The capital installation cost would also be high which leads us to the conclusion that biomass would not be a commercially-viable option for this development scheme.

Individual Air Source Heat Pumps (ASHP)

Air Source Heat Pumps (ASHPs) extract heat from the external air and condense this energy to heat a smaller space within a dwelling or non-domestic building. A pump circulates a refrigerant through a coil to absorb energy from the air. This refrigerant is then compressed to raise its temperature which can then be used for space heating and domestic hot water.

They can feed either low-temperature radiators or underfloor heating and often have electric immersion heater back-up for the winter months.

Air source heat pumps could be utilised and would require outdoor space for the fan-coil units to each dwelling. These outdoor units would be difficult to conceal without affecting the aesthetics of the building facades.

Ground Source Heat Pumps (GSHP)

Ground Source Heat Pumps (GSHPs) operate on the same principle as an Air Source Heat Pump (ASHP) in that they extract heat from a source (in this instance the ground) and compress this energy to increase temperature for space heating and hot water. Pipework is installed into the ground, either through coils or in bore holes and piles, circulating a mix of water and antifreeze to extract energy from the ground, where the year-round temperature is relatively consistent (approx. $10°$C at 4 metres depth). This leads to a reliable source of heat for the building.

Again, an electrically powered pump circulates the liquid and powers the compressor, however annual efficiencies for GSHPs tend to be higher than those of ASHPs.

Discounted on the grounds of costs and available space. Incompatible with individual gas boilers and blocks of apartments.

Solar Thermal

Solar Thermal generates domestic hot water from the sun's radiation. Glycol circulates within either flat plate or evacuated tube panels, absorbing heat from the sun, and transferring this energy to a water cylinder. A well designed solar thermal system will account for 50-60% of a dwelling's annual hot water demand. Sizing the system to meet a higher demand will lead to excess heat generation in the summer months and overheating of the system.

Unsuitable for blocks of flats and low carbon reduction efficiency compared to photovoltaic systems. Solar hot water systems for flatted blocks are only suitable where a central boiler plant room is provided to accommodate a central thermal store.

Solar Photovoltaics (PV)

Solar Photovoltaics convert solar radiation into electricity which can be used on site or exported to the national grid.

Appendix C – SAP Calculations

Baseline SAP Calculations

TER WorkSheet: New dwelling design stage

Assessor Name: Matt Fitzpatrick   **Stroma Number:** STRO003572

Software Name: Stroma FSAP 2012   **Software Version:** Version: 1.0.5.6

Property Address: 1F - 1Bed - North East

Address : 1F - 1Bed - North East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	52.77	(1a) x	2.5	(2a) =	131.93	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.77	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		131.93	(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) =	0.15 (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)	0.4 (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

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

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	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	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	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	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			2.12	x 1	=	2.12			(26)
Windows Type 1			3	x1/[1/(1.4)+ 0.04]	=	3.98			(27)
Windows Type 2			7.36	x1/[1/(1.4)+ 0.04]	=	9.76			(27)
Floor			52.77	x 0.13	=	6.8601			(28)
Walls Type1	35.99	10.36	25.63	x 0.18	=	4.61			(29)
Walls Type2	22.12	2.12	20	x 0.18	=	3.6			(29)
Total area of elements, m²			110.88						(31)
Party wall			21.28	x 0	=	0			(32)
Party ceiling			52.77						(32b)
Internal wall **			106.14						(32c)

* 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) =   30.93   (33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =   7560.53   (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   12.64   (36)

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

Total fabric heat loss   (33) + (36) =   43.57   (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= | 25.89 | 25.73 | 25.57 | 24.84 | 24.7 | 24.06 | 24.06 | 23.94 | 24.3 | 24.7 | 24.98 | 25.27 | | (38) |

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

| (39)m= | 69.46 | 69.3 | 69.15 | 68.41 | 68.27 | 67.63 | 67.63 | 67.51 | 67.88 | 68.27 | 68.55 | 68.84 | | |

Average = Sum(39)$_{1...12}$ /12= 68.41 (39)

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

| (40)m= | 1.32 | 1.31 | 1.31 | 1.3 | 1.29 | 1.28 | 1.28 | 1.28 | 1.29 | 1.29 | 1.3 | 1.3 | | |

Average = Sum(40)$_{1...12}$ /12= 1.3 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   1.77   (42)
   if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
   if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   76.28   (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= | 83.91 | 80.86 | 77.81 | 74.75 | 71.7 | 68.65 | 68.65 | 71.7 | 74.75 | 77.81 | 80.86 | 83.91 | | |

Total = Sum(44)$_{1...12}$ = 915.36 (44)

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

| (45)m= | 124.43 | 108.83 | 112.3 | 97.91 | 93.95 | 81.07 | 75.12 | 86.2 | 87.23 | 101.66 | 110.97 | 120.51 | | |

Total = Sum(45)$_{1...12}$ = 1200.18 (45)

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

| (46)m= | 18.66 | 16.32 | 16.85 | 14.69 | 14.09 | 12.16 | 11.27 | 12.93 | 13.08 | 15.25 | 16.65 | 18.08 | | (46) |

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b   0.54   (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a   0   (52)

Temperature factor from Table 2b   0   (53)

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

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

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

| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | | (56) |

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

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

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

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

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

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

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

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

(62)m=	171.03	150.92	158.9	143	140.54	126.16	121.72	132.8	132.32	148.26	156.06	167.1	(62)

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

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

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

Output from water heater

(64)m=	171.03	150.92	158.9	143	140.54	126.16	121.72	132.8	132.32	148.26	156.06	167.1	

Output from water heater (annual)₁...₁₂ | 1748.8 | (64)

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

(65)m=	78.65	69.85	74.62	68.63	68.51	63.03	62.25	65.94	65.08	71.08	72.97	77.34	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	(66)

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

(67)m=	13.89	12.34	10.03	7.6	5.68	4.79	5.18	6.73	9.04	11.48	13.39	14.28	(67)

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

(68)m=	154.42	156.02	151.99	143.39	132.54	122.34	115.53	113.92	117.96	126.56	137.41	147.61	(68)

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

(69)m=	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	(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=	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	(71)

Water heating gains (Table 5)

(72)m=	105.71	103.95	100.29	95.32	92.09	87.54	83.67	88.63	90.39	95.53	101.35	103.96	(72)

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

(73)m=	326.6	324.89	314.89	298.88	282.88	267.25	256.96	261.86	269.96	286.15	304.73	318.42	(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)	
Northeast 0.9x	0.77	x 3	x 11.28	x 0.63	x 0.7	= 10.34	(75)
Northeast 0.9x	0.77	x 3	x 22.97	x 0.63	x 0.7	= 21.06	(75)

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Northeast	0.9x	0.77	x	3	x	41.38	x	0.63	x	0.7	=	37.94	(75)
Northeast	0.9x	0.77	x	3	x	67.96	x	0.63	x	0.7	=	62.3	(75)
Northeast	0.9x	0.77	x	3	x	91.35	x	0.63	x	0.7	=	83.75	(75)
Northeast	0.9x	0.77	x	3	x	97.38	x	0.63	x	0.7	=	89.29	(75)
Northeast	0.9x	0.77	x	3	x	91.1	x	0.63	x	0.7	=	83.53	(75)
Northeast	0.9x	0.77	x	3	x	72.63	x	0.63	x	0.7	=	66.59	(75)
Northeast	0.9x	0.77	x	3	x	50.42	x	0.63	x	0.7	=	46.23	(75)
Northeast	0.9x	0.77	x	3	x	28.07	x	0.63	x	0.7	=	25.73	(75)
Northeast	0.9x	0.77	x	3	x	14.2	x	0.63	x	0.7	=	13.02	(75)
Northeast	0.9x	0.77	x	3	x	9.21	x	0.63	x	0.7	=	8.45	(75)
Northwest	0.9x	0.77	x	7.36	x	11.28	x	0.63	x	0.7	=	25.38	(81)
Northwest	0.9x	0.77	x	7.36	x	22.97	x	0.63	x	0.7	=	51.66	(81)
Northwest	0.9x	0.77	x	7.36	x	41.38	x	0.63	x	0.7	=	93.07	(81)
Northwest	0.9x	0.77	x	7.36	x	67.96	x	0.63	x	0.7	=	152.85	(81)
Northwest	0.9x	0.77	x	7.36	x	91.35	x	0.63	x	0.7	=	205.47	(81)
Northwest	0.9x	0.77	x	7.36	x	97.38	x	0.63	x	0.7	=	219.05	(81)
Northwest	0.9x	0.77	x	7.36	x	91.1	x	0.63	x	0.7	=	204.91	(81)
Northwest	0.9x	0.77	x	7.36	x	72.63	x	0.63	x	0.7	=	163.36	(81)
Northwest	0.9x	0.77	x	7.36	x	50.42	x	0.63	x	0.7	=	113.41	(81)
Northwest	0.9x	0.77	x	7.36	x	28.07	x	0.63	x	0.7	=	63.13	(81)
Northwest	0.9x	0.77	x	7.36	x	14.2	x	0.63	x	0.7	=	31.93	(81)
Northwest	0.9x	0.77	x	7.36	x	9.21	x	0.63	x	0.7	=	20.73	(81)

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

| (83)m= | 35.72 | 72.72 | 131.01 | 215.16 | 289.22 | 308.33 | 288.44 | 229.95 | 159.64 | 88.86 | 44.95 | 29.17 | | (83) |

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

| (84)m= | 362.33 | 397.61 | 445.9 | 514.04 | 572.1 | 575.58 | 545.4 | 491.81 | 429.6 | 375.01 | 349.68 | 347.59 | | (84) |

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.95	0.86	0.69	0.53	0.6	0.85	0.97	0.99	1	(86)

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

| (87)m= | 19.62 | 19.75 | 20.03 | 20.42 | 20.75 | 20.94 | 20.99 | 20.97 | 20.82 | 20.4 | 19.95 | 19.6 | (87) |

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

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

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

| (89)m= | 1 | 0.99 | 0.98 | 0.94 | 0.81 | 0.59 | 0.4 | 0.47 | 0.78 | 0.96 | 0.99 | 1 | (89) |

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

| (90)m= | 18.01 | 18.21 | 18.61 | 19.16 | 19.61 | 19.82 | 19.85 | 19.85 | 19.71 | 19.16 | 18.5 | 17.99 | (90) |

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

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

(92)m=	18.69	18.86	19.2	19.69	20.09	20.29	20.33	20.32	20.18	19.68	19.11	18.66		(92)

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

(93)m=	18.69	18.86	19.2	19.69	20.09	20.29	20.33	20.32	20.18	19.68	19.11	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	0.99	0.98	0.93	0.82	0.63	0.45	0.52	0.8	0.96	0.99	0.99		(94)

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

(95)m=	359.96	393.38	435.49	479.59	469.79	362.37	248.1	257.43	345.57	359.21	345.61	345.7		(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=	999.3	967.3	878.24	738.06	572.7	384.53	252.01	264.63	412.56	619.86	823.36	995.59		(97)

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

(98)m=	475.67	385.67	329.4	186.1	76.56	0	0	0	0	193.92	343.98	483.52		

Total per year (kWh/year) = Sum(98)₁…₅,₉…₁₂ = 2474.82 (98)

Space heating requirement in kWh/m²/year — 46.9 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 — 93.5 (206)

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

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

Space heating requirement (calculated above)

	475.67	385.67	329.4	186.1	76.56	0	0	0	0	193.92	343.98	483.52	

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

	508.74	412.48	352.3	199.04	81.89	0	0	0	0	207.4	367.89	517.13	

Total (kWh/year) =Sum(211)₁…₅,₁₀…₁₂= 2646.87 (211)

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

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

Total (kWh/year) =Sum(215)₁…₅,₁₀…₁₂= 0 (215)

Water heating

Output from water heater (calculated above)

	171.03	150.92	158.9	143	140.54	126.16	121.72	132.8	132.32	148.26	156.06	167.1	

Efficiency of water heater — 79.8 (216)

(217)m=	87.4	87.21	86.72	85.52	83.27	79.8	79.8	79.8	79.8	85.53	86.86	87.49		(217)

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

(219)m=	195.68	173.05	183.24	167.22	168.77	158.09	152.53	166.41	165.82	173.34	179.66	191		

Total = Sum(219a)₁…₁₂ = 2074.81 (219)

TER WorkSheet: New dwelling design stage

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			2646.87	
Water heating fuel used			2074.81	
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			245.34	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	571.72	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	448.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1019.88	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	127.33	(268)
Total CO2, kg/year	sum of (265)…(271) =			1186.14	(272)

TER = 22.48 (273)

TER WorkSheet: New dwelling design stage

Assessor Name: Matt Fitzpatrick **Stroma Number:** STRO003572

Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.6

Address : 1F - 1Bed - North, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.35	(1a) x	2.5	(2a) =	125.87	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.35	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.87	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 20 ÷ (5) = 0.16 (8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0 (12)
If no draught lobby, enter 0.05, else enter 0		0 (13)
Percentage of windows and doors draught stripped		0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.41 (18)

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

Number of sides sheltered		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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.44	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			2.12	x 1	=	2.12			(26)
Windows			8.55	x1/[1/(1.4)+ 0.04]	=	11.34			(27)
Floor			50.35	x 0.13	=	6.545499			(28)
Walls Type1	23.14	8.55	14.59	x 0.18	=	2.63			(29)
Walls Type2	29.29	2.12	27.17	x 0.18	=	4.89			(29)
Walls Type3	13.99	0	13.99	x 0.18	=	2.52			(29)
Total area of elements, m²			116.77						(31)
Party wall			13.69	x 0	=	0			(32)
Party ceiling			50.35						(32b)
Internal wall **			90.55						(32c)

* 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) =   30.04 (33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =   7156 (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   12.91 (36)

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

Total fabric heat loss   (33) + (36) =   42.95 (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= | 24.85 | 24.69 | 24.53 | 23.81 | 23.67 | 23.03 | 23.03 | 22.92 | 23.28 | 23.67 | 23.94 | 24.23 | | (38) |

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

| (39)m= | 67.79 | 67.63 | 67.48 | 66.75 | 66.61 | 65.98 | 65.98 | 65.86 | 66.22 | 66.61 | 66.89 | 67.18 |

Average = Sum(39)$_{1...12}$ /12=   66.75   (39)

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

| (40)m= | 1.35 | 1.34 | 1.34 | 1.33 | 1.32 | 1.31 | 1.31 | 1.31 | 1.32 | 1.32 | 1.33 | 1.33 |

Average = Sum(40)$_{1...12}$ /12=   1.33   (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   1.7   (42)
   if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
   if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   74.58   (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of

not more that 125 litres per person per day (all water use, hot and cold)

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

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

| (44)m= | 82.04 | 79.06 | 76.08 | 73.09 | 70.11 | 67.13 | 67.13 | 70.11 | 73.09 | 76.08 | 79.06 | 82.04 |

Total = Sum(44)$_{1...12}$ =   895.02   (44)

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

| (45)m= | 121.67 | 106.41 | 109.81 | 95.73 | 91.86 | 79.27 | 73.45 | 84.29 | 85.29 | 99.4 | 108.5 | 117.83 |

Total = Sum(45)$_{1...12}$ =   1173.51   (45)

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

| (46)m= | 18.25 | 15.96 | 16.47 | 14.36 | 13.78 | 11.89 | 11.02 | 12.64 | 12.79 | 14.91 | 16.28 | 17.67 | (46) |

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b   0.54   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   0.75   (50)
 b) If manufacturer's declared cylinder loss factor is not known:

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

If community heating see section 4.3

Volume factor from Table 2a   0   (52)

Temperature factor from Table 2b   0   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   0   (54)
 Enter (50) or (54) in (55)   0.75   (55)

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

| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | (56) |

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

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

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

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

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

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

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

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

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=	168.26	148.5	156.4	140.82	138.45	124.36	120.05	130.88	130.39	146	153.6	164.42	(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=	168.26	148.5	156.4	140.82	138.45	124.36	120.05	130.88	130.39	146	153.6	164.42	

Output from water heater (annual)₁...₁₂ | 1722.13 | (64)

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

(65)m=	77.73	69.05	73.79	67.9	67.82	62.43	61.7	65.3	64.43	70.33	72.15	76.45	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	(66)

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

(67)m=	13.62	12.1	9.84	7.45	5.57	4.7	5.08	6.6	8.86	11.25	13.14	14	(67)

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

(68)m=	148.14	149.68	145.81	137.56	127.15	117.36	110.83	109.29	113.16	121.41	131.82	141.61	(68)

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

(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(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=	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	(71)

Water heating gains (Table 5)

(72)m=	104.48	102.75	99.18	94.31	91.15	86.71	82.93	87.77	89.49	94.53	100.21	102.76	(72)

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

(73)m=	317.75	316.04	306.33	290.83	275.38	260.28	250.34	255.17	263.03	278.7	296.67	309.88	(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)	
Northwest 0.9x	0.77	x	8.55	x	11.28	x	0.63	x	0.7	=	29.48	(81)
Northwest 0.9x	0.77	x	8.55	x	22.97	x	0.63	x	0.7	=	60.01	(81)

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Northwest 0.9x	0.77 x	8.55 x	41.38 x	0.63 x	0.7 =	108.12 (81)
Northwest 0.9x	0.77 x	8.55 x	67.96 x	0.63 x	0.7 =	177.57 (81)
Northwest 0.9x	0.77 x	8.55 x	91.35 x	0.63 x	0.7 =	238.69 (81)
Northwest 0.9x	0.77 x	8.55 x	97.38 x	0.63 x	0.7 =	254.46 (81)
Northwest 0.9x	0.77 x	8.55 x	91.1 x	0.63 x	0.7 =	238.05 (81)
Northwest 0.9x	0.77 x	8.55 x	72.63 x	0.63 x	0.7 =	189.77 (81)
Northwest 0.9x	0.77 x	8.55 x	50.42 x	0.63 x	0.7 =	131.75 (81)
Northwest 0.9x	0.77 x	8.55 x	28.07 x	0.63 x	0.7 =	73.34 (81)
Northwest 0.9x	0.77 x	8.55 x	14.2 x	0.63 x	0.7 =	37.1 (81)
Northwest 0.9x	0.77 x	8.55 x	9.21 x	0.63 x	0.7 =	24.08 (81)

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

(83)m=

29.48	60.01	108.12	177.57	238.69	254.46	238.05	189.77	131.75	73.34	37.1	24.08	(83)

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

(84)m=

347.23	376.05	414.45	468.4	514.06	514.75	488.39	444.94	394.77	352.04	333.77	333.95	(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	
1	0.99	0.99	0.96	0.89	0.73	0.57	0.64	0.87	0.98	0.99	1	(86)

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

(87)m=

19.58	19.71	19.97	20.35	20.7	20.92	20.98	20.97	20.8	20.37	19.92	19.56	(87)

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

(88)m=

19.8	19.81	19.81	19.82	19.82	19.83	19.83	19.83	19.83	19.82	19.82	19.81	(88)

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

(89)m=

1	0.99	0.98	0.95	0.84	0.63	0.43	0.5	0.8	0.96	0.99	1	(89)

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

(90)m=

17.94	18.13	18.51	19.06	19.53	19.78	19.83	19.82	19.66	19.09	18.44	17.92	(90)

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

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

(92)m=

18.63	18.79	19.13	19.6	20.02	20.25	20.31	20.3	20.14	19.63	19.06	18.61	(92)

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

(93)m=

18.63	18.79	19.13	19.6	20.02	20.25	20.31	20.3	20.14	19.63	19.06	18.61	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=

0.99	0.99	0.98	0.94	0.85	0.67	0.49	0.56	0.82	0.96	0.99	0.99	(94)

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

(95)m=

344.9	372.18	405.69	441.56	435.73	344.37	239.24	247.46	325.31	338.19	329.88	332.07	(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)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	971.55	939.67	851.95	714.56	554.38	373.07	244.68	256.87	399.85	601.4	800.1	968		(97)

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

(98)m=	466.23	381.35	332.02	196.56	88.27	0	0	0	0	195.83	338.56	473.13		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2471.95 (98)

Space heating requirement in kWh/m²/year 49.1 (99)

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

Space heating:

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

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

Space heating requirement (calculated above)

	466.23	381.35	332.02	196.56	88.27	0	0	0	0	195.83	338.56	473.13	

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

	498.64	407.86	355.1	210.23	94.41	0	0	0	0	209.44	362.09	506.02	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2643.79 (211)

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

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

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

Water heating

Output from water heater (calculated above)

	168.26	148.5	156.4	140.82	138.45	124.36	120.05	130.88	130.39	146	153.6	164.42	

Efficiency of water heater 79.8 (216)

(217)m=	87.39	87.22	86.77	85.7	83.65	79.8	79.8	79.8	79.8	85.6	86.86	87.48		(217)

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

(219)m=	192.54	170.25	180.24	164.32	165.51	155.84	150.43	164.01	163.39	170.56	176.82	187.97	

Total = Sum(219a)$_{1...12}$ = 2041.88 (219)

Annual totals kWh/year kWh/year

Space heating fuel used, main system 1		2643.79	
Water heating fuel used		2041.88	

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		240.6	(232)

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

TER WorkSheet: New dwelling design stage

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	571.06	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	441.05	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1012.1	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	124.87	(268)
Total CO2, kg/year			sum of (265)…(271) =		1175.9	(272)

TER =   23.35   (273)

TER WorkSheet: New dwelling design stage

Property Address: 1F - 1Bed - South

Address : 1F - 1Bed - South, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.25	(1a) x	2.5	(2a) =	125.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.25	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.62	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.16	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.41	(18)

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

Number of sides sheltered		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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

TER 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			2.12	x 1 =	2.12			(26)
Windows			8.55	x1/[1/(1.4)+ 0.04] =	11.34			(27)
Floor			50.25	x 0.13 =	6.5325			(28)
Walls Type1	23.19	8.55	14.64	x 0.18 =	2.64			(29)
Walls Type2	12.4	2.12	10.28	x 0.18 =	1.85			(29)
Walls Type3	14	0	14	x 0.18 =	2.52			(29)
Total area of elements, m²			99.84					(31)
Party wall			30.53	x 0 =	0			(32)
Party ceiling			50.25					(32b)
Internal wall **			90.21					(32c)

* 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) = | 26.99 | (33)

Heat capacity Cm = S(A x k) | ((28)…(30) + (32) + (32a)…(32e) = | 7243.62 | (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K | Indicative Value: Medium | 250 | (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 11.22 | (36)

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

Total fabric heat loss | (33) + (36) = | 38.21 | (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= | 24.8 | 24.65 | 24.49 | 23.76 | 23.63 | 22.99 | 22.99 | 22.87 | 23.24 | 23.63 | 23.9 | 24.19 | | (38) |

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

| (39)m= | 63.01 | 62.86 | 62.7 | 61.97 | 61.84 | 61.2 | 61.2 | 61.08 | 61.45 | 61.84 | 62.11 | 62.4 | | (39) |

Average = Sum(39)$_{1...12}$ /12= **61.97** (39)

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

| (40)m= | 1.25 | 1.25 | 1.25 | 1.23 | 1.23 | 1.22 | 1.22 | 1.22 | 1.22 | 1.23 | 1.24 | 1.24 | | (40) |

Average = Sum(40)$_{1...12}$ /12= **1.23** (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N **1.7** (42)
  if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
  if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 **74.51** (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of

not more that 125 litres per person per day (all water use, hot and cold)

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

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

| (44)m= | 81.97 | 78.99 | 76.01 | 73.02 | 70.04 | 67.06 | 67.06 | 70.04 | 73.02 | 76.01 | 78.99 | 81.97 | | (44) |

Total = Sum(44)$_{1...12}$ = **894.18** (44)

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

| (45)m= | 121.55 | 106.31 | 109.7 | 95.64 | 91.77 | 79.19 | 73.38 | 84.21 | 85.21 | 99.31 | 108.4 | 117.72 | | (45) |

Total = Sum(45)$_{1...12}$ = **1172.41** (45)

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

| (46)m= | 18.23 | 15.95 | 16.46 | 14.35 | 13.77 | 11.88 | 11.01 | 12.63 | 12.78 | 14.9 | 16.26 | 17.66 | | (46) |

Water storage loss:

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

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

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

Water storage loss:

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

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

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

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

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

If community heating see section 4.3

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

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

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

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

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

| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | | (56) |

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

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

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

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

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

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

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

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

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= | 168.15 | 148.4 | 156.3 | 140.73 | 138.37 | 124.28 | 119.98 | 130.8 | 130.31 | 145.9 | 153.49 | 164.31 | (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= | 168.15 | 148.4 | 156.3 | 140.73 | 138.37 | 124.28 | 119.98 | 130.8 | 130.31 | 145.9 | 153.49 | 164.31 | |

Output from water heater (annual)₁...₁₂ | 1721.02 | (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= | 77.69 | 69.02 | 73.75 | 67.87 | 67.79 | 62.4 | 61.68 | 65.27 | 64.41 | 70.3 | 72.12 | 76.42 | (65) |

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	(66)

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

| (67)m= | 13.6 | 12.08 | 9.82 | 7.43 | 5.56 | 4.69 | 5.07 | 6.59 | 8.84 | 11.23 | 13.11 | 13.97 | (67) |

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

| (68)m= | 147.88 | 149.42 | 145.55 | 137.32 | 126.93 | 117.16 | 110.63 | 109.1 | 112.97 | 121.2 | 131.59 | 141.36 | (68) |

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

| (69)m= | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | (69) |

Pumps and fans gains (Table 5a)

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

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

| (71)m= | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | (71) |

Water heating gains (Table 5)

| (72)m= | 104.43 | 102.7 | 99.13 | 94.27 | 91.12 | 86.67 | 82.9 | 87.74 | 89.45 | 94.48 | 100.16 | 102.71 | (72) |

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

| (73)m= | 317.37 | 315.66 | 305.96 | 290.49 | 275.06 | 259.99 | 250.06 | 254.89 | 262.73 | 278.38 | 296.32 | 309.5 | (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)	
Southeast 0.9x	0.77	x	8.55	x	36.79	x	0.63	x	0.7	=	96.14	(77)
Southeast 0.9x	0.77	x	8.55	x	62.67	x	0.63	x	0.7	=	163.77	(77)

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Southeast 0.9x	0.77	x	8.55	x	85.75	x	0.63	x	0.7	=	224.07	(77)
Southeast 0.9x	0.77	x	8.55	x	106.25	x	0.63	x	0.7	=	277.63	(77)
Southeast 0.9x	0.77	x	8.55	x	119.01	x	0.63	x	0.7	=	310.97	(77)
Southeast 0.9x	0.77	x	8.55	x	118.15	x	0.63	x	0.7	=	308.72	(77)
Southeast 0.9x	0.77	x	8.55	x	113.91	x	0.63	x	0.7	=	297.64	(77)
Southeast 0.9x	0.77	x	8.55	x	104.39	x	0.63	x	0.7	=	272.77	(77)
Southeast 0.9x	0.77	x	8.55	x	92.85	x	0.63	x	0.7	=	242.62	(77)
Southeast 0.9x	0.77	x	8.55	x	69.27	x	0.63	x	0.7	=	181	(77)
Southeast 0.9x	0.77	x	8.55	x	44.07	x	0.63	x	0.7	=	115.16	(77)
Southeast 0.9x	0.77	x	8.55	x	31.49	x	0.63	x	0.7	=	82.28	(77)

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

(83)m=	96.14	163.77	224.07	277.63	310.97	308.72	297.64	272.77	242.62	181	115.16	82.28	(83)

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

(84)m=	413.51	479.42	530.03	568.12	586.03	568.71	547.71	527.66	505.35	459.37	411.48	391.78	(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	0.92	0.82	0.65	0.48	0.52	0.75	0.93	0.98	0.99	(86)

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

(87)m=	19.82	20.01	20.27	20.58	20.82	20.96	20.99	20.99	20.91	20.6	20.16	19.79	(87)

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

(88)m=	19.88	19.88	19.88	19.89	19.9	19.91	19.91	19.91	19.9	19.9	19.89	19.89	(88)

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

(89)m=	0.99	0.98	0.95	0.89	0.76	0.55	0.37	0.4	0.66	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=	18.34	18.61	18.99	19.42	19.73	19.88	19.9	19.9	19.84	19.47	18.83	18.3	(90)

fLA = Living area ÷ (4) = — 0.42 (91)

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

(92)m=	18.96	19.2	19.52	19.91	20.19	20.33	20.36	20.36	20.29	19.94	19.39	18.92	(92)

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

(93)m=	18.96	19.2	19.52	19.91	20.19	20.33	20.36	20.36	20.29	19.94	19.39	18.92	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.95	0.89	0.78	0.59	0.42	0.45	0.69	0.91	0.97	0.99	(94)

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

(95)m=	408.2	467.43	503.5	506.98	455.99	336.68	227.96	238.64	350.44	416.29	401.07	387.76	(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)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	923.85	898.6	816.61	682.18	524.98	350.74	230.05	241.74	380.37	577.74	763.27	918.68		(97)

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

(98)m=	383.65	289.75	232.96	126.14	51.32	0	0	0	0	120.12	260.78	395.01		(98)

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = **1859.73** (98)

Space heating requirement in kWh/m²/year **37.01** (99)

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

Space heating:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	383.65	289.75	232.96	126.14	51.32	0	0	0	0	120.12	260.78	395.01	

(211)m = {[(98)m x (204)] } x 100 ÷ (206)   (211)

	410.32	309.89	249.15	134.91	54.89	0	0	0	0	128.47	278.91	422.47	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= **1989.01** (211)

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

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

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

Water heating

Output from water heater (calculated above)

	168.15	148.4	156.3	140.73	138.37	124.28	119.98	130.8	130.31	145.9	153.49	164.31	

Efficiency of water heater **79.8** (216)

(217)m=	86.95	86.57	85.88	84.52	82.44	79.8	79.8	79.8	79.8	84.3	86.22	87.07	(217)

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

(219)m=	193.39	171.42	182	166.5	167.84	155.74	150.35	163.91	163.29	173.07	178.03	188.71	

Total = Sum(219a)$_{1...12}$ = **2054.28** (219)

Annual totals	kWh/year	kWh/year	
Space heating fuel used, main system 1		1989.01	
Water heating fuel used		2054.28	
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		240.1	(232)

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

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	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	429.63	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	443.72	(264)
Space and water heating	(261) + (262) + (263) + (264) =				873.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	124.61	(268)
Total CO2, kg/year			sum of (265)…(271) =		1036.89	(272)

TER =   20.63   (273)

TER WorkSheet: New dwelling design stage

Property Address: 1F - 2Bed - North West

Address : 1F - 2Bed - North West, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =		0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =		0	(6b)
Number of intermittent fans							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) =	0.17	(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)		0.42	(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) =	0.35	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	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=
| 0.6 | 0.6 | 0.59 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 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=
| 0.6 | 0.6 | 0.59 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 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			2.12	x 1 =	2.12			(26)
Windows Type 1			9.61	x1/[1/(1.4)+ 0.04] =	12.74			(27)
Windows Type 2			3.9	x1/[1/(1.4)+ 0.04] =	5.17			(27)
Floor			71.72	x 0.13 =	9.3236			(28)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96			(29)
Walls Type2	4	2.12	1.88	x 0.18 =	0.34			(29)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0			(32)
Party ceiling			71.72					(32b)
Internal wall **			142.3					(32c)

* 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) =	35.65	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	10139.7	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		13.24	(36)

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

Total fabric heat loss	(33) + (36) =	48.9	(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= | 35.64 | 35.4 | 35.17 | 34.09 | 33.89 | 32.94 | 32.94 | 32.77 | 33.31 | 33.89 | 34.3 | 34.72 | | (38) |

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

| (39)m= | 84.53 | 84.3 | 84.07 | 82.99 | 82.78 | 81.84 | 81.84 | 81.67 | 82.2 | 82.78 | 83.19 | 83.62 |

Average = Sum(39)$_{1...12}$ /12=   82.98   (39)

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

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

Average = Sum(40)$_{1...12}$ /12=   1.16   (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   2.29   (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   88.52   (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 |

Total = Sum(44)$_{1...12}$ =   1062.24   (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 |

Total = Sum(45)$_{1...12}$ =   1392.76   (45)

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

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   1.39   (48)
Temperature factor from Table 2b   0.54   (49)
Energy lost from water storage, kWh/year   (48) x (49) =   0.75   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   0   (51)
If community heating see section 4.3
Volume factor from Table 2a   0   (52)
Temperature factor from Table 2b   0   (53)
Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   0   (54)
 Enter (50) or (54) in (55)   0.75   (55)

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

| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | | (56) |

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

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

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

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

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

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

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

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

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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	(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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	

Output from water heater (annual)$_{1...12}$ | 1941.38 | (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=	85.29	75.66	80.61	73.85	73.52	67.35	66.26	70.54	69.73	76.5	78.89	83.77	(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=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

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

(67)m=	18.2	16.17	13.15	9.95	7.44	6.28	6.79	8.82	11.84	15.04	17.55	18.71	(67)

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

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

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

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	114.64	112.59	108.34	102.57	98.82	93.55	89.06	94.81	96.85	102.83	109.57	112.6	(72)

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

(73)m=	394.42	392.43	379.9	359.73	339.33	319.6	306.74	312.43	322.75	343.13	366.53	384.01	(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)	
Southwest 0.9x	0.77	x	3.9	x	36.79		0.63	x	0.7	=	43.85	(79)
Southwest 0.9x	0.77	x	3.9	x	62.67		0.63	x	0.7	=	74.7	(79)

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Southwest 0.9x	0.77	x	3.9	x	85.75	0.63	x	0.7	=	102.21	(79)
Southwest 0.9x	0.77	x	3.9	x	106.25	0.63	x	0.7	=	126.64	(79)
Southwest 0.9x	0.77	x	3.9	x	119.01	0.63	x	0.7	=	141.85	(79)
Southwest 0.9x	0.77	x	3.9	x	118.15	0.63	x	0.7	=	140.82	(79)
Southwest 0.9x	0.77	x	3.9	x	113.91	0.63	x	0.7	=	135.77	(79)
Southwest 0.9x	0.77	x	3.9	x	104.39	0.63	x	0.7	=	124.42	(79)
Southwest 0.9x	0.77	x	3.9	x	92.85	0.63	x	0.7	=	110.67	(79)
Southwest 0.9x	0.77	x	3.9	x	69.27	0.63	x	0.7	=	82.56	(79)
Southwest 0.9x	0.77	x	3.9	x	44.07	0.63	x	0.7	=	52.53	(79)
Southwest 0.9x	0.77	x	3.9	x	31.49	0.63	x	0.7	=	37.53	(79)
Northwest 0.9x	0.77	x	9.61	x	11.28	x 0.63	x	0.7	=	33.14	(81)
Northwest 0.9x	0.77	x	9.61	x	22.97	x 0.63	x	0.7	=	67.45	(81)
Northwest 0.9x	0.77	x	9.61	x	41.38	x 0.63	x	0.7	=	121.53	(81)
Northwest 0.9x	0.77	x	9.61	x	67.96	x 0.63	x	0.7	=	199.58	(81)
Northwest 0.9x	0.77	x	9.61	x	91.35	x 0.63	x	0.7	=	268.28	(81)
Northwest 0.9x	0.77	x	9.61	x	97.38	x 0.63	x	0.7	=	286.01	(81)
Northwest 0.9x	0.77	x	9.61	x	91.1	x 0.63	x	0.7	=	267.56	(81)
Northwest 0.9x	0.77	x	9.61	x	72.63	x 0.63	x	0.7	=	213.3	(81)
Northwest 0.9x	0.77	x	9.61	x	50.42	x 0.63	x	0.7	=	148.08	(81)
Northwest 0.9x	0.77	x	9.61	x	28.07	x 0.63	x	0.7	=	82.43	(81)
Northwest 0.9x	0.77	x	9.61	x	14.2	x 0.63	x	0.7	=	41.7	(81)
Northwest 0.9x	0.77	x	9.61	x	9.21	x 0.63	x	0.7	=	27.06	(81)

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

(83)m=	76.99	142.15	223.73	326.22	410.13	426.83	403.33	337.72	258.75	164.99	94.22	64.59	(83)

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

(84)m=	471.41	534.58	603.64	685.95	749.45	746.43	710.06	650.15	581.51	508.12	460.75	448.6	(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	0.84	0.66	0.5	0.56	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	19.92	20.19	20.54	20.82	20.96	20.99	20.99	20.88	20.52	20.09	19.75	(87)

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

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

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

(89)m=	1	0.99	0.98	0.93	0.79	0.57	0.39	0.44	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=	18.31	18.53	18.91	19.42	19.79	19.94	19.96	19.96	19.87	19.4	18.78	18.28	(90)

fLA = Living area ÷ (4) =   0.31   (91)

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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=	18.76	18.96	19.31	19.76	20.11	20.26	20.28	20.28	20.19	19.75	19.18	18.74		(92)

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

(93)m=	18.76	18.96	19.31	19.76	20.11	20.26	20.28	20.28	20.19	19.75	19.18	18.74		(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:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(94)m=	0.99	0.99	0.97	0.92	0.8	0.6	0.42	0.48	0.77	0.95	0.99	1		(94)

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

(95)m=	468.76	528.79	588.01	634.08	600.54	446.44	299.15	312.62	445.45	483.22	455.63	446.6		(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=	1222.69	1185.47	1076.61	901.58	695.93	463.08	301.44	316.94	500.31	757.3	1005.37	1215.73		(97)

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

(98)m=	560.92	441.29	363.52	192.6	70.97	0	0	0	0	203.91	395.82	572.23		

Total per year (kWh/year) = Sum(98)₁…₅,₉…₁₂ = **2801.27** (98)

Space heating requirement in kWh/m²/year **39.06** (99)

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

Space heating:

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

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

Space heating requirement (calculated above)

560.92	441.29	363.52	192.6	70.97	0	0	0	0	203.91	395.82	572.23

(211)m = {[(98)m x (204)] } x 100 ÷ (206)   (211)

599.92	471.97	388.79	205.99	75.91	0	0	0	0	218.09	423.34	612.01

Total (kWh/year) =Sum(211)₁…₅,₁₀…₁₂= **2996.01** (211)

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

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

Total (kWh/year) =Sum(215)₁…₅,₁₀…₁₂= **0** (215)

Water heating

Output from water heater (calculated above)

190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44

Efficiency of water heater **79.8** (216)

(217)m=	87.52	87.27	86.69	85.33	82.87	79.8	79.8	79.8	79.8	85.39	86.94	87.61	(217)

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

(219)m=	218.23	192.94	204.07	185.99	187.78	174.4	167.63	183.75	183.36	192.73	199.98	212.8	

Total = Sum(219a)₁…₁₂ = **2303.67** (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			2996.01	
Water heating fuel used			2303.67	
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			321.47	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	647.14	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	497.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1144.73	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.84	(268)
Total CO2, kg/year	sum of (265)…(271) =			1350.5	(272)

TER = | 18.83 | (273)

TER WorkSheet: New dwelling design stage

Property Address: 1F - 2Bed - South East

Address : 1F - 2Bed - South East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =		0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =		0	(6b)
Number of intermittent fans							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) =	0.17	(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)	0.42	(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) =	0.35	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	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=
0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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=
0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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			2.12	x 1 =	2.12			(26)
Windows Type 1			9.61	x1/[1/(1.4)+ 0.04] =	12.74			(27)
Windows Type 2			3.9	x1/[1/(1.4)+ 0.04] =	5.17			(27)
Floor			71.72	x 0.13 =	9.3236			(28)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96			(29)
Walls Type2	4	2.12	1.88	x 0.18 =	0.34			(29)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0			(32)
Party ceiling			71.72					(32b)
Internal wall **			142.3					(32c)

* 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) =	35.65	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	10139.7	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f
can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		13.24	(36)

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

Total fabric heat loss	(33) + (36) =	48.9	(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

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| (38)m= | 35.64 | 35.4 | 35.17 | 34.09 | 33.89 | 32.94 | 32.94 | 32.77 | 33.31 | 33.89 | 34.3 | 34.72 | | (38) |

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

| (39)m= | 84.53 | 84.3 | 84.07 | 82.99 | 82.78 | 81.84 | 81.84 | 81.67 | 82.2 | 82.78 | 83.19 | 83.62 |

Average = Sum(39)$_{1...12}$ /12 = **82.98** (39)

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

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

Average = Sum(40)$_{1...12}$ /12 = **1.16** (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   **2.29**   (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   **88.52**   (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 |

Total = Sum(44)$_{1...12}$ =   **1062.24**   (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 |

Total = Sum(45)$_{1...12}$ =   **1392.76**   (45)

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

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | (46) |

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   **1.39**   (48)

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

Energy lost from water storage, kWh/year (48) x (49) =   **0.75**   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   **0**   (51)
If community heating see section 4.3
Volume factor from Table 2a   **0**   (52)
Temperature factor from Table 2b   **0**   (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) =   **0**   (54)
 Enter (50) or (54) in (55)   **0.75**   (55)

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

| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | (56) |

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

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

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

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

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

(59)m=	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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	(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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44

Output from water heater (annual)₁...₁₂ | 1941.38 | (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=	85.29	75.66	80.61	73.85	73.52	67.35	66.26	70.54	69.73	76.5	78.89	83.77	(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=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

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

(67)m=	18.2	16.17	13.15	9.95	7.44	6.28	6.79	8.82	11.84	15.04	17.55	18.71	(67)

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

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

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

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	114.64	112.59	108.34	102.57	98.82	93.55	89.06	94.81	96.85	102.83	109.57	112.6	(72)

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

(73)m=	394.42	392.43	379.9	359.73	339.33	319.6	306.74	312.43	322.75	343.13	366.53	384.01	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.9	x	11.28	x	0.63	x	0.7	=	13.45	(75)
Northeast 0.9x	0.77	x	3.9	x	22.97	x	0.63	x	0.7	=	27.37	(75)

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Direction												
Northeast	0.9x	0.77	x	3.9	x	41.38	x	0.63	x	0.7	=	49.32	(75)
Northeast	0.9x	0.77	x	3.9	x	67.96	x	0.63	x	0.7	=	81	(75)
Northeast	0.9x	0.77	x	3.9	x	91.35	x	0.63	x	0.7	=	108.87	(75)
Northeast	0.9x	0.77	x	3.9	x	97.38	x	0.63	x	0.7	=	116.07	(75)
Northeast	0.9x	0.77	x	3.9	x	91.1	x	0.63	x	0.7	=	108.58	(75)
Northeast	0.9x	0.77	x	3.9	x	72.63	x	0.63	x	0.7	=	86.56	(75)
Northeast	0.9x	0.77	x	3.9	x	50.42	x	0.63	x	0.7	=	60.1	(75)
Northeast	0.9x	0.77	x	3.9	x	28.07	x	0.63	x	0.7	=	33.45	(75)
Northeast	0.9x	0.77	x	3.9	x	14.2	x	0.63	x	0.7	=	16.92	(75)
Northeast	0.9x	0.77	x	3.9	x	9.21	x	0.63	x	0.7	=	10.98	(75)
Southeast	0.9x	0.77	x	9.61	x	36.79	x	0.63	x	0.7	=	108.06	(77)
Southeast	0.9x	0.77	x	9.61	x	62.67	x	0.63	x	0.7	=	184.07	(77)
Southeast	0.9x	0.77	x	9.61	x	85.75	x	0.63	x	0.7	=	251.85	(77)
Southeast	0.9x	0.77	x	9.61	x	106.25	x	0.63	x	0.7	=	312.05	(77)
Southeast	0.9x	0.77	x	9.61	x	119.01	x	0.63	x	0.7	=	349.53	(77)
Southeast	0.9x	0.77	x	9.61	x	118.15	x	0.63	x	0.7	=	347	(77)
Southeast	0.9x	0.77	x	9.61	x	113.91	x	0.63	x	0.7	=	334.54	(77)
Southeast	0.9x	0.77	x	9.61	x	104.39	x	0.63	x	0.7	=	306.59	(77)
Southeast	0.9x	0.77	x	9.61	x	92.85	x	0.63	x	0.7	=	272.7	(77)
Southeast	0.9x	0.77	x	9.61	x	69.27	x	0.63	x	0.7	=	203.43	(77)
Southeast	0.9x	0.77	x	9.61	x	44.07	x	0.63	x	0.7	=	129.43	(77)
Southeast	0.9x	0.77	x	9.61	x	31.49	x	0.63	x	0.7	=	92.48	(77)

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

(83)m=	121.51	211.44	301.17	393.05	458.4	463.07	443.13	393.15	332.8	236.89	146.35	103.46	(83)

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

(84)m=	515.93	603.87	681.07	752.78	797.73	782.67	749.86	705.58	655.55	580.02	512.89	487.47	(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	0.93	0.82	0.64	0.47	0.52	0.77	0.95	0.99	1	(86)

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

(87)m=	19.83	20.01	20.28	20.6	20.85	20.97	20.99	20.99	20.92	20.59	20.15	19.8	(87)

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

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

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

(89)m=	0.99	0.99	0.97	0.9	0.76	0.55	0.37	0.41	0.69	0.93	0.99	1	(89)

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

(90)m=	18.39	18.66	19.04	19.5	19.81	19.95	19.97	19.97	19.9	19.5	18.87	18.36	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

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

| (92)m= | 18.84 | 19.08 | 19.42 | 19.84 | 20.13 | 20.26 | 20.28 | 20.28 | 20.22 | 19.84 | 19.27 | 18.8 | | (92) |

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

| (93)m= | 18.84 | 19.08 | 19.42 | 19.84 | 20.13 | 20.26 | 20.28 | 20.28 | 20.22 | 19.84 | 19.27 | 18.8 | | (93) |

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

| (94)m= | 0.99 | 0.98 | 0.96 | 0.9 | 0.77 | 0.57 | 0.4 | 0.45 | 0.71 | 0.93 | 0.98 | 0.99 | | (94) |

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

| (95)m= | 511.75 | 593.43 | 654.21 | 678.17 | 617.14 | 449.53 | 299.7 | 314.07 | 464.25 | 536.82 | 504.25 | 484.41 | | (95) |

Monthly average external temperature from Table 8

| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

| (97)m= | 1229 | 1195 | 1086.42 | 907.99 | 698.19 | 463.47 | 301.51 | 317.13 | 502.79 | 765.11 | 1012.46 | 1221.22 | | (97) |

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

| (98)m= | 533.63 | 404.26 | 321.56 | 165.47 | 60.31 | 0 | 0 | 0 | 0 | 169.85 | 365.92 | 548.19 | | |

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = | 2569.18 | (98)

Space heating requirement in kWh/m²/year | 35.82 | (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 | 93.5 | (206)

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

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

Space heating requirement (calculated above)

| | 533.63 | 404.26 | 321.56 | 165.47 | 60.31 | 0 | 0 | 0 | 0 | 169.85 | 365.92 | 548.19 | |

(211)m = {[(98)m x (204)] } x 100 ÷ (206)   (211)

| | 570.73 | 432.36 | 343.91 | 176.97 | 64.5 | 0 | 0 | 0 | 0 | 181.65 | 391.35 | 586.3 | |

Total (kWh/year) =Sum(211)₁...₅,₁₀....₁₂= | 2747.78 | (211)

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

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

Total (kWh/year) =Sum(215)₁...₅,₁₀....₁₂= | 0 | (215)

Water heating

Output from water heater (calculated above)

| | 190.99 | 168.38 | 176.92 | 158.71 | 155.61 | 139.17 | 133.77 | 146.63 | 146.32 | 164.57 | 173.87 | 186.44 | |

Efficiency of water heater | 79.8 | (216)

| (217)m= | 87.41 | 87.07 | 86.39 | 84.93 | 82.53 | 79.8 | 79.8 | 79.8 | 79.8 | 84.9 | 86.75 | 87.52 | | (217) |

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

| (219)m= | 218.5 | 193.39 | 204.79 | 186.88 | 188.57 | 174.4 | 167.63 | 183.75 | 183.36 | 193.84 | 200.42 | 213.02 | | |

Total = Sum(219a)₁...₁₂ = | 2308.54 | (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			2747.78	
Water heating fuel used			2308.54	
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			321.47	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	593.52	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	498.65	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1092.17	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.84	(268)
Total CO2, kg/year	sum of (265)…(271) =			1297.94	(272)

TER = | 18.1 | (273)

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Property Address: 1F - 2Bed - South West

Address : 1F - 2Bed - South West , Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							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) =	0.17 (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)		0.42 (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) =	0.35 (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	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=	0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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=	0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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			2.12	x 1 =	2.12			(26)
Windows Type 1			9.61	x1/[1/(1.4)+ 0.04] =	12.74			(27)
Windows Type 2			3.9	x1/[1/(1.4)+ 0.04] =	5.17			(27)
Floor			71.72	x 0.13 =	9.3236			(28)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96			(29)
Walls Type2	4	2.12	1.88	x 0.18 =	0.34			(29)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0			(32)
Party ceiling			71.72					(32b)
Internal wall **			142.3					(32c)

* 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) =	35.65 (33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	10139.7 (34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		13.24 (36)

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

Total fabric heat loss	(33) + (36) =	48.9 (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=	35.64	35.4	35.17	34.09	33.89	32.94	32.94	32.77	33.31	33.89	34.3	34.72		(38)

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

(39)m=	84.53	84.3	84.07	82.99	82.78	81.84	81.84	81.67	82.2	82.78	83.19	83.62		(39)

Average = Sum(39)$_{1...12}$ /12= $\quad$ 82.98 $\quad$ (39)

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

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

Average = Sum(40)$_{1...12}$ /12= $\quad$ 1.16 $\quad$ (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: $\qquad$ kWh/year:

Assumed occupancy, N $\qquad$ 2.29 $\quad$ (42)

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

$\quad$ if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 $\qquad$ 88.52 $\quad$ (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=	97.37	93.83	90.29	86.75	83.21	79.67	79.67	83.21	86.75	90.29	93.83	97.37		(44)

Total = Sum(44)$_{1...12}$ = $\quad$ 1062.24 $\quad$ (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=	144.4	126.29	130.32	113.62	109.02	94.08	87.17	100.03	101.23	117.97	128.78	139.84		(45)

Total = Sum(45)$_{1...12}$ = $\quad$ 1392.76 $\quad$ (45)

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

(46)m=	21.66	18.94	19.55	17.04	16.35	14.11	13.08	15.01	15.18	17.7	19.32	20.98		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel $\qquad$ 150 $\quad$ (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:

$\quad$ a) If manufacturer's declared loss factor is known (kWh/day): $\qquad$ 1.39 $\quad$ (48)

Temperature factor from Table 2b $\qquad$ 0.54 $\quad$ (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a $\qquad$ 0 $\quad$ (52)

Temperature factor from Table 2b $\qquad$ 0 $\quad$ (53)

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

$\quad$ Enter (50) or (54) in (55) $\qquad$ 0.75 $\quad$ (55)

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)

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

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

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

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

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

(59)m=	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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	(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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	

Output from water heater (annual)₁...₁₂ | 1941.38 | (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=	85.29	75.66	80.61	73.85	73.52	67.35	66.26	70.54	69.73	76.5	78.89	83.77	(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=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

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

(67)m=	18.2	16.17	13.15	9.95	7.44	6.28	6.79	8.82	11.84	15.04	17.55	18.71	(67)

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

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

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

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	114.64	112.59	108.34	102.57	98.82	93.55	89.06	94.81	96.85	102.83	109.57	112.6	(72)

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

(73)m=	394.42	392.43	379.9	359.73	339.33	319.6	306.74	312.43	322.75	343.13	366.53	384.01	(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)	
Southeast 0.9x	0.77	x 9.61	x 36.79	x 0.63	x 0.7	= 108.06	(77)
Southeast 0.9x	0.77	x 9.61	x 62.67	x 0.63	x 0.7	= 184.07	(77)

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Southeast 0.9x	0.77	x	9.61	x	85.75	x	0.63	x	0.7	=	251.85	(77)
Southeast 0.9x	0.77	x	9.61	x	106.25	x	0.63	x	0.7	=	312.05	(77)
Southeast 0.9x	0.77	x	9.61	x	119.01	x	0.63	x	0.7	=	349.53	(77)
Southeast 0.9x	0.77	x	9.61	x	118.15	x	0.63	x	0.7	=	347	(77)
Southeast 0.9x	0.77	x	9.61	x	113.91	x	0.63	x	0.7	=	334.54	(77)
Southeast 0.9x	0.77	x	9.61	x	104.39	x	0.63	x	0.7	=	306.59	(77)
Southeast 0.9x	0.77	x	9.61	x	92.85	x	0.63	x	0.7	=	272.7	(77)
Southeast 0.9x	0.77	x	9.61	x	69.27	x	0.63	x	0.7	=	203.43	(77)
Southeast 0.9x	0.77	x	9.61	x	44.07	x	0.63	x	0.7	=	129.43	(77)
Southeast 0.9x	0.77	x	9.61	x	31.49	x	0.63	x	0.7	=	92.48	(77)
Southwest 0.9x	0.77	x	3.9	x	36.79		0.63	x	0.7	=	43.85	(79)
Southwest 0.9x	0.77	x	3.9	x	62.67		0.63	x	0.7	=	74.7	(79)
Southwest 0.9x	0.77	x	3.9	x	85.75		0.63	x	0.7	=	102.21	(79)
Southwest 0.9x	0.77	x	3.9	x	106.25		0.63	x	0.7	=	126.64	(79)
Southwest 0.9x	0.77	x	3.9	x	119.01		0.63	x	0.7	=	141.85	(79)
Southwest 0.9x	0.77	x	3.9	x	118.15		0.63	x	0.7	=	140.82	(79)
Southwest 0.9x	0.77	x	3.9	x	113.91		0.63	x	0.7	=	135.77	(79)
Southwest 0.9x	0.77	x	3.9	x	104.39		0.63	x	0.7	=	124.42	(79)
Southwest 0.9x	0.77	x	3.9	x	92.85		0.63	x	0.7	=	110.67	(79)
Southwest 0.9x	0.77	x	3.9	x	69.27		0.63	x	0.7	=	82.56	(79)
Southwest 0.9x	0.77	x	3.9	x	44.07		0.63	x	0.7	=	52.53	(79)
Southwest 0.9x	0.77	x	3.9	x	31.49		0.63	x	0.7	=	37.53	(79)

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

(83)m=	151.92	258.77	354.06	438.7	491.37	487.82	470.31	431.01	383.37	285.99	181.96	130.01		(83)

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

(84)m=	546.34	651.2	733.96	798.43	830.7	807.42	777.05	743.44	706.12	629.12	548.49	514.02		(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(86)m=	0.99	0.99	0.97	0.91	0.8	0.62	0.46	0.5	0.73	0.93	0.99	1		(86)

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

(87)m=	19.87	20.07	20.33	20.64	20.86	20.97	20.99	20.99	20.93	20.64	20.2	19.83		(87)

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

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

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

(89)m=	0.99	0.98	0.96	0.89	0.74	0.53	0.35	0.39	0.65	0.91	0.98	0.99		(89)

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

(90)m=	18.45	18.74	19.12	19.55	19.83	19.95	19.97	19.97	19.92	19.57	18.94	18.41		(90)

fLA = Living area ÷ (4) = 0.31 (91)

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

(92)m=	18.89	19.15	19.5	19.89	20.15	20.27	20.28	20.28	20.23	19.9	19.33	18.85	(92)

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

(93)m=	18.89	19.15	19.5	19.89	20.15	20.27	20.28	20.28	20.23	19.9	19.33	18.85	(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	0.56	0.39	0.42	0.67	0.91	0.98	0.99	(94)

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

(95)m=	540.79	636.32	696.88	705.42	627.05	451.32	300	314.77	473.68	569.62	536.61	510.02	(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=	1233.28	1201.35	1092.75	911.92	699.53	463.7	301.55	317.22	504.01	769.86	1017.2	1224.95	(97)

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

(98)m=	515.21	379.7	294.53	148.68	53.93	0	0	0	0	148.98	346.02	531.91	

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = **2418.95** (98)

Space heating requirement in kWh/m²/year **33.73** (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 **93.5** (206)

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

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

Space heating requirement (calculated above)

	515.21	379.7	294.53	148.68	53.93	0	0	0	0	148.98	346.02	531.91	

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

	551.03	406.09	315	159.02	57.68	0	0	0	0	159.33	370.07	568.89	

Total (kWh/year) =Sum(211)₁...₅,₁₀....₁₂= **2587.11** (211)

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

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

Total (kWh/year) =Sum(215)₁...₅,₁₀....₁₂= **0** (215)

Water heating

Output from water heater (calculated above)

	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	

Efficiency of water heater **79.8** (216)

(217)m=	87.33	86.92	86.16	84.64	82.3	79.8	79.8	79.8	79.8	84.55	86.62	87.46	(217)

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

(219)m=	218.7	193.72	205.33	187.51	189.07	174.4	167.63	183.75	183.36	194.64	200.74	213.18	

Total = Sum(219a)₁...₁₂ = **2312.01** (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			2587.11	
Water heating fuel used			2312.01	
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			321.47	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	558.82	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	499.39	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1058.21	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.84	(268)
Total CO2, kg/year	sum of (265)...(271) =			1263.98	(272)

TER = | 17.62 | (273)

TER WorkSheet: New dwelling design stage

Property Address: MF - 1Bed - North

Address : MF - 1Bed - North, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.35	(1a) x	2.5	(2a) =	125.87	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.35	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.87	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.16 (8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0 (12)
If no draught lobby, enter 0.05, else enter 0		0 (13)
Percentage of windows and doors draught stripped		0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.41 (18)

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

Number of sides sheltered		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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.44	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			2.12	x 1 =	2.12			(26)
Windows			8.55	x1/[1/(1.4)+ 0.04] =	11.34			(27)
Walls Type1	23.14	8.55	14.59	x 0.18 =	2.63			(29)
Walls Type2	29.29	2.12	27.17	x 0.18 =	4.89			(29)
Walls Type3	13.99	0	13.99	x 0.18 =	2.52			(29)
Total area of elements, m²			66.42					(31)
Party wall			13.69	x 0 =	0			(32)
Party floor			50.35					(32a)
Party ceiling			50.35					(32b)
Internal wall **			90.55					(32c)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = | 23.49 | (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = | 5393.75 | (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 | 5.39 | (36)

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

Total fabric heat loss (33) + (36) = | 28.88 | (37)

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

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

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| (38)m= | 24.85 | 24.69 | 24.53 | 23.81 | 23.67 | 23.03 | 23.03 | 22.92 | 23.28 | 23.67 | 23.94 | 24.23 | | (38) |

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

| (39)m= | 53.73 | 53.57 | 53.41 | 52.68 | 52.55 | 51.91 | 51.91 | 51.8 | 52.16 | 52.55 | 52.82 | 53.11 |

Average = Sum(39)$_{1...12}$ /12= **52.68** (39)

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

| (40)m= | 1.07 | 1.06 | 1.06 | 1.05 | 1.04 | 1.03 | 1.03 | 1.03 | 1.04 | 1.04 | 1.05 | 1.05 |

Average = Sum(40)$_{1...12}$ /12= **1.05** (40)

Number of days in month (Table 1a)

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

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4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   **1.7** (42)
   if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
   if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   **74.58** (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of
not more that 125 litres per person per day (all water use, hot and cold)

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

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

| (44)m= | 82.04 | 79.06 | 76.08 | 73.09 | 70.11 | 67.13 | 67.13 | 70.11 | 73.09 | 76.08 | 79.06 | 82.04 |

Total = Sum(44)$_{1...12}$ = **895.02** (44)

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

| (45)m= | 121.67 | 106.41 | 109.81 | 95.73 | 91.86 | 79.27 | 73.45 | 84.29 | 85.29 | 99.4 | 108.5 | 117.83 |

Total = Sum(45)$_{1...12}$ = **1173.51** (45)

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

| (46)m= | 18.25 | 15.96 | 16.47 | 14.36 | 13.78 | 11.89 | 11.02 | 12.64 | 12.79 | 14.91 | 16.28 | 17.67 | (46) |

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   **1.39** (48)
Temperature factor from Table 2b   **0.54** (49)
Energy lost from water storage, kWh/year   (48) x (49) =   **0.75** (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   **0** (51)
If community heating see section 4.3
Volume factor from Table 2a   **0** (52)
Temperature factor from Table 2b   **0** (53)
Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   **0** (54)
 Enter (50) or (54) in (55)   **0.75** (55)

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

| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | (56) |

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

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

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

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

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

(59)m=	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=	168.26	148.5	156.4	140.82	138.45	124.36	120.05	130.88	130.39	146	153.6	164.42	(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=	168.26	148.5	156.4	140.82	138.45	124.36	120.05	130.88	130.39	146	153.6	164.42	

Output from water heater (annual)$_{1...12}$ | 1722.13 | (64)

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

(65)m=	77.73	69.05	73.79	67.9	67.82	62.43	61.7	65.3	64.43	70.33	72.15	76.45	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	(66)

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

(67)m=	13.62	12.1	9.84	7.45	5.57	4.7	5.08	6.6	8.86	11.25	13.14	14	(67)

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

(68)m=	148.14	149.68	145.81	137.56	127.15	117.36	110.83	109.29	113.16	121.41	131.82	141.61	(68)

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

(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(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=	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	(71)

Water heating gains (Table 5)

(72)m=	104.48	102.75	99.18	94.31	91.15	86.71	82.93	87.77	89.49	94.53	100.21	102.76	(72)

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

(73)m=	317.75	316.04	306.33	290.83	275.38	260.28	250.34	255.17	263.03	278.7	296.67	309.88	(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)	
Northwest 0.9x	0.77	x	8.55	x	11.28	x	0.63	x	0.7	=	29.48	(81)
Northwest 0.9x	0.77	x	8.55	x	22.97	x	0.63	x	0.7	=	60.01	(81)

Northwest 0.9x	0.77	x 8.55	x 41.38	x 0.63	x 0.7	= 108.12	(81)
Northwest 0.9x	0.77	x 8.55	x 67.96	x 0.63	x 0.7	= 177.57	(81)
Northwest 0.9x	0.77	x 8.55	x 91.35	x 0.63	x 0.7	= 238.69	(81)
Northwest 0.9x	0.77	x 8.55	x 97.38	x 0.63	x 0.7	= 254.46	(81)
Northwest 0.9x	0.77	x 8.55	x 91.1	x 0.63	x 0.7	= 238.05	(81)
Northwest 0.9x	0.77	x 8.55	x 72.63	x 0.63	x 0.7	= 189.77	(81)
Northwest 0.9x	0.77	x 8.55	x 50.42	x 0.63	x 0.7	= 131.75	(81)
Northwest 0.9x	0.77	x 8.55	x 28.07	x 0.63	x 0.7	= 73.34	(81)
Northwest 0.9x	0.77	x 8.55	x 14.2	x 0.63	x 0.7	= 37.1	(81)
Northwest 0.9x	0.77	x 8.55	x 9.21	x 0.63	x 0.7	= 24.08	(81)

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

| (83)m= | 29.48 | 60.01 | 108.12 | 177.57 | 238.69 | 254.46 | 238.05 | 189.77 | 131.75 | 73.34 | 37.1 | 24.08 | (83) |

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

| (84)m= | 347.23 | 376.05 | 414.45 | 468.4 | 514.06 | 514.75 | 488.39 | 444.94 | 394.77 | 352.04 | 333.77 | 333.95 | (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	0.82	0.62	0.46	0.53	0.8	0.97	0.99	1	(86)

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

| (87)m= | 19.96 | 20.07 | 20.3 | 20.63 | 20.87 | 20.98 | 21 | 20.99 | 20.92 | 20.61 | 20.23 | 19.94 | (87) |

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

| (88)m= | 20.03 | 20.03 | 20.03 | 20.04 | 20.05 | 20.06 | 20.06 | 20.06 | 20.05 | 20.05 | 20.04 | 20.04 | (88) |

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

| (89)m= | 0.99 | 0.99 | 0.98 | 0.92 | 0.77 | 0.54 | 0.37 | 0.42 | 0.73 | 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= | 18.64 | 18.82 | 19.15 | 19.61 | 19.93 | 20.04 | 20.06 | 20.06 | 19.99 | 19.6 | 19.06 | 18.62 | (90) |

fLA = Living area ÷ (4) =   0.42 (91)

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

| (92)m= | 19.19 | 19.34 | 19.63 | 20.04 | 20.33 | 20.44 | 20.45 | 20.45 | 20.38 | 20.02 | 19.55 | 19.17 | (92) |

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

| (93)m= | 19.19 | 19.34 | 19.63 | 20.04 | 20.33 | 20.44 | 20.45 | 20.45 | 20.38 | 20.02 | 19.55 | 19.17 | (93) |

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:

| (94)m= | 0.99 | 0.99 | 0.97 | 0.92 | 0.79 | 0.57 | 0.41 | 0.47 | 0.76 | 0.95 | 0.99 | 0.99 | (94) |

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

| (95)m= | 344.94 | 371.94 | 404.01 | 432.01 | 404.54 | 295.93 | 199 | 207.94 | 298.88 | 334.09 | 329.53 | 332.14 | (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) |

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	800.14	773.68	701.55	586.8	453.24	302.94	199.88	209.73	327.53	494.97	657.74	795.35		(97)

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

(98)m=	338.67	269.97	221.37	111.45	36.23	0	0	0	0	119.7	236.31	344.62		(98)

	Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1678.32	(98)

Space heating requirement in kWh/m²/year	33.33	(99)

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

Space heating:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	338.67	269.97	221.37	111.45	36.23	0	0	0	0	119.7	236.31	344.62	

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

	362.22	288.73	236.76	119.2	38.75	0	0	0	0	128.02	252.73	368.58	

	Total (kWh/year) =Sum(211)$_{1...5,10....12}$=	1795	(211)

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

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

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

Water heating

Output from water heater (calculated above)

	168.26	148.5	156.4	140.82	138.45	124.36	120.05	130.88	130.39	146	153.6	164.42	

Efficiency of water heater											79.8		(216)

(217)m=	86.64	86.39	85.74	84.2	81.81	79.8	79.8	79.8	79.8	84.29	85.96	86.74		(217)

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

(219)m=	194.2	171.89	182.41	167.25	169.24	155.84	150.43	164.01	163.39	173.21	178.68	189.55	

	Total = Sum(219a)$_{1...12}$ =	2060.12	(219)

Annual totals   kWh/year   kWh/year

Space heating fuel used, main system 1	1795	
Water heating fuel used	2060.12	

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		240.6	(232)

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

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	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	387.72	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	444.99	(264)
Space and water heating	(261) + (262) + (263) + (264) =				832.71	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	124.87	(268)
Total CO2, kg/year			sum of (265)…(271) =		996.5	(272)

TER =   19.79   (273)

TER WorkSheet: New dwelling design stage

Assessor Name:	Matt Fitzpatrick	**Stroma Number:**	STRO003572
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.6

Property Address: MF - 1Bed - South

Address : MF - 1Bed - South, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.25	(1a) x	2.5	(2a) =	125.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.25	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.62	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.16	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.41	(18)

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

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

Infiltration rate modified for monthly wind speed

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation:

$\boxed{0}$ (23a)

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

$\boxed{0}$ (23b)

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

$\boxed{0}$ (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			2.12	x 1	= 2.12			(26)
Windows			8.55	x1/[1/(1.4)+ 0.04] =	11.34			(27)
Walls Type1	23.19	8.55	14.64	x 0.18	= 2.64			(29)
Walls Type2	12.4	2.12	10.28	x 0.18	= 1.85			(29)
Walls Type3	14	0	14	x 0.18	= 2.52			(29)
Total area of elements, m²			49.59					(31)
Party wall			30.53	x 0	= 0			(32)
Party floor			50.25					(32a)
Party ceiling			50.25					(32b)
Internal wall **			90.21					(32c)

* 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) = $\boxed{20.46}$ (33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) = $\boxed{5484.87}$ (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   Indicative Value: Medium $\boxed{250}$ (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 $\boxed{4.3}$ (36)

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

Total fabric heat loss   (33) + (36) = $\boxed{24.76}$ (37)

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

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

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| (38)m= | 24.8 | 24.65 | 24.49 | 23.76 | 23.63 | 22.99 | 22.99 | 22.87 | 23.24 | 23.63 | 23.9 | 24.19 | | (38) |

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

| (39)m= | 49.57 | 49.41 | 49.25 | 48.53 | 48.39 | 47.75 | 47.75 | 47.64 | 48 | 48.39 | 48.67 | 48.95 | | |

Average = Sum(39)$_{1...12}$ /12= | 48.53 | (39)

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

| (40)m= | 0.99 | 0.98 | 0.98 | 0.97 | 0.96 | 0.95 | 0.95 | 0.95 | 0.96 | 0.96 | 0.97 | 0.97 | | |

Average = Sum(40)$_{1...12}$ /12= | 0.97 | (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 1.7 | (42)
   if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
   if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 74.51 | (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of
not more that 125 litres per person per day (all water use, hot and cold)

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

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

| (44)m= | 81.97 | 78.99 | 76.01 | 73.02 | 70.04 | 67.06 | 67.06 | 70.04 | 73.02 | 76.01 | 78.99 | 81.97 | | |

Total = Sum(44)$_{1...12}$ = | 894.18 | (44)

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

| (45)m= | 121.55 | 106.31 | 109.7 | 95.64 | 91.77 | 79.19 | 73.38 | 84.21 | 85.21 | 99.31 | 108.4 | 117.72 | | |

Total = Sum(45)$_{1...12}$ = | 1172.41 | (45)

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

| (46)m= | 18.23 | 15.95 | 16.46 | 14.35 | 13.77 | 11.88 | 11.01 | 12.63 | 12.78 | 14.9 | 16.26 | 17.66 | | (46) |

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day): | 1.39 | (48)

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

Energy lost from water storage, kWh/year $\qquad$ (48) x (49) = | 0.75 | (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)
If community heating see section 4.3
Volume factor from Table 2a | 0 | (52)
Temperature factor from Table 2b | 0 | (53)

Energy lost from water storage, kWh/year $\qquad$ (47) x (51) x (52) x (53) = | 0 | (54)
 Enter (50) or (54) in (55) | 0.75 | (55)

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

| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | | (56) |

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

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

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

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

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

(59)m=	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=	168.15	148.4	156.3	140.73	138.37	124.28	119.98	130.8	130.31	145.9	153.49	164.31	(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=	168.15	148.4	156.3	140.73	138.37	124.28	119.98	130.8	130.31	145.9	153.49	164.31	

Output from water heater (annual)₁...₁₂ | 1721.02 | (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=	77.69	69.02	73.75	67.87	67.79	62.4	61.68	65.27	64.41	70.3	72.12	76.42	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	(66)

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

(67)m=	13.6	12.08	9.82	7.43	5.56	4.69	5.07	6.59	8.84	11.23	13.11	13.97	(67)

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

(68)m=	147.88	149.42	145.55	137.32	126.93	117.16	110.63	109.1	112.97	121.2	131.59	141.36	(68)

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

(69)m=	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	(71)

Water heating gains (Table 5)

(72)m=	104.43	102.7	99.13	94.27	91.12	86.67	82.9	87.74	89.45	94.48	100.16	102.71	(72)

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

(73)m=	317.37	315.66	305.96	290.49	275.06	259.99	250.06	254.89	262.73	278.38	296.32	309.5	(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)	
Southeast 0.9x	0.77	x	8.55	x	36.79	x	0.63	x	0.7	=	96.14	(77)
Southeast 0.9x	0.77	x	8.55	x	62.67	x	0.63	x	0.7	=	163.77	(77)

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Southeast 0.9x	0.77	x	8.55	x	85.75	x	0.63	x	0.7	=	224.07	(77)
Southeast 0.9x	0.77	x	8.55	x	106.25	x	0.63	x	0.7	=	277.63	(77)
Southeast 0.9x	0.77	x	8.55	x	119.01	x	0.63	x	0.7	=	310.97	(77)
Southeast 0.9x	0.77	x	8.55	x	118.15	x	0.63	x	0.7	=	308.72	(77)
Southeast 0.9x	0.77	x	8.55	x	113.91	x	0.63	x	0.7	=	297.64	(77)
Southeast 0.9x	0.77	x	8.55	x	104.39	x	0.63	x	0.7	=	272.77	(77)
Southeast 0.9x	0.77	x	8.55	x	92.85	x	0.63	x	0.7	=	242.62	(77)
Southeast 0.9x	0.77	x	8.55	x	69.27	x	0.63	x	0.7	=	181	(77)
Southeast 0.9x	0.77	x	8.55	x	44.07	x	0.63	x	0.7	=	115.16	(77)
Southeast 0.9x	0.77	x	8.55	x	31.49	x	0.63	x	0.7	=	82.28	(77)

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

(83)m=	96.14	163.77	224.07	277.63	310.97	308.72	297.64	272.77	242.62	181	115.16	82.28	(83)

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

(84)m=	413.51	479.42	530.03	568.12	586.03	568.71	547.71	527.66	505.35	459.37	411.48	391.78	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) $\quad$ 21 $\quad$ (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	0.87	0.72	0.53	0.38	0.41	0.64	0.89	0.98	0.99	(86)

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

(87)m=	20.19	20.37	20.59	20.82	20.95	20.99	21	21	20.98	20.82	20.47	20.16	(87)

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

(88)m=	20.09	20.1	20.1	20.11	20.11	20.12	20.12	20.13	20.12	20.11	20.11	20.1	(88)

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

(89)m=	0.99	0.97	0.93	0.83	0.67	0.46	0.31	0.34	0.56	0.85	0.97	0.99	(89)

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

(90)m=	19.04	19.29	19.6	19.91	20.07	20.12	20.12	20.13	20.11	19.92	19.45	19	(90)

fLA = Living area ÷ (4) = $\quad$ 0.42 $\quad$ (91)

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

(92)m=	19.52	19.74	20.02	20.29	20.44	20.49	20.49	20.49	20.47	20.3	19.88	19.49	(92)

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

(93)m=	19.52	19.74	20.02	20.29	20.44	20.49	20.49	20.49	20.47	20.3	19.88	19.49	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.93	0.84	0.69	0.49	0.34	0.37	0.59	0.86	0.97	0.99	(94)

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

(95)m=	407.31	463.86	492.64	477.72	402.93	278.79	185.59	194.57	299.27	395.97	397.84	387.21	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	754.53	733.39	665.7	552.77	422.75	281.08	185.81	194.92	305.89	469.2	621.7	748.37		(97)

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

(98)m=	258.33	181.12	128.75	54.03	14.75	0	0	0	0	54.48	161.18	268.7		(98)

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =   **1121.35**   (98)

Space heating requirement in kWh/m²/year   **22.32**   (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1   **93.5**   (206)

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

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

Space heating requirement (calculated above)

	258.33	181.12	128.75	54.03	14.75	0	0	0	0	54.48	161.18	268.7	

(211)m = {[(98)m x (204)] } x 100 ÷ (206)   (211)

	276.29	193.71	137.7	57.79	15.77	0	0	0	0	58.27	172.38	287.38	

Total (kWh/year) =Sum(211)₁...₅,₁₀....₁₂=   **1199.31**   (211)

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

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

Total (kWh/year) =Sum(215)₁...₅,₁₀....₁₂=   **0**   (215)

Water heating

Output from water heater (calculated above)

	168.15	148.4	156.3	140.73	138.37	124.28	119.98	130.8	130.31	145.9	153.49	164.31	

Efficiency of water heater   **79.8**   (216)

(217)m=	85.96	85.35	84.3	82.51	80.72	79.8	79.8	79.8	79.8	82.45	84.94	86.12		(217)

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

(219)m=	195.62	173.88	185.4	170.57	171.42	155.74	150.35	163.91	163.29	176.96	180.7	190.8	

Total = Sum(219a)₁...₁₂ =   **2078.65**   (219)

Annual totals   kWh/year   kWh/year

Space heating fuel used, main system 1   **1199.31**

Water heating fuel used   **2078.65**

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   **240.1**   (232)

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

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	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	259.05	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	448.99	(264)
Space and water heating	(261) + (262) + (263) + (264) =			708.04	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	124.61	(268)
Total CO2, kg/year		sum of (265)…(271) =		871.57	(272)

TER =   17.34   (273)

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1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other	total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans						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) =	0.17	(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)		0.42	(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) =	0.35	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	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) x 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	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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=

0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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			2.12	x 1 =	2.12			(26)
Windows Type 1			9.61	x1/[1/(1.4)+ 0.04] =	12.74			(27)
Windows Type 2			3.9	x1/[1/(1.4)+ 0.04] =	5.17			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96			(29)
Walls Type2	4	2.12	1.88	x 0.18 =	0.34			(29)
Total area of elements, m²			50.63					(31)
Party wall			41.92	x 0 =	0			(32)
Party floor			71.72					(32a)
Party ceiling			71.72					(32b)
Internal wall **			142.3					(32c)

* 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) =	26.33 (33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	7629.5 (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		5.5 (36)

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

Total fabric heat loss	(33) + (36) =	31.83 (37)

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

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

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(38)m=	35.64	35.4	35.17	34.09	33.89	32.94	32.94	32.77	33.31	33.89	34.3	34.72		(38)

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

(39)m=	67.47	67.23	67	65.92	65.72	64.77	64.77	64.6	65.14	65.72	66.13	66.55		(39)

Average = Sum(39)$_{1…12}$ /12= **65.92** (39)

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

(40)m=	0.94	0.94	0.93	0.92	0.92	0.9	0.9	0.9	0.91	0.92	0.92	0.93		(40)

Average = Sum(40)$_{1…12}$ /12= **0.92** (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   **2.29**   (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   **88.52**   (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=	97.37	93.83	90.29	86.75	83.21	79.67	79.67	83.21	86.75	90.29	93.83	97.37		(44)

Total = Sum(44)$_{1…12}$ = **1062.24** (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=	144.4	126.29	130.32	113.62	109.02	94.08	87.17	100.03	101.23	117.97	128.78	139.84		(45)

Total = Sum(45)$_{1…12}$ = **1392.76** (45)

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

(46)m=	21.66	18.94	19.55	17.04	16.35	14.11	13.08	15.01	15.18	17.7	19.32	20.98		(46)

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   **1.39**   (48)

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

Energy lost from water storage, kWh/year   (48) x (49) =   **0.75**   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   **0**   (51)
If community heating see section 4.3
Volume factor from Table 2a   **0**   (52)
Temperature factor from Table 2b   **0**   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   **0**   (54)
 Enter (50) or (54) in (55)   **0.75**   (55)

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)

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

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

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

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

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

| (59)m= | 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= | 190.99 | 168.38 | 176.92 | 158.71 | 155.61 | 139.17 | 133.77 | 146.63 | 146.32 | 164.57 | 173.87 | 186.44 | (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= | 190.99 | 168.38 | 176.92 | 158.71 | 155.61 | 139.17 | 133.77 | 146.63 | 146.32 | 164.57 | 173.87 | 186.44 | |

Output from water heater (annual)$_{1...12}$ | 1941.38 | (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= | 85.29 | 75.66 | 80.61 | 73.85 | 73.52 | 67.35 | 66.26 | 70.54 | 69.73 | 76.5 | 78.89 | 83.77 | (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=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

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

| (67)m= | 18.2 | 16.17 | 13.15 | 9.95 | 7.44 | 6.28 | 6.79 | 8.82 | 11.84 | 15.04 | 17.55 | 18.71 | (67) |

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

| (68)m= | 201.28 | 203.37 | 198.1 | 186.9 | 172.75 | 159.46 | 150.58 | 148.49 | 153.75 | 164.96 | 179.1 | 192.4 | (68) |

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

| (69)m= | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | (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= | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | (71) |

Water heating gains (Table 5)

| (72)m= | 114.64 | 112.59 | 108.34 | 102.57 | 98.82 | 93.55 | 89.06 | 94.81 | 96.85 | 102.83 | 109.57 | 112.6 | (72) |

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

| (73)m= | 394.42 | 392.43 | 379.9 | 359.73 | 339.33 | 319.6 | 306.74 | 312.43 | 322.75 | 343.13 | 366.53 | 384.01 | (73) |

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.9	x	11.28	x	0.63	x	0.7	=	13.45	(75)
Northeast 0.9x	0.77	x	3.9	x	22.97	x	0.63	x	0.7	=	27.37	(75)

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	0.9x		x		x		x		=		
Northeast	0.77	x	3.9	x	41.38	x	0.63	x	0.7	=	49.32	(75)
Northeast	0.77	x	3.9	x	67.96	x	0.63	x	0.7	=	81	(75)
Northeast	0.77	x	3.9	x	91.35	x	0.63	x	0.7	=	108.87	(75)
Northeast	0.77	x	3.9	x	97.38	x	0.63	x	0.7	=	116.07	(75)
Northeast	0.77	x	3.9	x	91.1	x	0.63	x	0.7	=	108.58	(75)
Northeast	0.77	x	3.9	x	72.63	x	0.63	x	0.7	=	86.56	(75)
Northeast	0.77	x	3.9	x	50.42	x	0.63	x	0.7	=	60.1	(75)
Northeast	0.77	x	3.9	x	28.07	x	0.63	x	0.7	=	33.45	(75)
Northeast	0.77	x	3.9	x	14.2	x	0.63	x	0.7	=	16.92	(75)
Northeast	0.77	x	3.9	x	9.21	x	0.63	x	0.7	=	10.98	(75)
Northwest	0.77	x	9.61	x	11.28	x	0.63	x	0.7	=	33.14	(81)
Northwest	0.77	x	9.61	x	22.97	x	0.63	x	0.7	=	67.45	(81)
Northwest	0.77	x	9.61	x	41.38	x	0.63	x	0.7	=	121.53	(81)
Northwest	0.77	x	9.61	x	67.96	x	0.63	x	0.7	=	199.58	(81)
Northwest	0.77	x	9.61	x	91.35	x	0.63	x	0.7	=	268.28	(81)
Northwest	0.77	x	9.61	x	97.38	x	0.63	x	0.7	=	286.01	(81)
Northwest	0.77	x	9.61	x	91.1	x	0.63	x	0.7	=	267.56	(81)
Northwest	0.77	x	9.61	x	72.63	x	0.63	x	0.7	=	213.3	(81)
Northwest	0.77	x	9.61	x	50.42	x	0.63	x	0.7	=	148.08	(81)
Northwest	0.77	x	9.61	x	28.07	x	0.63	x	0.7	=	82.43	(81)
Northwest	0.77	x	9.61	x	14.2	x	0.63	x	0.7	=	41.7	(81)
Northwest	0.77	x	9.61	x	9.21	x	0.63	x	0.7	=	27.06	(81)

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

(83)m=	46.59	94.83	170.85	280.58	377.15	402.08	376.14	299.86	208.18	115.88	58.62	38.04	(83)

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

(84)m=	441.01	487.26	550.75	640.31	716.48	721.68	682.88	612.29	530.93	459.01	425.15	422.06	(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	0.98	0.93	0.78	0.57	0.42	0.48	0.78	0.97	0.99	1	(86)

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

(87)m=	20.07	20.19	20.42	20.73	20.93	20.99	21	21	20.95	20.67	20.32	20.05	(87)

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

(88)m=	20.13	20.14	20.14	20.15	20.15	20.16	20.16	20.17	20.16	20.15	20.15	20.14	(88)

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

(89)m=	1	0.99	0.98	0.91	0.73	0.5	0.34	0.4	0.71	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=	18.88	19.06	19.39	19.84	20.09	20.16	20.16	20.17	20.12	19.77	19.27	18.86	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

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

| (92)m= | 19.25 | 19.41 | 19.71 | 20.11 | 20.35 | 20.42 | 20.42 | 20.42 | 20.38 | 20.05 | 19.59 | 19.23 | (92) |

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

| (93)m= | 19.25 | 19.41 | 19.71 | 20.11 | 20.35 | 20.42 | 20.42 | 20.42 | 20.38 | 20.05 | 19.59 | 19.23 | (93) |

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

| (94)m= | 1 | 0.99 | 0.98 | 0.91 | 0.74 | 0.52 | 0.36 | 0.42 | 0.73 | 0.95 | 0.99 | 1 | (94) |

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

| (95)m= | 439.15 | 483.27 | 537.94 | 583.69 | 532.48 | 373.43 | 247.32 | 259.15 | 386.31 | 437.24 | 421.33 | 420.66 | (95) |

Monthly average external temperature from Table 8

| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

| (97)m= | 1008.42 | 975.36 | 885 | 739.1 | 568.45 | 376.82 | 247.63 | 259.92 | 409.01 | 621.19 | 826.16 | 1000.41 | (97) |

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

| (98)m= | 423.53 | 330.68 | 258.21 | 111.9 | 26.76 | 0 | 0 | 0 | 0 | 136.86 | 291.48 | 431.33 | |

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =

| 2010.75 | (98) |

Space heating requirement in kWh/m²/year

| 28.04 | (99) |

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

Space heating:

Fraction of space heat from secondary/supplementary system

| 0 | (201) |

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

| 1 | (202) |

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

| 1 | (204) |

Efficiency of main space heating system 1

| 93.5 | (206) |

Efficiency of secondary/supplementary heating system, %

| 0 | (208) |

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

Space heating requirement (calculated above)

| | 423.53 | 330.68 | 258.21 | 111.9 | 26.76 | 0 | 0 | 0 | 0 | 136.86 | 291.48 | 431.33 | |

(211)m = {[(98)m x (204)] } x 100 ÷ (206)   (211)

| | 452.98 | 353.67 | 276.17 | 119.67 | 28.62 | 0 | 0 | 0 | 0 | 146.37 | 311.74 | 461.31 | |

Total (kWh/year) =Sum(211)₁...₅,₁₀....₁₂=

| 2150.54 | (211) |

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

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

Total (kWh/year) =Sum(215)₁...₅,₁₀....₁₂=

| 0 | (215) |

Water heating

Output from water heater (calculated above)

| | 190.99 | 168.38 | 176.92 | 158.71 | 155.61 | 139.17 | 133.77 | 146.63 | 146.32 | 164.57 | 173.87 | 186.44 | |

Efficiency of water heater

| 79.8 | (216) |

| (217)m= | 86.88 | 86.58 | 85.82 | 83.9 | 81.21 | 79.8 | 79.8 | 79.8 | 79.8 | 84.33 | 86.18 | 86.98 | (217) |

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

| (219)m= | 219.84 | 194.47 | 206.15 | 189.16 | 191.62 | 174.4 | 167.63 | 183.75 | 183.36 | 195.15 | 201.74 | 214.35 | |

Total = Sum(219a)₁...₁₂ =

| 2321.62 | (219) |

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			2150.54	
Water heating fuel used			2321.62	
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			321.47	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	464.52	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	501.47	(264)
Space and water heating	(261) + (262) + (263) + (264) =			965.99	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.84	(268)
Total CO2, kg/year	sum of (265)…(271) =			1171.76	(272)

TER =	16.34	(273)

TER WorkSheet: New dwelling design stage

Assessor Name: Matt Fitzpatrick

Stroma Number: STRO003572

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.5.6

Property Address: MF - 2Bed - North West

Address : MF - 2Bed - North West, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =		0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =		0	(6b)
Number of intermittent fans							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) =	0.17	(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)	0.42	(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) =	0.35	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	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) x 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	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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=

0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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			2.12	x 1 =	2.12			(26)
Windows Type 1			9.61	x1/[1/(1.4)+ 0.04] =	12.74			(27)
Windows Type 2			3.9	x1/[1/(1.4)+ 0.04] =	5.17			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96			(29)
Walls Type2	4	2.12	1.88	x 0.18 =	0.34			(29)
Total area of elements, m²			50.63					(31)
Party wall			41.92	x 0 =	0			(32)
Party floor			71.72					(32a)
Party ceiling			71.72					(32b)
Internal wall **			142.3					(32c)

* 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) = | 26.33 | (33)

Heat capacity Cm = S(A x k) | ((28)…(30) + (32) + (32a)…(32e) = | 7629.5 | (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 | 5.5 | (36)

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

Total fabric heat loss | (33) + (36) = | 31.83 | (37)

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

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

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| (38)m= | 35.64 | 35.4 | 35.17 | 34.09 | 33.89 | 32.94 | 32.94 | 32.77 | 33.31 | 33.89 | 34.3 | 34.72 | | (38) |

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

| (39)m= | 67.47 | 67.23 | 67 | 65.92 | 65.72 | 64.77 | 64.77 | 64.6 | 65.14 | 65.72 | 66.13 | 66.55 | | |

Average = Sum(39)$_{1...12}$ /12= **65.92** (39)

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

| (40)m= | 0.94 | 0.94 | 0.93 | 0.92 | 0.92 | 0.9 | 0.9 | 0.9 | 0.91 | 0.92 | 0.92 | 0.93 | | |

Average = Sum(40)$_{1...12}$ /12= **0.92** (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 $\qquad$ **2.29** (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 $\qquad$ **88.52** (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | |

Total = Sum(44)$_{1...12}$ = **1062.24** (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | |

Total = Sum(45)$_{1...12}$ = **1392.76** (45)

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

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel $\qquad$ **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): $\qquad$ **1.39** (48)
Temperature factor from Table 2b $\qquad$ **0.54** (49)
Energy lost from water storage, kWh/year $\qquad$ (48) x (49) = **0.75** (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) $\qquad$ **0** (51)
If community heating see section 4.3
Volume factor from Table 2a $\qquad$ **0** (52)
Temperature factor from Table 2b $\qquad$ **0** (53)
Energy lost from water storage, kWh/year $\qquad$ (47) x (51) x (52) x (53) = **0** (54)
 Enter (50) or (54) in (55) $\qquad$ **0.75** (55)
Water storage loss calculated for each month $\qquad$ ((56)m = (55) × (41)m

| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | | (56) |

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

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

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

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

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

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

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

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

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= | 190.99 | 168.38 | 176.92 | 158.71 | 155.61 | 139.17 | 133.77 | 146.63 | 146.32 | 164.57 | 173.87 | 186.44 | (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= | 190.99 | 168.38 | 176.92 | 158.71 | 155.61 | 139.17 | 133.77 | 146.63 | 146.32 | 164.57 | 173.87 | 186.44 | |

Output from water heater (annual)$_{1...12}$ | 1941.38 | (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= | 85.29 | 75.66 | 80.61 | 73.85 | 73.52 | 67.35 | 66.26 | 70.54 | 69.73 | 76.5 | 78.89 | 83.77 | (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=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

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

| (67)m= | 18.2 | 16.17 | 13.15 | 9.95 | 7.44 | 6.28 | 6.79 | 8.82 | 11.84 | 15.04 | 17.55 | 18.71 | (67) |

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

| (68)m= | 201.28 | 203.37 | 198.1 | 186.9 | 172.75 | 159.46 | 150.58 | 148.49 | 153.75 | 164.96 | 179.1 | 192.4 | (68) |

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

| (69)m= | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | (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= | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | (71) |

Water heating gains (Table 5)

| (72)m= | 114.64 | 112.59 | 108.34 | 102.57 | 98.82 | 93.55 | 89.06 | 94.81 | 96.85 | 102.83 | 109.57 | 112.6 | (72) |

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

| (73)m= | 394.42 | 392.43 | 379.9 | 359.73 | 339.33 | 319.6 | 306.74 | 312.43 | 322.75 | 343.13 | 366.53 | 384.01 | (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)	
Southwest 0.9x	0.77	x	3.9	x	36.79		0.63	x	0.7	=	43.85	(79)
Southwest 0.9x	0.77	x	3.9	x	62.67		0.63	x	0.7	=	74.7	(79)

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Southwest 0.9x	0.77	x	3.9	x	85.75		0.63	x	0.7	=	102.21	(79)
Southwest 0.9x	0.77	x	3.9	x	106.25		0.63	x	0.7	=	126.64	(79)
Southwest 0.9x	0.77	x	3.9	x	119.01		0.63	x	0.7	=	141.85	(79)
Southwest 0.9x	0.77	x	3.9	x	118.15		0.63	x	0.7	=	140.82	(79)
Southwest 0.9x	0.77	x	3.9	x	113.91		0.63	x	0.7	=	135.77	(79)
Southwest 0.9x	0.77	x	3.9	x	104.39		0.63	x	0.7	=	124.42	(79)
Southwest 0.9x	0.77	x	3.9	x	92.85		0.63	x	0.7	=	110.67	(79)
Southwest 0.9x	0.77	x	3.9	x	69.27		0.63	x	0.7	=	82.56	(79)
Southwest 0.9x	0.77	x	3.9	x	44.07		0.63	x	0.7	=	52.53	(79)
Southwest 0.9x	0.77	x	3.9	x	31.49		0.63	x	0.7	=	37.53	(79)
Northwest 0.9x	0.77	x	9.61	x	11.28	x	0.63	x	0.7	=	33.14	(81)
Northwest 0.9x	0.77	x	9.61	x	22.97	x	0.63	x	0.7	=	67.45	(81)
Northwest 0.9x	0.77	x	9.61	x	41.38	x	0.63	x	0.7	=	121.53	(81)
Northwest 0.9x	0.77	x	9.61	x	67.96	x	0.63	x	0.7	=	199.58	(81)
Northwest 0.9x	0.77	x	9.61	x	91.35	x	0.63	x	0.7	=	268.28	(81)
Northwest 0.9x	0.77	x	9.61	x	97.38	x	0.63	x	0.7	=	286.01	(81)
Northwest 0.9x	0.77	x	9.61	x	91.1	x	0.63	x	0.7	=	267.56	(81)
Northwest 0.9x	0.77	x	9.61	x	72.63	x	0.63	x	0.7	=	213.3	(81)
Northwest 0.9x	0.77	x	9.61	x	50.42	x	0.63	x	0.7	=	148.08	(81)
Northwest 0.9x	0.77	x	9.61	x	28.07	x	0.63	x	0.7	=	82.43	(81)
Northwest 0.9x	0.77	x	9.61	x	14.2	x	0.63	x	0.7	=	41.7	(81)
Northwest 0.9x	0.77	x	9.61	x	9.21	x	0.63	x	0.7	=	27.06	(81)

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

| (83)m= | 76.99 | 142.15 | 223.73 | 326.22 | 410.13 | 426.83 | 403.33 | 337.72 | 258.75 | 164.99 | 94.22 | 64.59 | | (83) |

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

| (84)m= | 471.41 | 534.58 | 603.64 | 685.95 | 749.45 | 746.43 | 710.06 | 650.15 | 581.51 | 508.12 | 460.75 | 448.6 | | (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	0.91	0.76	0.55	0.4	0.46	0.73	0.95	0.99	1	(86)

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

| (87)m= | 20.11 | 20.25 | 20.48 | 20.77 | 20.94 | 20.99 | 21 | 21 | 20.97 | 20.73 | 20.37 | 20.08 | (87) |

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

| (88)m= | 20.13 | 20.14 | 20.14 | 20.15 | 20.15 | 20.16 | 20.16 | 20.17 | 20.16 | 20.15 | 20.15 | 20.14 | (88) |

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

| (89)m= | 1 | 0.99 | 0.97 | 0.89 | 0.71 | 0.48 | 0.32 | 0.37 | 0.66 | 0.93 | 0.99 | 1 | (89) |

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

| (90)m= | 18.94 | 19.15 | 19.48 | 19.89 | 20.1 | 20.16 | 20.16 | 20.17 | 20.13 | 19.84 | 19.33 | 18.92 | (90) |

fLA = Living area ÷ (4) =   0.31 (91)

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

(92)m=	19.3	19.49	19.79	20.16	20.36	20.42	20.42	20.42	20.39	20.12	19.65	19.28	(92)

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

(93)m=	19.3	19.49	19.79	20.16	20.36	20.42	20.42	20.42	20.39	20.12	19.65	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=	0.99	0.99	0.97	0.89	0.72	0.5	0.35	0.4	0.68	0.93	0.99	1	(94)

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

(95)m=	468.67	527.87	583.07	610.08	538.93	374.03	247.39	259.39	394.22	472.87	454.74	446.6	(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=	1012.02	980.82	890.54	742.24	569.15	376.89	247.64	259.95	409.86	625.46	830.2	1003.54	(97)

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

(98)m=	404.26	304.38	228.76	95.15	22.49	0	0	0	0	113.53	270.33	414.36

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 1853.26 | (98)

Space heating requirement in kWh/m²/year | 25.84 | (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 | 93.5 | (206)

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

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

Space heating requirement (calculated above)

	404.26	304.38	228.76	95.15	22.49	0	0	0	0	113.53	270.33	414.36

(211)m = {[(98)m x (204)] } x 100 ÷ (206) | | (211)

	432.36	325.54	244.66	101.77	24.05	0	0	0	0	121.42	289.12	443.17

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= | 1982.09 | (211)

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

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

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

Water heating

Output from water heater (calculated above)

	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44

Efficiency of water heater | 79.8 | (216)

(217)m=	86.77	86.38	85.5	83.5	81.01	79.8	79.8	79.8	79.8	83.85	85.99	86.88	(217)

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

(219)m=	220.12	194.94	206.92	190.07	192.09	174.4	167.63	183.75	183.36	196.27	202.2	214.58

Total = Sum(219a)$_{1...12}$ = | 2326.34 | (219)

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Annual totals	kWh/year	kWh/year	
Space heating fuel used, main system 1		1982.09	
Water heating fuel used		2326.34	
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		321.47	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	428.13	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	502.49	(264)
Space and water heating	(261) + (262) + (263) + (264) =			930.62	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.84	(268)
Total CO2, kg/year	sum of (265)…(271) =			1136.39	(272)

TER = 15.84 (273)

TER WorkSheet: New dwelling design stage

Property Address: MF - 2Bed - South East

Address : MF - 2Bed - South East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =		0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =		0	(6b)
Number of intermittent fans							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) =	0.17	(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)	0.42	(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) =	0.35	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	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=
0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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=
0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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			2.12	x 1 =	2.12			(26)
Windows Type 1			9.61	x1/[1/(1.4)+ 0.04] =	12.74			(27)
Windows Type 2			3.9	x1/[1/(1.4)+ 0.04] =	5.17			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96			(29)
Walls Type2	4	2.12	1.88	x 0.18 =	0.34			(29)
Total area of elements, m²			50.63					(31)
Party wall			41.92	x 0 =	0			(32)
Party floor			71.72					(32a)
Party ceiling			71.72					(32b)
Internal wall **			142.3					(32c)

* 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) =
26.33	(33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =
7629.5	(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
5.5	(36)

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

Total fabric heat loss   (33) + (36) =
31.83	(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= | 35.64 | 35.4 | 35.17 | 34.09 | 33.89 | 32.94 | 32.94 | 32.77 | 33.31 | 33.89 | 34.3 | 34.72 | | (38) |

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

| (39)m= | 67.47 | 67.23 | 67 | 65.92 | 65.72 | 64.77 | 64.77 | 64.6 | 65.14 | 65.72 | 66.13 | 66.55 | | |

Average = Sum(39)$_{1...12}$ /12=   65.92   (39)

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

| (40)m= | 0.94 | 0.94 | 0.93 | 0.92 | 0.92 | 0.9 | 0.9 | 0.9 | 0.91 | 0.92 | 0.92 | 0.93 | | |

Average = Sum(40)$_{1...12}$ /12=   0.92   (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   2.29   (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   88.52   (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | |

Total = Sum(44)$_{1...12}$ =   1062.24   (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | |

Total = Sum(45)$_{1...12}$ =   1392.76   (45)

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

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   1.39   (48)
Temperature factor from Table 2b   0.54   (49)
Energy lost from water storage, kWh/year   (48) x (49) =   0.75   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   0   (51)
If community heating see section 4.3
Volume factor from Table 2a   0   (52)
Temperature factor from Table 2b   0   (53)
Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   0   (54)
 Enter (50) or (54) in (55)   0.75   (55)
Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | | (56) |

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

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

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

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

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

(59)m=	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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	(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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	

Output from water heater (annual)₁…₁₂ | 1941.38 | (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=	85.29	75.66	80.61	73.85	73.52	67.35	66.26	70.54	69.73	76.5	78.89	83.77	(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=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

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

(67)m=	18.2	16.17	13.15	9.95	7.44	6.28	6.79	8.82	11.84	15.04	17.55	18.71	(67)

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

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

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

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	114.64	112.59	108.34	102.57	98.82	93.55	89.06	94.81	96.85	102.83	109.57	112.6	(72)

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

(73)m=	394.42	392.43	379.9	359.73	339.33	319.6	306.74	312.43	322.75	343.13	366.53	384.01	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.9	x	11.28	x	0.63	x	0.7	=	13.45	(75)
Northeast 0.9x	0.77	x	3.9	x	22.97	x	0.63	x	0.7	=	27.37	(75)

Orientation												(ref)
Northeast	0.9x	0.77	x	3.9	x	41.38	x	0.63	x	0.7	=	49.32	(75)
Northeast	0.9x	0.77	x	3.9	x	67.96	x	0.63	x	0.7	=	81	(75)
Northeast	0.9x	0.77	x	3.9	x	91.35	x	0.63	x	0.7	=	108.87	(75)
Northeast	0.9x	0.77	x	3.9	x	97.38	x	0.63	x	0.7	=	116.07	(75)
Northeast	0.9x	0.77	x	3.9	x	91.1	x	0.63	x	0.7	=	108.58	(75)
Northeast	0.9x	0.77	x	3.9	x	72.63	x	0.63	x	0.7	=	86.56	(75)
Northeast	0.9x	0.77	x	3.9	x	50.42	x	0.63	x	0.7	=	60.1	(75)
Northeast	0.9x	0.77	x	3.9	x	28.07	x	0.63	x	0.7	=	33.45	(75)
Northeast	0.9x	0.77	x	3.9	x	14.2	x	0.63	x	0.7	=	16.92	(75)
Northeast	0.9x	0.77	x	3.9	x	9.21	x	0.63	x	0.7	=	10.98	(75)
Southeast	0.9x	0.77	x	9.61	x	36.79	x	0.63	x	0.7	=	108.06	(77)
Southeast	0.9x	0.77	x	9.61	x	62.67	x	0.63	x	0.7	=	184.07	(77)
Southeast	0.9x	0.77	x	9.61	x	85.75	x	0.63	x	0.7	=	251.85	(77)
Southeast	0.9x	0.77	x	9.61	x	106.25	x	0.63	x	0.7	=	312.05	(77)
Southeast	0.9x	0.77	x	9.61	x	119.01	x	0.63	x	0.7	=	349.53	(77)
Southeast	0.9x	0.77	x	9.61	x	118.15	x	0.63	x	0.7	=	347	(77)
Southeast	0.9x	0.77	x	9.61	x	113.91	x	0.63	x	0.7	=	334.54	(77)
Southeast	0.9x	0.77	x	9.61	x	104.39	x	0.63	x	0.7	=	306.59	(77)
Southeast	0.9x	0.77	x	9.61	x	92.85	x	0.63	x	0.7	=	272.7	(77)
Southeast	0.9x	0.77	x	9.61	x	69.27	x	0.63	x	0.7	=	203.43	(77)
Southeast	0.9x	0.77	x	9.61	x	44.07	x	0.63	x	0.7	=	129.43	(77)
Southeast	0.9x	0.77	x	9.61	x	31.49	x	0.63	x	0.7	=	92.48	(77)

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

(83)m=	121.51	211.44	301.17	393.05	458.4	463.07	443.13	393.15	332.8	236.89	146.35	103.46	(83)

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

(84)m=	515.93	603.87	681.07	752.78	797.73	782.67	749.86	705.58	655.55	580.02	512.89	487.47	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.88	0.72	0.52	0.38	0.42	0.66	0.92	0.99	1	(86)

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

(87)m=	20.16	20.34	20.57	20.82	20.95	20.99	21	21	20.98	20.79	20.44	20.14	(87)

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

(88)m=	20.13	20.14	20.14	20.15	20.15	20.16	20.16	20.17	20.16	20.15	20.15	20.14	(88)

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

(89)m=	0.99	0.98	0.95	0.85	0.67	0.46	0.31	0.34	0.59	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=	19.02	19.27	19.6	19.95	20.11	20.16	20.16	20.17	20.15	19.93	19.43	18.99	(90)

fLA = Living area ÷ (4) =   0.31   (91)

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

(92)m=	19.38	19.6	19.9	20.22	20.37	20.42	20.42	20.42	20.4	20.2	19.74	19.35	(92)

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

(93)m=	19.38	19.6	19.9	20.22	20.37	20.42	20.42	20.42	20.4	20.2	19.74	19.35	(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	0.85	0.69	0.48	0.33	0.37	0.61	0.89	0.98	0.99	(94)

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

(95)m=	511.33	590.86	643.95	642.9	546.52	374.72	247.46	259.62	401.44	517.1	502.07	484.21	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1017.25	988.56	898.02	746.09	569.98	376.96	247.65	259.97	410.63	630.72	835.93	1008.08	(97)

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

(98)m=	376.41	267.25	189.03	74.29	17.46	0	0	0	0	84.53	240.38	389.76	

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = **1639.11** (98)

Space heating requirement in kWh/m²/year **22.85** (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 **93.5** (206)

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

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

Space heating requirement (calculated above)

	376.41	267.25	189.03	74.29	17.46	0	0	0	0	84.53	240.38	389.76	

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

	402.57	285.83	202.17	79.46	18.67	0	0	0	0	90.41	257.09	416.86	

Total (kWh/year) =Sum(211)₁...₅,₁₀....₁₂= **1753.05** (211)

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

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

Total (kWh/year) =Sum(215)₁...₅,₁₀....₁₂= **0** (215)

Water heating

Output from water heater (calculated above)

	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	

Efficiency of water heater **79.8** (216)

(217)m=	86.59	86.04	84.99	82.93	80.76	79.8	79.8	79.8	79.8	83.14	85.68	86.74	(217)

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

(219)m=	220.57	195.7	208.16	191.39	192.68	174.4	167.63	183.75	183.36	197.95	202.93	214.95	

Total = Sum(219a)₁...₁₂ = **2333.46** (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			1753.05	
Water heating fuel used			2333.46	
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			321.47	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	378.66	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	504.03	(264)
Space and water heating	(261) + (262) + (263) + (264) =			882.69	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.84	(268)
Total CO2, kg/year	sum of (265)…(271) =			1088.46	(272)

TER = 15.18 (273)

TER WorkSheet: New dwelling design stage

Property Address: MF - 2Bed - South West

Address : MF - 2Bed - South West , Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							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) =	0.17	(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)		0.42	(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) =	0.35	(21)

Infiltration rate modified for monthly wind speed

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	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) x 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	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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=

0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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			2.12	x 1 =	2.12			(26)
Windows Type 1			9.61	x1/[1/(1.4)+ 0.04] =	12.74			(27)
Windows Type 2			3.9	x1/[1/(1.4)+ 0.04] =	5.17			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96			(29)
Walls Type2	4	2.12	1.88	x 0.18 =	0.34			(29)
Total area of elements, m²			50.63					(31)
Party wall			41.92	x 0 =	0			(32)
Party floor			71.72					(32a)
Party ceiling			71.72					(32b)
Internal wall **			142.3					(32c)

* 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) =	26.33	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	7629.5	(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		5.5	(36)

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

Total fabric heat loss	(33) + (36) =	31.83	(37)

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

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

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| (38)m= | 35.64 | 35.4 | 35.17 | 34.09 | 33.89 | 32.94 | 32.94 | 32.77 | 33.31 | 33.89 | 34.3 | 34.72 | | (38) |

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

| (39)m= | 67.47 | 67.23 | 67 | 65.92 | 65.72 | 64.77 | 64.77 | 64.6 | 65.14 | 65.72 | 66.13 | 66.55 | | (39) |

Average = Sum(39)$_{1...12}$ /12= **65.92** (39)

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

| (40)m= | 0.94 | 0.94 | 0.93 | 0.92 | 0.92 | 0.9 | 0.9 | 0.9 | 0.91 | 0.92 | 0.92 | 0.93 | | (40) |

Average = Sum(40)$_{1...12}$ /12= **0.92** (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   **2.29** (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   **88.52** (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | (44) |

Total = Sum(44)$_{1...12}$ = **1062.24** (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | (45) |

Total = Sum(45)$_{1...12}$ = **1392.76** (45)

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

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

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

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

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

Water storage loss:

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

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

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

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

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

If community heating see section 4.3

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

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

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

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

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

| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | | (56) |

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

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

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

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

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

| (59)m= | 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= | 190.99 | 168.38 | 176.92 | 158.71 | 155.61 | 139.17 | 133.77 | 146.63 | 146.32 | 164.57 | 173.87 | 186.44 | (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= | 190.99 | 168.38 | 176.92 | 158.71 | 155.61 | 139.17 | 133.77 | 146.63 | 146.32 | 164.57 | 173.87 | 186.44 | |

Output from water heater (annual)$_{1...12}$ | 1941.38 | (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= | 85.29 | 75.66 | 80.61 | 73.85 | 73.52 | 67.35 | 66.26 | 70.54 | 69.73 | 76.5 | 78.89 | 83.77 | (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=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

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

| (67)m= | 18.2 | 16.17 | 13.15 | 9.95 | 7.44 | 6.28 | 6.79 | 8.82 | 11.84 | 15.04 | 17.55 | 18.71 | (67) |

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

| (68)m= | 201.28 | 203.37 | 198.1 | 186.9 | 172.75 | 159.46 | 150.58 | 148.49 | 153.75 | 164.96 | 179.1 | 192.4 | (68) |

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

| (69)m= | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | (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= | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | (71) |

Water heating gains (Table 5)

| (72)m= | 114.64 | 112.59 | 108.34 | 102.57 | 98.82 | 93.55 | 89.06 | 94.81 | 96.85 | 102.83 | 109.57 | 112.6 | (72) |

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

| (73)m= | 394.42 | 392.43 | 379.9 | 359.73 | 339.33 | 319.6 | 306.74 | 312.43 | 322.75 | 343.13 | 366.53 | 384.01 | (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)	
Southeast 0.9x	0.77	x 9.61	x 36.79	x 0.63	x 0.7	= 108.06	(77)
Southeast 0.9x	0.77	x 9.61	x 62.67	x 0.63	x 0.7	= 184.07	(77)

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Southeast 0.9x	0.77	x	9.61	x	85.75	x	0.63	x	0.7	=	251.85	(77)
Southeast 0.9x	0.77	x	9.61	x	106.25	x	0.63	x	0.7	=	312.05	(77)
Southeast 0.9x	0.77	x	9.61	x	119.01	x	0.63	x	0.7	=	349.53	(77)
Southeast 0.9x	0.77	x	9.61	x	118.15	x	0.63	x	0.7	=	347	(77)
Southeast 0.9x	0.77	x	9.61	x	113.91	x	0.63	x	0.7	=	334.54	(77)
Southeast 0.9x	0.77	x	9.61	x	104.39	x	0.63	x	0.7	=	306.59	(77)
Southeast 0.9x	0.77	x	9.61	x	92.85	x	0.63	x	0.7	=	272.7	(77)
Southeast 0.9x	0.77	x	9.61	x	69.27	x	0.63	x	0.7	=	203.43	(77)
Southeast 0.9x	0.77	x	9.61	x	44.07	x	0.63	x	0.7	=	129.43	(77)
Southeast 0.9x	0.77	x	9.61	x	31.49	x	0.63	x	0.7	=	92.48	(77)
Southwest 0.9x	0.77	x	3.9	x	36.79		0.63	x	0.7	=	43.85	(79)
Southwest 0.9x	0.77	x	3.9	x	62.67		0.63	x	0.7	=	74.7	(79)
Southwest 0.9x	0.77	x	3.9	x	85.75		0.63	x	0.7	=	102.21	(79)
Southwest 0.9x	0.77	x	3.9	x	106.25		0.63	x	0.7	=	126.64	(79)
Southwest 0.9x	0.77	x	3.9	x	119.01		0.63	x	0.7	=	141.85	(79)
Southwest 0.9x	0.77	x	3.9	x	118.15		0.63	x	0.7	=	140.82	(79)
Southwest 0.9x	0.77	x	3.9	x	113.91		0.63	x	0.7	=	135.77	(79)
Southwest 0.9x	0.77	x	3.9	x	104.39		0.63	x	0.7	=	124.42	(79)
Southwest 0.9x	0.77	x	3.9	x	92.85		0.63	x	0.7	=	110.67	(79)
Southwest 0.9x	0.77	x	3.9	x	69.27		0.63	x	0.7	=	82.56	(79)
Southwest 0.9x	0.77	x	3.9	x	44.07		0.63	x	0.7	=	52.53	(79)
Southwest 0.9x	0.77	x	3.9	x	31.49		0.63	x	0.7	=	37.53	(79)

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

(83)m=	151.92	258.77	354.06	438.7	491.37	487.82	470.31	431.01	383.37	285.99	181.96	130.01		(83)

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

(84)m=	546.34	651.2	733.96	798.43	830.7	807.42	777.05	743.44	706.12	629.12	548.49	514.02		(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.86	0.7	0.51	0.37	0.4	0.62	0.89	0.98	0.99	(86)

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

(87)m=	20.2	20.39	20.62	20.85	20.96	21	21	21	20.99	20.83	20.48	20.17	(87)

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

(88)m=	20.13	20.14	20.14	20.15	20.15	20.16	20.16	20.17	20.16	20.15	20.15	20.14	(88)

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

(89)m=	0.99	0.97	0.93	0.82	0.65	0.44	0.3	0.33	0.55	0.86	0.98	0.99	(89)

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

(90)m=	19.08	19.36	19.68	19.98	20.12	20.16	20.16	20.17	20.15	19.98	19.49	19.04	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

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

(92)m=	19.43	19.68	19.97	20.25	20.38	20.42	20.42	20.42	20.41	20.24	19.8	19.39	(92)

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

(93)m=	19.43	19.68	19.97	20.25	20.38	20.42	20.42	20.42	20.41	20.24	19.8	19.39	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.93	0.83	0.66	0.46	0.32	0.35	0.57	0.86	0.97	0.99	(94)

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

(95)m=	539.99	631.92	681.51	661.58	550.66	375.1	247.5	259.72	404.48	541.83	533.08	509.59	(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=	1020.77	993.61	902.62	748.25	570.43	377	247.65	259.99	410.95	633.61	839.69	1011.16	(97)

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

(98)m=	357.7	243.06	164.5	62.4	14.71	0	0	0	0	68.29	220.77	373.17

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = **1504.59** (98)

Space heating requirement in kWh/m²/year **20.98** (99)

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

Space heating:

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

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

Space heating requirement (calculated above)

357.7	243.06	164.5	62.4	14.71	0	0	0	0	68.29	220.77	373.17

(211)m = {[(98)m x (204)] } x 100 ÷ (206)   (211)

382.57	259.95	175.94	66.74	15.73	0	0	0	0	73.03	236.11	399.11

Total (kWh/year) =Sum(211)₁...₅,₁₀....₁₂= **1609.19** (211)

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

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

Total (kWh/year) =Sum(215)₁...₅,₁₀....₁₂= **0** (215)

Water heating

Output from water heater (calculated above)

190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44

Efficiency of water heater		79.8	(216)

(217)m=	86.46	85.79	84.62	82.55	80.62	79.8	79.8	79.8	79.8	82.67	85.45	86.63	(217)

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

(219)m=	220.89	196.26	209.07	192.25	193.01	174.4	167.63	183.75	183.36	199.07	203.47	215.21

Total = Sum(219a)₁...₁₂ = **2338.38** (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			1609.19	
Water heating fuel used			2338.38	
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			321.47	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	347.58	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	505.09	(264)
Space and water heating	(261) + (262) + (263) + (264) =			852.68	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.84	(268)
Total CO2, kg/year	sum of (265)…(271) =			1058.44	(272)

TER = 14.76 (273)

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Property Address: TF - 1Bed - South

Address : TF - 1Bed - South, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.25	(1a) x	2.5	(2a) =	125.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.25	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.62	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.16	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.41	(18)

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

Number of sides sheltered		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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.44	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			2.12	x 1	= 2.12			(26)
Windows			8.55	x1/[1/(1.4)+ 0.04] =	11.34			(27)
Walls Type1	23.19	8.55	14.64	x 0.18	= 2.64			(29)
Walls Type2	12.4	2.12	10.28	x 0.18	= 1.85			(29)
Walls Type3	14	0	14	x 0.18	= 2.52			(29)
Roof	50.25	0	50.25	x 0.13	= 6.53			(30)
Total area of elements, m²			99.84					(31)
Party wall			30.53	x 0	= 0			(32)
Party floor			50.25					(32a)
Internal wall **			90.21					(32c)

* 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) = | 26.99 | (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = | 4429.62 | (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium | 250 | (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 15.49 | (36)

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

Total fabric heat loss (33) + (36) = | 42.48 | (37)

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

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

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| (38)m= | 24.8 | 24.65 | 24.49 | 23.76 | 23.63 | 22.99 | 22.99 | 22.87 | 23.24 | 23.63 | 23.9 | 24.19 | | | (38) |

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

| (39)m= | 67.29 | 67.13 | 66.97 | 66.25 | 66.11 | 65.47 | 65.47 | 65.36 | 65.72 | 66.11 | 66.39 | 66.67 | | | |

Average = Sum(39)$_{1...12}$ /12= | 66.25 | (39)

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

| (40)m= | 1.34 | 1.34 | 1.33 | 1.32 | 1.32 | 1.3 | 1.3 | 1.3 | 1.31 | 1.32 | 1.32 | 1.33 | | | |

Average = Sum(40)$_{1...12}$ /12= | 1.32 | (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 1.7 | (42)
   if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
   if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 74.51 | (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of

not more that 125 litres per person per day (all water use, hot and cold)

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

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

| (44)m= | 81.97 | 78.99 | 76.01 | 73.02 | 70.04 | 67.06 | 67.06 | 70.04 | 73.02 | 76.01 | 78.99 | 81.97 | | | |

Total = Sum(44)$_{1...12}$ = | 894.18 | (44)

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

| (45)m= | 121.55 | 106.31 | 109.7 | 95.64 | 91.77 | 79.19 | 73.38 | 84.21 | 85.21 | 99.31 | 108.4 | 117.72 | | | |

Total = Sum(45)$_{1...12}$ = | 1172.41 | (45)

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

| (46)m= | 18.23 | 15.95 | 16.46 | 14.35 | 13.77 | 11.88 | 11.01 | 12.63 | 12.78 | 14.9 | 16.26 | 17.66 | | | (46) |

Water storage loss:

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

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

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

Water storage loss:

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

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

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

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

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

If community heating see section 4.3

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

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

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

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

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

| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | | | (56) |

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

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

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

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

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

(59)m=	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=	168.15	148.4	156.3	140.73	138.37	124.28	119.98	130.8	130.31	145.9	153.49	164.31	(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=	168.15	148.4	156.3	140.73	138.37	124.28	119.98	130.8	130.31	145.9	153.49	164.31	

Output from water heater (annual)₁...₁₂ | 1721.02 | (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=	77.69	69.02	73.75	67.87	67.79	62.4	61.68	65.27	64.41	70.3	72.12	76.42	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	(66)

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

(67)m=	13.6	12.08	9.82	7.43	5.56	4.69	5.07	6.59	8.84	11.23	13.11	13.97	(67)

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

(68)m=	147.88	149.42	145.55	137.32	126.93	117.16	110.63	109.1	112.97	121.2	131.59	141.36	(68)

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

(69)m=	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	(71)

Water heating gains (Table 5)

(72)m=	104.43	102.7	99.13	94.27	91.12	86.67	82.9	87.74	89.45	94.48	100.16	102.71	(72)

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

(73)m=	317.37	315.66	305.96	290.49	275.06	259.99	250.06	254.89	262.73	278.38	296.32	309.5	(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)	
Southeast 0.9x	0.77	x 8.55	x 36.79	x 0.63	x 0.7	= 96.14	(77)
Southeast 0.9x	0.77	x 8.55	x 62.67	x 0.63	x 0.7	= 163.77	(77)

Southeast 0.9x	0.77	x	8.55	x	85.75	x	0.63	x	0.7	=	224.07	(77)
Southeast 0.9x	0.77	x	8.55	x	106.25	x	0.63	x	0.7	=	277.63	(77)
Southeast 0.9x	0.77	x	8.55	x	119.01	x	0.63	x	0.7	=	310.97	(77)
Southeast 0.9x	0.77	x	8.55	x	118.15	x	0.63	x	0.7	=	308.72	(77)
Southeast 0.9x	0.77	x	8.55	x	113.91	x	0.63	x	0.7	=	297.64	(77)
Southeast 0.9x	0.77	x	8.55	x	104.39	x	0.63	x	0.7	=	272.77	(77)
Southeast 0.9x	0.77	x	8.55	x	92.85	x	0.63	x	0.7	=	242.62	(77)
Southeast 0.9x	0.77	x	8.55	x	69.27	x	0.63	x	0.7	=	181	(77)
Southeast 0.9x	0.77	x	8.55	x	44.07	x	0.63	x	0.7	=	115.16	(77)
Southeast 0.9x	0.77	x	8.55	x	31.49	x	0.63	x	0.7	=	82.28	(77)

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

(83)m=	96.14	163.77	224.07	277.63	310.97	308.72	297.64	272.77	242.62	181	115.16	82.28	(83)

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

(84)m=	413.51	479.42	530.03	568.12	586.03	568.71	547.71	527.66	505.35	459.37	411.48	391.78	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.93	0.84	0.68	0.51	0.55	0.77	0.94	0.99	0.99	(86)

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

(87)m=	19.71	19.9	20.17	20.5	20.78	20.94	20.99	20.98	20.89	20.54	20.06	19.68	(87)

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

(88)m=	19.81	19.81	19.82	19.83	19.83	19.84	19.84	19.84	19.83	19.83	19.82	19.82	(88)

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

(89)m=	0.99	0.98	0.96	0.9	0.78	0.58	0.38	0.42	0.68	0.91	0.98	0.99	(89)

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

(90)m=	18.13	18.41	18.8	19.27	19.62	19.8	19.83	19.83	19.75	19.32	18.65	18.09	(90)

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

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

(92)m=	18.79	19.03	19.37	19.78	20.1	20.28	20.32	20.31	20.23	19.83	19.24	18.75	(92)

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

(93)m=	18.79	19.03	19.37	19.78	20.1	20.28	20.32	20.31	20.23	19.83	19.24	18.75	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.95	0.9	0.8	0.62	0.44	0.48	0.72	0.91	0.98	0.99	(94)

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

(95)m=	408.26	467.89	505.14	511.89	466.62	351.2	239.94	250.87	361.87	419.61	401.49	387.77	(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)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m− (96)m]

(97)m=	975.25	948.68	862.2	720.97	555.5	371.7	243.34	255.81	402.6	610.24	806.1	970.38		(97)

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

(98)m=	421.84	323.09	265.66	150.54	66.12	0	0	0	0	141.83	291.32	433.46		(98)

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = **2093.86** (98)

Space heating requirement in kWh/m²/year **41.67** (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 **93.5** (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	421.84	323.09	265.66	150.54	66.12	0	0	0	0	141.83	291.32	433.46	

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

	451.16	345.55	284.12	161.01	70.72	0	0	0	0	151.69	311.57	463.6	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= **2239.42** (211)

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

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

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

Water heating

Output from water heater (calculated above)

	168.15	148.4	156.3	140.73	138.37	124.28	119.98	130.8	130.31	145.9	153.49	164.31

Efficiency of water heater **79.8** (216)

(217)m=	87.17	86.84	86.22	84.99	82.97	79.8	79.8	79.8	79.8	84.74	86.5	87.28		(217)

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

(219)m=	192.9	170.89	181.28	165.58	166.76	155.74	150.35	163.91	163.29	172.18	177.45	188.25

Total = Sum(219a)$_{1...12}$ = **2048.61** (219)

Annual totals kWh/year kWh/year

Space heating fuel used, main system 1 **2239.42**

Water heating fuel used **2048.61**

Electricity for pumps, fans and electric keep-hot

  central heating pump: **30** (230c)

  boiler with a fan-assisted flue **45** (230e)

Total electricity for the above, kWh/year sum of (230a)…(230g) = **75** (231)

Electricity for lighting **240.1** (232)

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

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	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	483.72	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	442.5	(264)
Space and water heating	(261) + (262) + (263) + (264) =				926.21	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	124.61	(268)
Total CO2, kg/year			sum of (265)…(271) =		1089.75	(272)

TER =   21.69   (273)

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Property Address: TF - 2Bed - North East

Address : TF - 2Bed - North East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other	total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans						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) =	0.17	(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)		0.42	(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) =	0.35	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	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=
| 0.6 | 0.6 | 0.59 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 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=
| 0.6 | 0.6 | 0.59 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 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			2.12	x 1 =	2.12			(26)
Windows Type 1			3.9	x1/[1/(1.4)+ 0.04] =	5.17			(27)
Windows Type 2			9.61	x1/[1/(1.4)+ 0.04] =	12.74			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96			(29)
Walls Type2	4	2.12	1.88	x 0.18 =	0.34			(29)
Roof	71.72	0	71.72	x 0.13 =	9.32			(30)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0			(32)
Party floor			71.72					(32a)
Internal wall **			142.3					(32c)

* 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) = | 35.65 | (33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) = | 6123.38 | (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   Indicative Value: Medium | 250 | (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 18.1 | (36)

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

Total fabric heat loss   (33) + (36) = | 53.76 | (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= | 35.64 | 35.4 | 35.17 | 34.09 | 33.89 | 32.94 | 32.94 | 32.77 | 33.31 | 33.89 | 34.3 | 34.72 | | (38) |

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

| (39)m= | 89.39 | 89.16 | 88.93 | 87.85 | 87.65 | 86.7 | 86.7 | 86.53 | 87.07 | 87.65 | 88.05 | 88.48 |

Average = Sum(39)$_{1...12}$ /12= 87.85 (39)

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

| (40)m= | 1.25 | 1.24 | 1.24 | 1.22 | 1.22 | 1.21 | 1.21 | 1.21 | 1.21 | 1.22 | 1.23 | 1.23 |

Average = Sum(40)$_{1...12}$ /12= 1.22 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.29 (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 88.52 (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 |

Total = Sum(44)$_{1...12}$ = 1062.24 (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 |

Total = Sum(45)$_{1...12}$ = 1392.76 (45)

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

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | (46) |

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)
Temperature factor from Table 2b 0.54 (49)
Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)
If community heating see section 4.3
Volume factor from Table 2a 0 (52)
Temperature factor from Table 2b 0 (53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)
 Enter (50) or (54) in (55) 0.75 (55)
Water storage loss calculated for each month ((56)m = (55) × (41)m)

| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | (56) |

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

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

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

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

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

(59)m=	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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	(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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	

Output from water heater (annual)$_{1...12}$	1941.38	(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=	85.29	75.66	80.61	73.85	73.52	67.35	66.26	70.54	69.73	76.5	78.89	83.77	(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=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

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

(67)m=	18.2	16.17	13.15	9.95	7.44	6.28	6.79	8.82	11.84	15.04	17.55	18.71	(67)

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

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

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

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	114.64	112.59	108.34	102.57	98.82	93.55	89.06	94.81	96.85	102.83	109.57	112.6	(72)

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

(73)m=	394.42	392.43	379.9	359.73	339.33	319.6	306.74	312.43	322.75	343.13	366.53	384.01	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.9	x	11.28	x	0.63	x	0.7	=	13.45	(75)
Northeast 0.9x	0.77	x	3.9	x	22.97	x	0.63	x	0.7	=	27.37	(75)

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	0.9x	0.77	x	3.9	x	41.38	x	0.63	x	0.7	=	49.32	(75)
Northeast		0.77	x	3.9	x	67.96	x	0.63	x	0.7	=	81	(75)
Northeast		0.77	x	3.9	x	91.35	x	0.63	x	0.7	=	108.87	(75)
Northeast		0.77	x	3.9	x	97.38	x	0.63	x	0.7	=	116.07	(75)
Northeast		0.77	x	3.9	x	91.1	x	0.63	x	0.7	=	108.58	(75)
Northeast		0.77	x	3.9	x	72.63	x	0.63	x	0.7	=	86.56	(75)
Northeast		0.77	x	3.9	x	50.42	x	0.63	x	0.7	=	60.1	(75)
Northeast		0.77	x	3.9	x	28.07	x	0.63	x	0.7	=	33.45	(75)
Northeast		0.77	x	3.9	x	14.2	x	0.63	x	0.7	=	16.92	(75)
Northeast		0.77	x	3.9	x	9.21	x	0.63	x	0.7	=	10.98	(75)
Northwest		0.77	x	9.61	x	11.28	x	0.63	x	0.7	=	33.14	(81)
Northwest		0.77	x	9.61	x	22.97	x	0.63	x	0.7	=	67.45	(81)
Northwest		0.77	x	9.61	x	41.38	x	0.63	x	0.7	=	121.53	(81)
Northwest		0.77	x	9.61	x	67.96	x	0.63	x	0.7	=	199.58	(81)
Northwest		0.77	x	9.61	x	91.35	x	0.63	x	0.7	=	268.28	(81)
Northwest		0.77	x	9.61	x	97.38	x	0.63	x	0.7	=	286.01	(81)
Northwest		0.77	x	9.61	x	91.1	x	0.63	x	0.7	=	267.56	(81)
Northwest		0.77	x	9.61	x	72.63	x	0.63	x	0.7	=	213.3	(81)
Northwest		0.77	x	9.61	x	50.42	x	0.63	x	0.7	=	148.08	(81)
Northwest		0.77	x	9.61	x	28.07	x	0.63	x	0.7	=	82.43	(81)
Northwest		0.77	x	9.61	x	14.2	x	0.63	x	0.7	=	41.7	(81)
Northwest		0.77	x	9.61	x	9.21	x	0.63	x	0.7	=	27.06	(81)

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

(83)m=	46.59	94.83	170.85	280.58	377.15	402.08	376.14	299.86	208.18	115.88	58.62	38.04		(83)

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

(84)m=	441.01	487.26	550.75	640.31	716.48	721.68	682.88	612.29	530.93	459.01	425.15	422.06		(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	0.62	0.87	0.98	1	1	(86)

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

(87)m=	19.65	19.78	20.04	20.42	20.76	20.94	20.99	20.98	20.82	20.4	19.97	19.63	(87)

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

(88)m=	19.88	19.89	19.89	19.9	19.9	19.91	19.91	19.91	19.91	19.9	19.9	19.89	(88)

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

(89)m=	1	0.99	0.99	0.95	0.83	0.61	0.42	0.49	0.81	0.97	0.99	1	(89)

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

(90)m=	18.09	18.28	18.67	19.22	19.67	19.87	19.91	19.9	19.76	19.2	18.57	18.07	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

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

(92)m=	18.57	18.74	19.09	19.59	20	20.2	20.24	20.24	20.09	19.58	19	18.55		(92)

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

(93)m=	18.57	18.74	19.09	19.59	20	20.2	20.24	20.24	20.09	19.58	19	18.55		(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.94	0.83	0.64	0.46	0.53	0.82	0.97	0.99	1		(94)

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

(95)m=	439.07	483.59	540.85	603.67	597.3	459.82	311.66	323.89	435.69	443.85	421.71	420.55		(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1275.6	1234.3	1119.82	939.36	727.8	485.92	315.8	331.98	521.65	786.62	1047.85	1269.65		(97)

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

(98)m=	622.38	504.48	430.75	241.7	97.09	0	0	0	0	255.02	450.82	631.73

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = | 3233.96 | (98)

Space heating requirement in kWh/m²/year | 45.09 | (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 | 93.5 | (206)

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

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

Space heating requirement (calculated above)

	622.38	504.48	430.75	241.7	97.09	0	0	0	0	255.02	450.82	631.73

(211)m = {[(98)m x (204)] } x 100 ÷ (206)   (211)

	665.64	539.55	460.7	258.5	103.84	0	0	0	0	272.75	482.16	675.64

Total (kWh/year) =Sum(211)₁...₅,₁₀....₁₂= | 3458.78 | (211)

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

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

Total (kWh/year) =Sum(215)₁...₅,₁₀....₁₂= | 0 | (215)

Water heating

Output from water heater (calculated above)

	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44

Efficiency of water heater | 79.8 | (216)

(217)m=	87.74	87.56	87.1	85.93	83.6	79.8	79.8	79.8	79.8	85.98	87.24	87.82		(217)

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

(219)m=	217.69	192.3	203.12	184.69	186.15	174.4	167.63	183.75	183.36	191.41	199.29	212.3

Total = Sum(219a)₁...₁₂ = | 2296.08 | (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			3458.78	
Water heating fuel used			2296.08	
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			321.47	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	747.1	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	495.95	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1243.05	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.84	(268)
Total CO2, kg/year	sum of (265)…(271) =			1448.82	(272)

TER =   20.2   (273)

TER WorkSheet: New dwelling design stage

Property Address: TF - 2Bed - North West

Address : TF - 2Bed - North West, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							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) =	0.17	(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)		0.42	(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) =		0.35	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	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=
0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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=
0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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			2.12	x 1 =	2.12			(26)
Windows Type 1			9.61	x1/[1/(1.4)+ 0.04] =	12.74			(27)
Windows Type 2			3.9	x1/[1/(1.4)+ 0.04] =	5.17			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96			(29)
Walls Type2	4	2.12	1.88	x 0.18 =	0.34			(29)
Roof	71.72	0	71.72	x 0.13 =	9.32			(30)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0			(32)
Party floor			71.72					(32a)
Internal wall **			142.3					(32c)

* 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) =	35.65 (33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6123.38 (34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		18.1 (36)

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

Total fabric heat loss	(33) + (36) =	53.76 (37)

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

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

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(38)m=	35.64	35.4	35.17	34.09	33.89	32.94	32.94	32.77	33.31	33.89	34.3	34.72		(38)

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

(39)m=	89.39	89.16	88.93	87.85	87.65	86.7	86.7	86.53	87.07	87.65	88.05	88.48		(39)

Average = Sum(39)$_{1...12}$ /12= 87.85 (39)

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

(40)m=	1.25	1.24	1.24	1.22	1.22	1.21	1.21	1.21	1.21	1.22	1.23	1.23		(40)

Average = Sum(40)$_{1...12}$ /12= 1.22 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.29 (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 88.52 (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=	97.37	93.83	90.29	86.75	83.21	79.67	79.67	83.21	86.75	90.29	93.83	97.37		(44)

Total = Sum(44)$_{1...12}$ = 1062.24 (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=	144.4	126.29	130.32	113.62	109.02	94.08	87.17	100.03	101.23	117.97	128.78	139.84		(45)

Total = Sum(45)$_{1...12}$ = 1392.76 (45)

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

(46)m=	21.66	18.94	19.55	17.04	16.35	14.11	13.08	15.01	15.18	17.7	19.32	20.98		(46)

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)
If community heating see section 4.3
Volume factor from Table 2a 0 (52)
Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)
 Enter (50) or (54) in (55) 0.75 (55)

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)

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

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

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

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

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

(59)m=	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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	(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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	

Output from water heater (annual)₁...₁₂ | 1941.38 | (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=	85.29	75.66	80.61	73.85	73.52	67.35	66.26	70.54	69.73	76.5	78.89	83.77	(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=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

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

(67)m=	18.2	16.17	13.15	9.95	7.44	6.28	6.79	8.82	11.84	15.04	17.55	18.71	(67)

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

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

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

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	114.64	112.59	108.34	102.57	98.82	93.55	89.06	94.81	96.85	102.83	109.57	112.6	(72)

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

(73)m=	394.42	392.43	379.9	359.73	339.33	319.6	306.74	312.43	322.75	343.13	366.53	384.01	(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)	
Southwest 0.9x	0.77	x	3.9	x	36.79		0.63	x	0.7	=	43.85	(79)
Southwest 0.9x	0.77	x	3.9	x	62.67		0.63	x	0.7	=	74.7	(79)

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Orientation													Ref
Southwest 0.9x	0.77	x	3.9	x	85.75			0.63	x	0.7	=	102.21	(79)
Southwest 0.9x	0.77	x	3.9	x	106.25			0.63	x	0.7	=	126.64	(79)
Southwest 0.9x	0.77	x	3.9	x	119.01			0.63	x	0.7	=	141.85	(79)
Southwest 0.9x	0.77	x	3.9	x	118.15			0.63	x	0.7	=	140.82	(79)
Southwest 0.9x	0.77	x	3.9	x	113.91			0.63	x	0.7	=	135.77	(79)
Southwest 0.9x	0.77	x	3.9	x	104.39			0.63	x	0.7	=	124.42	(79)
Southwest 0.9x	0.77	x	3.9	x	92.85			0.63	x	0.7	=	110.67	(79)
Southwest 0.9x	0.77	x	3.9	x	69.27			0.63	x	0.7	=	82.56	(79)
Southwest 0.9x	0.77	x	3.9	x	44.07			0.63	x	0.7	=	52.53	(79)
Southwest 0.9x	0.77	x	3.9	x	31.49			0.63	x	0.7	=	37.53	(79)
Northwest 0.9x	0.77	x	9.61	x	11.28	x		0.63	x	0.7	=	33.14	(81)
Northwest 0.9x	0.77	x	9.61	x	22.97	x		0.63	x	0.7	=	67.45	(81)
Northwest 0.9x	0.77	x	9.61	x	41.38	x		0.63	x	0.7	=	121.53	(81)
Northwest 0.9x	0.77	x	9.61	x	67.96	x		0.63	x	0.7	=	199.58	(81)
Northwest 0.9x	0.77	x	9.61	x	91.35	x		0.63	x	0.7	=	268.28	(81)
Northwest 0.9x	0.77	x	9.61	x	97.38	x		0.63	x	0.7	=	286.01	(81)
Northwest 0.9x	0.77	x	9.61	x	91.1	x		0.63	x	0.7	=	267.56	(81)
Northwest 0.9x	0.77	x	9.61	x	72.63	x		0.63	x	0.7	=	213.3	(81)
Northwest 0.9x	0.77	x	9.61	x	50.42	x		0.63	x	0.7	=	148.08	(81)
Northwest 0.9x	0.77	x	9.61	x	28.07	x		0.63	x	0.7	=	82.43	(81)
Northwest 0.9x	0.77	x	9.61	x	14.2	x		0.63	x	0.7	=	41.7	(81)
Northwest 0.9x	0.77	x	9.61	x	9.21	x		0.63	x	0.7	=	27.06	(81)

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

(83)m=	76.99	142.15	223.73	326.22	410.13	426.83	403.33	337.72	258.75	164.99	94.22	64.59		(83)

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

(84)m=	471.41	534.58	603.64	685.95	749.45	746.43	710.06	650.15	581.51	508.12	460.75	448.6		(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.95	0.86	0.69	0.52	0.59	0.84	0.97	0.99	1	(86)

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

(87)m=	19.68	19.84	20.1	20.47	20.78	20.95	20.99	20.98	20.86	20.46	20.01	19.66	(87)

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

(88)m=	19.88	19.89	19.89	19.9	19.9	19.91	19.91	19.91	19.91	19.9	19.9	19.89	(88)

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

(89)m=	1	0.99	0.98	0.93	0.81	0.59	0.4	0.46	0.77	0.96	0.99	1	(89)

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

(90)m=	18.14	18.37	18.76	19.28	19.69	19.88	19.91	19.91	19.79	19.28	18.63	18.11	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

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

(92)m=	18.62	18.82	19.18	19.65	20.03	20.21	20.24	20.24	20.12	19.65	19.06	18.59	(92)

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

(93)m=	18.62	18.82	19.18	19.65	20.03	20.21	20.24	20.24	20.12	19.65	19.06	18.59	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.98	0.93	0.82	0.62	0.44	0.5	0.78	0.95	0.99	1	(94)

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

(95)m=	468.72	528.85	588.64	637.65	611.64	463.02	312.35	325.79	455.08	484.66	455.69	446.56	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1280.14	1241.24	1127.19	944.57	729.89	486.35	315.89	332.24	524.4	792.86	1053.01	1273.59	(97)

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

(98)m=	603.7	478.73	400.69	220.98	87.97	0	0	0	0	229.3	430.07	615.31	

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = **3066.75** (98)

Space heating requirement in kWh/m²/year **42.76** (99)

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

Space heating:

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

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

Space heating requirement (calculated above)

	603.7	478.73	400.69	220.98	87.97	0	0	0	0	229.3	430.07	615.31	

(211)m = {[(98)m x (204)] } x 100 ÷ (206)   (211)

	645.66	512.01	428.54	236.35	94.09	0	0	0	0	245.24	459.97	658.09	

Total (kWh/year) =Sum(211)₁...₅,₁₀....₁₂= **3279.95** (211)

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

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

Total (kWh/year) =Sum(215)₁...₅,₁₀....₁₂= **0** (215)

Water heating

Output from water heater (calculated above)

	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	

Efficiency of water heater **79.8** (216)

(217)m=	87.67	87.45	86.93	85.7	83.36	79.8	79.8	79.8	79.8	85.7	87.14	87.76	(217)

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

(219)m=	217.84	192.54	203.52	185.2	186.68	174.4	167.63	183.75	183.36	192.03	199.54	212.43	

Total = Sum(219a)₁...₁₂ = **2298.92** (219)

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Annual totals	kWh/year	kWh/year	
Space heating fuel used, main system 1		3279.95	
Water heating fuel used		2298.92	
Electricity for pumps, fans and electric keep-hot			
central heating pump:		30	(230c)
boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		321.47	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	708.47	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	496.57	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1205.04	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.84	(268)
Total CO2, kg/year	sum of (265)…(271) =			1410.81	(272)

TER = 19.67 (273)

TER WorkSheet: New dwelling design stage

Property Address: TF - 2Bed - South East

Address : TF - 2Bed - South East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =		0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =		0	(6b)
Number of intermittent fans							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) =	0.17	(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)	0.42	(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) =	0.35	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	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=
| 0.6 | 0.6 | 0.59 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 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=
| 0.6 | 0.6 | 0.59 | 0.58 | 0.57 | 0.56 | 0.56 | 0.55 | 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			2.12	x 1 =	2.12			(26)
Windows Type 1			3.9	x1/[1/(1.4)+ 0.04] =	5.17			(27)
Windows Type 2			9.61	x1/[1/(1.4)+ 0.04] =	12.74			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96			(29)
Walls Type2	4	2.12	1.88	x 0.18 =	0.34			(29)
Roof	71.72	0	71.72	x 0.13 =	9.32			(30)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0			(32)
Party floor			71.72					(32a)
Internal wall **			142.3					(32c)

* 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) = | 35.65 | (33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) = | 6123.38 | (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   Indicative Value: Medium | 250 | (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 18.1 | (36)

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

Total fabric heat loss   (33) + (36) = | 53.76 | (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= | 35.64 | 35.4 | 35.17 | 34.09 | 33.89 | 32.94 | 32.94 | 32.77 | 33.31 | 33.89 | 34.3 | 34.72 | | (38) |

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

| (39)m= | 89.39 | 89.16 | 88.93 | 87.85 | 87.65 | 86.7 | 86.7 | 86.53 | 87.07 | 87.65 | 88.05 | 88.48 | | |

Average = Sum(39)$_{1...12}$ /12= | 87.85 | (39)

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

| (40)m= | 1.25 | 1.24 | 1.24 | 1.22 | 1.22 | 1.21 | 1.21 | 1.21 | 1.21 | 1.22 | 1.23 | 1.23 | | |

Average = Sum(40)$_{1...12}$ /12= | 1.22 | (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.29 | (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 | 88.52 | (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | |

Total = Sum(44)$_{1...12}$ = | 1062.24 | (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | |

Total = Sum(45)$_{1...12}$ = | 1392.76 | (45)

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

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

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

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

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

Water storage loss:

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

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

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

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

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

If community heating see section 4.3

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

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

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

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

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

| (56)m= | 23.33 | 21.07 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | 23.33 | 22.58 | 23.33 | 22.58 | 23.33 | | (56) |

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

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

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

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

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

(59)m=	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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	(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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	

Output from water heater (annual)₁...₁₂   [1941.38]   (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=	85.29	75.66	80.61	73.85	73.52	67.35	66.26	70.54	69.73	76.5	78.89	83.77	(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=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

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

(67)m=	18.2	16.17	13.15	9.95	7.44	6.28	6.79	8.82	11.84	15.04	17.55	18.71	(67)

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

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

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

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	114.64	112.59	108.34	102.57	98.82	93.55	89.06	94.81	96.85	102.83	109.57	112.6	(72)

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

(73)m=	394.42	392.43	379.9	359.73	339.33	319.6	306.74	312.43	322.75	343.13	366.53	384.01	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.9	x	11.28	x	0.63	x	0.7	=	13.45	(75)
Northeast 0.9x	0.77	x	3.9	x	22.97	x	0.63	x	0.7	=	27.37	(75)

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Northeast	0.9x	0.77	x	3.9	x	41.38	x	0.63	x	0.7	=	49.32	(75)
Northeast	0.9x	0.77	x	3.9	x	67.96	x	0.63	x	0.7	=	81	(75)
Northeast	0.9x	0.77	x	3.9	x	91.35	x	0.63	x	0.7	=	108.87	(75)
Northeast	0.9x	0.77	x	3.9	x	97.38	x	0.63	x	0.7	=	116.07	(75)
Northeast	0.9x	0.77	x	3.9	x	91.1	x	0.63	x	0.7	=	108.58	(75)
Northeast	0.9x	0.77	x	3.9	x	72.63	x	0.63	x	0.7	=	86.56	(75)
Northeast	0.9x	0.77	x	3.9	x	50.42	x	0.63	x	0.7	=	60.1	(75)
Northeast	0.9x	0.77	x	3.9	x	28.07	x	0.63	x	0.7	=	33.45	(75)
Northeast	0.9x	0.77	x	3.9	x	14.2	x	0.63	x	0.7	=	16.92	(75)
Northeast	0.9x	0.77	x	3.9	x	9.21	x	0.63	x	0.7	=	10.98	(75)
Southeast	0.9x	0.77	x	9.61	x	36.79	x	0.63	x	0.7	=	108.06	(77)
Southeast	0.9x	0.77	x	9.61	x	62.67	x	0.63	x	0.7	=	184.07	(77)
Southeast	0.9x	0.77	x	9.61	x	85.75	x	0.63	x	0.7	=	251.85	(77)
Southeast	0.9x	0.77	x	9.61	x	106.25	x	0.63	x	0.7	=	312.05	(77)
Southeast	0.9x	0.77	x	9.61	x	119.01	x	0.63	x	0.7	=	349.53	(77)
Southeast	0.9x	0.77	x	9.61	x	118.15	x	0.63	x	0.7	=	347	(77)
Southeast	0.9x	0.77	x	9.61	x	113.91	x	0.63	x	0.7	=	334.54	(77)
Southeast	0.9x	0.77	x	9.61	x	104.39	x	0.63	x	0.7	=	306.59	(77)
Southeast	0.9x	0.77	x	9.61	x	92.85	x	0.63	x	0.7	=	272.7	(77)
Southeast	0.9x	0.77	x	9.61	x	69.27	x	0.63	x	0.7	=	203.43	(77)
Southeast	0.9x	0.77	x	9.61	x	44.07	x	0.63	x	0.7	=	129.43	(77)
Southeast	0.9x	0.77	x	9.61	x	31.49	x	0.63	x	0.7	=	92.48	(77)

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

(83)m=	121.51	211.44	301.17	393.05	458.4	463.07	443.13	393.15	332.8	236.89	146.35	103.46	(83)

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

(84)m=	515.93	603.87	681.07	752.78	797.73	782.67	749.86	705.58	655.55	580.02	512.89	487.47	(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	0.66	0.5	0.55	0.79	0.95	0.99	1	(86)

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

(87)m=	19.74	19.92	20.2	20.54	20.81	20.95	20.99	20.99	20.89	20.54	20.08	19.71	(87)

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

(88)m=	19.88	19.89	19.89	19.9	19.9	19.91	19.91	19.91	19.91	19.9	19.9	19.89	(88)

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

(89)m=	0.99	0.99	0.97	0.91	0.78	0.57	0.38	0.43	0.71	0.93	0.99	1	(89)

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

(90)m=	18.22	18.49	18.89	19.37	19.72	19.88	19.91	19.91	19.83	19.38	18.72	18.19	(90)

fLA = Living area ÷ (4) = | 0.31 | (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=	18.69	18.93	19.29	19.73	20.06	20.22	20.24	20.24	20.16	19.74	19.14	18.66		(92)

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

(93)m=	18.69	18.93	19.29	19.73	20.06	20.22	20.24	20.24	20.16	19.74	19.14	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:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(94)m=	0.99	0.98	0.96	0.91	0.79	0.6	0.42	0.46	0.73	0.93	0.98	0.99		(94)

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

(95)m=	511.75	593.72	655.63	683.63	630.39	467.05	313.17	327.83	477.01	539.73	504.48	484.38		(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=	1286.74	1251.24	1137.57	951.59	732.59	486.88	316	332.51	527.45	801.27	1060.45	1279.34		(97)

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

(98)m=	576.59	441.85	358.56	192.93	76.04	0	0	0	0	194.59	400.3	591.45		

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = **2832.32** (98)

Space heating requirement in kWh/m²/year **39.49** (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 **93.5** (206)

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

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

Space heating requirement (calculated above)

576.59	441.85	358.56	192.93	76.04	0	0	0	0	194.59	400.3	591.45	

(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)

616.68	472.57	383.49	206.34	81.33	0	0	0	0	208.12	428.13	632.56

Total (kWh/year) =Sum(211)₁...₅,₁₀....₁₂= **3029.22** (211)

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

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

Total (kWh/year) =Sum(215)₁...₅,₁₀....₁₂= **0** (215)

Water heating

Output from water heater (calculated above)

190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44

Efficiency of water heater **79.8** (216)

(217)m=	87.58	87.27	86.66	85.34	83.02	79.8	79.8	79.8	79.8	85.26	86.97	87.68	(217)

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

(219)m=	218.08	192.94	204.15	185.98	187.44	174.4	167.63	183.75	183.36	193.02	199.92	212.63	

Total = Sum(219a)₁...₁₂ **2303.29** (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			3029.22	
Water heating fuel used			2303.29	
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			321.47	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	654.31	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	497.51	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1151.82	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.84	(268)
Total CO2, kg/year	sum of (265)…(271) =			1357.59	(272)

TER =

18.93	(273)

TER WorkSheet: New dwelling design stage

Property Address: TF - 2Bed - South West

Address : TF - 2Bed - South West, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =		0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =		0	(6b)
Number of intermittent fans							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) =	0.17	(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)	0.42	(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) =	0.35	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	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=

0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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=

0.6	0.6	0.59	0.58	0.57	0.56	0.56	0.55	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			2.12	x 1	= 2.12			(26)
Windows Type 1			9.61	x1/[1/(1.4)+ 0.04]	= 12.74			(27)
Windows Type 2			3.9	x1/[1/(1.4)+ 0.04]	= 5.17			(27)
Walls Type1	46.63	13.51	33.12	x 0.18	= 5.96			(29)
Walls Type2	4	2.12	1.88	x 0.18	= 0.34			(29)
Roof	71.72	0	71.72	x 0.13	= 9.32			(30)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0	= 0			(32)
Party floor			71.72					(32a)
Internal wall **			142.3					(32c)

* 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) =   ☐ 35.65 (33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =   ☐ 6123.38 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   Indicative Value: Medium   ☐ 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K   ☐ 18.1 (36)

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

Total fabric heat loss   (33) + (36) =   ☐ 53.76 (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=	35.64	35.4	35.17	34.09	33.89	32.94	32.94	32.77	33.31	33.89	34.3	34.72		(38)

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

(39)m=	89.39	89.16	88.93	87.85	87.65	86.7	86.7	86.53	87.07	87.65	88.05	88.48		

Average = Sum(39)$_{1...12}$ /12=   87.85   (39)

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

(40)m=	1.25	1.24	1.24	1.22	1.22	1.21	1.21	1.21	1.21	1.22	1.23	1.23		

Average = Sum(40)$_{1...12}$ /12=   1.22   (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   2.29   (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   88.52   (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=	97.37	93.83	90.29	86.75	83.21	79.67	79.67	83.21	86.75	90.29	93.83	97.37		

Total = Sum(44)$_{1...12}$ =   1062.24   (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=	144.4	126.29	130.32	113.62	109.02	94.08	87.17	100.03	101.23	117.97	128.78	139.84		

Total = Sum(45)$_{1...12}$ =   1392.76   (45)

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

(46)m=	21.66	18.94	19.55	17.04	16.35	14.11	13.08	15.01	15.18	17.7	19.32	20.98		(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b   0.54   (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a   0   (52)

Temperature factor from Table 2b   0   (53)

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

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

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)

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

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

TER WorkSheet: New dwelling design stage

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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	(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=	190.99	168.38	176.92	158.71	155.61	139.17	133.77	146.63	146.32	164.57	173.87	186.44	

Output from water heater (annual)₁...₁₂ | 1941.38 | (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=	85.29	75.66	80.61	73.85	73.52	67.35	66.26	70.54	69.73	76.5	78.89	83.77	(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=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

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

(67)m=	18.2	16.17	13.15	9.95	7.44	6.28	6.79	8.82	11.84	15.04	17.55	18.71	(67)

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

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

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

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	114.64	112.59	108.34	102.57	98.82	93.55	89.06	94.81	96.85	102.83	109.57	112.6	(72)

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

(73)m=	394.42	392.43	379.9	359.73	339.33	319.6	306.74	312.43	322.75	343.13	366.53	384.01	(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)	
Southeast 0.9x	0.77	x 9.61	x 36.79	x 0.63	x 0.7	= 108.06	(77)
Southeast 0.9x	0.77	x 9.61	x 62.67	x 0.63	x 0.7	= 184.07	(77)

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Orientation							Result	Ref
Southeast	0.9x 0.77	x 9.61	x 85.75	x 0.63	x 0.7	=	251.85	(77)
Southeast	0.9x 0.77	x 9.61	x 106.25	x 0.63	x 0.7	=	312.05	(77)
Southeast	0.9x 0.77	x 9.61	x 119.01	x 0.63	x 0.7	=	349.53	(77)
Southeast	0.9x 0.77	x 9.61	x 118.15	x 0.63	x 0.7	=	347	(77)
Southeast	0.9x 0.77	x 9.61	x 113.91	x 0.63	x 0.7	=	334.54	(77)
Southeast	0.9x 0.77	x 9.61	x 104.39	x 0.63	x 0.7	=	306.59	(77)
Southeast	0.9x 0.77	x 9.61	x 92.85	x 0.63	x 0.7	=	272.7	(77)
Southeast	0.9x 0.77	x 9.61	x 69.27	x 0.63	x 0.7	=	203.43	(77)
Southeast	0.9x 0.77	x 9.61	x 44.07	x 0.63	x 0.7	=	129.43	(77)
Southeast	0.9x 0.77	x 9.61	x 31.49	x 0.63	x 0.7	=	92.48	(77)
Southwest	0.9x 0.77	x 3.9	x 36.79	x 0.63	x 0.7	=	43.85	(79)
Southwest	0.9x 0.77	x 3.9	x 62.67	x 0.63	x 0.7	=	74.7	(79)
Southwest	0.9x 0.77	x 3.9	x 85.75	x 0.63	x 0.7	=	102.21	(79)
Southwest	0.9x 0.77	x 3.9	x 106.25	x 0.63	x 0.7	=	126.64	(79)
Southwest	0.9x 0.77	x 3.9	x 119.01	x 0.63	x 0.7	=	141.85	(79)
Southwest	0.9x 0.77	x 3.9	x 118.15	x 0.63	x 0.7	=	140.82	(79)
Southwest	0.9x 0.77	x 3.9	x 113.91	x 0.63	x 0.7	=	135.77	(79)
Southwest	0.9x 0.77	x 3.9	x 104.39	x 0.63	x 0.7	=	124.42	(79)
Southwest	0.9x 0.77	x 3.9	x 92.85	x 0.63	x 0.7	=	110.67	(79)
Southwest	0.9x 0.77	x 3.9	x 69.27	x 0.63	x 0.7	=	82.56	(79)
Southwest	0.9x 0.77	x 3.9	x 44.07	x 0.63	x 0.7	=	52.53	(79)
Southwest	0.9x 0.77	x 3.9	x 31.49	x 0.63	x 0.7	=	37.53	(79)

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

| (83)m= | 151.92 | 258.77 | 354.06 | 438.7 | 491.37 | 487.82 | 470.31 | 431.01 | 383.37 | 285.99 | 181.96 | 130.01 | | (83) |

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

| (84)m= | 546.34 | 651.2 | 733.96 | 798.43 | 830.7 | 807.42 | 777.05 | 743.44 | 706.12 | 629.12 | 548.49 | 514.02 | | (84) |

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.92	0.82	0.65	0.48	0.52	0.76	0.94	0.99	1	(86)

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

| (87)m= | 19.78 | 19.98 | 20.25 | 20.58 | 20.83 | 20.96 | 20.99 | 20.99 | 20.91 | 20.59 | 20.12 | 19.74 | (87) |

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

| (88)m= | 19.88 | 19.89 | 19.89 | 19.9 | 19.9 | 19.91 | 19.91 | 19.91 | 19.91 | 19.9 | 19.9 | 19.89 | (88) |

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

| (89)m= | 0.99 | 0.98 | 0.96 | 0.9 | 0.76 | 0.55 | 0.37 | 0.41 | 0.67 | 0.92 | 0.98 | 0.99 | (89) |

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

| (90)m= | 18.28 | 18.57 | 18.97 | 19.42 | 19.74 | 19.89 | 19.91 | 19.91 | 19.85 | 19.45 | 18.79 | 18.24 | (90) |

fLA = Living area ÷ (4) = | 0.31 | (91)

TER WorkSheet: New dwelling design stage

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

| (92)m= | 18.74 | 19.01 | 19.37 | 19.78 | 20.08 | 20.22 | 20.25 | 20.24 | 20.18 | 19.8 | 19.2 | 18.7 | | (92) |

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

| (93)m= | 18.74 | 19.01 | 19.37 | 19.78 | 20.08 | 20.22 | 20.25 | 20.24 | 20.18 | 19.8 | 19.2 | 18.7 | | (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 | 0.89 | 0.77 | 0.58 | 0.4 | 0.44 | 0.69 | 0.91 | 0.98 | 0.99 | | (94) |

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

| (95)m= | 540.83 | 636.86 | 699.07 | 712.41 | 641.75 | 469.41 | 313.62 | 328.85 | 488.38 | 573.88 | 537.04 | 510.01 | | (95) |

Monthly average external temperature from Table 8

| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

| (97)m= | 1291.22 | 1257.91 | 1144.31 | 955.95 | 734.21 | 487.19 | 316.06 | 332.64 | 529.01 | 806.46 | 1065.43 | 1283.24 | | (97) |

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

| (98)m= | 558.28 | 417.34 | 331.26 | 175.35 | 68.79 | 0 | 0 | 0 | 0 | 173.05 | 380.44 | 575.28 | | |

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =   **2679.79**   (98)

Space heating requirement in kWh/m²/year   **37.36**   (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system	0	(201)
Fraction of space heat from main system(s) (202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1	93.5	(206)
Efficiency of secondary/supplementary heating system, %	0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year

Space heating requirement (calculated above)

| | 558.28 | 417.34 | 331.26 | 175.35 | 68.79 | 0 | 0 | 0 | 0 | 173.05 | 380.44 | 575.28 | |

(211)m = {[(98)m x (204)] } x 100 ÷ (206)   (211)

| | 597.1 | 446.35 | 354.29 | 187.55 | 73.57 | 0 | 0 | 0 | 0 | 185.08 | 406.89 | 615.27 | |

Total (kWh/year) =Sum(211)₁...₅,₁₀....₁₂=   **2866.09**   (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

Total (kWh/year) =Sum(215)₁...₅,₁₀....₁₂=   **0**   (215)

Water heating

Output from water heater (calculated above)

| | 190.99 | 168.38 | 176.92 | 158.71 | 155.61 | 139.17 | 133.77 | 146.63 | 146.32 | 164.57 | 173.87 | 186.44 | |

Efficiency of water heater   **79.8**   (216)

| (217)m= | 87.51 | 87.14 | 86.46 | 85.08 | 82.8 | 79.8 | 79.8 | 79.8 | 79.8 | 84.95 | 86.85 | 87.62 | | (217) |

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

| (219)m= | 218.26 | 193.23 | 204.61 | 186.54 | 187.94 | 174.4 | 167.63 | 183.75 | 183.36 | 193.73 | 200.2 | 212.77 | |

Total = Sum(219a)₁...₁₂ =   **2306.41**   (219)

TER WorkSheet: New dwelling design stage

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			2866.09	
Water heating fuel used			2306.41	
Electricity for pumps, fans and electric keep-hot				
central heating pump:			30	(230c)
boiler with a fan-assisted flue			45	(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			321.47	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	619.08	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	498.18	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1117.26	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	166.84	(268)
Total CO2, kg/year	sum of (265)…(271) =				1323.03	(272)

TER =	18.45	(273)

Be Lean SAP Calculations

DER WorkSheet: New dwelling design stage

Property Address: 1F - 1Bed - North East

Address : 1F - 1Bed - North East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	52.77	(1a) x	2.5	(2a) =	131.93	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.77	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		131.93	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0 (9)
Additional infiltration	[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0 (12)
If no draught lobby, enter 0.05, else enter 0		0 (13)
Percentage of windows and doors draught stripped		0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.23 (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) =	0.2 (21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

	0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

	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=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=
0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			3	x1/[1/(1.2)+ 0.04] =	3.44			(27)
Windows Type 2			7.36	x1/[1/(1.2)+ 0.04] =	8.43			(27)
Floor			52.77	x 0.12 =	6.3324	75	3957.75	(28)
Walls Type1	35.99	10.36	25.63	x 0.18 =	4.61	14	358.82	(29)
Walls Type2	22.12	2.12	20	x 0.23 =	4.51	14	280	(29)
Total area of elements, m²			110.88					(31)
Party wall			21.28	x 0 =	0	20	425.6	(32)
Party ceiling			52.77			30	1583.1	(32b)
Internal wall **			106.14			9	955.26	(32c)

* 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) =	30.5	(33)

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	7560.53	(34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	143.27	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		14.5	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	45	(37)

Ventilation heat loss calculated monthly · · · · · · · · · (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 21.85 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | | (38) |

Heat transfer coefficient, W/K $\quad$ (39)m = (37) + (38)m

| (39)m= | 66.85 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 | | |

Average = Sum(39)$_{1...12}$ /12= $\quad$ 66.77 $\quad$ (39)

Heat loss parameter (HLP), W/m²K $\quad$ (40)m = (39)m ÷ (4)

| (40)m= | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | | |

Average = Sum(40)$_{1...12}$ /12= $\quad$ 1.27 $\quad$ (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: $\hspace{3cm}$ kWh/year:

Assumed occupancy, N $\hspace{6cm}$ 1.77 $\quad$ (42)
$\quad$ if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
$\quad$ if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 $\hspace{1cm}$ 76.28 $\quad$ (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= | 83.91 | 80.86 | 77.81 | 74.75 | 71.7 | 68.65 | 68.65 | 71.7 | 74.75 | 77.81 | 80.86 | 83.91 | | |

Total = Sum(44)$_{1...12}$ = $\quad$ 915.36 $\quad$ (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

| (45)m= | 124.43 | 108.83 | 112.3 | 97.91 | 93.95 | 81.07 | 75.12 | 86.2 | 87.23 | 101.66 | 110.97 | 120.51 | | |

Total = Sum(45)$_{1...12}$ = $\quad$ 1200.18 $\quad$ (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 18.66 | 16.32 | 16.85 | 14.69 | 14.09 | 12.16 | 11.27 | 12.93 | 13.08 | 15.25 | 16.65 | 18.08 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel $\hspace{1cm}$ 0 $\quad$ (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:

$\quad$ a) If manufacturer's declared loss factor is known (kWh/day): $\hspace{2cm}$ 0 $\quad$ (48)

Temperature factor from Table 2b $\hspace{5cm}$ 0 $\quad$ (49)

Energy lost from water storage, kWh/year $\hspace{2cm}$ (48) x (49) = $\hspace{1cm}$ 110 $\quad$ (50)
$\quad$ b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) $\hspace{3cm}$ 0.02 $\quad$ (51)
If community heating see section 4.3

Volume factor from Table 2a $\hspace{5cm}$ 1.03 $\quad$ (52)

Temperature factor from Table 2b $\hspace{5cm}$ 0.6 $\quad$ (53)

Energy lost from water storage, kWh/year $\hspace{1cm}$ (47) x (51) x (52) x (53) = $\hspace{0.5cm}$ 1.03 $\quad$ (54)

$\quad$ Enter (50) or (54) in (55) $\hspace{6cm}$ 1.03 $\quad$ (55)

Water storage loss calculated for each month $\hspace{1cm}$ ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	179.71	158.76	167.58	151.4	149.22	134.56	130.4	141.48	140.73	156.94	164.46	175.78	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	179.71	158.76	167.58	151.4	149.22	134.56	130.4	141.48	140.73	156.94	164.46	175.78	

Output from water heater (annual)$_{1...12}$ | 1851.02 | (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=	85.6	76.13	81.56	75.35	75.46	69.75	69.2	72.88	71.8	78.02	79.69	84.29	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.77	12.23	9.94	7.53	5.63	4.75	5.13	6.67	8.96	11.37	13.27	14.15	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	154.42	156.02	151.99	143.39	132.54	122.34	115.53	113.92	117.96	126.56	137.41	147.61	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	(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=	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	(71)

Water heating gains (Table 5)

(72)m=	115.05	113.29	109.63	104.65	101.42	96.87	93.01	97.96	99.72	104.87	110.68	113.29	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	332.81	331.11	321.13	305.15	289.16	273.54	263.25	268.13	276.22	292.38	310.94	324.63	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3	x	11.28	x	0.55	x	0.8	=	10.32	(75)
Northeast 0.9x	0.77	x	3	x	22.97	x	0.55	x	0.8	=	21.01	(75)

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Northeast 0.9x	0.77	x	3	x	41.38	x	0.55	x	0.8	=	37.85	(75)
Northeast 0.9x	0.77	x	3	x	67.96	x	0.55	x	0.8	=	62.16	(75)
Northeast 0.9x	0.77	x	3	x	91.35	x	0.55	x	0.8	=	83.56	(75)
Northeast 0.9x	0.77	x	3	x	97.38	x	0.55	x	0.8	=	89.08	(75)
Northeast 0.9x	0.77	x	3	x	91.1	x	0.55	x	0.8	=	83.34	(75)
Northeast 0.9x	0.77	x	3	x	72.63	x	0.55	x	0.8	=	66.44	(75)
Northeast 0.9x	0.77	x	3	x	50.42	x	0.55	x	0.8	=	46.12	(75)
Northeast 0.9x	0.77	x	3	x	28.07	x	0.55	x	0.8	=	25.67	(75)
Northeast 0.9x	0.77	x	3	x	14.2	x	0.55	x	0.8	=	12.99	(75)
Northeast 0.9x	0.77	x	3	x	9.21	x	0.55	x	0.8	=	8.43	(75)
Northwest 0.9x	0.77	x	7.36	x	11.28	x	0.55	x	0.8	=	25.32	(81)
Northwest 0.9x	0.77	x	7.36	x	22.97	x	0.55	x	0.8	=	51.54	(81)
Northwest 0.9x	0.77	x	7.36	x	41.38	x	0.55	x	0.8	=	92.86	(81)
Northwest 0.9x	0.77	x	7.36	x	67.96	x	0.55	x	0.8	=	152.51	(81)
Northwest 0.9x	0.77	x	7.36	x	91.35	x	0.55	x	0.8	=	205	(81)
Northwest 0.9x	0.77	x	7.36	x	97.38	x	0.55	x	0.8	=	218.55	(81)
Northwest 0.9x	0.77	x	7.36	x	91.1	x	0.55	x	0.8	=	204.45	(81)
Northwest 0.9x	0.77	x	7.36	x	72.63	x	0.55	x	0.8	=	162.99	(81)
Northwest 0.9x	0.77	x	7.36	x	50.42	x	0.55	x	0.8	=	113.15	(81)
Northwest 0.9x	0.77	x	7.36	x	28.07	x	0.55	x	0.8	=	62.99	(81)
Northwest 0.9x	0.77	x	7.36	x	14.2	x	0.55	x	0.8	=	31.86	(81)
Northwest 0.9x	0.77	x	7.36	x	9.21	x	0.55	x	0.8	=	20.68	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	35.64	72.55	130.71	214.67	288.56	307.63	287.79	229.43	159.28	88.66	44.85	29.11	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	368.45	403.66	451.85	519.82	577.72	581.18	551.03	497.56	435.49	381.04	355.79	353.73	(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=	0.98	0.97	0.95	0.89	0.78	0.63	0.49	0.56	0.78	0.92	0.97	0.98	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.03	19.22	19.59	20.1	20.56	20.84	20.94	20.92	20.68	20.11	19.48	18.98	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.87	19.87	19.87	19.87	19.87	19.87	19.87	19.87	19.87	19.87	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.96	0.94	0.87	0.73	0.55	0.38	0.44	0.71	0.9	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.27	17.54	18.08	18.79	19.4	19.74	19.84	19.82	19.57	18.82	17.92	17.2	(90)

fLA = Living area ÷ (4) =   0.42   (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.01	18.24	18.71	19.34	19.89	20.2	20.3	20.28	20.04	19.36	18.57	17.95	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.01	18.24	18.71	19.34	19.89	20.2	20.3	20.28	20.04	19.36	18.57	17.95	(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=	0.96	0.95	0.92	0.85	0.73	0.57	0.43	0.49	0.72	0.89	0.95	0.97	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	354.99	383.88	416.32	443.68	424.47	333.28	235.4	241.53	313.3	338.44	337.27	342.15	(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=	916.39	890.96	815.45	697.24	546.79	374.03	247.23	259.24	396.52	584.79	766.09	917.75	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	417.68	340.76	296.96	182.56	91	0	0	0	0	183.28	308.75	428.24	

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = **2249.23** (98)

Space heating requirement in kWh/m²/year **42.62** (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none **0** (301)

Fraction of space heat from community system 1 – (301) = **1** (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers **1** (303a)

Fraction of total space heat from Community boilers   (302) x (303a) = **1** (304a)

Factor for control and charging method (Table 4c(3)) for community heating system **1** (305)

Distribution loss factor (Table 12c) for community heating system **1.05** (306)

Space heating **kWh/year**

Annual space heating requirement **2249.23**

Space heat from Community boilers   (98) x (304a) x (305) x (306) = **2361.7** (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) **0** (308

Space heating requirement from secondary/supplementary system   (98) x (301) x 100 ÷ (308) = **0** (309)

Water heating

Annual water heating requirement **1851.02**

If DHW from community scheme:
Water heat from Community boilers   (64) x (303a) x (305) x (306) = **1943.57** (310a)

Electricity used for heat distribution   0.01 × [(307a)...(307e) + (310a)...(310e)] = **43.05** (313)

Cooling System Energy Efficiency Ratio **0** (314)

Space cooling (if there is a fixed cooling system, if not enter 0)   = (107) ÷ (314) = **0** (315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		38.96	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	38.96	(331)
Energy for lighting (calculated in Appendix L)		243.1	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	978.88	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	22.34	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1001.23	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1001.23	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	20.22	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	126.17	(379)
Total CO2, kg/year	sum of (376)…(382) =				1147.61	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				21.75	(384)
EI rating (section 14)					84.27	(385)

DER WorkSheet: New dwelling design stage

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.35	(1a) x	2.5	(2a) =	125.87	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.35	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.87	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows			8.55	x1/[1/(1.2)+ 0.04] =	9.79			(27)
Floor			50.35	x 0.12 =	6.042	75	3776.25	(28)
Walls Type1	23.14	8.55	14.59	x 0.18 =	2.63	14	204.26	(29)
Walls Type2	29.29	2.12	27.17	x 0.23 =	6.13	14	380.38	(29)
Walls Type3	13.99	0	13.99	x 0.2 =	2.86	14	195.86	(29)
Total area of elements, m²			116.77					(31)
Party wall			13.69	x 0 =	0	20	273.8	(32)
Party ceiling			50.35			30	1510.5	(32b)
Internal wall **			90.55			9	814.95	(32c)

* 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) =	30.63	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	7156	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	142.13	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		14.27	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	44.9	(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

DER WorkSheet: New dwelling design stage

(38)m=	20.85	20.77	20.77	20.77	20.77	20.77	20.77	20.77	20.77	20.77	20.77	20.77	(38)

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

(39)m=	65.75	65.67	65.67	65.67	65.67	65.67	65.67	65.67	65.67	65.67	65.67	65.67	(39)

Average = Sum(39)$_{1...12}$ /12=   65.67   (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	(40)

Average = Sum(40)$_{1...12}$ /12=   1.3   (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   1.7   (42)
   if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
   if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   74.58   (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of
not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	82.04	79.06	76.08	73.09	70.11	67.13	67.13	70.11	73.09	76.08	79.06	82.04	(44)

Total = Sum(44)$_{1...12}$ =   895.02   (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.67	106.41	109.81	95.73	91.86	79.27	73.45	84.29	85.29	99.4	108.5	117.83	(45)

Total = Sum(45)$_{1...12}$ =   1173.51   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.25	15.96	16.47	14.36	13.78	11.89	11.02	12.64	12.79	14.91	16.28	17.67	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)
Temperature factor from Table 2b   0   (49)
Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)
If community heating see section 4.3
Volume factor from Table 2a   1.03   (52)
Temperature factor from Table 2b   0.6   (53)
Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)
 Enter (50) or (54) in (55)   1.03   (55)
Water storage loss calculated for each month   ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	176.94	156.34	165.08	149.23	147.13	132.76	128.73	139.56	138.79	154.68	162	173.11	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	176.94	156.34	165.08	149.23	147.13	132.76	128.73	139.56	138.79	154.68	162	173.11

Output from water heater (annual)₁...₁₂ | 1824.35 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.68	75.32	80.73	74.63	74.76	69.15	68.64	72.25	71.16	77.27	78.87	83.4	(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=	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.35	11.85	9.64	7.3	5.46	4.61	4.98	6.47	8.68	11.02	12.87	13.72	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	148.14	149.68	145.81	137.56	127.15	117.36	110.83	109.29	113.16	121.41	131.82	141.61	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(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=	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	(71)

Water heating gains (Table 5)

(72)m=	113.81	112.09	108.51	103.65	100.49	96.04	92.26	97.11	98.83	103.86	109.55	112.1	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	323.81	322.13	312.46	297.01	281.6	266.52	256.57	261.37	269.18	284.8	302.74	315.93	(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)	
Northwest 0.9x	0.77	x	8.55	x	11.28	x	0.55	x	0.8	=	29.42	(81)
Northwest 0.9x	0.77	x	8.55	x	22.97	x	0.55	x	0.8	=	59.88	(81)

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Northwest 0.9x	0.77	x	8.55	x	41.38	x	0.55	x	0.8	=	107.88	(81)
Northwest 0.9x	0.77	x	8.55	x	67.96	x	0.55	x	0.8	=	177.17	(81)
Northwest 0.9x	0.77	x	8.55	x	91.35	x	0.55	x	0.8	=	238.14	(81)
Northwest 0.9x	0.77	x	8.55	x	97.38	x	0.55	x	0.8	=	253.89	(81)
Northwest 0.9x	0.77	x	8.55	x	91.1	x	0.55	x	0.8	=	237.51	(81)
Northwest 0.9x	0.77	x	8.55	x	72.63	x	0.55	x	0.8	=	189.34	(81)
Northwest 0.9x	0.77	x	8.55	x	50.42	x	0.55	x	0.8	=	131.45	(81)
Northwest 0.9x	0.77	x	8.55	x	28.07	x	0.55	x	0.8	=	73.17	(81)
Northwest 0.9x	0.77	x	8.55	x	14.2	x	0.55	x	0.8	=	37.01	(81)
Northwest 0.9x	0.77	x	8.55	x	9.21	x	0.55	x	0.8	=	24.02	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	29.42	59.88	107.88	177.17	238.14	253.89	237.51	189.34	131.45	73.17	37.01	24.02	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	353.22	382	420.34	474.18	519.74	520.41	494.08	450.72	400.63	357.98	339.75	339.95	(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=	0.98	0.97	0.95	0.9	0.81	0.67	0.53	0.59	0.8	0.93	0.97	0.98	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.96	19.14	19.5	20.01	20.48	20.8	20.93	20.9	20.63	20.05	19.41	18.91	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.96	0.94	0.88	0.76	0.58	0.41	0.47	0.73	0.91	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.14	17.4	17.93	18.64	19.29	19.67	19.8	19.78	19.5	18.71	17.81	17.07	(90)

fLA = Living area ÷ (4) =   0.42 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.9	18.13	18.59	19.21	19.79	20.15	20.27	20.25	19.97	19.27	18.48	17.84	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.9	18.13	18.59	19.21	19.79	20.15	20.27	20.25	19.97	19.27	18.48	17.84	(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=	0.96	0.95	0.93	0.87	0.76	0.61	0.46	0.51	0.74	0.89	0.95	0.97	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	339.93	363.38	388.85	410.48	394.57	315.3	226.09	231.22	295.17	319.23	321.84	328.39	(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)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	894.37	868.63	793.63	677.22	531.08	364.17	241.09	252.68	385.78	569.49	747.37	895.88		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	412.51	339.53	301.16	192.06	101.56	0	0	0	0	186.19	306.39	422.22		(98)

	Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =	2261.61	(98)

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2261.61 (98)

Space heating requirement in kWh/m²/year 44.92 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

Space heating **kWh/year**

Annual space heating requirement 2261.61

Space heat from Community boilers (98) x (304a) x (305) x (306) = 2374.69 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0 (308)

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = 0 (309)

Water heating

Annual water heating requirement 1824.35

If DHW from community scheme:
Water heat from Community boilers (64) x (303a) x (305) x (306) = 1915.57 (310a)

Electricity used for heat distribution 0.01 × [(307a)…(307e) + (310a)…(310e)] = 42.9 (313)

Cooling System Energy Efficiency Ratio 0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0) = (107) ÷ (314) = 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside 37.17 (330a)

warm air heating system fans 0 (330b)

pump for solar water heating 0 (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = 37.17 (331)

Energy for lighting (calculated in Appendix L) 235.69 (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*			95 (367a)

DER WorkSheet: New dwelling design stage

CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	975.47	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	22.27	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	997.74	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			997.74	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	19.29	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	122.32	(379)
Total CO2, kg/year	sum of (376)…(382) =			1139.35	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			22.63	(384)
EI rating (section 14)				83.99	(385)

DER WorkSheet: New dwelling design stage

Property Address: 1F - 1Bed - South

Address : 1F - 1Bed - South, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.25	(1a) x	2.5	(2a) =	125.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.25	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.62	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 = 0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) = 0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x	1.5	= 3.18			(26)
Windows			8.55	x1/[1/(1.2)+ 0.04]		= 9.79			(27)
Floor			50.25	x	0.12	= 6.03	75	3768.75	(28)
Walls Type1	23.19	8.55	14.64	x	0.18	= 2.64	14	204.96	(29)
Walls Type2	12.4	2.12	10.28	x	0.23	= 2.32	14	143.92	(29)
Walls Type3	14	0	14	x	0.2	= 2.86	14	196	(29)
Total area of elements, m²			99.84						(31)
Party wall			30.53	x	0	= 0	20	610.6	(32)
Party ceiling			50.25				30	1507.5	(32b)
Internal wall **			90.21				9	811.89	(32c)

* 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) =

26.81	(33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =

7243.62	(34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) =

144.15	(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

12.88	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) =

39.69	(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=	20.81	20.73	20.73	20.73	20.73	20.73	20.73	20.73	20.73	20.73	20.73	20.73		(38)

Heat transfer coefficient, W/K　　　　　　　　　　　　　(39)m = (37) + (38)m

(39)m=	60.5	60.42	60.42	60.42	60.42	60.42	60.42	60.42	60.42	60.42	60.42	60.42		

Average = Sum(39)$_{1...12}$ /12=　　60.43　(39)

Heat loss parameter (HLP), W/m²K　　　　　　　　(40)m = (39)m ÷ (4)

(40)m=	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2		

Average = Sum(40)$_{1...12}$ /12=　　1.2　(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:　　　　　　　　　　　kWh/year:

Assumed occupancy, N　　　　　　　　　　　　　　　　　　1.7　(42)
　if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
　if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36　　74.51　(43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of

not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	81.97	78.99	76.01	73.02	70.04	67.06	67.06	70.04	73.02	76.01	78.99	81.97		

Total = Sum(44)$_{1...12}$ =　　894.18　(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.55	106.31	109.7	95.64	91.77	79.19	73.38	84.21	85.21	99.31	108.4	117.72		

Total = Sum(45)$_{1...12}$ =　　1172.41　(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.23	15.95	16.46	14.35	13.77	11.88	11.01	12.63	12.78	14.9	16.26	17.66		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel　　0　(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

　a) If manufacturer's declared loss factor is known (kWh/day):　　0　(48)

Temperature factor from Table 2b　　0　(49)

Energy lost from water storage, kWh/year　　　　　　(48) x (49) =　　110　(50)

　b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)　　0.02　(51)

If community heating see section 4.3

Volume factor from Table 2a　　1.03　(52)

Temperature factor from Table 2b　　0.6　(53)

Energy lost from water storage, kWh/year　　　　(47) x (51) x (52) x (53) =　　1.03　(54)

　Enter (50) or (54) in (55)　　1.03　(55)

Water storage loss calculated for each month　　　　((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	176.83	156.24	164.98	149.14	147.05	132.69	128.66	139.48	138.71	154.58	161.9	172.99	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	176.83	156.24	164.98	149.14	147.05	132.69	128.66	139.48	138.71	154.58	161.9	172.99	

Output from water heater (annual)₁...₁₂ | 1823.25 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.64	75.29	80.7	74.6	74.74	69.13	68.62	72.22	71.13	77.24	78.84	83.36	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.32	11.83	9.62	7.28	5.44	4.6	4.97	6.46	8.66	11	12.84	13.69	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.88	149.42	145.55	137.32	126.93	117.16	110.63	109.1	112.97	121.2	131.59	141.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	(71)

Water heating gains (Table 5)

(72)m=	113.76	112.04	108.47	103.61	100.45	96.01	92.23	97.07	98.79	103.82	109.5	112.05	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	323.42	321.75	312.1	296.67	281.28	266.23	256.3	261.09	268.88	284.48	302.39	315.56	(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)	
Southeast	0.9x	0.77	x	8.55	x	36.79	x	0.55	x	0.8	=	95.92	(77)
Southeast	0.9x	0.77	x	8.55	x	62.67	x	0.55	x	0.8	=	163.39	(77)

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Southeast 0.9x	0.77	x	8.55	x	85.75	x	0.55	x	0.8	=	223.56	(77)
Southeast 0.9x	0.77	x	8.55	x	106.25	x	0.55	x	0.8	=	277.01	(77)
Southeast 0.9x	0.77	x	8.55	x	119.01	x	0.55	x	0.8	=	310.27	(77)
Southeast 0.9x	0.77	x	8.55	x	118.15	x	0.55	x	0.8	=	308.02	(77)
Southeast 0.9x	0.77	x	8.55	x	113.91	x	0.55	x	0.8	=	296.97	(77)
Southeast 0.9x	0.77	x	8.55	x	104.39	x	0.55	x	0.8	=	272.15	(77)
Southeast 0.9x	0.77	x	8.55	x	92.85	x	0.55	x	0.8	=	242.07	(77)
Southeast 0.9x	0.77	x	8.55	x	69.27	x	0.55	x	0.8	=	180.59	(77)
Southeast 0.9x	0.77	x	8.55	x	44.07	x	0.55	x	0.8	=	114.89	(77)
Southeast 0.9x	0.77	x	8.55	x	31.49	x	0.55	x	0.8	=	82.09	(77)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	95.92	163.39	223.56	277.01	310.27	308.02	296.97	272.15	242.07	180.59	114.89	82.09	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	419.35	485.14	535.66	573.67	591.55	574.25	553.26	533.24	510.95	465.07	417.29	397.65	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)   21   (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.96	0.94	0.91	0.85	0.74	0.6	0.46	0.49	0.68	0.86	0.94	0.97	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.32	19.57	19.92	20.32	20.66	20.88	20.96	20.95	20.81	20.37	19.77	19.26	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.92	19.92	19.92	19.92	19.92	19.92	19.92	19.92	19.92	19.92	19.92	19.92	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.93	0.89	0.82	0.69	0.52	0.35	0.39	0.61	0.83	0.93	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.71	18.07	18.57	19.12	19.57	19.82	19.9	19.89	19.75	19.2	18.35	17.62	(90)

fLA = Living area ÷ (4) =   0.42   (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.39	18.7	19.13	19.62	20.02	20.26	20.34	20.34	20.19	19.69	18.95	18.31	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.39	18.7	19.13	19.62	20.02	20.26	20.34	20.34	20.19	19.69	18.95	18.31	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.95	0.92	0.88	0.81	0.7	0.54	0.39	0.43	0.63	0.82	0.92	0.95	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	396.45	445.67	469.84	463.03	412.85	312.82	218.52	227.65	320.37	382.38	383.16	378.67	(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)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	852.36	833.94	763.4	647.76	502.97	342.25	226.2	237.76	368.16	549.27	715.69	852.28		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	339.2	260.91	218.41	133.01	67.05	0	0	0	0	124.17	239.42	352.37		

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = | 1734.54 | (98)

Space heating requirement in kWh/m²/year | 34.52 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers | 1 | (303a)

Fraction of total space heat from Community boilers   (302) x (303a) = | 1 | (304a)

Factor for control and charging method (Table 4c(3)) for community heating system | 1 | (305)

Distribution loss factor (Table 12c) for community heating system | 1.05 | (306)

Space heating   **kWh/year**

Annual space heating requirement | 1734.54 |

Space heat from Community boilers   (98) x (304a) x (305) x (306) = | 1821.26 | (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0 | (308)

Space heating requirement from secondary/supplementary system   (98) x (301) x 100 ÷ (308) = | 0 | (309)

Water heating

Annual water heating requirement | 1823.25 |

If DHW from community scheme:
Water heat from Community boilers   (64) x (303a) x (305) x (306) = | 1914.41 | (310a)

Electricity used for heat distribution   0.01 × [(307a)...(307e) + (310a)...(310e)] = | 37.36 | (313)

Cooling System Energy Efficiency Ratio | 0 | (314)

Space cooling (if there is a fixed cooling system, if not enter 0)   = (107) ÷ (314) = | 0 | (315)

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 37.1 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year   =(330a) + (330b) + (330g) = | 37.1 | (331)

Energy for lighting (calculated in Appendix L) | 235.22 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year

CO2 from other sources of space and water heating (not CHP)
Efficiency of heat source 1 (%)   *If there is CHP using two fuels repeat (363) to (366) for the second fuel* | 95 | (367a)

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CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	849.37	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	19.39	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	868.76	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			868.76	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	19.25	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	122.08	(379)
Total CO2, kg/year	sum of (376)…(382) =			1010.09	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			20.1	(384)
EI rating (section 14)				85.79	(385)

DER WorkSheet: New dwelling design stage

Property Address: 1F - 2Bed - North West

Address : 1F - 2Bed - North West, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation: | 0.5 | (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) | 0.5 | (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Floor			71.72	x 0.12 =	8.6064	75	5379	(28)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party ceiling			71.72			30	2151.6	(32b)
Internal wall **			142.3			9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	33.64	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	10139.7	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	141.38	(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		15.8	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	49.45	(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=	29.7	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	(38)

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

(39)m=	79.15	79.03	79.03	79.03	79.03	79.03	79.03	79.03	79.03	79.03	79.03	79.03	(39)

Average = Sum(39)$_{1...12}$ /12= | 79.04 | (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

(40)m=	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	(40)

Average = Sum(40)$_{1...12}$ /12= | 1.1 | (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.29 | (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 | 88.52 | (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=	97.37	93.83	90.29	86.75	83.21	79.67	79.67	83.21	86.75	90.29	93.83	97.37	(44)

Total = Sum(44)$_{1...12}$ = | 1062.24 | (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=	144.4	126.29	130.32	113.62	109.02	94.08	87.17	100.03	101.23	117.97	128.78	139.84	(45)

Total = Sum(45)$_{1...12}$ = | 1392.76 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.66	18.94	19.55	17.04	16.35	14.11	13.08	15.01	15.18	17.7	19.32	20.98	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)
Temperature factor from Table 2b | 0 | (49)
Energy lost from water storage, kWh/year   (48) x (49) = | 110 | (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.02 | (51)
If community heating see section 4.3
Volume factor from Table 2a | 1.03 | (52)
Temperature factor from Table 2b | 0.6 | (53)
Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) = | 1.03 | (54)
 Enter (50) or (54) in (55) | 1.03 | (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

DER WorkSheet: New dwelling design stage

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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂ — [2043.6] (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest 0.9x	0.77	x	3.9	x	36.79		0.55	x	0.8	=	43.75	(79)
Southwest 0.9x	0.77	x	3.9	x	62.67		0.55	x	0.8	=	74.53	(79)

	0.9x	0.77	x	3.9	x	85.75		0.55	x	0.8	=	101.98	(79)
Southwest	0.9x	0.77	x	3.9	x	106.25		0.55	x	0.8	=	126.35	(79)
Southwest	0.9x	0.77	x	3.9	x	119.01		0.55	x	0.8	=	141.53	(79)
Southwest	0.9x	0.77	x	3.9	x	118.15		0.55	x	0.8	=	140.5	(79)
Southwest	0.9x	0.77	x	3.9	x	113.91		0.55	x	0.8	=	135.46	(79)
Southwest	0.9x	0.77	x	3.9	x	104.39		0.55	x	0.8	=	124.14	(79)
Southwest	0.9x	0.77	x	3.9	x	92.85		0.55	x	0.8	=	110.42	(79)
Southwest	0.9x	0.77	x	3.9	x	69.27		0.55	x	0.8	=	82.37	(79)
Southwest	0.9x	0.77	x	3.9	x	44.07		0.55	x	0.8	=	52.41	(79)
Southwest	0.9x	0.77	x	3.9	x	31.49		0.55	x	0.8	=	37.44	(79)
Northwest	0.9x	0.77	x	9.61	x	11.28	x	0.55	x	0.8	=	33.06	(81)
Northwest	0.9x	0.77	x	9.61	x	22.97	x	0.55	x	0.8	=	67.3	(81)
Northwest	0.9x	0.77	x	9.61	x	41.38	x	0.55	x	0.8	=	121.25	(81)
Northwest	0.9x	0.77	x	9.61	x	67.96	x	0.55	x	0.8	=	199.13	(81)
Northwest	0.9x	0.77	x	9.61	x	91.35	x	0.55	x	0.8	=	267.67	(81)
Northwest	0.9x	0.77	x	9.61	x	97.38	x	0.55	x	0.8	=	285.36	(81)
Northwest	0.9x	0.77	x	9.61	x	91.1	x	0.55	x	0.8	=	266.95	(81)
Northwest	0.9x	0.77	x	9.61	x	72.63	x	0.55	x	0.8	=	212.82	(81)
Northwest	0.9x	0.77	x	9.61	x	50.42	x	0.55	x	0.8	=	147.75	(81)
Northwest	0.9x	0.77	x	9.61	x	28.07	x	0.55	x	0.8	=	82.24	(81)
Northwest	0.9x	0.77	x	9.61	x	14.2	x	0.55	x	0.8	=	41.6	(81)
Northwest	0.9x	0.77	x	9.61	x	9.21	x	0.55	x	0.8	=	27	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	76.82	141.83	223.23	325.48	409.2	425.87	402.41	336.96	258.17	164.62	94.01	64.45		(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	477.34	540.39	609.29	691.42	754.76	751.72	715.39	655.61	587.1	513.88	466.65	454.55		(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.97	0.94	0.88	0.76	0.6	0.46	0.52	0.74	0.91	0.97	0.98	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.27	19.48	19.84	20.29	20.68	20.89	20.97	20.95	20.78	20.29	19.69	19.22	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20	20	20	20	20	20	20	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.93	0.85	0.71	0.53	0.37	0.42	0.68	0.89	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.7	18	18.52	19.15	19.65	19.91	19.98	19.97	19.79	19.15	18.31	17.62	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

DER WorkSheet: New dwelling design stage

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| (92)m= | 18.19 | 18.46 | 18.93 | 19.5 | 19.97 | 20.22 | 20.29 | 20.27 | 20.1 | 19.5 | 18.74 | 18.12 | | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m= | 18.19 | 18.46 | 18.93 | 19.5 | 19.97 | 20.22 | 20.29 | 20.27 | 20.1 | 19.5 | 18.74 | 18.12 | | (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= | 0.97 | 0.95 | 0.91 | 0.84 | 0.71 | 0.55 | 0.4 | 0.45 | 0.68 | 0.88 | 0.95 | 0.97 | | (94) |

Useful gains, hmGm , W = (94)m x (84)m

| (95)m= | 460.69 | 512.45 | 556.62 | 580.34 | 538.28 | 409.72 | 282.85 | 293.24 | 401.13 | 449.7 | 442.12 | 440.75 | | (95) |

Monthly average external temperature from Table 8

| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

| (97)m= | 1099.09 | 1071.86 | 982.15 | 838.03 | 653.64 | 443.8 | 291.34 | 306.18 | 474.1 | 703.67 | 919.62 | 1099.71 | | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| (98)m= | 474.97 | 375.92 | 316.59 | 185.53 | 85.83 | 0 | 0 | 0 | 0 | 188.95 | 343.8 | 490.27 | | (98) |

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = | 2461.86 | (98)

Space heating requirement in kWh/m²/year | 34.33 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers | 1 | (303a)

Fraction of total space heat from Community boilers   (302) x (303a) = | 1 | (304a)

Factor for control and charging method (Table 4c(3)) for community heating system | 1 | (305)

Distribution loss factor (Table 12c) for community heating system | 1.05 | (306)

Space heating   kWh/year

Annual space heating requirement | 2461.86

Space heat from Community boilers   (98) x (304a) x (305) x (306) = | 2584.96 | (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0 | (308

Space heating requirement from secondary/supplementary system   (98) x (301) x 100 ÷ (308) = | 0 | (309)

Water heating

Annual water heating requirement | 2043.6

If DHW from community scheme:
Water heat from Community boilers   (64) x (303a) x (305) x (306) = | 2145.78 | (310a)

Electricity used for heat distribution   0.01 × [(307a)…(307e) + (310a)…(310e)] = | 47.31 | (313)

Cooling System Energy Efficiency Ratio | 0 | (314)

Space cooling (if there is a fixed cooling system, if not enter 0)   = (107) ÷ (314) = | 0 | (315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 52.46 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = | 52.46 | (331)

Energy for lighting (calculated in Appendix L) | 317.29 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*			95	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.22 =	1075.62	(367)
Electrical energy for heat distribution [(313) x		0.52 =	24.55	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)		=	1100.17	(373)
CO2 associated with space heating (secondary) (309) x		0 =	0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.22 =	0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			1100.17	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52 =	27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52 =	164.67	(379)

Total CO2, kg/year sum of (376)…(382) = | 1292.07 | (383)

Dwelling CO2 Emission Rate (383) ÷ (4) = | 18.02 | (384)

EI rating (section 14) | 85.17 | (385)

DER WorkSheet: New dwelling design stage

Property Address: 1F - 2Bed - South East

Address : 1F - 2Bed - South East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	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=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=
0	0	0	0	0	0	0	0	0	0	0	0
(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Floor			71.72	x 0.12 =	8.6064	75	5379	(28)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party ceiling			71.72			30	2151.6	(32b)
Internal wall **			142.3			9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	33.64	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	10139.7	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	141.38	(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		15.8	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	49.45	(37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

(38)m=	29.7	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	(38)

Heat transfer coefficient, W/K $(39)m = (37) + (38)m$

(39)m=	79.15	79.03	79.03	79.03	79.03	79.03	79.03	79.03	79.03	79.03	79.03	79.03	(39)

Average = Sum(39)$_{1...12}$ /12= **79.04** (39)

Heat loss parameter (HLP), W/m²K $(40)m = (39)m ÷ (4)$

(40)m=	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	(40)

Average = Sum(40)$_{1...12}$ /12= **1.1** (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N **2.29** (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 **88.52** (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=	97.37	93.83	90.29	86.75	83.21	79.67	79.67	83.21	86.75	90.29	93.83	97.37	(44)

Total = Sum(44)$_{1...12}$ = **1062.24** (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=	144.4	126.29	130.32	113.62	109.02	94.08	87.17	100.03	101.23	117.97	128.78	139.84	(45)

Total = Sum(45)$_{1...12}$ = **1392.76** (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.66	18.94	19.55	17.04	16.35	14.11	13.08	15.01	15.18	17.7	19.32	20.98	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel **0** (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day): **0** (48)

Temperature factor from Table 2b **0** (49)

Energy lost from water storage, kWh/year (48) x (49) = **110** (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) **0.02** (51)
If community heating see section 4.3
Volume factor from Table 2a **1.03** (52)
Temperature factor from Table 2b **0.6** (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = **1.03** (54)
 Enter (50) or (54) in (55) **1.03** (55)

Water storage loss calculated for each month $((56)m = (55) × (41)m$

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

DER WorkSheet: New dwelling design stage

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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.9	x	11.28	x	0.55	x	0.8	=	13.42	(75)
Northeast 0.9x	0.77	x	3.9	x	22.97	x	0.55	x	0.8	=	27.31	(75)

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Northeast 0.9x	0.77	x	3.9	x	41.38	x	0.55	x	0.8	=	49.21	(75)
Northeast 0.9x	0.77	x	3.9	x	67.96	x	0.55	x	0.8	=	80.81	(75)
Northeast 0.9x	0.77	x	3.9	x	91.35	x	0.55	x	0.8	=	108.63	(75)
Northeast 0.9x	0.77	x	3.9	x	97.38	x	0.55	x	0.8	=	115.81	(75)
Northeast 0.9x	0.77	x	3.9	x	91.1	x	0.55	x	0.8	=	108.34	(75)
Northeast 0.9x	0.77	x	3.9	x	72.63	x	0.55	x	0.8	=	86.37	(75)
Northeast 0.9x	0.77	x	3.9	x	50.42	x	0.55	x	0.8	=	59.96	(75)
Northeast 0.9x	0.77	x	3.9	x	28.07	x	0.55	x	0.8	=	33.38	(75)
Northeast 0.9x	0.77	x	3.9	x	14.2	x	0.55	x	0.8	=	16.88	(75)
Northeast 0.9x	0.77	x	3.9	x	9.21	x	0.55	x	0.8	=	10.96	(75)
Southeast 0.9x	0.77	x	9.61	x	36.79	x	0.55	x	0.8	=	107.82	(77)
Southeast 0.9x	0.77	x	9.61	x	62.67	x	0.55	x	0.8	=	183.65	(77)
Southeast 0.9x	0.77	x	9.61	x	85.75	x	0.55	x	0.8	=	251.28	(77)
Southeast 0.9x	0.77	x	9.61	x	106.25	x	0.55	x	0.8	=	311.35	(77)
Southeast 0.9x	0.77	x	9.61	x	119.01	x	0.55	x	0.8	=	348.73	(77)
Southeast 0.9x	0.77	x	9.61	x	118.15	x	0.55	x	0.8	=	346.21	(77)
Southeast 0.9x	0.77	x	9.61	x	113.91	x	0.55	x	0.8	=	333.79	(77)
Southeast 0.9x	0.77	x	9.61	x	104.39	x	0.55	x	0.8	=	305.89	(77)
Southeast 0.9x	0.77	x	9.61	x	92.85	x	0.55	x	0.8	=	272.08	(77)
Southeast 0.9x	0.77	x	9.61	x	69.27	x	0.55	x	0.8	=	202.97	(77)
Southeast 0.9x	0.77	x	9.61	x	44.07	x	0.55	x	0.8	=	129.14	(77)
Southeast 0.9x	0.77	x	9.61	x	31.49	x	0.55	x	0.8	=	92.27	(77)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	121.23	210.96	300.49	392.16	457.36	462.02	442.12	392.26	332.04	236.35	146.02	103.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	521.76	609.52	686.55	758.1	802.93	787.87	755.11	710.91	660.98	585.62	518.66	493.33	(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=	0.97	0.95	0.92	0.85	0.74	0.58	0.44	0.48	0.69	0.88	0.96	0.98	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.36	19.6	19.96	20.37	20.71	20.9	20.97	20.96	20.82	20.38	19.78	19.29	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20	20	20	20	20	20	20	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.95	0.91	0.82	0.69	0.51	0.35	0.39	0.62	0.85	0.95	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.82	18.17	18.68	19.25	19.69	19.92	19.98	19.98	19.84	19.28	18.44	17.72	(90)

fLA = Living area ÷ (4) =   [0.31] (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| (92)m= | 18.29 | 18.62 | 19.08 | 19.6 | 20.01 | 20.23 | 20.29 | 20.28 | 20.14 | 19.62 | 18.85 | 18.21 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m= | 18.29 | 18.62 | 19.08 | 19.6 | 20.01 | 20.23 | 20.29 | 20.28 | 20.14 | 19.62 | 18.85 | 18.21 | (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=	0.96	0.93	0.89	0.81	0.69	0.53	0.38	0.42	0.63	0.84	0.93	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

| (95)m= | 499.11 | 567.99 | 610.65 | 615.31 | 552.96 | 414.02 | 284.27 | 296.25 | 419.34 | 492.36 | 483.91 | 474.94 | (95) |

Monthly average external temperature from Table 8

| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

| (97)m= | 1107.5 | 1084.09 | 994.06 | 845.56 | 656.6 | 444.59 | 291.59 | 306.72 | 477.67 | 712.95 | 928.82 | 1107.17 | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| (98)m= | 452.64 | 346.82 | 285.26 | 165.78 | 77.11 | 0 | 0 | 0 | 0 | 164.12 | 320.33 | 470.38 | (98) |

| | Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = | 2282.45 | (98) |

Space heating requirement in kWh/m²/year | 31.82 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers | 1 | (303a)

Fraction of total space heat from Community boilers | (302) x (303a) = | 1 | (304a)

Factor for control and charging method (Table 4c(3)) for community heating system | 1 | (305)

Distribution loss factor (Table 12c) for community heating system | 1.05 | (306)

Space heating   **kWh/year**

Annual space heating requirement | 2282.45

Space heat from Community boilers | (98) x (304a) x (305) x (306) = | 2396.57 | (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0 | (308

Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309)

Water heating

Annual water heating requirement | 2043.6

If DHW from community scheme:
Water heat from Community boilers | (64) x (303a) x (305) x (306) = | 2145.78 | (310a)

Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 45.42 | (313)

Cooling System Energy Efficiency Ratio | 0 | (314)

Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 52.46 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = | 52.46 | (331)

Energy for lighting (calculated in Appendix L) | 317.29 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*			95	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.22	= 1032.79	(367)
Electrical energy for heat distribution [(313) x		0.52	= 23.57	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)			= 1056.36	(373)
CO2 associated with space heating (secondary) (309) x		0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.22	= 0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			1056.36	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52	= 27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52	= 164.67	(379)

Total CO2, kg/year sum of (376)…(382) = | 1248.26 | (383)

Dwelling CO2 Emission Rate (383) ÷ (4) = | 17.4 | (384)

EI rating (section 14) | 85.67 | (385)

DER WorkSheet: New dwelling design stage

Property Address: 1F - 2Bed - South West

Address : 1F - 2Bed - South West , Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation: | 0.5 | (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) | 0.5 | (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5	=	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04]	=	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04]	=	4.47			(27)
Floor			71.72	x 0.12	=	8.6064	75	5379	(28)
Walls Type1	46.63	13.51	33.12	x 0.18	=	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23	=	0.42	14	26.32	(29)
Total area of elements, m²			122.35						(31)
Party wall			41.92	x 0	=	0	20	838.4	(32)
Party ceiling			71.72				30	2151.6	(32b)
Internal wall **			142.3				9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	33.64	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	10139.7	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	141.38	(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		15.8	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	49.45	(37)

Ventilation heat loss calculated monthly | (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	29.7	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58		(38)

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

(39)m=	79.15	79.03	79.03	79.03	79.03	79.03	79.03	79.03	79.03	79.03	79.03	79.03

Average = Sum(39)$_{1...12}$ /12= **79.04** (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

(40)m=	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1

Average = Sum(40)$_{1...12}$ /12= **1.1** (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   **2.29**   (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   **88.52**   (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=	97.37	93.83	90.29	86.75	83.21	79.67	79.67	83.21	86.75	90.29	93.83	97.37

Total = Sum(44)$_{1...12}$ = **1062.24**   (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=	144.4	126.29	130.32	113.62	109.02	94.08	87.17	100.03	101.23	117.97	128.78	139.84

Total = Sum(45)$_{1...12}$ = **1392.76**   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.66	18.94	19.55	17.04	16.35	14.11	13.08	15.01	15.18	17.7	19.32	20.98	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   **0**   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

 a) If manufacturer's declared loss factor is known (kWh/day):   **0**   (48)

Temperature factor from Table 2b   **0**   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   **110**   (50)

 b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)   **0.02**   (51)

If community heating see section 4.3

Volume factor from Table 2a   **1.03**   (52)

Temperature factor from Table 2b   **0.6**   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   **1.03**   (54)

 Enter (50) or (54) in (55)   **1.03**   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3   0   (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| (59)m= | 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= | 199.68 | 176.22 | 185.6 | 167.11 | 164.3 | 147.57 | 142.45 | 155.31 | 154.72 | 173.25 | 182.27 | 195.12 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| (64)m= | 199.68 | 176.22 | 185.6 | 167.11 | 164.3 | 147.57 | 142.45 | 155.31 | 154.72 | 173.25 | 182.27 | 195.12 | |

Output from water heater (annual)₁...₁₂   2043.6   (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

| (65)m= | 92.23 | 81.93 | 87.55 | 80.57 | 80.47 | 74.08 | 73.21 | 77.48 | 76.45 | 83.45 | 85.61 | 90.72 | (65) |

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| (67)m= | 17.97 | 15.96 | 12.98 | 9.82 | 7.34 | 6.2 | 6.7 | 8.71 | 11.69 | 14.84 | 17.32 | 18.47 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| (68)m= | 201.28 | 203.37 | 198.1 | 186.9 | 172.75 | 159.46 | 150.58 | 148.49 | 153.75 | 164.96 | 179.1 | 192.4 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| (69)m= | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | (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= | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | (71) |

Water heating gains (Table 5)

| (72)m= | 123.97 | 121.93 | 117.68 | 111.91 | 108.16 | 102.88 | 98.4 | 104.14 | 106.19 | 112.16 | 118.91 | 121.93 | (72) |

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| (73)m= | 400.52 | 398.56 | 386.07 | 365.94 | 345.56 | 325.85 | 312.98 | 318.65 | 328.94 | 349.27 | 372.64 | 390.1 | (73) |

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	9.61	x	36.79	x	0.55	x	0.8	=	107.82	(77)
Southeast 0.9x	0.77	x	9.61	x	62.67	x	0.55	x	0.8	=	183.65	(77)

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Southeast	0.9x	0.77	x	9.61	x	85.75	x	0.55	x	0.8	=	251.28	(77)
Southeast	0.9x	0.77	x	9.61	x	106.25	x	0.55	x	0.8	=	311.35	(77)
Southeast	0.9x	0.77	x	9.61	x	119.01	x	0.55	x	0.8	=	348.73	(77)
Southeast	0.9x	0.77	x	9.61	x	118.15	x	0.55	x	0.8	=	346.21	(77)
Southeast	0.9x	0.77	x	9.61	x	113.91	x	0.55	x	0.8	=	333.79	(77)
Southeast	0.9x	0.77	x	9.61	x	104.39	x	0.55	x	0.8	=	305.89	(77)
Southeast	0.9x	0.77	x	9.61	x	92.85	x	0.55	x	0.8	=	272.08	(77)
Southeast	0.9x	0.77	x	9.61	x	69.27	x	0.55	x	0.8	=	202.97	(77)
Southeast	0.9x	0.77	x	9.61	x	44.07	x	0.55	x	0.8	=	129.14	(77)
Southeast	0.9x	0.77	x	9.61	x	31.49	x	0.55	x	0.8	=	92.27	(77)
Southwest	0.9x	0.77	x	3.9	x	36.79		0.55	x	0.8	=	43.75	(79)
Southwest	0.9x	0.77	x	3.9	x	62.67		0.55	x	0.8	=	74.53	(79)
Southwest	0.9x	0.77	x	3.9	x	85.75		0.55	x	0.8	=	101.98	(79)
Southwest	0.9x	0.77	x	3.9	x	106.25		0.55	x	0.8	=	126.35	(79)
Southwest	0.9x	0.77	x	3.9	x	119.01		0.55	x	0.8	=	141.53	(79)
Southwest	0.9x	0.77	x	3.9	x	118.15		0.55	x	0.8	=	140.5	(79)
Southwest	0.9x	0.77	x	3.9	x	113.91		0.55	x	0.8	=	135.46	(79)
Southwest	0.9x	0.77	x	3.9	x	104.39		0.55	x	0.8	=	124.14	(79)
Southwest	0.9x	0.77	x	3.9	x	92.85		0.55	x	0.8	=	110.42	(79)
Southwest	0.9x	0.77	x	3.9	x	69.27		0.55	x	0.8	=	82.37	(79)
Southwest	0.9x	0.77	x	3.9	x	44.07		0.55	x	0.8	=	52.41	(79)
Southwest	0.9x	0.77	x	3.9	x	31.49		0.55	x	0.8	=	37.44	(79)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	151.57	258.18	353.26	437.7	490.26	486.72	469.25	430.03	382.5	285.35	181.55	129.71		(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	552.09	656.74	739.32	803.64	835.83	812.57	782.23	748.68	711.44	634.61	554.19	519.82		(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) [21] (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.95	0.91	0.83	0.72	0.57	0.43	0.46	0.66	0.86	0.95	0.97	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.41	19.68	20.04	20.42	20.73	20.91	20.97	20.97	20.85	20.44	19.84	19.34	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20	20	20	20	20	20	20	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.94	0.89	0.8	0.67	0.49	0.34	0.37	0.59	0.83	0.94	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.89	18.28	18.79	19.32	19.72	19.93	19.98	19.98	19.86	19.36	18.52	17.79	(90)

fLA = Living area ÷ (4) =   [0.31] (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| (92)m= | 18.36 | 18.72 | 19.17 | 19.66 | 20.03 | 20.23 | 20.29 | 20.28 | 20.17 | 19.69 | 18.93 | 18.27 | | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m= | 18.36 | 18.72 | 19.17 | 19.66 | 20.03 | 20.23 | 20.29 | 20.28 | 20.17 | 19.69 | 18.93 | 18.27 | | (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=	0.95	0.92	0.87	0.79	0.67	0.51	0.36	0.4	0.6	0.82	0.92	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

| (95)m= | 524.67 | 604.01 | 644.83 | 637.04 | 562.03 | 416.66 | 285.1 | 297.9 | 429.38 | 518.38 | 511.2 | 497.79 | | (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= | 1113.12 | 1092.04 | 1001.57 | 850.19 | 658.41 | 445.08 | 291.74 | 307.02 | 479.6 | 718.55 | 934.84 | 1112.17 | | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| (98)m= | 437.81 | 327.96 | 265.41 | 153.47 | 71.71 | 0 | 0 | 0 | 0 | 148.93 | 305.02 | 457.1 | | (98) |

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =

| | 2167.4 | (98) |

Space heating requirement in kWh/m²/year

| | 30.22 | (99) |

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

| | 0 | (301) |

Fraction of space heat from community system 1 – (301) =

| | 1 | (302) |

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers

| | 1 | (303a) |

Fraction of total space heat from Community boilers   (302) x (303a) =

| | 1 | (304a) |

Factor for control and charging method (Table 4c(3)) for community heating system

| | 1 | (305) |

Distribution loss factor (Table 12c) for community heating system

| | 1.05 | (306) |

Space heating   kWh/year

Annual space heating requirement

| | 2167.4 | |

Space heat from Community boilers   (98) x (304a) x (305) x (306) =

| | 2275.77 | (307a) |

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

| | 0 | (308 |

Space heating requirement from secondary/supplementary system   (98) x (301) x 100 ÷ (308) =

| | 0 | (309) |

Water heating

Annual water heating requirement

| | 2043.6 | |

If DHW from community scheme:
Water heat from Community boilers   (64) x (303a) x (305) x (306) =

| | 2145.78 | (310a) |

Electricity used for heat distribution   0.01 × [(307a)...(307e) + (310a)...(310e)] =

| | 44.22 | (313) |

Cooling System Energy Efficiency Ratio

| | 0 | (314) |

Space cooling (if there is a fixed cooling system, if not enter 0)   = (107) ÷ (314) =

| | 0 | (315) |

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Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	52.46	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year =(330a) + (330b) + (330g) =	52.46	(331)
Energy for lighting (calculated in Appendix L)	317.29	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*				95	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	1005.32	(367)
Electrical energy for heat distribution [(313) x		0.52	=	22.95	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)			=	1028.27	(373)
CO2 associated with space heating (secondary) (309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =				1028.27	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52	=	27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52	=	164.67	(379)
Total CO2, kg/year sum of (376)…(382) =				1220.17	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =				17.01	(384)
EI rating (section 14)				85.99	(385)

DER WorkSheet: New dwelling design stage

Assessor Name: Matt Fitzpatrick   **Stroma Number:** STRO003572

Software Name: Stroma FSAP 2012   **Software Version:** Version: 1.0.5.6

Property Address: MF - 1Bed - North

Address : MF - 1Bed - North, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.35	(1a) x	2.5	(2a) =	125.87	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.35	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.87	(5)

2. Ventilation rate:

	main heating		secondary heating		other	total		m³ per hour	
Number of chimneys	0	+	0	+	0	= 0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	= 0	x 20 =	0	(6b)
Number of intermittent fans						0	x 10 =	0	(7a)
Number of passive vents						0	x 10 =	0	(7b)
Number of flueless gas fires						0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 = 0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) = 0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows			8.55	x1/[1/(1.2)+ 0.04] =	9.79			(27)
Walls Type1	23.14	8.55	14.59	x 0.18 =	2.63	14	204.26	(29)
Walls Type2	29.29	2.12	27.17	x 0.23 =	6.13	14	380.38	(29)
Walls Type3	13.99	0	13.99	x 0.2 =	2.86	14	195.86	(29)
Total area of elements, m²			66.42					(31)
Party wall			13.69	x 0 =	0	20	273.8	(32)
Party floor			50.35			40	2014	(32a)
Party ceiling			50.35			30	1510.5	(32b)
Internal wall **			90.55			9	814.95	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	24.58	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5393.75	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	107.13	(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		6.75	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	31.34	(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= | 20.85 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 52.19 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | | |

Average = Sum(39)$_{1…12}$ /12= **52.11** (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 1.04 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | | |

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   **1.7** (42)
   if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
   if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   **74.58** (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of

not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

| (44)m= | 82.04 | 79.06 | 76.08 | 73.09 | 70.11 | 67.13 | 67.13 | 70.11 | 73.09 | 76.08 | 79.06 | 82.04 | | |

Total = Sum(44)$_{1…12}$ = **895.02** (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

| (45)m= | 121.67 | 106.41 | 109.81 | 95.73 | 91.86 | 79.27 | 73.45 | 84.29 | 85.29 | 99.4 | 108.5 | 117.83 | | |

Total = Sum(45)$_{1…12}$ = **1173.51** (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 18.25 | 15.96 | 16.47 | 14.36 | 13.78 | 11.89 | 11.02 | 12.64 | 12.79 | 14.91 | 16.28 | 17.67 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   **0** (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

 a) If manufacturer's declared loss factor is known (kWh/day):   **0** (48)

Temperature factor from Table 2b   **0** (49)

Energy lost from water storage, kWh/year   (48) x (49) =   **110** (50)

 b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)   **0.02** (51)

If community heating see section 4.3

Volume factor from Table 2a   **1.03** (52)

Temperature factor from Table 2b   **0.6** (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   **1.03** (54)

 Enter (50) or (54) in (55)   **1.03** (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3 | | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	176.94	156.34	165.08	149.23	147.13	132.76	128.73	139.56	138.79	154.68	162	173.11	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	176.94	156.34	165.08	149.23	147.13	132.76	128.73	139.56	138.79	154.68	162	173.11	

Output from water heater (annual)₁...₁₂ | 1824.35 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.68	75.32	80.73	74.63	74.76	69.15	68.64	72.25	71.16	77.27	78.87	83.4	(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=	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.35	11.85	9.64	7.3	5.46	4.61	4.98	6.47	8.68	11.02	12.87	13.72	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	148.14	149.68	145.81	137.56	127.15	117.36	110.83	109.29	113.16	121.41	131.82	141.61	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(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=	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	(71)

Water heating gains (Table 5)

(72)m=	113.81	112.09	108.51	103.65	100.49	96.04	92.26	97.11	98.83	103.86	109.55	112.1	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	323.81	322.13	312.46	297.01	281.6	266.52	256.57	261.37	269.18	284.8	302.74	315.93	(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)	
Northwest 0.9x	0.77	x	8.55	x	11.28	x	0.55	x	0.8	=	29.42	(81)
Northwest 0.9x	0.77	x	8.55	x	22.97	x	0.55	x	0.8	=	59.88	(81)

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Northwest	0.9x	0.77	x	8.55	x	41.38	x	0.55	x	0.8	=	107.88	(81)
Northwest	0.9x	0.77	x	8.55	x	67.96	x	0.55	x	0.8	=	177.17	(81)
Northwest	0.9x	0.77	x	8.55	x	91.35	x	0.55	x	0.8	=	238.14	(81)
Northwest	0.9x	0.77	x	8.55	x	97.38	x	0.55	x	0.8	=	253.89	(81)
Northwest	0.9x	0.77	x	8.55	x	91.1	x	0.55	x	0.8	=	237.51	(81)
Northwest	0.9x	0.77	x	8.55	x	72.63	x	0.55	x	0.8	=	189.34	(81)
Northwest	0.9x	0.77	x	8.55	x	50.42	x	0.55	x	0.8	=	131.45	(81)
Northwest	0.9x	0.77	x	8.55	x	28.07	x	0.55	x	0.8	=	73.17	(81)
Northwest	0.9x	0.77	x	8.55	x	14.2	x	0.55	x	0.8	=	37.01	(81)
Northwest	0.9x	0.77	x	8.55	x	9.21	x	0.55	x	0.8	=	24.02	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	29.42	59.88	107.88	177.17	238.14	253.89	237.51	189.34	131.45	73.17	37.01	24.02		(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	353.22	382	420.34	474.18	519.74	520.41	494.08	450.72	400.63	357.98	339.75	339.95		(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) $\qquad$ 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=	0.96	0.94	0.91	0.84	0.72	0.56	0.44	0.49	0.7	0.87	0.94	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.11	19.31	19.68	20.18	20.61	20.86	20.95	20.93	20.72	20.19	19.57	19.06	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.93	0.9	0.81	0.68	0.5	0.35	0.4	0.64	0.85	0.93	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.53	17.81	18.35	19.04	19.62	19.93	20.02	20.01	19.78	19.08	18.19	17.46	(90)

fLA = Living area ÷ (4) = 0.42 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.19	18.44	18.91	19.52	20.03	20.32	20.41	20.39	20.18	19.54	18.77	18.13	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.19	18.44	18.91	19.52	20.03	20.32	20.41	20.39	20.18	19.54	18.77	18.13	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.93	0.92	0.88	0.8	0.67	0.52	0.38	0.43	0.65	0.83	0.91	0.94	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	329.53	349.82	368.94	378.89	350.52	269.75	190.05	195.76	261.15	298.27	309.16	319.09	(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)

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Heat loss rate for mean internal temperature, L_m, W =[(39)m x [(93)m– (96)m]

(97)m=	725.12	705.4	646.52	553.35	434.15	297.97	198.62	208.12	316.66	465.99	607.91	725.67		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	294.32	238.95	206.52	125.61	62.22	0	0	0	0	124.78	215.1	302.49		

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = | 1569.99 | (98)

Space heating requirement in kWh/m²/year | 31.18 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers | 1 | (303a)

Fraction of total space heat from Community boilers | (302) x (303a) = | 1 | (304a)

Factor for control and charging method (Table 4c(3)) for community heating system | 1 | (305)

Distribution loss factor (Table 12c) for community heating system | 1.05 | (306)

Space heating | **kWh/year**

Annual space heating requirement | 1569.99

Space heat from Community boilers | (98) x (304a) x (305) x (306) = | 1648.49 | (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0 | (308)

Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309)

Water heating

Annual water heating requirement | 1824.35

If DHW from community scheme:
Water heat from Community boilers | (64) x (303a) x (305) x (306) = | 1915.57 | (310a)

Electricity used for heat distribution | 0.01 × [(307a)...(307e) + (310a)...(310e)] = | 35.64 | (313)

Cooling System Energy Efficiency Ratio | 0 | (314)

Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315)

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 37.17 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 37.17 | (331)

Energy for lighting (calculated in Appendix L) | 235.69 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year

CO2 from other sources of space and water heating (not CHP)
Efficiency of heat source 1 (%) | If there is CHP using two fuels repeat (363) to (366) for the second fuel | 95 | (367a)

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CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	810.35	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	18.5	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	828.85	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			828.85	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	19.29	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	122.32	(379)
Total CO2, kg/year	sum of (376)…(382) =			970.46	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			19.27	(384)
EI rating (section 14)				86.36	(385)

DER WorkSheet: New dwelling design stage

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.25	(1a) x	2.5	(2a) =	125.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.25	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.62	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 = 0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) = 0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

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=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=
0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows			8.55	x1/[1/(1.2)+ 0.04] =	9.79			(27)
Walls Type1	23.19	8.55	14.64	x 0.18 =	2.64	14	204.96	(29)
Walls Type2	12.4	2.12	10.28	x 0.23 =	2.32	14	143.92	(29)
Walls Type3	14	0	14	x 0.2 =	2.86	14	196	(29)
Total area of elements, m²			49.59					(31)
Party wall			30.53	x 0 =	0	20	610.6	(32)
Party floor			50.25			40	2010	(32a)
Party ceiling			50.25			30	1507.5	(32b)
Internal wall **			90.21			9	811.89	(32c)

* 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) =	20.78	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5484.87	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	109.15	(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		5.96	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	26.75	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 20.81 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 47.56 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | | |

Average = Sum(39)$_{1...12}$ /12= **47.48** (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 0.95 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | | |

Average = Sum(40)$_{1...12}$ /12= **0.94** (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   **1.7**   (42)
    if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
    if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   **74.51**   (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of
not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

| (44)m= | 81.97 | 78.99 | 76.01 | 73.02 | 70.04 | 67.06 | 67.06 | 70.04 | 73.02 | 76.01 | 78.99 | 81.97 | | |

Total = Sum(44)$_{1...12}$ = **894.18** (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

| (45)m= | 121.55 | 106.31 | 109.7 | 95.64 | 91.77 | 79.19 | 73.38 | 84.21 | 85.21 | 99.31 | 108.4 | 117.72 | | |

Total = Sum(45)$_{1...12}$ = **1172.41** (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 18.23 | 15.95 | 16.46 | 14.35 | 13.77 | 11.88 | 11.01 | 12.63 | 12.78 | 14.9 | 16.26 | 17.66 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   **0**   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   **0**   (48)

Temperature factor from Table 2b   **0**   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   **110**   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   **0.02**   (51)
If community heating see section 4.3
Volume factor from Table 2a   **1.03**   (52)
Temperature factor from Table 2b   **0.6**   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   **1.03**   (54)
 Enter (50) or (54) in (55)   **1.03**   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	176.83	156.24	164.98	149.14	147.05	132.69	128.66	139.48	138.71	154.58	161.9	172.99	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	176.83	156.24	164.98	149.14	147.05	132.69	128.66	139.48	138.71	154.58	161.9	172.99	

Output from water heater (annual)₁...₁₂ | 1823.25 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.64	75.29	80.7	74.6	74.74	69.13	68.62	72.22	71.13	77.24	78.84	83.36	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.32	11.83	9.62	7.28	5.44	4.6	4.97	6.46	8.66	11	12.84	13.69	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.88	149.42	145.55	137.32	126.93	117.16	110.63	109.1	112.97	121.2	131.59	141.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	(71)

Water heating gains (Table 5)

(72)m=	113.76	112.04	108.47	103.61	100.45	96.01	92.23	97.07	98.79	103.82	109.5	112.05	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	323.42	321.75	312.1	296.67	281.28	266.23	256.3	261.09	268.88	284.48	302.39	315.56	(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)	
Southeast 0.9x	0.77	x	8.55	x	36.79	x	0.55	x	0.8	=	95.92	(77)
Southeast 0.9x	0.77	x	8.55	x	62.67	x	0.55	x	0.8	=	163.39	(77)

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Southeast 0.9x	0.77	x	8.55	x	85.75	x	0.55	x	0.8	=	223.56	(77)
Southeast 0.9x	0.77	x	8.55	x	106.25	x	0.55	x	0.8	=	277.01	(77)
Southeast 0.9x	0.77	x	8.55	x	119.01	x	0.55	x	0.8	=	310.27	(77)
Southeast 0.9x	0.77	x	8.55	x	118.15	x	0.55	x	0.8	=	308.02	(77)
Southeast 0.9x	0.77	x	8.55	x	113.91	x	0.55	x	0.8	=	296.97	(77)
Southeast 0.9x	0.77	x	8.55	x	104.39	x	0.55	x	0.8	=	272.15	(77)
Southeast 0.9x	0.77	x	8.55	x	92.85	x	0.55	x	0.8	=	242.07	(77)
Southeast 0.9x	0.77	x	8.55	x	69.27	x	0.55	x	0.8	=	180.59	(77)
Southeast 0.9x	0.77	x	8.55	x	44.07	x	0.55	x	0.8	=	114.89	(77)
Southeast 0.9x	0.77	x	8.55	x	31.49	x	0.55	x	0.8	=	82.09	(77)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	95.92	163.39	223.56	277.01	310.27	308.02	296.97	272.15	242.07	180.59	114.89	82.09	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	419.35	485.14	535.66	573.67	591.55	574.25	553.26	533.24	510.95	465.07	417.29	397.65	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) [21] (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.93	0.9	0.84	0.76	0.64	0.49	0.37	0.39	0.57	0.78	0.9	0.94	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.54	19.81	20.15	20.5	20.77	20.92	20.98	20.97	20.87	20.53	19.97	19.47	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.13	20.13	20.13	20.13	20.13	20.13	20.13	20.13	20.13	20.13	20.13	20.13	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.88	0.82	0.73	0.6	0.44	0.3	0.33	0.52	0.75	0.88	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.19	18.57	19.04	19.52	19.88	20.06	20.11	20.11	20.01	19.58	18.8	18.09	(90)

fLA = Living area ÷ (4) = [0.42] (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.76	19.09	19.5	19.93	20.25	20.42	20.48	20.47	20.37	19.97	19.29	18.67	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.76	19.09	19.5	19.93	20.25	20.42	20.48	20.47	20.37	19.97	19.29	18.67	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.9	0.87	0.81	0.72	0.6	0.46	0.33	0.35	0.53	0.74	0.87	0.92	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	379.49	419.96	433.51	414.68	356.53	261.29	180.11	188.08	272.26	344.85	361.1	364.04	(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)

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Heat loss rate for mean internal temperature, L_m, W =[(39)m x [(93)m– (96)m]

(97)m=	687.59	673.71	617.42	523.75	406.02	276.48	184.03	193.25	297.8	445.07	578.83	686.84		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	229.23	170.51	136.83	78.53	36.82	0	0	0	0	74.56	156.77	240.16		

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = | 1123.42 | (98)

Space heating requirement in kWh/m²/year | 22.36 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers | 1 | (303a)

Fraction of total space heat from Community boilers   (302) x (303a) = | 1 | (304a)

Factor for control and charging method (Table 4c(3)) for community heating system | 1 | (305)

Distribution loss factor (Table 12c) for community heating system | 1.05 | (306)

Space heating   kWh/year

Annual space heating requirement | 1123.42 |

Space heat from Community boilers   (98) x (304a) x (305) x (306) = | 1179.59 | (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0 | (308)

Space heating requirement from secondary/supplementary system   (98) x (301) x 100 ÷ (308) = | 0 | (309)

Water heating

Annual water heating requirement | 1823.25 |

If DHW from community scheme:
Water heat from Community boilers   (64) x (303a) x (305) x (306) = | 1914.41 | (310a)

Electricity used for heat distribution   0.01 × [(307a)…(307e) + (310a)…(310e)] = | 30.94 | (313)

Cooling System Energy Efficiency Ratio | 0 | (314)

Space cooling (if there is a fixed cooling system, if not enter 0)   = (107) ÷ (314) = | 0 | (315)

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 37.1 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year   =(330a) + (330b) + (330g) = | 37.1 | (331)

Energy for lighting (calculated in Appendix L) | 235.22 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year

CO2 from other sources of space and water heating (not CHP)
Efficiency of heat source 1 (%)   If there is CHP using two fuels repeat (363) to (366) for the second fuel | 95 | (367a)

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CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	703.48	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	16.06	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	719.53	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			719.53	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	19.25	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	122.08	(379)

Total CO2, kg/year   sum of (376)…(382) =   860.87   (383)

Dwelling CO2 Emission Rate   (383) ÷ (4) =   17.13   (384)

EI rating (section 14)   87.89   (385)

DER WorkSheet: New dwelling design stage

Property Address: MF - 2Bed - North East

Address : MF - 2Bed - North East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 = 0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) = 0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation: | 0.5 | (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) | 0.5 | (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 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=

| 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | (24c)
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d)
|---|---|---|---|---|---|---|---|---|---|---|---|

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

| 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | (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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Total area of elements, m²			50.63					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Party ceiling			71.72			30	2151.6	(32b)
Internal wall **			142.3			9	1280.7	(32c)

* 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) =	25.04	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	7629.5	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	106.38	(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		8.06	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	33.1	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K $\qquad$ (39)m = (37) + (38)m

| (39)m= | 62.8 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | | |

Average = Sum(39)$_{1...12}$ /12= **62.69** (39)

Heat loss parameter (HLP), W/m²K $\qquad$ (40)m = (39)m ÷ (4)

| (40)m= | 0.88 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | | |

Average = Sum(40)$_{1...12}$ /12= **0.87** (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 $\qquad$ **2.29** (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 $\qquad$ **88.52** (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | |

Total = Sum(44)$_{1...12}$ = **1062.24** (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | |

Total = Sum(45)$_{1...12}$ = **1392.76** (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel $\qquad$ **0** (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day): $\qquad$ **0** (48)

Temperature factor from Table 2b $\qquad$ **0** (49)

Energy lost from water storage, kWh/year $\qquad$ (48) x (49) = **110** (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) $\qquad$ **0.02** (51)
If community heating see section 4.3

Volume factor from Table 2a $\qquad$ **1.03** (52)

Temperature factor from Table 2b $\qquad$ **0.6** (53)

Energy lost from water storage, kWh/year $\qquad$ (47) x (51) x (52) x (53) = **1.03** (54)
 Enter (50) or (54) in (55) $\qquad$ **1.03** (55)

Water storage loss calculated for each month $\qquad$ ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.9	x	11.28	x	0.55	x	0.8	=	13.42	(75)
Northeast 0.9x	0.77	x	3.9	x	22.97	x	0.55	x	0.8	=	27.31	(75)

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Orientation												Result	
Northeast	0.9x	0.77	x	3.9	x	41.38	x	0.55	x	0.8	=	49.21	(75)
Northeast	0.9x	0.77	x	3.9	x	67.96	x	0.55	x	0.8	=	80.81	(75)
Northeast	0.9x	0.77	x	3.9	x	91.35	x	0.55	x	0.8	=	108.63	(75)
Northeast	0.9x	0.77	x	3.9	x	97.38	x	0.55	x	0.8	=	115.81	(75)
Northeast	0.9x	0.77	x	3.9	x	91.1	x	0.55	x	0.8	=	108.34	(75)
Northeast	0.9x	0.77	x	3.9	x	72.63	x	0.55	x	0.8	=	86.37	(75)
Northeast	0.9x	0.77	x	3.9	x	50.42	x	0.55	x	0.8	=	59.96	(75)
Northeast	0.9x	0.77	x	3.9	x	28.07	x	0.55	x	0.8	=	33.38	(75)
Northeast	0.9x	0.77	x	3.9	x	14.2	x	0.55	x	0.8	=	16.88	(75)
Northeast	0.9x	0.77	x	3.9	x	9.21	x	0.55	x	0.8	=	10.96	(75)
Northwest	0.9x	0.77	x	9.61	x	11.28	x	0.55	x	0.8	=	33.06	(81)
Northwest	0.9x	0.77	x	9.61	x	22.97	x	0.55	x	0.8	=	67.3	(81)
Northwest	0.9x	0.77	x	9.61	x	41.38	x	0.55	x	0.8	=	121.25	(81)
Northwest	0.9x	0.77	x	9.61	x	67.96	x	0.55	x	0.8	=	199.13	(81)
Northwest	0.9x	0.77	x	9.61	x	91.35	x	0.55	x	0.8	=	267.67	(81)
Northwest	0.9x	0.77	x	9.61	x	97.38	x	0.55	x	0.8	=	285.36	(81)
Northwest	0.9x	0.77	x	9.61	x	91.1	x	0.55	x	0.8	=	266.95	(81)
Northwest	0.9x	0.77	x	9.61	x	72.63	x	0.55	x	0.8	=	212.82	(81)
Northwest	0.9x	0.77	x	9.61	x	50.42	x	0.55	x	0.8	=	147.75	(81)
Northwest	0.9x	0.77	x	9.61	x	28.07	x	0.55	x	0.8	=	82.24	(81)
Northwest	0.9x	0.77	x	9.61	x	14.2	x	0.55	x	0.8	=	41.6	(81)
Northwest	0.9x	0.77	x	9.61	x	9.21	x	0.55	x	0.8	=	27	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	46.48	94.61	170.46	279.94	376.3	401.17	375.29	299.18	207.71	115.62	58.48	37.96		(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	447	493.17	556.53	645.88	721.86	727.02	688.27	617.83	536.64	464.89	431.12	428.06		(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=	0.96	0.95	0.91	0.82	0.68	0.51	0.39	0.44	0.68	0.87	0.95	0.97	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.37	19.57	19.94	20.4	20.75	20.93	20.98	20.96	20.82	20.35	19.78	19.31	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.94	0.9	0.8	0.64	0.46	0.32	0.37	0.62	0.85	0.94	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.99	18.28	18.8	19.45	19.91	20.12	20.17	20.16	20.01	19.4	18.58	17.91	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

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Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 – fLA) x T2

| (92)m= | 18.41 | 18.68 | 19.15 | 19.74 | 20.17 | 20.37 | 20.42 | 20.41 | 20.26 | 19.69 | 18.95 | 18.34 | | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m= | 18.41 | 18.68 | 19.15 | 19.74 | 20.17 | 20.37 | 20.42 | 20.41 | 20.26 | 19.69 | 18.95 | 18.34 | | (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= | 0.94 | 0.92 | 0.88 | 0.78 | 0.64 | 0.47 | 0.34 | 0.39 | 0.63 | 0.84 | 0.92 | 0.95 | | (94) |

Useful gains, hmGm , W = (94)m x (84)m

| (95)m= | 421.67 | 455.52 | 489.2 | 506.38 | 460.19 | 341.94 | 234.53 | 243.3 | 336.76 | 388.71 | 396.94 | 406.36 | | (95) |

Monthly average external temperature from Table 8

| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

| (97)m= | 886.31 | 863.52 | 793.18 | 679.6 | 531.12 | 361.7 | 239.63 | 251.48 | 385.93 | 569.95 | 742.73 | 886.42 | | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| (98)m= | 345.69 | 274.17 | 226.16 | 124.72 | 52.78 | 0 | 0 | 0 | 0 | 134.84 | 248.98 | 357.16 | | (98) |

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = | 1764.5 | (98)

Space heating requirement in kWh/m²/year | 24.6 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers | 1 | (303a)

Fraction of total space heat from Community boilers | (302) x (303a) = | 1 | (304a)

Factor for control and charging method (Table 4c(3)) for community heating system | 1 | (305)

Distribution loss factor (Table 12c) for community heating system | 1.05 | (306)

Space heating | **kWh/year**

Annual space heating requirement | 1764.5

Space heat from Community boilers | (98) x (304a) x (305) x (306) = | 1852.73 | (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0 | (308

Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309)

Water heating

Annual water heating requirement | 2043.6

If DHW from community scheme:
Water heat from Community boilers | (64) x (303a) x (305) x (306) = | 2145.78 | (310a)

Electricity used for heat distribution | 0.01 x [(307a)...(307e) + (310a)...(310e)] = | 39.99 | (313)

Cooling System Energy Efficiency Ratio | 0 | (314)

Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315)

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Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	52.46	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year =(330a) + (330b) + (330g) =	52.46	(331)
Energy for lighting (calculated in Appendix L)	317.29	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) If there is CHP using two fuels repeat (363) to (366) for the second fuel			95	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.22	= 909.13	(367)
Electrical energy for heat distribution [(313) x		0.52	= 20.75	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)			= 929.89	(373)
CO2 associated with space heating (secondary) (309) x		0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.22	= 0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			929.89	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52	= 27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52	= 164.67	(379)
Total CO2, kg/year sum of (376)…(382) =			1121.79	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =			15.64	(384)
EI rating (section 14)			87.12	(385)

DER WorkSheet: New dwelling design stage

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 = 0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) = 0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Total area of elements, m²			50.63					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Party ceiling			71.72			30	2151.6	(32b)
Internal wall **			142.3			9	1280.7	(32c)

* 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) =

25.04	(33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =

7629.5	(34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) =

106.38	(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

8.06	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) =

33.1	(37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | (38) |

Heat transfer coefficient, W/K $(39)m = (37) + (38)m$

| (39)m= | 62.8 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | (39) |

Average = Sum(39)$_{1...12}$ /12= **62.69** (39)

Heat loss parameter (HLP), W/m²K $(40)m = (39)m ÷ (4)$

| (40)m= | 0.88 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | (40) |

Average = Sum(40)$_{1...12}$ /12= **0.87** (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 **2.29** (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 **88.52** (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | (44) |

Total = Sum(44)$_{1...12}$ = **1062.24** (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | (45) |

Total = Sum(45)$_{1...12}$ = **1392.76** (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel **0** (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day): **0** (48)
Temperature factor from Table 2b **0** (49)
Energy lost from water storage, kWh/year (48) x (49) = **110** (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) **0.02** (51)
If community heating see section 4.3
Volume factor from Table 2a **1.03** (52)
Temperature factor from Table 2b **0.6** (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = **1.03** (54)
 Enter (50) or (54) in (55) **1.03** (55)

Water storage loss calculated for each month $((56)m = (55) × (41)m$

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

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Primary circuit loss (annual) from Table 3   [0]   (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂   [2043.6]   (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest 0.9x	0.77	x	3.9	x	36.79		0.55	x	0.8	=	43.75	(79)
Southwest 0.9x	0.77	x	3.9	x	62.67		0.55	x	0.8	=	74.53	(79)

Southwest 0.9x	0.77	x	3.9	x	85.75		0.55	x	0.8	=	101.98	(79)
Southwest 0.9x	0.77	x	3.9	x	106.25		0.55	x	0.8	=	126.35	(79)
Southwest 0.9x	0.77	x	3.9	x	119.01		0.55	x	0.8	=	141.53	(79)
Southwest 0.9x	0.77	x	3.9	x	118.15		0.55	x	0.8	=	140.5	(79)
Southwest 0.9x	0.77	x	3.9	x	113.91		0.55	x	0.8	=	135.46	(79)
Southwest 0.9x	0.77	x	3.9	x	104.39		0.55	x	0.8	=	124.14	(79)
Southwest 0.9x	0.77	x	3.9	x	92.85		0.55	x	0.8	=	110.42	(79)
Southwest 0.9x	0.77	x	3.9	x	69.27		0.55	x	0.8	=	82.37	(79)
Southwest 0.9x	0.77	x	3.9	x	44.07		0.55	x	0.8	=	52.41	(79)
Southwest 0.9x	0.77	x	3.9	x	31.49		0.55	x	0.8	=	37.44	(79)
Northwest 0.9x	0.77	x	9.61	x	11.28	x	0.55	x	0.8	=	33.06	(81)
Northwest 0.9x	0.77	x	9.61	x	22.97	x	0.55	x	0.8	=	67.3	(81)
Northwest 0.9x	0.77	x	9.61	x	41.38	x	0.55	x	0.8	=	121.25	(81)
Northwest 0.9x	0.77	x	9.61	x	67.96	x	0.55	x	0.8	=	199.13	(81)
Northwest 0.9x	0.77	x	9.61	x	91.35	x	0.55	x	0.8	=	267.67	(81)
Northwest 0.9x	0.77	x	9.61	x	97.38	x	0.55	x	0.8	=	285.36	(81)
Northwest 0.9x	0.77	x	9.61	x	91.1	x	0.55	x	0.8	=	266.95	(81)
Northwest 0.9x	0.77	x	9.61	x	72.63	x	0.55	x	0.8	=	212.82	(81)
Northwest 0.9x	0.77	x	9.61	x	50.42	x	0.55	x	0.8	=	147.75	(81)
Northwest 0.9x	0.77	x	9.61	x	28.07	x	0.55	x	0.8	=	82.24	(81)
Northwest 0.9x	0.77	x	9.61	x	14.2	x	0.55	x	0.8	=	41.6	(81)
Northwest 0.9x	0.77	x	9.61	x	9.21	x	0.55	x	0.8	=	27	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	76.82	141.83	223.23	325.48	409.2	425.87	402.41	336.96	258.17	164.62	94.01	64.45	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	477.34	540.39	609.29	691.42	754.76	751.72	715.39	655.61	587.1	513.88	466.65	454.55	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.96	0.93	0.89	0.8	0.66	0.5	0.37	0.42	0.64	0.85	0.93	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.44	19.67	20.03	20.46	20.77	20.93	20.98	20.97	20.85	20.43	19.85	19.37	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.93	0.88	0.77	0.62	0.44	0.31	0.35	0.58	0.82	0.92	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.08	18.42	18.93	19.52	19.94	20.13	20.18	20.17	20.04	19.5	18.68	17.99	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

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Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 – fLA) x T2

(92)m=	18.5	18.8	19.27	19.81	20.2	20.38	20.42	20.42	20.29	19.78	19.05	18.42		(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.5	18.8	19.27	19.81	20.2	20.38	20.42	20.42	20.29	19.78	19.05	18.42		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		

Utilisation factor for gains, hm:

(94)m=	0.93	0.91	0.86	0.76	0.62	0.46	0.33	0.37	0.59	0.81	0.91	0.94		(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	446.05	490.51	522.17	525.99	467.37	343.82	235.16	244.74	346.67	414.39	423.07	428.15		(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=	891.9	871.56	800.71	683.9	532.58	362.05	239.74	251.75	387.92	575.7	748.73	891.4		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	331.71	256.06	207.23	113.7	48.51	0	0	0	0	120.02	234.48	344.66		

	Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =	1656.37	(98)

Space heating requirement in kWh/m²/year	23.09	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating   **kWh/year**

Annual space heating requirement		1656.37	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1739.18	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		2043.6	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2145.78	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	38.85	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)

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Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 52.46 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = | 52.46 | (331)

Energy for lighting (calculated in Appendix L) | 317.29 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*			95	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.22 =	883.32	(367)
Electrical energy for heat distribution [(313) x		0.52 =	20.16	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)		=	903.48	(373)
CO2 associated with space heating (secondary) (309) x		0 =	0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.22 =	0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			903.48	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52 =	27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52 =	164.67	(379)

Total CO2, kg/year   sum of (376)…(382) = | 1095.38 | (383)

Dwelling CO2 Emission Rate   (383) ÷ (4) = | 15.27 | (384)

EI rating (section 14) | 87.42 | (385)

DER WorkSheet: New dwelling design stage

Property Address: MF - 2Bed - South East

Address :   MF - 2Bed - South East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =		0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =		0	(6b)
Number of intermittent fans							0	x 10 =		0	(7a)
Number of passive vents							0	x 10 =		0	(7b)
Number of flueless gas fires							0	x 40 =		0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation: — 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) — 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = — 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=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=
0	0	0	0	0	0	0	0	0	0	0	0
(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Total area of elements, m²			50.63					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Party ceiling			71.72			30	2151.6	(32b)
Internal wall **			142.3			9	1280.7	(32c)

* 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) =   25.04 (33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =   7629.5 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) =   106.38 (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   8.06 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) =   33.1 (37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 62.8 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | | |

Average = Sum(39)$_{1...12}$ /12= 62.69   (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 0.88 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | | |

Average = Sum(40)$_{1...12}$ /12= 0.87   (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   2.29   (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   88.52   (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | |

Total = Sum(44)$_{1...12}$ = 1062.24   (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | |

Total = Sum(45)$_{1...12}$ = 1392.76   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)
Temperature factor from Table 2b   0   (49)
Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)
If community heating see section 4.3
Volume factor from Table 2a   1.03   (52)
Temperature factor from Table 2b   0.6   (53)
Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)
 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3

0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂

2043.6	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.9	x	11.28	x	0.55	x	0.8	=	13.42	(75)
Northeast 0.9x	0.77	x	3.9	x	22.97	x	0.55	x	0.8	=	27.31	(75)

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	0.9x												
Northeast	0.9x	0.77	x	3.9	x	41.38	x	0.55	x	0.8	=	49.21	(75)
Northeast	0.9x	0.77	x	3.9	x	67.96	x	0.55	x	0.8	=	80.81	(75)
Northeast	0.9x	0.77	x	3.9	x	91.35	x	0.55	x	0.8	=	108.63	(75)
Northeast	0.9x	0.77	x	3.9	x	97.38	x	0.55	x	0.8	=	115.81	(75)
Northeast	0.9x	0.77	x	3.9	x	91.1	x	0.55	x	0.8	=	108.34	(75)
Northeast	0.9x	0.77	x	3.9	x	72.63	x	0.55	x	0.8	=	86.37	(75)
Northeast	0.9x	0.77	x	3.9	x	50.42	x	0.55	x	0.8	=	59.96	(75)
Northeast	0.9x	0.77	x	3.9	x	28.07	x	0.55	x	0.8	=	33.38	(75)
Northeast	0.9x	0.77	x	3.9	x	14.2	x	0.55	x	0.8	=	16.88	(75)
Northeast	0.9x	0.77	x	3.9	x	9.21	x	0.55	x	0.8	=	10.96	(75)
Southeast	0.9x	0.77	x	9.61	x	36.79	x	0.55	x	0.8	=	107.82	(77)
Southeast	0.9x	0.77	x	9.61	x	62.67	x	0.55	x	0.8	=	183.65	(77)
Southeast	0.9x	0.77	x	9.61	x	85.75	x	0.55	x	0.8	=	251.28	(77)
Southeast	0.9x	0.77	x	9.61	x	106.25	x	0.55	x	0.8	=	311.35	(77)
Southeast	0.9x	0.77	x	9.61	x	119.01	x	0.55	x	0.8	=	348.73	(77)
Southeast	0.9x	0.77	x	9.61	x	118.15	x	0.55	x	0.8	=	346.21	(77)
Southeast	0.9x	0.77	x	9.61	x	113.91	x	0.55	x	0.8	=	333.79	(77)
Southeast	0.9x	0.77	x	9.61	x	104.39	x	0.55	x	0.8	=	305.89	(77)
Southeast	0.9x	0.77	x	9.61	x	92.85	x	0.55	x	0.8	=	272.08	(77)
Southeast	0.9x	0.77	x	9.61	x	69.27	x	0.55	x	0.8	=	202.97	(77)
Southeast	0.9x	0.77	x	9.61	x	44.07	x	0.55	x	0.8	=	129.14	(77)
Southeast	0.9x	0.77	x	9.61	x	31.49	x	0.55	x	0.8	=	92.27	(77)

Solar gains in watts, calculated for each month $(83)m = Sum(74)m \ldots (82)m$

(83)m=	121.23	210.96	300.49	392.16	457.36	462.02	442.12	392.26	332.04	236.35	146.02	103.23		(83)

Total gains – internal and solar $(84)m = (73)m + (83)m$, watts

(84)m=	521.76	609.52	686.55	758.1	802.93	787.87	755.11	710.91	660.98	585.62	518.66	493.33		(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=	0.95	0.91	0.86	0.77	0.63	0.48	0.36	0.39	0.59	0.8	0.92	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.53	19.8	20.16	20.53	20.8	20.94	20.98	20.98	20.88	20.52	19.95	19.46	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.94	0.9	0.84	0.74	0.59	0.43	0.29	0.33	0.53	0.77	0.9	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.22	18.61	19.11	19.62	19.97	20.13	20.18	20.17	20.07	19.62	18.83	18.12	(90)

fLA = Living area ÷ (4) = — 0.31 — (91)

DER WorkSheet: New dwelling design stage

Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 – fLA) x T2

(92)m=	18.63	18.98	19.43	19.9	20.23	20.38	20.43	20.42	20.32	19.9	19.18	18.53		(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.63	18.98	19.43	19.9	20.23	20.38	20.43	20.42	20.32	19.9	19.18	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=	0.92	0.88	0.82	0.73	0.59	0.44	0.31	0.35	0.54	0.76	0.88	0.93		(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	480.37	538.2	565.76	551.45	476.71	346.26	235.93	246.41	357.96	446.9	459	459.03		(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=	899.78	882.5	810.58	689.41	534.46	362.51	239.88	252.05	390.13	582.87	756.98	898.48		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	312.04	231.37	182.14	99.34	42.96	0	0	0	0	101.16	214.54	326.95		(98)

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = **1510.5** (98)

Space heating requirement in kWh/m²/year   **21.06** (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none   **0** (301)

Fraction of space heat from community system 1 – (301) =   **1** (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers   **1** (303a)

Fraction of total space heat from Community boilers   (302) x (303a) =   **1** (304a)

Factor for control and charging method (Table 4c(3)) for community heating system   **1** (305)

Distribution loss factor (Table 12c) for community heating system   **1.05** (306)

Space heating   kWh/year

Annual space heating requirement   **1510.5**

Space heat from Community boilers   (98) x (304a) x (305) x (306) =   **1586.02** (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)   **0** (308

Space heating requirement from secondary/supplementary system   (98) x (301) x 100 ÷ (308) =   **0** (309)

Water heating

Annual water heating requirement   **2043.6**

If DHW from community scheme:
Water heat from Community boilers   (64) x (303a) x (305) x (306) =   **2145.78** (310a)

Electricity used for heat distribution   0.01 × [(307a)…(307e) + (310a)…(310e)] =   **37.32** (313)

Cooling System Energy Efficiency Ratio   **0** (314)

Space cooling (if there is a fixed cooling system, if not enter 0)   = (107) ÷ (314) =   **0** (315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 52.46 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 52.46 | (331)

Energy for lighting (calculated in Appendix L) | 317.29 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	= 848.49	(367)
Electrical energy for heat distribution	[(313) x	0.52	= 19.37	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)	=	867.86	(373)
CO2 associated with space heating (secondary)	(309) x	0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	= 0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =		867.86	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	= 27.23	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	= 164.67	(379)

Total CO2, kg/year | sum of (376)…(382) = | 1059.76 | (383)

Dwelling CO2 Emission Rate | (383) ÷ (4) = | 14.78 | (384)

EI rating (section 14) | 87.83 | (385)

DER WorkSheet: New dwelling design stage

Property Address: MF - 2Bed - South West

Address : MF - 2Bed - South West , Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Total area of elements, m²			50.63					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Party ceiling			71.72			30	2151.6	(32b)
Internal wall **			142.3			9	1280.7	(32c)

* 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) =

25.04	(33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =

7629.5	(34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) =

106.38	(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

8.06	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) =

33.1	(37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| (39)m= | 62.8 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | | |

Average = Sum(39)₁...₁₂ /12= **62.69** (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| (40)m= | 0.88 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | | |

Average = Sum(40)₁...₁₂ /12= **0.87** (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 **2.29** (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 **88.52** (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | |

Total = Sum(44)₁...₁₂ = **1062.24** (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | |

Total = Sum(45)₁...₁₂ = **1392.76** (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel **0** (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day): **0** (48)

Temperature factor from Table 2b **0** (49)

Energy lost from water storage, kWh/year (48) x (49) = **110** (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) **0.02** (51)
If community heating see section 4.3
Volume factor from Table 2a **1.03** (52)
Temperature factor from Table 2b **0.6** (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = **1.03** (54)
 Enter (50) or (54) in (55) **1.03** (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	9.61	x	36.79	x	0.55	x	0.8	=	107.82	(77)
Southeast 0.9x	0.77	x	9.61	x	62.67	x	0.55	x	0.8	=	183.65	(77)

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	0.9x											
Southeast	0.9x	0.77	x	9.61	x	85.75	x	0.55	x	0.8	=	251.28	(77)

Southeast 0.9x | 0.77 | x | 9.61 | x | 85.75 | x | 0.55 | x | 0.8 | = | 251.28 | (77)
Southeast 0.9x | 0.77 | x | 9.61 | x | 106.25 | x | 0.55 | x | 0.8 | = | 311.35 | (77)
Southeast 0.9x | 0.77 | x | 9.61 | x | 119.01 | x | 0.55 | x | 0.8 | = | 348.73 | (77)
Southeast 0.9x | 0.77 | x | 9.61 | x | 118.15 | x | 0.55 | x | 0.8 | = | 346.21 | (77)
Southeast 0.9x | 0.77 | x | 9.61 | x | 113.91 | x | 0.55 | x | 0.8 | = | 333.79 | (77)
Southeast 0.9x | 0.77 | x | 9.61 | x | 104.39 | x | 0.55 | x | 0.8 | = | 305.89 | (77)
Southeast 0.9x | 0.77 | x | 9.61 | x | 92.85 | x | 0.55 | x | 0.8 | = | 272.08 | (77)
Southeast 0.9x | 0.77 | x | 9.61 | x | 69.27 | x | 0.55 | x | 0.8 | = | 202.97 | (77)
Southeast 0.9x | 0.77 | x | 9.61 | x | 44.07 | x | 0.55 | x | 0.8 | = | 129.14 | (77)
Southeast 0.9x | 0.77 | x | 9.61 | x | 31.49 | x | 0.55 | x | 0.8 | = | 92.27 | (77)
Southwest 0.9x | 0.77 | x | 3.9 | x | 36.79 | | 0.55 | x | 0.8 | = | 43.75 | (79)
Southwest 0.9x | 0.77 | x | 3.9 | x | 62.67 | | 0.55 | x | 0.8 | = | 74.53 | (79)
Southwest 0.9x | 0.77 | x | 3.9 | x | 85.75 | | 0.55 | x | 0.8 | = | 101.98 | (79)
Southwest 0.9x | 0.77 | x | 3.9 | x | 106.25 | | 0.55 | x | 0.8 | = | 126.35 | (79)
Southwest 0.9x | 0.77 | x | 3.9 | x | 119.01 | | 0.55 | x | 0.8 | = | 141.53 | (79)
Southwest 0.9x | 0.77 | x | 3.9 | x | 118.15 | | 0.55 | x | 0.8 | = | 140.5 | (79)
Southwest 0.9x | 0.77 | x | 3.9 | x | 113.91 | | 0.55 | x | 0.8 | = | 135.46 | (79)
Southwest 0.9x | 0.77 | x | 3.9 | x | 104.39 | | 0.55 | x | 0.8 | = | 124.14 | (79)
Southwest 0.9x | 0.77 | x | 3.9 | x | 92.85 | | 0.55 | x | 0.8 | = | 110.42 | (79)
Southwest 0.9x | 0.77 | x | 3.9 | x | 69.27 | | 0.55 | x | 0.8 | = | 82.37 | (79)
Southwest 0.9x | 0.77 | x | 3.9 | x | 44.07 | | 0.55 | x | 0.8 | = | 52.41 | (79)
Southwest 0.9x | 0.77 | x | 3.9 | x | 31.49 | | 0.55 | x | 0.8 | = | 37.44 | (79)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

| (83)m= | 151.57 | 258.18 | 353.26 | 437.7 | 490.26 | 486.72 | 469.25 | 430.03 | 382.5 | 285.35 | 181.55 | 129.71 | | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| (84)m= | 552.09 | 656.74 | 739.32 | 803.64 | 835.83 | 812.57 | 782.23 | 748.68 | 711.44 | 634.61 | 554.19 | 519.82 | | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.94	0.9	0.84	0.74	0.61	0.47	0.34	0.37	0.55	0.78	0.9	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| (87)m= | 19.6 | 19.89 | 20.23 | 20.57 | 20.82 | 20.94 | 20.98 | 20.98 | 20.9 | 20.58 | 20.02 | 19.52 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| (88)m= | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| (89)m= | 0.93 | 0.88 | 0.82 | 0.71 | 0.57 | 0.41 | 0.28 | 0.31 | 0.5 | 0.74 | 0.89 | 0.94 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| (90)m= | 18.31 | 18.73 | 19.21 | 19.67 | 19.99 | 20.14 | 20.18 | 20.17 | 20.09 | 19.69 | 18.92 | 18.2 | (90) |

fLA = Living area ÷ (4) = | 0.31 | (91)

DER WorkSheet: New dwelling design stage

Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 – fLA) x T2

(92)m=	18.71	19.09	19.53	19.95	20.24	20.39	20.43	20.42	20.34	19.97	19.26	18.61	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.71	19.09	19.53	19.95	20.24	20.39	20.43	20.42	20.34	19.97	19.26	18.61	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.91	0.87	0.8	0.71	0.58	0.43	0.3	0.33	0.51	0.73	0.87	0.92	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	502.86	568.38	592.51	566.81	482.36	347.73	236.38	247.32	363.97	465.99	481.96	479.41	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	904.96	889.41	816.57	692.69	535.58	362.78	239.97	252.21	391.28	587.01	762.23	903.15	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	299.16	215.73	166.7	90.63	39.59	0	0	0	0	90.04	201.79	315.27	(98)

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = **1418.91** (98)

Space heating requirement in kWh/m²/year **19.78** (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none **0** (301)

Fraction of space heat from community system 1 – (301) = **1** (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers **1** (303a)

Fraction of total space heat from Community boilers (302) x (303a) = **1** (304a)

Factor for control and charging method (Table 4c(3)) for community heating system **1** (305)

Distribution loss factor (Table 12c) for community heating system **1.05** (306)

Space heating **kWh/year**

Annual space heating requirement **1418.91**

Space heat from Community boilers (98) x (304a) x (305) x (306) = **1489.85** (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) **0** (308)

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = **0** (309)

Water heating

Annual water heating requirement **2043.6**

If DHW from community scheme:
Water heat from Community boilers (64) x (303a) x (305) x (306) = **2145.78** (310a)

Electricity used for heat distribution 0.01 x [(307a)…(307e) + (310a)…(310e)] = **36.36** (313)

Cooling System Energy Efficiency Ratio **0** (314)

Space cooling (if there is a fixed cooling system, if not enter 0) = (107) ÷ (314) = **0** (315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	52.46	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year =(330a) + (330b) + (330g) =	52.46	(331)
Energy for lighting (calculated in Appendix L)	317.29	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) _If there is CHP using two fuels repeat (363) to (366) for the second fuel_				95	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	826.63	(367)
Electrical energy for heat distribution [(313) x		0.52	=	18.87	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)			=	845.5	(373)
CO2 associated with space heating (secondary) (309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =				845.5	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52	=	27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52	=	164.67	(379)
Total CO2, kg/year sum of (376)…(382) =				1037.4	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =				14.46	(384)
EI rating (section 14)				88.09	(385)

DER WorkSheet: New dwelling design stage

Property Address: TF - 1Bed - South

Address : TF - 1Bed - South, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.25	(1a) x	2.5	(2a) =	125.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.25	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.62	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0 (9)
Additional infiltration	[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0 (12)
If no draught lobby, enter 0.05, else enter 0		0 (13)
Percentage of windows and doors draught stripped		0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.23 (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) =	0.2 (21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows			8.55	x1/[1/(1.2)+ 0.04] =	9.79			(27)
Walls Type1	23.19	8.55	14.64	x 0.18 =	2.64	14	204.96	(29)
Walls Type2	12.4	2.12	10.28	x 0.23 =	2.32	14	143.92	(29)
Walls Type3	14	0	14	x 0.2 =	2.86	14	196	(29)
Roof	50.25	0	50.25	x 0.13 =	6.53	9	452.25	(30)
Total area of elements, m²			99.84					(31)
Party wall			30.53	x 0 =	0	20	610.6	(32)
Party floor			50.25			40	2010	(32a)
Internal wall **			90.21			9	811.89	(32c)

* 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) =

27.32	(33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =

4429.62	(34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) =

88.15	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

13.06	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) =

40.38	(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= | 20.81 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 61.19 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 |

Average = Sum(39)$_{1...12}$ /12= 61.11 (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 |

Average = Sum(40)$_{1...12}$ /12= 1.22 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   1.7 (42)
   if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
   if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   74.51 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of
not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

| (44)m= | 81.97 | 78.99 | 76.01 | 73.02 | 70.04 | 67.06 | 67.06 | 70.04 | 73.02 | 76.01 | 78.99 | 81.97 |

Total = Sum(44)$_{1...12}$ = 894.18 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

| (45)m= | 121.55 | 106.31 | 109.7 | 95.64 | 91.77 | 79.19 | 73.38 | 84.21 | 85.21 | 99.31 | 108.4 | 117.72 |

Total = Sum(45)$_{1...12}$ = 1172.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 18.23 | 15.95 | 16.46 | 14.35 | 13.77 | 11.88 | 11.01 | 12.63 | 12.78 | 14.9 | 16.26 | 17.66 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)

Temperature factor from Table 2b   0   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)
If community heating see section 4.3
Volume factor from Table 2a   1.03   (52)
Temperature factor from Table 2b   0.6   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)
 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m)

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

   (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	176.83	156.24	164.98	149.14	147.05	132.69	128.66	139.48	138.71	154.58	161.9	172.99	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	176.83	156.24	164.98	149.14	147.05	132.69	128.66	139.48	138.71	154.58	161.9	172.99	

Output from water heater (annual)₁...₁₂ | 1823.25 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.64	75.29	80.7	74.6	74.74	69.13	68.62	72.22	71.13	77.24	78.84	83.36	(65)

   include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.32	11.83	9.62	7.28	5.44	4.6	4.97	6.46	8.66	11	12.84	13.69	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.88	149.42	145.55	137.32	126.93	117.16	110.63	109.1	112.97	121.2	131.59	141.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	(71)

Water heating gains (Table 5)

(72)m=	113.76	112.04	108.47	103.61	100.45	96.01	92.23	97.07	98.79	103.82	109.5	112.05	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	323.42	321.75	312.1	296.67	281.28	266.23	256.3	261.09	268.88	284.48	302.39	315.56	(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)	
Southeast 0.9x	0.77	x	8.55	x	36.79	x	0.55	x	0.8	=	95.92	(77)
Southeast 0.9x	0.77	x	8.55	x	62.67	x	0.55	x	0.8	=	163.39	(77)

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Southeast 0.9x	0.77	x	8.55	x	85.75	x	0.55	x	0.8	=	223.56	(77)
Southeast 0.9x	0.77	x	8.55	x	106.25	x	0.55	x	0.8	=	277.01	(77)
Southeast 0.9x	0.77	x	8.55	x	119.01	x	0.55	x	0.8	=	310.27	(77)
Southeast 0.9x	0.77	x	8.55	x	118.15	x	0.55	x	0.8	=	308.02	(77)
Southeast 0.9x	0.77	x	8.55	x	113.91	x	0.55	x	0.8	=	296.97	(77)
Southeast 0.9x	0.77	x	8.55	x	104.39	x	0.55	x	0.8	=	272.15	(77)
Southeast 0.9x	0.77	x	8.55	x	92.85	x	0.55	x	0.8	=	242.07	(77)
Southeast 0.9x	0.77	x	8.55	x	69.27	x	0.55	x	0.8	=	180.59	(77)
Southeast 0.9x	0.77	x	8.55	x	44.07	x	0.55	x	0.8	=	114.89	(77)
Southeast 0.9x	0.77	x	8.55	x	31.49	x	0.55	x	0.8	=	82.09	(77)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	95.92	163.39	223.56	277.01	310.27	308.02	296.97	272.15	242.07	180.59	114.89	82.09	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	419.35	485.14	535.66	573.67	591.55	574.25	553.26	533.24	510.95	465.07	417.29	397.65	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 — (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.92	0.89	0.85	0.78	0.69	0.56	0.44	0.46	0.63	0.8	0.89	0.93	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.63	18.94	19.39	19.92	20.39	20.74	20.9	20.87	20.63	20.02	19.22	18.55	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.91	19.91	19.91	19.91	19.91	19.91	19.91	19.91	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.91	0.88	0.83	0.75	0.64	0.49	0.34	0.37	0.57	0.77	0.88	0.92	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.78	17.22	17.86	18.59	19.24	19.67	19.84	19.82	19.55	18.75	17.63	16.66	(90)

fLA = Living area ÷ (4) =   0.42   (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.55	17.94	18.5	19.15	19.72	20.12	20.28	20.26	20	19.28	18.3	17.45	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.55	17.94	18.5	19.15	19.72	20.12	20.28	20.26	20	19.28	18.3	17.45	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate
the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.88	0.85	0.8	0.73	0.63	0.5	0.38	0.4	0.57	0.75	0.85	0.89	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	370.72	411.87	429.24	419.3	374.27	289.04	207.89	215.12	292.43	346.65	354.05	355.47	(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)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	810.91	797.1	733.4	626.25	490.23	337.12	224.94	235.98	360.61	530.4	684.14	809.7		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	327.5	258.87	226.3	149.01	86.27	0	0	0	0	136.71	237.67	337.94		(98)

	Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =	1760.27	(98)

Space heating requirement in kWh/m²/year | 35.03 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers | 1 | (303a)

Fraction of total space heat from Community boilers | (302) x (303a) = | 1 | (304a)

Factor for control and charging method (Table 4c(3)) for community heating system | 1 | (305)

Distribution loss factor (Table 12c) for community heating system | 1.05 | (306)

Space heating | **kWh/year**

Annual space heating requirement | 1760.27

Space heat from Community boilers | (98) x (304a) x (305) x (306) = | 1848.29 | (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0 | (308)

Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309)

Water heating

Annual water heating requirement | 1823.25

If DHW from community scheme:
Water heat from Community boilers | (64) x (303a) x (305) x (306) = | 1914.41 | (310a)

Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 37.63 | (313)

Cooling System Energy Efficiency Ratio | 0 | (314)

Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315)

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 37.1 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 37.1 | (331)

Energy for lighting (calculated in Appendix L) | 235.22 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*			95 (367a)

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CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	855.52	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	19.53	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	875.05	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			875.05	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	19.25	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	122.08	(379)
Total CO2, kg/year	sum of (376)…(382) =			1016.38	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			20.23	(384)
EI rating (section 14)				85.7	(385)

DER WorkSheet: New dwelling design stage

Property Address: TF - 2Bed - North East

Address : TF - 2Bed - North East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0 (9)
Additional infiltration	[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0 (12)
If no draught lobby, enter 0.05, else enter 0		0 (13)
Percentage of windows and doors draught stripped		0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743 (17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23 (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) =	0.2 (21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation: | 0.5 | (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) | 0.5 | (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 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=

| 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | (24c)
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d)
|---|---|---|---|---|---|---|---|---|---|---|---|

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

| 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | (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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Windows Type 2			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Roof	71.72	0	71.72	x 0.13 =	9.32	9	645.48	(30)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Internal wall **			142.3			9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)   (26)…(30) + (32) = | 34.36 | (33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) = | 6123.38 | (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) = | 85.38 | (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 | 15 | (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) = | 49.35 | (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=	29.7	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	(38)

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

(39)m=	79.06	78.94	78.94	78.94	78.94	78.94	78.94	78.94	78.94	78.94	78.94	78.94

Average = Sum(39)$_{1...12}$ /12=   78.95   (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

(40)m=	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1

Average = Sum(40)$_{1...12}$ /12=   1.1   (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   2.29   (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   88.52   (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=	97.37	93.83	90.29	86.75	83.21	79.67	79.67	83.21	86.75	90.29	93.83	97.37

Total = Sum(44)$_{1...12}$ =   1062.24   (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=	144.4	126.29	130.32	113.62	109.02	94.08	87.17	100.03	101.23	117.97	128.78	139.84

Total = Sum(45)$_{1...12}$ =   1392.76   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.66	18.94	19.55	17.04	16.35	14.11	13.08	15.01	15.18	17.7	19.32	20.98	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)

Temperature factor from Table 2b   0   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)

 b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)

If community heating see section 4.3

Volume factor from Table 2a   1.03   (52)

Temperature factor from Table 2b   0.6   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)

 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.9	x	11.28	x	0.55	x	0.8	=	13.42	(75)
Northeast 0.9x	0.77	x	3.9	x	22.97	x	0.55	x	0.8	=	27.31	(75)

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Northeast	0.9x	0.77	x	3.9	x	41.38	x	0.55	x	0.8	=	49.21	(75)
Northeast	0.9x	0.77	x	3.9	x	67.96	x	0.55	x	0.8	=	80.81	(75)
Northeast	0.9x	0.77	x	3.9	x	91.35	x	0.55	x	0.8	=	108.63	(75)
Northeast	0.9x	0.77	x	3.9	x	97.38	x	0.55	x	0.8	=	115.81	(75)
Northeast	0.9x	0.77	x	3.9	x	91.1	x	0.55	x	0.8	=	108.34	(75)
Northeast	0.9x	0.77	x	3.9	x	72.63	x	0.55	x	0.8	=	86.37	(75)
Northeast	0.9x	0.77	x	3.9	x	50.42	x	0.55	x	0.8	=	59.96	(75)
Northeast	0.9x	0.77	x	3.9	x	28.07	x	0.55	x	0.8	=	33.38	(75)
Northeast	0.9x	0.77	x	3.9	x	14.2	x	0.55	x	0.8	=	16.88	(75)
Northeast	0.9x	0.77	x	3.9	x	9.21	x	0.55	x	0.8	=	10.96	(75)
Northwest	0.9x	0.77	x	9.61	x	11.28	x	0.55	x	0.8	=	33.06	(81)
Northwest	0.9x	0.77	x	9.61	x	22.97	x	0.55	x	0.8	=	67.3	(81)
Northwest	0.9x	0.77	x	9.61	x	41.38	x	0.55	x	0.8	=	121.25	(81)
Northwest	0.9x	0.77	x	9.61	x	67.96	x	0.55	x	0.8	=	199.13	(81)
Northwest	0.9x	0.77	x	9.61	x	91.35	x	0.55	x	0.8	=	267.67	(81)
Northwest	0.9x	0.77	x	9.61	x	97.38	x	0.55	x	0.8	=	285.36	(81)
Northwest	0.9x	0.77	x	9.61	x	91.1	x	0.55	x	0.8	=	266.95	(81)
Northwest	0.9x	0.77	x	9.61	x	72.63	x	0.55	x	0.8	=	212.82	(81)
Northwest	0.9x	0.77	x	9.61	x	50.42	x	0.55	x	0.8	=	147.75	(81)
Northwest	0.9x	0.77	x	9.61	x	28.07	x	0.55	x	0.8	=	82.24	(81)
Northwest	0.9x	0.77	x	9.61	x	14.2	x	0.55	x	0.8	=	41.6	(81)
Northwest	0.9x	0.77	x	9.61	x	9.21	x	0.55	x	0.8	=	27	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	46.48	94.61	170.46	279.94	376.3	401.17	375.29	299.18	207.71	115.62	58.48	37.96		(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	447	493.17	556.53	645.88	721.86	727.02	688.27	617.83	536.64	464.89	431.12	428.06		(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=	0.95	0.94	0.9	0.83	0.71	0.57	0.45	0.51	0.71	0.87	0.94	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.51	18.75	19.21	19.84	20.39	20.75	20.9	20.86	20.55	19.85	19.07	18.45	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20	20	20	20	20	20	20	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.93	0.89	0.81	0.67	0.51	0.37	0.42	0.66	0.85	0.93	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.66	17.01	17.68	18.55	19.31	19.77	19.93	19.9	19.54	18.59	17.47	16.57	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 − fLA) × T2

(92)m=	17.24	17.55	18.15	18.95	19.65	20.07	20.23	20.2	19.85	18.98	17.97	17.15		(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.24	17.55	18.15	18.95	19.65	20.07	20.23	20.2	19.85	18.98	17.97	17.15		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.92	0.9	0.86	0.78	0.66	0.51	0.39	0.44	0.65	0.82	0.9	0.93		(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	411.37	444.05	477.92	502.36	474.84	372.79	265.8	270.9	347.64	381.55	386.86	396.67		(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=	1022.68	998.33	919.79	793.45	627.36	432.01	286.61	299.82	454.14	661.28	857.95	1022.63		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	454.81	372.47	328.75	209.59	113.47	0	0	0	0	208.11	339.19	465.71		(98)

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =	2492.11	(98)

Space heating requirement in kWh/m²/year

34.75	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating — kWh/year

Annual space heating requirement		2492.11	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2616.72	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		2043.6	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2145.78	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	47.62	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)

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Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 52.46 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = | 52.46 | (331)

Energy for lighting (calculated in Appendix L) | 317.29 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) _If there is CHP using two fuels repeat (363) to (366) for the second fuel_			95	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.22	= 1082.84	(367)
Electrical energy for heat distribution [(313) x		0.52	= 24.72	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)			= 1107.56	(373)
CO2 associated with space heating (secondary) (309) x		0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.22	= 0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			1107.56	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52	= 27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52	= 164.67	(379)

Total CO2, kg/year sum of (376)…(382) = | 1299.46 | (383)

Dwelling CO2 Emission Rate (383) ÷ (4) = | 18.12 | (384)

EI rating (section 14) | 85.08 | (385)

DER WorkSheet: New dwelling design stage

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	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=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=
0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Roof	71.72	0	71.72	x 0.13 =	9.32	9	645.48	(30)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Internal wall **			142.3			9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	34.36	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6123.38	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	85.38	(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		15	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	49.35	(37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K $\qquad$ (39)m = (37) + (38)m

| (39)m= | 79.06 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | | (39) |

Average = Sum(39)₁...₁₂ /12=   78.95   (39)

Heat loss parameter (HLP), W/m²K $\qquad$ (40)m = (39)m ÷ (4)

| (40)m= | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | | (40) |

Average = Sum(40)₁...₁₂ /12=   1.1   (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N $\qquad$ 2.29   (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 $\qquad$ 88.52   (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | (44) |

Total = Sum(44)₁...₁₂ =   1062.24   (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | (45) |

Total = Sum(45)₁...₁₂ =   1392.76   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)
Temperature factor from Table 2b   0   (49)
Energy lost from water storage, kWh/year $\qquad$ (48) x (49) =   110   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)
If community heating see section 4.3
Volume factor from Table 2a   1.03   (52)
Temperature factor from Table 2b   0.6   (53)
Energy lost from water storage, kWh/year $\qquad$ (47) x (51) x (52) x (53) =   1.03   (54)
 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month $\qquad$ ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3									0				(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

   (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁…₁₂	2043.6	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

   include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest 0.9x	0.77	x	3.9	x	36.79		0.55	x	0.8	=	43.75	(79)
Southwest 0.9x	0.77	x	3.9	x	62.67		0.55	x	0.8	=	74.53	(79)

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Direction											Result	Ref
Southwest 0.9x	0.77	x	3.9	x	85.75		0.55	x	0.8	=	101.98	(79)
Southwest 0.9x	0.77	x	3.9	x	106.25		0.55	x	0.8	=	126.35	(79)
Southwest 0.9x	0.77	x	3.9	x	119.01		0.55	x	0.8	=	141.53	(79)
Southwest 0.9x	0.77	x	3.9	x	118.15		0.55	x	0.8	=	140.5	(79)
Southwest 0.9x	0.77	x	3.9	x	113.91		0.55	x	0.8	=	135.46	(79)
Southwest 0.9x	0.77	x	3.9	x	104.39		0.55	x	0.8	=	124.14	(79)
Southwest 0.9x	0.77	x	3.9	x	92.85		0.55	x	0.8	=	110.42	(79)
Southwest 0.9x	0.77	x	3.9	x	69.27		0.55	x	0.8	=	82.37	(79)
Southwest 0.9x	0.77	x	3.9	x	44.07		0.55	x	0.8	=	52.41	(79)
Southwest 0.9x	0.77	x	3.9	x	31.49		0.55	x	0.8	=	37.44	(79)
Northwest 0.9x	0.77	x	9.61	x	11.28	x	0.55	x	0.8	=	33.06	(81)
Northwest 0.9x	0.77	x	9.61	x	22.97	x	0.55	x	0.8	=	67.3	(81)
Northwest 0.9x	0.77	x	9.61	x	41.38	x	0.55	x	0.8	=	121.25	(81)
Northwest 0.9x	0.77	x	9.61	x	67.96	x	0.55	x	0.8	=	199.13	(81)
Northwest 0.9x	0.77	x	9.61	x	91.35	x	0.55	x	0.8	=	267.67	(81)
Northwest 0.9x	0.77	x	9.61	x	97.38	x	0.55	x	0.8	=	285.36	(81)
Northwest 0.9x	0.77	x	9.61	x	91.1	x	0.55	x	0.8	=	266.95	(81)
Northwest 0.9x	0.77	x	9.61	x	72.63	x	0.55	x	0.8	=	212.82	(81)
Northwest 0.9x	0.77	x	9.61	x	50.42	x	0.55	x	0.8	=	147.75	(81)
Northwest 0.9x	0.77	x	9.61	x	28.07	x	0.55	x	0.8	=	82.24	(81)
Northwest 0.9x	0.77	x	9.61	x	14.2	x	0.55	x	0.8	=	41.6	(81)
Northwest 0.9x	0.77	x	9.61	x	9.21	x	0.55	x	0.8	=	27	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	76.82	141.83	223.23	325.48	409.2	425.87	402.41	336.96	258.17	164.62	94.01	64.45		(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	477.34	540.39	609.29	691.42	754.76	751.72	715.39	655.61	587.1	513.88	466.65	454.55		(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.94	0.92	0.89	0.81	0.7	0.56	0.44	0.49	0.68	0.85	0.92	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.58	18.85	19.32	19.91	20.43	20.76	20.91	20.88	20.6	19.93	19.15	18.51	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20	20	20	20	20	20	20	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.94	0.91	0.87	0.79	0.66	0.5	0.35	0.4	0.62	0.82	0.91	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.77	17.16	17.82	18.65	19.35	19.78	19.94	19.91	19.59	18.7	17.59	16.66	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.33	17.68	18.28	19.04	19.68	20.09	20.24	20.21	19.9	19.08	18.07	17.24	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.33	17.68	18.28	19.04	19.68	20.09	20.24	20.21	19.9	19.08	18.07	17.24	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.91	0.89	0.84	0.76	0.64	0.5	0.37	0.42	0.62	0.8	0.88	0.92	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	434.93	478.31	511.47	524.65	485.17	376.66	267.64	274.54	362.31	408.93	412.47	417.67	(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=	1030	1009.01	930.25	800.23	630.3	433.01	287.05	300.71	458.24	669.72	865.94	1029.13	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	442.73	356.63	311.57	198.42	107.98	0	0	0	0	194.02	326.5	454.93	(98)

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = **2392.79** (98)

Space heating requirement in kWh/m²/year **33.36** (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating **kWh/year**

Annual space heating requirement		2392.79	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2512.43	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		2043.6	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2145.78	(310a)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	46.58	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)

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Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	52.46	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year =(330a) + (330b) + (330g) =	52.46	(331)
Energy for lighting (calculated in Appendix L)	317.29	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) If there is CHP using two fuels repeat (363) to (366) for the second fuel			95	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.22 =	1059.13	(367)
Electrical energy for heat distribution [(313) x		0.52 =	24.18	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)		=	1083.3	(373)
CO2 associated with space heating (secondary) (309) x		0 =	0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.22 =	0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			1083.3	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52 =	27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52 =	164.67	(379)
Total CO2, kg/year sum of (376)…(382) =			1275.21	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =			17.78	(384)
EI rating (section 14)			85.36	(385)

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User Details:

Assessor Name: Matt Fitzpatrick   **Stroma Number:** STRO003572

Software Name: Stroma FSAP 2012   **Software Version:** Version: 1.0.5.6

Property Address: TF - 2Bed - South East

Address : TF - 2Bed - South East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Windows Type 2			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Roof	71.72	0	71.72	x 0.13 =	9.32	9	645.48	(30)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Internal wall **			142.3			9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)   (26)…(30) + (32) =

34.36	(33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =

6123.38	(34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) =

85.38	(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

15	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) =

49.35	(37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| (39)m= | 79.06 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | | |

Average = Sum(39)$_{1...12}$ /12= 78.95 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| (40)m= | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | | |

Average = Sum(40)$_{1...12}$ /12= 1.1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.29 (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 88.52 (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | |

Total = Sum(44)$_{1...12}$ = 1062.24 (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | |

Total = Sum(45)$_{1...12}$ = 1392.76 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)
Temperature factor from Table 2b 0 (49)
Energy lost from water storage, kWh/year (48) x (49) = 110 (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)
If community heating see section 4.3
Volume factor from Table 2a 1.03 (52)
Temperature factor from Table 2b 0.6 (53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)
 Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| (59)m= | 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= | 199.68 | 176.22 | 185.6 | 167.11 | 164.3 | 147.57 | 142.45 | 155.31 | 154.72 | 173.25 | 182.27 | 195.12 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| (64)m= | 199.68 | 176.22 | 185.6 | 167.11 | 164.3 | 147.57 | 142.45 | 155.31 | 154.72 | 173.25 | 182.27 | 195.12 | |

Output from water heater (annual)₁…₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

| (65)m= | 92.23 | 81.93 | 87.55 | 80.57 | 80.47 | 74.08 | 73.21 | 77.48 | 76.45 | 83.45 | 85.61 | 90.72 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| (67)m= | 17.97 | 15.96 | 12.98 | 9.82 | 7.34 | 6.2 | 6.7 | 8.71 | 11.69 | 14.84 | 17.32 | 18.47 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| (68)m= | 201.28 | 203.37 | 198.1 | 186.9 | 172.75 | 159.46 | 150.58 | 148.49 | 153.75 | 164.96 | 179.1 | 192.4 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| (69)m= | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | (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= | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | (71) |

Water heating gains (Table 5)

| (72)m= | 123.97 | 121.93 | 117.68 | 111.91 | 108.16 | 102.88 | 98.4 | 104.14 | 106.19 | 112.16 | 118.91 | 121.93 | (72) |

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| (73)m= | 400.52 | 398.56 | 386.07 | 365.94 | 345.56 | 325.85 | 312.98 | 318.65 | 328.94 | 349.27 | 372.64 | 390.1 | (73) |

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)	
Northeast 0.9x	0.77	x 3.9	x 11.28	x 0.55	x 0.8	= 13.42	(75)
Northeast 0.9x	0.77	x 3.9	x 22.97	x 0.55	x 0.8	= 27.31	(75)

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Northeast	0.9x	0.77	x	3.9	x	41.38	x	0.55	x	0.8	=	49.21	(75)
Northeast	0.9x	0.77	x	3.9	x	67.96	x	0.55	x	0.8	=	80.81	(75)
Northeast	0.9x	0.77	x	3.9	x	91.35	x	0.55	x	0.8	=	108.63	(75)
Northeast	0.9x	0.77	x	3.9	x	97.38	x	0.55	x	0.8	=	115.81	(75)
Northeast	0.9x	0.77	x	3.9	x	91.1	x	0.55	x	0.8	=	108.34	(75)
Northeast	0.9x	0.77	x	3.9	x	72.63	x	0.55	x	0.8	=	86.37	(75)
Northeast	0.9x	0.77	x	3.9	x	50.42	x	0.55	x	0.8	=	59.96	(75)
Northeast	0.9x	0.77	x	3.9	x	28.07	x	0.55	x	0.8	=	33.38	(75)
Northeast	0.9x	0.77	x	3.9	x	14.2	x	0.55	x	0.8	=	16.88	(75)
Northeast	0.9x	0.77	x	3.9	x	9.21	x	0.55	x	0.8	=	10.96	(75)
Southeast	0.9x	0.77	x	9.61	x	36.79	x	0.55	x	0.8	=	107.82	(77)
Southeast	0.9x	0.77	x	9.61	x	62.67	x	0.55	x	0.8	=	183.65	(77)
Southeast	0.9x	0.77	x	9.61	x	85.75	x	0.55	x	0.8	=	251.28	(77)
Southeast	0.9x	0.77	x	9.61	x	106.25	x	0.55	x	0.8	=	311.35	(77)
Southeast	0.9x	0.77	x	9.61	x	119.01	x	0.55	x	0.8	=	348.73	(77)
Southeast	0.9x	0.77	x	9.61	x	118.15	x	0.55	x	0.8	=	346.21	(77)
Southeast	0.9x	0.77	x	9.61	x	113.91	x	0.55	x	0.8	=	333.79	(77)
Southeast	0.9x	0.77	x	9.61	x	104.39	x	0.55	x	0.8	=	305.89	(77)
Southeast	0.9x	0.77	x	9.61	x	92.85	x	0.55	x	0.8	=	272.08	(77)
Southeast	0.9x	0.77	x	9.61	x	69.27	x	0.55	x	0.8	=	202.97	(77)
Southeast	0.9x	0.77	x	9.61	x	44.07	x	0.55	x	0.8	=	129.14	(77)
Southeast	0.9x	0.77	x	9.61	x	31.49	x	0.55	x	0.8	=	92.27	(77)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	121.23	210.96	300.49	392.16	457.36	462.02	442.12	392.26	332.04	236.35	146.02	103.23		(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	521.76	609.52	686.55	758.1	802.93	787.87	755.11	710.91	660.98	585.62	518.66	493.33		(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=	0.93	0.91	0.86	0.79	0.68	0.54	0.42	0.46	0.64	0.82	0.91	0.94	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.68	19	19.46	20	20.47	20.78	20.92	20.89	20.66	20.05	19.26	18.6	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20	20	20	20	20	20	20	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.93	0.89	0.84	0.76	0.63	0.48	0.34	0.37	0.58	0.79	0.89	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.91	17.36	18.02	18.77	19.4	19.8	19.94	19.92	19.66	18.85	17.74	16.79	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.46	17.87	18.46	19.15	19.73	20.1	20.24	20.22	19.97	19.22	18.21	17.35		(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.46	17.87	18.46	19.15	19.73	20.1	20.24	20.22	19.97	19.22	18.21	17.35		(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=	0.9	0.86	0.81	0.73	0.62	0.48	0.36	0.39	0.58	0.76	0.86	0.91		(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	468.29	525.71	557.09	554.77	499.17	381.9	270.04	279.08	380.59	445.2	448.13	447.55		(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1040.39	1023.82	944.42	809.3	634.24	434.35	287.63	301.81	463.23	680.78	877.07	1038.41		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	425.65	334.73	288.18	183.26	100.49	0	0	0	0	175.27	308.84	439.6		

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =	2256.01	(98)

Space heating requirement in kWh/m²/year

	31.46	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

	0	(301)

Fraction of space heat from community system 1 – (301) =

	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers

	1	(303a)

Fraction of total space heat from Community boilers   (302) x (303a) =

	1	(304a)

Factor for control and charging method (Table 4c(3)) for community heating system

	1	(305)

Distribution loss factor (Table 12c) for community heating system

	1.05	(306)

Space heating   **kWh/year**

Annual space heating requirement

	2256.01	

Space heat from Community boilers   (98) x (304a) x (305) x (306) =

	2368.81	(307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

	0	(308

Space heating requirement from secondary/supplementary system   (98) x (301) x 100 ÷ (308) =

	0	(309)

Water heating

Annual water heating requirement

	2043.6	

If DHW from community scheme:
Water heat from Community boilers   (64) x (303a) x (305) x (306) =

	2145.78	(310a)

Electricity used for heat distribution   0.01 × [(307a)...(307e) + (310a)...(310e)] =

	45.15	(313)

Cooling System Energy Efficiency Ratio

	0	(314)

Space cooling (if there is a fixed cooling system, if not enter 0)   = (107) ÷ (314) =

	0	(315)

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Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 52.46 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = | 52.46 | (331)

Energy for lighting (calculated in Appendix L) | 317.29 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*			95	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.22	= 1026.48	(367)
Electrical energy for heat distribution [(313) x		0.52	= 23.43	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)			= 1049.91	(373)
CO2 associated with space heating (secondary) (309) x		0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.22	= 0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			1049.91	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52	= 27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52	= 164.67	(379)

Total CO2, kg/year sum of (376)…(382) = | 1241.81 | (383)

Dwelling CO2 Emission Rate (383) ÷ (4) = | 17.31 | (384)

EI rating (section 14) | 85.74 | (385)

DER WorkSheet: New dwelling design stage

Property Address: TF - 2Bed - South West

Address : TF - 2Bed - South West, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation: | 0.5 | (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) | 0.5 | (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 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=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=
0	0	0	0	0	0	0	0	0	0	0	0
(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Roof	71.72	0	71.72	x 0.13 =	9.32	9	645.48	(30)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Internal wall **			142.3			9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)   (26)…(30) + (32) = | 34.36 | (33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) = | 6123.38 | (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) = | 85.38 | (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 | 15 | (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) = | 49.35 | (37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 79.06 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 |

Average = Sum(39)$_{1...12}$ /12=   78.95   (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |

Average = Sum(40)$_{1...12}$ /12=   1.1   (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   2.29   (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   88.52   (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 |

Total = Sum(44)$_{1...12}$ =   1062.24   (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 |

Total = Sum(45)$_{1...12}$ =   1392.76   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)
Temperature factor from Table 2b   0   (49)
Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)
If community heating see section 4.3
Volume factor from Table 2a   1.03   (52)
Temperature factor from Table 2b   0.6   (53)
Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)
 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁…₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	9.61	x	36.79	x	0.55	x	0.8	=	107.82	(77)
Southeast 0.9x	0.77	x	9.61	x	62.67	x	0.55	x	0.8	=	183.65	(77)

Southeast 0.9x	0.77	x	9.61	x	85.75	x	0.55	x	0.8	=	251.28	(77)
Southeast 0.9x	0.77	x	9.61	x	106.25	x	0.55	x	0.8	=	311.35	(77)
Southeast 0.9x	0.77	x	9.61	x	119.01	x	0.55	x	0.8	=	348.73	(77)
Southeast 0.9x	0.77	x	9.61	x	118.15	x	0.55	x	0.8	=	346.21	(77)
Southeast 0.9x	0.77	x	9.61	x	113.91	x	0.55	x	0.8	=	333.79	(77)
Southeast 0.9x	0.77	x	9.61	x	104.39	x	0.55	x	0.8	=	305.89	(77)
Southeast 0.9x	0.77	x	9.61	x	92.85	x	0.55	x	0.8	=	272.08	(77)
Southeast 0.9x	0.77	x	9.61	x	69.27	x	0.55	x	0.8	=	202.97	(77)
Southeast 0.9x	0.77	x	9.61	x	44.07	x	0.55	x	0.8	=	129.14	(77)
Southeast 0.9x	0.77	x	9.61	x	31.49	x	0.55	x	0.8	=	92.27	(77)
Southwest 0.9x	0.77	x	3.9	x	36.79		0.55	x	0.8	=	43.75	(79)
Southwest 0.9x	0.77	x	3.9	x	62.67		0.55	x	0.8	=	74.53	(79)
Southwest 0.9x	0.77	x	3.9	x	85.75		0.55	x	0.8	=	101.98	(79)
Southwest 0.9x	0.77	x	3.9	x	106.25		0.55	x	0.8	=	126.35	(79)
Southwest 0.9x	0.77	x	3.9	x	119.01		0.55	x	0.8	=	141.53	(79)
Southwest 0.9x	0.77	x	3.9	x	118.15		0.55	x	0.8	=	140.5	(79)
Southwest 0.9x	0.77	x	3.9	x	113.91		0.55	x	0.8	=	135.46	(79)
Southwest 0.9x	0.77	x	3.9	x	104.39		0.55	x	0.8	=	124.14	(79)
Southwest 0.9x	0.77	x	3.9	x	92.85		0.55	x	0.8	=	110.42	(79)
Southwest 0.9x	0.77	x	3.9	x	69.27		0.55	x	0.8	=	82.37	(79)
Southwest 0.9x	0.77	x	3.9	x	44.07		0.55	x	0.8	=	52.41	(79)
Southwest 0.9x	0.77	x	3.9	x	31.49		0.55	x	0.8	=	37.44	(79)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

| (83)m= | 151.57 | 258.18 | 353.26 | 437.7 | 490.26 | 486.72 | 469.25 | 430.03 | 382.5 | 285.35 | 181.55 | 129.71 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| (84)m= | 552.09 | 656.74 | 739.32 | 803.64 | 835.83 | 812.57 | 782.23 | 748.68 | 711.44 | 634.61 | 554.19 | 519.82 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.93	0.89	0.84	0.77	0.66	0.53	0.41	0.44	0.61	0.79	0.9	0.94	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| (87)m= | 18.75 | 19.09 | 19.55 | 20.06 | 20.5 | 20.79 | 20.92 | 20.9 | 20.69 | 20.12 | 19.33 | 18.66 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| (88)m= | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| (89)m= | 0.92 | 0.88 | 0.82 | 0.74 | 0.62 | 0.47 | 0.33 | 0.36 | 0.55 | 0.76 | 0.88 | 0.93 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| (90)m= | 17.01 | 17.5 | 18.14 | 18.85 | 19.44 | 19.81 | 19.95 | 19.93 | 19.7 | 18.95 | 17.84 | 16.88 | (90) |

fLA = Living area ÷ (4) = | 0.31 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| (92)m= | 17.55 | 17.99 | 18.58 | 19.22 | 19.77 | 20.11 | 20.25 | 20.23 | 20 | 19.31 | 18.3 | 17.43 | | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m= | 17.55 | 17.99 | 18.58 | 19.22 | 19.77 | 20.11 | 20.25 | 20.23 | 20 | 19.31 | 18.3 | 17.43 | | (93) |

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.89	0.85	0.79	0.71	0.61	0.47	0.35	0.38	0.55	0.74	0.85	0.9	(94)

Useful gains, hmGm , W = (94)m x (84)m

| (95)m= | 490.3 | 556.25 | 585.98 | 573.75 | 508.03 | 385.2 | 271.5 | 281.72 | 391.22 | 467.59 | 471.29 | 467.36 | (95) |

Monthly average external temperature from Table 8

| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

| (97)m= | 1047.27 | 1033.36 | 953.34 | 814.95 | 636.7 | 435.19 | 287.97 | 302.45 | 466.08 | 687.52 | 884.3 | 1044.58 | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| (98)m= | 414.38 | 320.61 | 273.31 | 173.66 | 95.73 | 0 | 0 | 0 | 0 | 163.63 | 297.37 | 429.45 | (98) |

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =

| | 2168.14 | (98) |

Space heating requirement in kWh/m²/year

| | 30.23 | (99) |

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

| | 0 | (301) |

Fraction of space heat from community system 1 – (301) =

| | 1 | (302) |

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers

| | 1 | (303a) |

Fraction of total space heat from Community boilers   (302) x (303a) =

| | 1 | (304a) |

Factor for control and charging method (Table 4c(3)) for community heating system

| | 1 | (305) |

Distribution loss factor (Table 12c) for community heating system

| | 1.05 | (306) |

Space heating   **kWh/year**

Annual space heating requirement

| | 2168.14 | |

Space heat from Community boilers   (98) x (304a) x (305) x (306) =

| | 2276.55 | (307a) |

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

| | 0 | (308 |

Space heating requirement from secondary/supplementary system   (98) x (301) x 100 ÷ (308) =

| | 0 | (309) |

Water heating

Annual water heating requirement

| | 2043.6 | |

If DHW from community scheme:
Water heat from Community boilers   (64) x (303a) x (305) x (306) =

| | 2145.78 | (310a) |

Electricity used for heat distribution   0.01 × [(307a)…(307e) + (310a)…(310e)] =

| | 44.22 | (313) |

Cooling System Energy Efficiency Ratio

| | 0 | (314) |

Space cooling (if there is a fixed cooling system, if not enter 0)   = (107) ÷ (314) =

| | 0 | (315) |

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 52.46 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = | 52.46 | (331)

Energy for lighting (calculated in Appendix L) | 317.29 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) _If there is CHP using two fuels repeat (363) to (366) for the second fuel_			95	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.22	= 1005.5	(367)
Electrical energy for heat distribution [(313) x		0.52	= 22.95	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)			= 1028.45	(373)
CO2 associated with space heating (secondary) (309) x		0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.22	= 0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			1028.45	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52	= 27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52	= 164.67	(379)

Total CO2, kg/year sum of (376)…(382) = | 1220.35 | (383)

Dwelling CO2 Emission Rate (383) ÷ (4) = | 17.02 | (384)

EI rating (section 14) | 85.99 | (385)

BE GREEN SAP CALCULATIONS

DER WorkSheet: New dwelling design stage

Assessor Name: Matt Fitzpatrick **Stroma Number:** STRO003572

Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.6

Property Address: 1F - 1Bed - North East

Address : 1F - 1Bed - North East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	52.77	(1a) x	2.5	(2a) =	131.93	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.77	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		131.93	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total	m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 = 0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 = 0	(6b)
Number of intermittent fans							0	x 10 = 0	(7a)
Number of passive vents							0	x 10 = 0	(7b)
Number of flueless gas fires							0	x 40 = 0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			3	x1/[1/(1.2)+ 0.04] =	3.44			(27)
Windows Type 2			7.36	x1/[1/(1.2)+ 0.04] =	8.43			(27)
Floor			52.77	x 0.12 =	6.3324	75	3957.75	(28)
Walls Type1	35.99	10.36	25.63	x 0.18 =	4.61	14	358.82	(29)
Walls Type2	22.12	2.12	20	x 0.23 =	4.51	14	280	(29)
Total area of elements, m²			110.88					(31)
Party wall			21.28	x 0 =	0	20	425.6	(32)
Party ceiling			52.77			30	1583.1	(32b)
Internal wall **			106.14			9	955.26	(32c)

* 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) =	30.5	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	7560.53	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	143.27	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		14.5	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	45	(37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

| (38)m= | 21.85 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | 21.77 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 66.85 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 | 66.77 |

Average = Sum(39)$_{1...12}$ /12= | 66.77 | (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 | 1.27 |

Average = Sum(40)$_{1...12}$ /12= | 1.27 | (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 1.77 | (42)
  if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
  if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 76.28 | (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= | 83.91 | 80.86 | 77.81 | 74.75 | 71.7 | 68.65 | 68.65 | 71.7 | 74.75 | 77.81 | 80.86 | 83.91 |

Total = Sum(44)$_{1...12}$ = | 915.36 | (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

| (45)m= | 124.43 | 108.83 | 112.3 | 97.91 | 93.95 | 81.07 | 75.12 | 86.2 | 87.23 | 101.66 | 110.97 | 120.51 |

Total = Sum(45)$_{1...12}$ = | 1200.18 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 18.66 | 16.32 | 16.85 | 14.69 | 14.09 | 12.16 | 11.27 | 12.93 | 13.08 | 15.25 | 16.65 | 18.08 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

 a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year   (48) x (49) = | 110 | (50)

 b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.02 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 1.03 | (52)

Temperature factor from Table 2b | 0.6 | (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) = | 1.03 | (54)

 Enter (50) or (54) in (55) | 1.03 | (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	179.71	158.76	167.58	151.4	149.22	134.56	130.4	141.48	140.73	156.94	164.46	175.78	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	179.71	158.76	167.58	151.4	149.22	134.56	130.4	141.48	140.73	156.94	164.46	175.78	

Output from water heater (annual)₁...₁₂ | 1851.02 | (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=	85.6	76.13	81.56	75.35	75.46	69.75	69.2	72.88	71.8	78.02	79.69	84.29	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	88.59	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.77	12.23	9.94	7.53	5.63	4.75	5.13	6.67	8.96	11.37	13.27	14.15	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	154.42	156.02	151.99	143.39	132.54	122.34	115.53	113.92	117.96	126.56	137.41	147.61	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	31.86	(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=	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	-70.87	(71)

Water heating gains (Table 5)

(72)m=	115.05	113.29	109.63	104.65	101.42	96.87	93.01	97.96	99.72	104.87	110.68	113.29	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	332.81	331.11	321.13	305.15	289.16	273.54	263.25	268.13	276.22	292.38	310.94	324.63	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3	x	11.28	x	0.55	x	0.8	=	10.32	(75)
Northeast 0.9x	0.77	x	3	x	22.97	x	0.55	x	0.8	=	21.01	(75)

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Northeast	0.9x	0.77	x	3	x	41.38	x	0.55	x	0.8	=	37.85	(75)
Northeast	0.9x	0.77	x	3	x	67.96	x	0.55	x	0.8	=	62.16	(75)
Northeast	0.9x	0.77	x	3	x	91.35	x	0.55	x	0.8	=	83.56	(75)
Northeast	0.9x	0.77	x	3	x	97.38	x	0.55	x	0.8	=	89.08	(75)
Northeast	0.9x	0.77	x	3	x	91.1	x	0.55	x	0.8	=	83.34	(75)
Northeast	0.9x	0.77	x	3	x	72.63	x	0.55	x	0.8	=	66.44	(75)
Northeast	0.9x	0.77	x	3	x	50.42	x	0.55	x	0.8	=	46.12	(75)
Northeast	0.9x	0.77	x	3	x	28.07	x	0.55	x	0.8	=	25.67	(75)
Northeast	0.9x	0.77	x	3	x	14.2	x	0.55	x	0.8	=	12.99	(75)
Northeast	0.9x	0.77	x	3	x	9.21	x	0.55	x	0.8	=	8.43	(75)
Northwest	0.9x	0.77	x	7.36	x	11.28	x	0.55	x	0.8	=	25.32	(81)
Northwest	0.9x	0.77	x	7.36	x	22.97	x	0.55	x	0.8	=	51.54	(81)
Northwest	0.9x	0.77	x	7.36	x	41.38	x	0.55	x	0.8	=	92.86	(81)
Northwest	0.9x	0.77	x	7.36	x	67.96	x	0.55	x	0.8	=	152.51	(81)
Northwest	0.9x	0.77	x	7.36	x	91.35	x	0.55	x	0.8	=	205	(81)
Northwest	0.9x	0.77	x	7.36	x	97.38	x	0.55	x	0.8	=	218.55	(81)
Northwest	0.9x	0.77	x	7.36	x	91.1	x	0.55	x	0.8	=	204.45	(81)
Northwest	0.9x	0.77	x	7.36	x	72.63	x	0.55	x	0.8	=	162.99	(81)
Northwest	0.9x	0.77	x	7.36	x	50.42	x	0.55	x	0.8	=	113.15	(81)
Northwest	0.9x	0.77	x	7.36	x	28.07	x	0.55	x	0.8	=	62.99	(81)
Northwest	0.9x	0.77	x	7.36	x	14.2	x	0.55	x	0.8	=	31.86	(81)
Northwest	0.9x	0.77	x	7.36	x	9.21	x	0.55	x	0.8	=	20.68	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

| (83)m= | 35.64 | 72.55 | 130.71 | 214.67 | 288.56 | 307.63 | 287.79 | 229.43 | 159.28 | 88.66 | 44.85 | 29.11 | | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| (84)m= | 368.45 | 403.66 | 451.85 | 519.82 | 577.72 | 581.18 | 551.03 | 497.56 | 435.49 | 381.04 | 355.79 | 353.73 | | (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=	0.98	0.97	0.95	0.89	0.78	0.63	0.49	0.56	0.78	0.92	0.97	0.98	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| (87)m= | 19.03 | 19.22 | 19.59 | 20.1 | 20.56 | 20.84 | 20.94 | 20.92 | 20.68 | 20.11 | 19.48 | 18.98 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| (88)m= | 19.87 | 19.87 | 19.87 | 19.87 | 19.87 | 19.87 | 19.87 | 19.87 | 19.87 | 19.87 | 19.87 | 19.87 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| (89)m= | 0.97 | 0.96 | 0.94 | 0.87 | 0.73 | 0.55 | 0.38 | 0.44 | 0.71 | 0.9 | 0.96 | 0.98 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| (90)m= | 17.27 | 17.54 | 18.08 | 18.79 | 19.4 | 19.74 | 19.84 | 19.82 | 19.57 | 18.82 | 17.92 | 17.2 | (90) |

fLA = Living area ÷ (4) = | 0.42 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 − fLA) × T2

| (92)m= | 18.01 | 18.24 | 18.71 | 19.34 | 19.89 | 20.2 | 20.3 | 20.28 | 20.04 | 19.36 | 18.57 | 17.95 | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m= | 18.01 | 18.24 | 18.71 | 19.34 | 19.89 | 20.2 | 20.3 | 20.28 | 20.04 | 19.36 | 18.57 | 17.95 | (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=	0.96	0.95	0.92	0.85	0.73	0.57	0.43	0.49	0.72	0.89	0.95	0.97	(94)

Useful gains, hmGm , W = (94)m x (84)m

| (95)m= | 354.99 | 383.88 | 416.32 | 443.68 | 424.47 | 333.28 | 235.4 | 241.53 | 313.3 | 338.44 | 337.27 | 342.15 | (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= | 916.39 | 890.96 | 815.45 | 697.24 | 546.79 | 374.03 | 247.23 | 259.24 | 396.52 | 584.79 | 766.09 | 917.75 | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| (98)m= | 417.68 | 340.76 | 296.96 | 182.56 | 91 | 0 | 0 | 0 | 0 | 183.28 | 308.75 | 428.24 | |

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = | 2249.23 | (98)

Space heating requirement in kWh/m²/year | 42.62 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating   **kWh/year**

Annual space heating requirement		2249.23	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2361.7	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1851.02	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1943.57	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	43.05	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	38.96	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year =(330a) + (330b) + (330g) =	38.96	(331)
Energy for lighting (calculated in Appendix L)	243.1	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	798.01	(367)
Electrical energy for heat distribution [(313) x		0.52	=	22.34	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)			=	820.36	(373)
CO2 associated with space heating (secondary) (309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =				820.36	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52	=	20.22	(378)
CO2 associated with electricity for lighting (332))) x		0.52	=	126.17	(379)
Total CO2, kg/year sum of (376)…(382) =				966.74	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =				18.32	(384)
EI rating (section 14)				86.75	(385)

DER WorkSheet: New dwelling design stage

Property Address: 1F - 1Bed - North

Address : 1F - 1Bed - North, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.35	(1a) x	2.5	(2a) =	125.87	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.35	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.87	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total	m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

	0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

	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=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=
0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5	=	3.18			(26)
Windows			8.55	x1/[1/(1.2)+ 0.04]	=	9.79			(27)
Floor			50.35	x 0.12	=	6.042	75	3776.25	(28)
Walls Type1	23.14	8.55	14.59	x 0.18	=	2.63	14	204.26	(29)
Walls Type2	29.29	2.12	27.17	x 0.23	=	6.13	14	380.38	(29)
Walls Type3	13.99	0	13.99	x 0.2	=	2.86	14	195.86	(29)
Total area of elements, m²			116.77						(31)
Party wall			13.69	x 0	=	0	20	273.8	(32)
Party ceiling			50.35				30	1510.5	(32b)
Internal wall **			90.55				9	814.95	(32c)

* 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) =

	30.63	(33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =

	7156	(34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) =

	142.13	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

	14.27	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) =

	44.9	(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

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| (38)m= | 20.85 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 65.75 | 65.67 | 65.67 | 65.67 | 65.67 | 65.67 | 65.67 | 65.67 | 65.67 | 65.67 | 65.67 | 65.67 | | |

Average = Sum(39)$_{1...12}$ /12= **65.67** (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 1.31 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | | |

Average = Sum(40)$_{1...12}$ /12= **1.3** (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   **1.7**   (42)
  if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
  if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   **74.58**   (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of
not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

| (44)m= | 82.04 | 79.06 | 76.08 | 73.09 | 70.11 | 67.13 | 67.13 | 70.11 | 73.09 | 76.08 | 79.06 | 82.04 | | |

Total = Sum(44)$_{1...12}$ = **895.02** (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

| (45)m= | 121.67 | 106.41 | 109.81 | 95.73 | 91.86 | 79.27 | 73.45 | 84.29 | 85.29 | 99.4 | 108.5 | 117.83 | | |

Total = Sum(45)$_{1...12}$ = **1173.51** (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 18.25 | 15.96 | 16.47 | 14.36 | 13.78 | 11.89 | 11.02 | 12.64 | 12.79 | 14.91 | 16.28 | 17.67 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   **0**   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   **0**   (48)
Temperature factor from Table 2b   **0**   (49)
Energy lost from water storage, kWh/year   (48) x (49) =   **110**   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   **0.02**   (51)
If community heating see section 4.3
Volume factor from Table 2a   **1.03**   (52)
Temperature factor from Table 2b   **0.6**   (53)
Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   **1.03**   (54)
 Enter (50) or (54) in (55)   **1.03**   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	176.94	156.34	165.08	149.23	147.13	132.76	128.73	139.56	138.79	154.68	162	173.11	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	176.94	156.34	165.08	149.23	147.13	132.76	128.73	139.56	138.79	154.68	162	173.11	(64)

Output from water heater (annual)₁...₁₂ | 1824.35 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.68	75.32	80.73	74.63	74.76	69.15	68.64	72.25	71.16	77.27	78.87	83.4	(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=	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.35	11.85	9.64	7.3	5.46	4.61	4.98	6.47	8.68	11.02	12.87	13.72	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	148.14	149.68	145.81	137.56	127.15	117.36	110.83	109.29	113.16	121.41	131.82	141.61	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(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=	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	(71)

Water heating gains (Table 5)

(72)m=	113.81	112.09	108.51	103.65	100.49	96.04	92.26	97.11	98.83	103.86	109.55	112.1	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	323.81	322.13	312.46	297.01	281.6	266.52	256.57	261.37	269.18	284.8	302.74	315.93	(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)	
Northwest 0.9x	0.77	x	8.55	x	11.28	x	0.55	x	0.8	=	29.42	(81)
Northwest 0.9x	0.77	x	8.55	x	22.97	x	0.55	x	0.8	=	59.88	(81)

Direction												Result	
Northwest	0.9x	0.77	x	8.55	x	41.38	x	0.55	x	0.8	=	107.88	(81)
Northwest	0.9x	0.77	x	8.55	x	67.96	x	0.55	x	0.8	=	177.17	(81)
Northwest	0.9x	0.77	x	8.55	x	91.35	x	0.55	x	0.8	=	238.14	(81)
Northwest	0.9x	0.77	x	8.55	x	97.38	x	0.55	x	0.8	=	253.89	(81)
Northwest	0.9x	0.77	x	8.55	x	91.1	x	0.55	x	0.8	=	237.51	(81)
Northwest	0.9x	0.77	x	8.55	x	72.63	x	0.55	x	0.8	=	189.34	(81)
Northwest	0.9x	0.77	x	8.55	x	50.42	x	0.55	x	0.8	=	131.45	(81)
Northwest	0.9x	0.77	x	8.55	x	28.07	x	0.55	x	0.8	=	73.17	(81)
Northwest	0.9x	0.77	x	8.55	x	14.2	x	0.55	x	0.8	=	37.01	(81)
Northwest	0.9x	0.77	x	8.55	x	9.21	x	0.55	x	0.8	=	24.02	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	29.42	59.88	107.88	177.17	238.14	253.89	237.51	189.34	131.45	73.17	37.01	24.02	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	353.22	382	420.34	474.18	519.74	520.41	494.08	450.72	400.63	357.98	339.75	339.95	(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=	0.98	0.97	0.95	0.9	0.81	0.67	0.53	0.59	0.8	0.93	0.97	0.98	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.96	19.14	19.5	20.01	20.48	20.8	20.93	20.9	20.63	20.05	19.41	18.91	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.96	0.94	0.88	0.76	0.58	0.41	0.47	0.73	0.91	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.14	17.4	17.93	18.64	19.29	19.67	19.8	19.78	19.5	18.71	17.81	17.07	(90)

fLA = Living area ÷ (4) =   0.42   (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.9	18.13	18.59	19.21	19.79	20.15	20.27	20.25	19.97	19.27	18.48	17.84	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.9	18.13	18.59	19.21	19.79	20.15	20.27	20.25	19.97	19.27	18.48	17.84	(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=	0.96	0.95	0.93	0.87	0.76	0.61	0.46	0.51	0.74	0.89	0.95	0.97	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	339.93	363.38	388.85	410.48	394.57	315.3	226.09	231.22	295.17	319.23	321.84	328.39	(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)

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Heat loss rate for mean internal temperature, L_m, W = [(39)m x [(93)m – (96)m]

(97)m=	894.37	868.63	793.63	677.22	531.08	364.17	241.09	252.68	385.78	569.49	747.37	895.88		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	412.51	339.53	301.16	192.06	101.56	0	0	0	0	186.19	306.39	422.22		(98)

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =   2261.61   (98)

Space heating requirement in kWh/m²/year   44.92   (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none   0   (301)

Fraction of space heat from community system 1 – (301) =   1   (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump   1   (303a)

Fraction of total space heat from Community heat pump   (302) x (303a) =   1   (304a)

Factor for control and charging method (Table 4c(3)) for community heating system   1   (305)

Distribution loss factor (Table 12c) for community heating system   1.05   (306)

Space heating   **kWh/year**

Annual space heating requirement   2261.61

Space heat from Community heat pump   (98) x (304a) x (305) x (306) =   2374.69   (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)   0   (308

Space heating requirement from secondary/supplementary system   (98) x (301) x 100 ÷ (308) =   0   (309)

Water heating
Annual water heating requirement   1824.35

If DHW from community scheme:
Water heat from Community heat pump   (64) x (303a) x (305) x (306) =   1915.57   (310a)

Electricity used for heat distribution   0.01 × [(307a)...(307e) + (310a)...(310e)] =   42.9   (313)

Cooling System Energy Efficiency Ratio   0   (314)

Space cooling (if there is a fixed cooling system, if not enter 0)   = (107) ÷ (314) =   0   (315)

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside   37.17   (330a)

warm air heating system fans   0   (330b)

pump for solar water heating   0   (330g)

Total electricity for the above, kWh/year   =(330a) + (330b) + (330g) =   37.17   (331)

Energy for lighting (calculated in Appendix L)   235.69   (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*			280	(367a)

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CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	795.23	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	22.27	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	817.5	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			817.5	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	19.29	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	122.32	(379)
Total CO2, kg/year	sum of (376)…(382) =			959.11	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			19.05	(384)
EI rating (section 14)				86.52	(385)

DER WorkSheet: New dwelling design stage

Assessor Name: Matt Fitzpatrick   **Stroma Number:** STRO003572

Software Name: Stroma FSAP 2012   **Software Version:** Version: 1.0.5.6

Property Address: 1F - 1Bed - South

Address : 1F - 1Bed - South, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.25	(1a) x	2.5	(2a) =	125.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.25	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.62	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

		0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

		0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

		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=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=
0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5	=	3.18			(26)
Windows			8.55	x1/[1/(1.2)+ 0.04]	=	9.79			(27)
Floor			50.25	x 0.12	=	6.03	75	3768.75	(28)
Walls Type1	23.19	8.55	14.64	x 0.18	=	2.64	14	204.96	(29)
Walls Type2	12.4	2.12	10.28	x 0.23	=	2.32	14	143.92	(29)
Walls Type3	14	0	14	x 0.2	=	2.86	14	196	(29)
Total area of elements, m²			99.84						(31)
Party wall			30.53	x 0	=	0	20	610.6	(32)
Party ceiling			50.25				30	1507.5	(32b)
Internal wall **			90.21				9	811.89	(32c)

* 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) =	26.81	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	7243.62	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	144.15	(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		12.88	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	39.69	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 20.81 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | | (38) |

Heat transfer coefficient, W/K $\quad$ (39)m = (37) + (38)m

| (39)m= | 60.5 | 60.42 | 60.42 | 60.42 | 60.42 | 60.42 | 60.42 | 60.42 | 60.42 | 60.42 | 60.42 | 60.42 | |

Average = Sum(39)$_{1...12}$ /12= $\quad$ 60.43 $\quad$ (39)

Heat loss parameter (HLP), W/m²K $\quad$ (40)m = (39)m ÷ (4)

| (40)m= | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | |

Average = Sum(40)$_{1...12}$ /12= $\quad$ 1.2 $\quad$ (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: $\qquad$ kWh/year:

Assumed occupancy, N $\qquad$ 1.7 $\qquad$ (42)
$\quad$ if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
$\quad$ if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 $\qquad$ 74.51 $\qquad$ (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of
not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

| (44)m= | 81.97 | 78.99 | 76.01 | 73.02 | 70.04 | 67.06 | 67.06 | 70.04 | 73.02 | 76.01 | 78.99 | 81.97 | |

Total = Sum(44)$_{1...12}$ = $\qquad$ 894.18 $\quad$ (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

| (45)m= | 121.55 | 106.31 | 109.7 | 95.64 | 91.77 | 79.19 | 73.38 | 84.21 | 85.21 | 99.31 | 108.4 | 117.72 | |

Total = Sum(45)$_{1...12}$ = $\qquad$ 1172.41 $\quad$ (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 18.23 | 15.95 | 16.46 | 14.35 | 13.77 | 11.88 | 11.01 | 12.63 | 12.78 | 14.9 | 16.26 | 17.66 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel $\qquad$ 0 $\qquad$ (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:
$\quad$ a) If manufacturer's declared loss factor is known (kWh/day): $\qquad$ 0 $\qquad$ (48)

Temperature factor from Table 2b $\qquad$ 0 $\qquad$ (49)

Energy lost from water storage, kWh/year $\qquad$ (48) x (49) = $\qquad$ 110 $\qquad$ (50)
$\quad$ b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) $\qquad$ 0.02 $\qquad$ (51)
If community heating see section 4.3
Volume factor from Table 2a $\qquad$ 1.03 $\qquad$ (52)
Temperature factor from Table 2b $\qquad$ 0.6 $\qquad$ (53)

Energy lost from water storage, kWh/year $\qquad$ (47) x (51) x (52) x (53) = $\qquad$ 1.03 $\qquad$ (54)
$\quad$ Enter (50) or (54) in (55) $\qquad$ 1.03 $\qquad$ (55)

Water storage loss calculated for each month $\qquad$ ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	176.83	156.24	164.98	149.14	147.05	132.69	128.66	139.48	138.71	154.58	161.9	172.99	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	176.83	156.24	164.98	149.14	147.05	132.69	128.66	139.48	138.71	154.58	161.9	172.99	

Output from water heater (annual)$_{1...12}$ | 1823.25 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.64	75.29	80.7	74.6	74.74	69.13	68.62	72.22	71.13	77.24	78.84	83.36	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.32	11.83	9.62	7.28	5.44	4.6	4.97	6.46	8.66	11	12.84	13.69	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.88	149.42	145.55	137.32	126.93	117.16	110.63	109.1	112.97	121.2	131.59	141.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	(71)

Water heating gains (Table 5)

(72)m=	113.76	112.04	108.47	103.61	100.45	96.01	92.23	97.07	98.79	103.82	109.5	112.05	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	323.42	321.75	312.1	296.67	281.28	266.23	256.3	261.09	268.88	284.48	302.39	315.56	(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)	
Southeast 0.9x	0.77	x	8.55	x	36.79	x	0.55	x	0.8	=	95.92	(77)
Southeast 0.9x	0.77	x	8.55	x	62.67	x	0.55	x	0.8	=	163.39	(77)

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Southeast	0.9x	0.77	x	8.55	x	85.75	x	0.55	x	0.8	=	223.56	(77)
Southeast	0.9x	0.77	x	8.55	x	106.25	x	0.55	x	0.8	=	277.01	(77)
Southeast	0.9x	0.77	x	8.55	x	119.01	x	0.55	x	0.8	=	310.27	(77)
Southeast	0.9x	0.77	x	8.55	x	118.15	x	0.55	x	0.8	=	308.02	(77)
Southeast	0.9x	0.77	x	8.55	x	113.91	x	0.55	x	0.8	=	296.97	(77)
Southeast	0.9x	0.77	x	8.55	x	104.39	x	0.55	x	0.8	=	272.15	(77)
Southeast	0.9x	0.77	x	8.55	x	92.85	x	0.55	x	0.8	=	242.07	(77)
Southeast	0.9x	0.77	x	8.55	x	69.27	x	0.55	x	0.8	=	180.59	(77)
Southeast	0.9x	0.77	x	8.55	x	44.07	x	0.55	x	0.8	=	114.89	(77)
Southeast	0.9x	0.77	x	8.55	x	31.49	x	0.55	x	0.8	=	82.09	(77)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	95.92	163.39	223.56	277.01	310.27	308.02	296.97	272.15	242.07	180.59	114.89	82.09		(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	419.35	485.14	535.66	573.67	591.55	574.25	553.26	533.24	510.95	465.07	417.29	397.65		(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) **21** (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.96	0.94	0.91	0.85	0.74	0.6	0.46	0.49	0.68	0.86	0.94	0.97	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.32	19.57	19.92	20.32	20.66	20.88	20.96	20.95	20.81	20.37	19.77	19.26	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.92	19.92	19.92	19.92	19.92	19.92	19.92	19.92	19.92	19.92	19.92	19.92	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.93	0.89	0.82	0.69	0.52	0.35	0.39	0.61	0.83	0.93	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.71	18.07	18.57	19.12	19.57	19.82	19.9	19.89	19.75	19.2	18.35	17.62	(90)

fLA = Living area ÷ (4) =   **0.42** (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.39	18.7	19.13	19.62	20.02	20.26	20.34	20.34	20.19	19.69	18.95	18.31	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.39	18.7	19.13	19.62	20.02	20.26	20.34	20.34	20.19	19.69	18.95	18.31	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate
the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.95	0.92	0.88	0.81	0.7	0.54	0.39	0.43	0.63	0.82	0.92	0.95	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	396.45	445.67	469.84	463.03	412.85	312.82	218.52	227.65	320.37	382.38	383.16	378.67	(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)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	852.36	833.94	763.4	647.76	502.97	342.25	226.2	237.76	368.16	549.27	715.69	852.28		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	339.2	260.91	218.41	133.01	67.05	0	0	0	0	124.17	239.42	352.37		(98)

	Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =	1734.54	(98)

Space heating requirement in kWh/m²/year — 34.52 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none — 0 (301)

Fraction of space heat from community system 1 – (301) = — 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump — 1 (303a)

Fraction of total space heat from Community heat pump — (302) x (303a) = — 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system — 1 (305)

Distribution loss factor (Table 12c) for community heating system — 1.05 (306)

Space heating — **kWh/year**

Annual space heating requirement — 1734.54

Space heat from Community heat pump — (98) x (304a) x (305) x (306) = — 1821.26 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) — 0 (308)

Space heating requirement from secondary/supplementary system — (98) x (301) x 100 ÷ (308) = — 0 (309)

Water heating

Annual water heating requirement — 1823.25

If DHW from community scheme:
Water heat from Community heat pump — (64) x (303a) x (305) x (306) = — 1914.41 (310a)

Electricity used for heat distribution — 0.01 × [(307a)…(307e) + (310a)…(310e)] = — 37.36 (313)

Cooling System Energy Efficiency Ratio — 0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0) — = (107) ÷ (314) = — 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside — 37.1 (330a)

warm air heating system fans — 0 (330b)

pump for solar water heating — 0 (330g)

Total electricity for the above, kWh/year — =(330a) + (330b) + (330g) = — 37.1 (331)

Energy for lighting (calculated in Appendix L) — 235.22 (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*			280 (367a)

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CO_2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	692.43	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	19.39	(372)
Total CO_2 associated with community systems	(363)…(366) + (368)...(372)		=	711.82	(373)
CO_2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO_2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO_2 associated with space and water heating	(373) + (374) + (375) =			711.82	(376)
CO_2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	19.25	(378)
CO_2 associated with electricity for lighting	(332))) x	0.52	=	122.08	(379)

Total CO_2, kg/year   sum of (376)…(382) =   853.15 (383)

Dwelling CO_2 Emission Rate   (383) ÷ (4) =   16.98 (384)

EI rating (section 14)   88 (385)

DER WorkSheet: New dwelling design stage

Property Address: 1F - 2Bed - North West

Address : 1F - 2Bed - North West, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 = 0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) = 0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Floor			71.72	x 0.12 =	8.6064	75	5379	(28)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party ceiling			71.72			30	2151.6	(32b)
Internal wall **			142.3			9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	33.64	(33)

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	10139.7	(34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	141.38	(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		15.8	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	49.45	(37)

Ventilation heat loss calculated monthly $(38)m = 0.33 \times (25)m \times (5)$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 79.15 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 |

Average = Sum(39)$_{1...12}$ /12=   79.04   (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |

Average = Sum(40)$_{1...12}$ /12=   1.1   (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   2.29   (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   88.52   (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 |

Total = Sum(44)$_{1...12}$ =   1062.24   (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 |

Total = Sum(45)$_{1...12}$ =   1392.76   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)
Temperature factor from Table 2b   0   (49)
Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)
If community heating see section 4.3
Volume factor from Table 2a   1.03   (52)
Temperature factor from Table 2b   0.6   (53)
Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)
 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

   (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12

Output from water heater (annual)₁...₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

   include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest 0.9x	0.77	x	3.9	x	36.79		0.55	x	0.8	=	43.75	(79)
Southwest 0.9x	0.77	x	3.9	x	62.67		0.55	x	0.8	=	74.53	(79)

Southwest 0.9x	0.77	x	3.9	x	85.75		0.55	x	0.8	=	101.98	(79)
Southwest 0.9x	0.77	x	3.9	x	106.25		0.55	x	0.8	=	126.35	(79)
Southwest 0.9x	0.77	x	3.9	x	119.01		0.55	x	0.8	=	141.53	(79)
Southwest 0.9x	0.77	x	3.9	x	118.15		0.55	x	0.8	=	140.5	(79)
Southwest 0.9x	0.77	x	3.9	x	113.91		0.55	x	0.8	=	135.46	(79)
Southwest 0.9x	0.77	x	3.9	x	104.39		0.55	x	0.8	=	124.14	(79)
Southwest 0.9x	0.77	x	3.9	x	92.85		0.55	x	0.8	=	110.42	(79)
Southwest 0.9x	0.77	x	3.9	x	69.27		0.55	x	0.8	=	82.37	(79)
Southwest 0.9x	0.77	x	3.9	x	44.07		0.55	x	0.8	=	52.41	(79)
Southwest 0.9x	0.77	x	3.9	x	31.49		0.55	x	0.8	=	37.44	(79)
Northwest 0.9x	0.77	x	9.61	x	11.28	x	0.55	x	0.8	=	33.06	(81)
Northwest 0.9x	0.77	x	9.61	x	22.97	x	0.55	x	0.8	=	67.3	(81)
Northwest 0.9x	0.77	x	9.61	x	41.38	x	0.55	x	0.8	=	121.25	(81)
Northwest 0.9x	0.77	x	9.61	x	67.96	x	0.55	x	0.8	=	199.13	(81)
Northwest 0.9x	0.77	x	9.61	x	91.35	x	0.55	x	0.8	=	267.67	(81)
Northwest 0.9x	0.77	x	9.61	x	97.38	x	0.55	x	0.8	=	285.36	(81)
Northwest 0.9x	0.77	x	9.61	x	91.1	x	0.55	x	0.8	=	266.95	(81)
Northwest 0.9x	0.77	x	9.61	x	72.63	x	0.55	x	0.8	=	212.82	(81)
Northwest 0.9x	0.77	x	9.61	x	50.42	x	0.55	x	0.8	=	147.75	(81)
Northwest 0.9x	0.77	x	9.61	x	28.07	x	0.55	x	0.8	=	82.24	(81)
Northwest 0.9x	0.77	x	9.61	x	14.2	x	0.55	x	0.8	=	41.6	(81)
Northwest 0.9x	0.77	x	9.61	x	9.21	x	0.55	x	0.8	=	27	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

| (83)m= | 76.82 | 141.83 | 223.23 | 325.48 | 409.2 | 425.87 | 402.41 | 336.96 | 258.17 | 164.62 | 94.01 | 64.45 | | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| (84)m= | 477.34 | 540.39 | 609.29 | 691.42 | 754.76 | 751.72 | 715.39 | 655.61 | 587.1 | 513.88 | 466.65 | 454.55 | | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.97	0.94	0.88	0.76	0.6	0.46	0.52	0.74	0.91	0.97	0.98	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| (87)m= | 19.27 | 19.48 | 19.84 | 20.29 | 20.68 | 20.89 | 20.97 | 20.95 | 20.78 | 20.29 | 19.69 | 19.22 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| (88)m= | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| (89)m= | 0.98 | 0.96 | 0.93 | 0.85 | 0.71 | 0.53 | 0.37 | 0.42 | 0.68 | 0.89 | 0.96 | 0.98 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| (90)m= | 17.7 | 18 | 18.52 | 19.15 | 19.65 | 19.91 | 19.98 | 19.97 | 19.79 | 19.15 | 18.31 | 17.62 | (90) |

fLA = Living area ÷ (4) = | 0.31 | (91)

DER WorkSheet: New dwelling design stage

Mean internal temperature (for the whole dwelling) = fLA ✕ T1 + (1 – fLA) ✕ T2

(92)m=	18.19	18.46	18.93	19.5	19.97	20.22	20.29	20.27	20.1	19.5	18.74	18.12	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.19	18.46	18.93	19.5	19.97	20.22	20.29	20.27	20.1	19.5	18.74	18.12	(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=	0.97	0.95	0.91	0.84	0.71	0.55	0.4	0.45	0.68	0.88	0.95	0.97	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	460.69	512.45	556.62	580.34	538.28	409.72	282.85	293.24	401.13	449.7	442.12	440.75	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1099.09	1071.86	982.15	838.03	653.64	443.8	291.34	306.18	474.1	703.67	919.62	1099.71	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	474.97	375.92	316.59	185.53	85.83	0	0	0	0	188.95	343.8	490.27	(98)

	Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =	2461.86	(98)

Space heating requirement in kWh/m²/year | 34.33 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump | 1 | (303a)

Fraction of total space heat from Community heat pump | (302) x (303a) = | 1 | (304a)

Factor for control and charging method (Table 4c(3)) for community heating system | 1 | (305)

Distribution loss factor (Table 12c) for community heating system | 1.05 | (306)

Space heating | **kWh/year**

Annual space heating requirement | 2461.86

Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 2584.96 | (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0 | (308

Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309)

Water heating

Annual water heating requirement | 2043.6

If DHW from community scheme:
Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 2145.78 | (310a)

Electricity used for heat distribution | 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 47.31 | (313)

Cooling System Energy Efficiency Ratio | 0 | (314)

Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 52.46 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = | 52.46 | (331)

Energy for lighting (calculated in Appendix L) | 317.29 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*			280	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.52	= 876.88	(367)
Electrical energy for heat distribution [(313) x		0.52	= 24.55	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)			= 901.43	(373)
CO2 associated with space heating (secondary) (309) x		0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.52	= 0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			901.43	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52	= 27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52	= 164.67	(379)

Total CO2, kg/year sum of (376)…(382) = | 1093.33 | (383)

Dwelling CO2 Emission Rate (383) ÷ (4) = | 15.24 | (384)

EI rating (section 14) | 87.45 | (385)

DER WorkSheet: New dwelling design stage

Property Address: 1F - 2Bed - South East

Address : 1F - 2Bed - South East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =		0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =		0	(6b)
Number of intermittent fans							0	x 10 =		0	(7a)
Number of passive vents							0	x 10 =		0	(7b)
Number of flueless gas fires							0	x 40 =		0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 = 0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) = 0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Floor			71.72	x 0.12 =	8.6064	75	5379	(28)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party ceiling			71.72			30	2151.6	(32b)
Internal wall **			142.3			9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	33.64	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	10139.7	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	141.38	(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		15.8	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	49.45	(37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

| (38)m= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 79.15 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | | |

Average = Sum(39)$_{1...12}$ /12= **79.04** (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | | |

Average = Sum(40)$_{1...12}$ /12= **1.1** (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   **2.29** (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   **88.52** (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | |

Total = Sum(44)$_{1...12}$ = **1062.24** (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | |

Total = Sum(45)$_{1...12}$ = **1392.76** (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   **0** (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   **0** (48)
Temperature factor from Table 2b   **0** (49)
Energy lost from water storage, kWh/year   (48) x (49) =   **110** (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   **0.02** (51)
If community heating see section 4.3
Volume factor from Table 2a   **1.03** (52)
Temperature factor from Table 2b   **0.6** (53)
Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   **1.03** (54)
 Enter (50) or (54) in (55)   **1.03** (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

DER WorkSheet: New dwelling design stage

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= | 199.68 | 176.22 | 185.6 | 167.11 | 164.3 | 147.57 | 142.45 | 155.31 | 154.72 | 173.25 | 182.27 | 195.12 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| (64)m= | 199.68 | 176.22 | 185.6 | 167.11 | 164.3 | 147.57 | 142.45 | 155.31 | 154.72 | 173.25 | 182.27 | 195.12 | |

Output from water heater (annual)₁...₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

| (65)m= | 92.23 | 81.93 | 87.55 | 80.57 | 80.47 | 74.08 | 73.21 | 77.48 | 76.45 | 83.45 | 85.61 | 90.72 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| (67)m= | 17.97 | 15.96 | 12.98 | 9.82 | 7.34 | 6.2 | 6.7 | 8.71 | 11.69 | 14.84 | 17.32 | 18.47 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| (68)m= | 201.28 | 203.37 | 198.1 | 186.9 | 172.75 | 159.46 | 150.58 | 148.49 | 153.75 | 164.96 | 179.1 | 192.4 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| (69)m= | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | (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= | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | (71) |

Water heating gains (Table 5)

| (72)m= | 123.97 | 121.93 | 117.68 | 111.91 | 108.16 | 102.88 | 98.4 | 104.14 | 106.19 | 112.16 | 118.91 | 121.93 | (72) |

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| (73)m= | 400.52 | 398.56 | 386.07 | 365.94 | 345.56 | 325.85 | 312.98 | 318.65 | 328.94 | 349.27 | 372.64 | 390.1 | (73) |

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)	
Northeast 0.9x	0.77	x 3.9	x 11.28	x 0.55	x 0.8	= 13.42	(75)
Northeast 0.9x	0.77	x 3.9	x 22.97	x 0.55	x 0.8	= 27.31	(75)

DER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	3.9	x	41.38	x	0.55	x	0.8	=	49.21	(75)
Northeast 0.9x	0.77	x	3.9	x	67.96	x	0.55	x	0.8	=	80.81	(75)
Northeast 0.9x	0.77	x	3.9	x	91.35	x	0.55	x	0.8	=	108.63	(75)
Northeast 0.9x	0.77	x	3.9	x	97.38	x	0.55	x	0.8	=	115.81	(75)
Northeast 0.9x	0.77	x	3.9	x	91.1	x	0.55	x	0.8	=	108.34	(75)
Northeast 0.9x	0.77	x	3.9	x	72.63	x	0.55	x	0.8	=	86.37	(75)
Northeast 0.9x	0.77	x	3.9	x	50.42	x	0.55	x	0.8	=	59.96	(75)
Northeast 0.9x	0.77	x	3.9	x	28.07	x	0.55	x	0.8	=	33.38	(75)
Northeast 0.9x	0.77	x	3.9	x	14.2	x	0.55	x	0.8	=	16.88	(75)
Northeast 0.9x	0.77	x	3.9	x	9.21	x	0.55	x	0.8	=	10.96	(75)
Southeast 0.9x	0.77	x	9.61	x	36.79	x	0.55	x	0.8	=	107.82	(77)
Southeast 0.9x	0.77	x	9.61	x	62.67	x	0.55	x	0.8	=	183.65	(77)
Southeast 0.9x	0.77	x	9.61	x	85.75	x	0.55	x	0.8	=	251.28	(77)
Southeast 0.9x	0.77	x	9.61	x	106.25	x	0.55	x	0.8	=	311.35	(77)
Southeast 0.9x	0.77	x	9.61	x	119.01	x	0.55	x	0.8	=	348.73	(77)
Southeast 0.9x	0.77	x	9.61	x	118.15	x	0.55	x	0.8	=	346.21	(77)
Southeast 0.9x	0.77	x	9.61	x	113.91	x	0.55	x	0.8	=	333.79	(77)
Southeast 0.9x	0.77	x	9.61	x	104.39	x	0.55	x	0.8	=	305.89	(77)
Southeast 0.9x	0.77	x	9.61	x	92.85	x	0.55	x	0.8	=	272.08	(77)
Southeast 0.9x	0.77	x	9.61	x	69.27	x	0.55	x	0.8	=	202.97	(77)
Southeast 0.9x	0.77	x	9.61	x	44.07	x	0.55	x	0.8	=	129.14	(77)
Southeast 0.9x	0.77	x	9.61	x	31.49	x	0.55	x	0.8	=	92.27	(77)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	121.23	210.96	300.49	392.16	457.36	462.02	442.12	392.26	332.04	236.35	146.02	103.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	521.76	609.52	686.55	758.1	802.93	787.87	755.11	710.91	660.98	585.62	518.66	493.33	(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=	0.97	0.95	0.92	0.85	0.74	0.58	0.44	0.48	0.69	0.88	0.96	0.98	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.36	19.6	19.96	20.37	20.71	20.9	20.97	20.96	20.82	20.38	19.78	19.29	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20	20	20	20	20	20	20	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.95	0.91	0.82	0.69	0.51	0.35	0.39	0.62	0.85	0.95	0.97	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.82	18.17	18.68	19.25	19.69	19.92	19.98	19.98	19.84	19.28	18.44	17.72	(90)

fLA = Living area ÷ (4) = | 0.31 (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| (92)m= | 18.29 | 18.62 | 19.08 | 19.6 | 20.01 | 20.23 | 20.29 | 20.28 | 20.14 | 19.62 | 18.85 | 18.21 | | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m= | 18.29 | 18.62 | 19.08 | 19.6 | 20.01 | 20.23 | 20.29 | 20.28 | 20.14 | 19.62 | 18.85 | 18.21 | | (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=	0.96	0.93	0.89	0.81	0.69	0.53	0.38	0.42	0.63	0.84	0.93	0.96	(94)

Useful gains, hmGm , W = (94)m x (84)m

| (95)m= | 499.11 | 567.99 | 610.65 | 615.31 | 552.96 | 414.02 | 284.27 | 296.25 | 419.34 | 492.36 | 483.91 | 474.94 | (95) |

Monthly average external temperature from Table 8

| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

| (97)m= | 1107.5 | 1084.09 | 994.06 | 845.56 | 656.6 | 444.59 | 291.59 | 306.72 | 477.67 | 712.95 | 928.82 | 1107.17 | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| (98)m= | 452.64 | 346.82 | 285.26 | 165.78 | 77.11 | 0 | 0 | 0 | 0 | 164.12 | 320.33 | 470.38 | (98) |

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = | 2282.45 | (98)

Space heating requirement in kWh/m²/year | 31.82 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump | 1 | (303a)

Fraction of total space heat from Community heat pump | (302) x (303a) = | 1 | (304a)

Factor for control and charging method (Table 4c(3)) for community heating system | 1 | (305)

Distribution loss factor (Table 12c) for community heating system | 1.05 | (306)

Space heating | **kWh/year**

Annual space heating requirement | 2282.45

Space heat from Community heat pump | (98) x (304a) x (305) x (306) = | 2396.57 | (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0 | (308)

Space heating requirement from secondary/supplementary system | (98) x (301) x 100 ÷ (308) = | 0 | (309)

Water heating

Annual water heating requirement | 2043.6

If DHW from community scheme:
Water heat from Community heat pump | (64) x (303a) x (305) x (306) = | 2145.78 | (310a)

Electricity used for heat distribution | 0.01 × [(307a)...(307e) + (310a)...(310e)] = | 45.42 | (313)

Cooling System Energy Efficiency Ratio | 0 | (314)

Space cooling (if there is a fixed cooling system, if not enter 0) | = (107) ÷ (314) = | 0 | (315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 52.46 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = | 52.46 | (331)

Energy for lighting (calculated in Appendix L) | 317.29 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*			280	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.52	= 841.96	(367)
Electrical energy for heat distribution [(313) x		0.52	= 23.57	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)			= 865.53	(373)
CO2 associated with space heating (secondary) (309) x		0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.52	= 0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			865.53	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52	= 27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52	= 164.67	(379)

Total CO2, kg/year sum of (376)…(382) = | 1057.43 | (383)

Dwelling CO2 Emission Rate (383) ÷ (4) = | 14.74 | (384)

EI rating (section 14) | 87.86 | (385)

DER WorkSheet: New dwelling design stage

Assessor Name: Matt Fitzpatrick   **Stroma Number:** STRO003572

Software Name: Stroma FSAP 2012   **Software Version:** Version: 1.0.5.6

Address : 1F - 2Bed - South West , Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 = 0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) = 0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0

(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

(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			2.12	x	1.5	=	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04]		=	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04]		=	4.47			(27)
Floor			71.72	x	0.12	=	8.6064	75	5379	(28)
Walls Type1	46.63	13.51	33.12	x	0.18	=	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x	0.23	=	0.42	14	26.32	(29)
Total area of elements, m²			122.35							(31)
Party wall			41.92	x	0	=	0	20	838.4	(32)
Party ceiling			71.72					30	2151.6	(32b)
Internal wall **			142.3					9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	33.64	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	10139.7	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	141.38	(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		15.8	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	49.45	(37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

| (38)m= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 79.15 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | 79.03 | | |

Average = Sum(39)$_{1...12}$ /12= | 79.04 | (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | | |

Average = Sum(40)$_{1...12}$ /12= | 1.1 | (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.29 | (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 | 88.52 | (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | |

Total = Sum(44)$_{1...12}$ = | 1062.24 | (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | |

Total = Sum(45)$_{1...12}$ = | 1392.76 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)
Temperature factor from Table 2b | 0 | (49)
Energy lost from water storage, kWh/year   (48) x (49) = | 110 | (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.02 | (51)
If community heating see section 4.3
Volume factor from Table 2a | 1.03 | (52)
Temperature factor from Table 2b | 0.6 | (53)
Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) = | 1.03 | (54)
 Enter (50) or (54) in (55) | 1.03 | (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

DER WorkSheet: New dwelling design stage

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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂   [2043.6]   (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	9.61	x	36.79	x	0.55	x	0.8	=	107.82	(77)
Southeast 0.9x	0.77	x	9.61	x	62.67	x	0.55	x	0.8	=	183.65	(77)

Orientation												Result	
Southeast	0.9x	0.77	x	9.61	x	85.75	x	0.55	x	0.8	=	251.28	(77)
Southeast	0.9x	0.77	x	9.61	x	106.25	x	0.55	x	0.8	=	311.35	(77)
Southeast	0.9x	0.77	x	9.61	x	119.01	x	0.55	x	0.8	=	348.73	(77)
Southeast	0.9x	0.77	x	9.61	x	118.15	x	0.55	x	0.8	=	346.21	(77)
Southeast	0.9x	0.77	x	9.61	x	113.91	x	0.55	x	0.8	=	333.79	(77)
Southeast	0.9x	0.77	x	9.61	x	104.39	x	0.55	x	0.8	=	305.89	(77)
Southeast	0.9x	0.77	x	9.61	x	92.85	x	0.55	x	0.8	=	272.08	(77)
Southeast	0.9x	0.77	x	9.61	x	69.27	x	0.55	x	0.8	=	202.97	(77)
Southeast	0.9x	0.77	x	9.61	x	44.07	x	0.55	x	0.8	=	129.14	(77)
Southeast	0.9x	0.77	x	9.61	x	31.49	x	0.55	x	0.8	=	92.27	(77)
Southwest	0.9x	0.77	x	3.9	x	36.79		0.55	x	0.8	=	43.75	(79)
Southwest	0.9x	0.77	x	3.9	x	62.67		0.55	x	0.8	=	74.53	(79)
Southwest	0.9x	0.77	x	3.9	x	85.75		0.55	x	0.8	=	101.98	(79)
Southwest	0.9x	0.77	x	3.9	x	106.25		0.55	x	0.8	=	126.35	(79)
Southwest	0.9x	0.77	x	3.9	x	119.01		0.55	x	0.8	=	141.53	(79)
Southwest	0.9x	0.77	x	3.9	x	118.15		0.55	x	0.8	=	140.5	(79)
Southwest	0.9x	0.77	x	3.9	x	113.91		0.55	x	0.8	=	135.46	(79)
Southwest	0.9x	0.77	x	3.9	x	104.39		0.55	x	0.8	=	124.14	(79)
Southwest	0.9x	0.77	x	3.9	x	92.85		0.55	x	0.8	=	110.42	(79)
Southwest	0.9x	0.77	x	3.9	x	69.27		0.55	x	0.8	=	82.37	(79)
Southwest	0.9x	0.77	x	3.9	x	44.07		0.55	x	0.8	=	52.41	(79)
Southwest	0.9x	0.77	x	3.9	x	31.49		0.55	x	0.8	=	37.44	(79)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

| (83)m= | 151.57 | 258.18 | 353.26 | 437.7 | 490.26 | 486.72 | 469.25 | 430.03 | 382.5 | 285.35 | 181.55 | 129.71 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| (84)m= | 552.09 | 656.74 | 739.32 | 803.64 | 835.83 | 812.57 | 782.23 | 748.68 | 711.44 | 634.61 | 554.19 | 519.82 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.95	0.91	0.83	0.72	0.57	0.43	0.46	0.66	0.86	0.95	0.97	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| (87)m= | 19.41 | 19.68 | 20.04 | 20.42 | 20.73 | 20.91 | 20.97 | 20.97 | 20.85 | 20.44 | 19.84 | 19.34 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| (88)m= | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| (89)m= | 0.96 | 0.94 | 0.89 | 0.8 | 0.67 | 0.49 | 0.34 | 0.37 | 0.59 | 0.83 | 0.94 | 0.97 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| (90)m= | 17.89 | 18.28 | 18.79 | 19.32 | 19.72 | 19.93 | 19.98 | 19.98 | 19.86 | 19.36 | 18.52 | 17.79 | (90) |

fLA = Living area ÷ (4) =   0.31   (91)

DER WorkSheet: New dwelling design stage

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 − fLA) × T2

| (92)m= | 18.36 | 18.72 | 19.17 | 19.66 | 20.03 | 20.23 | 20.29 | 20.28 | 20.17 | 19.69 | 18.93 | 18.27 | | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m= | 18.36 | 18.72 | 19.17 | 19.66 | 20.03 | 20.23 | 20.29 | 20.28 | 20.17 | 19.69 | 18.93 | 18.27 | | (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= | 0.95 | 0.92 | 0.87 | 0.79 | 0.67 | 0.51 | 0.36 | 0.4 | 0.6 | 0.82 | 0.92 | 0.96 | | (94) |

Useful gains, hmGm , W = (94)m x (84)m

| (95)m= | 524.67 | 604.01 | 644.83 | 637.04 | 562.03 | 416.66 | 285.1 | 297.9 | 429.38 | 518.38 | 511.2 | 497.79 | | (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= | 1113.12 | 1092.04 | 1001.57 | 850.19 | 658.41 | 445.08 | 291.74 | 307.02 | 479.6 | 718.55 | 934.84 | 1112.17 | | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m − (95)m] x (41)m

| (98)m= | 437.81 | 327.96 | 265.41 | 153.47 | 71.71 | 0 | 0 | 0 | 0 | 148.93 | 305.02 | 457.1 | | (98) |

	Total per year (kWh/year) = Sum(98)₁...5,9...12 =	2167.4	(98)

Space heating requirement in kWh/m²/year — 30.22 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none — 0 (301)

Fraction of space heat from community system 1 – (301) = — 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump — 1 (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = — 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system — 1 (305)

Distribution loss factor (Table 12c) for community heating system — 1.05 (306)

Space heating — **kWh/year**

Annual space heating requirement — 2167.4

Space heat from Community heat pump (98) x (304a) x (305) x (306) = — 2275.77 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) — 0 (308

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = — 0 (309)

Water heating

Annual water heating requirement — 2043.6

If DHW from community scheme:
Water heat from Community heat pump (64) x (303a) x (305) x (306) = — 2145.78 (310a)

Electricity used for heat distribution 0.01 × [(307a)...(307e) + (310a)...(310e)] = — 44.22 (313)

Cooling System Energy Efficiency Ratio — 0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0) = (107) ÷ (314) = — 0 (315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	52.46	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year =(330a) + (330b) + (330g) =	52.46	(331)
Energy for lighting (calculated in Appendix L)	317.29	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*			280	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.52 =	819.57	(367)
Electrical energy for heat distribution [(313) x		0.52 =	22.95	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)		=	842.51	(373)
CO2 associated with space heating (secondary) (309) x		0 =	0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.52 =	0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			842.51	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52 =	27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52 =	164.67	(379)

Total CO2, kg/year sum of (376)…(382) =	1034.41	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =	14.42	(384)
EI rating (section 14)	88.12	(385)

DER WorkSheet: New dwelling design stage

Property Address: MF - 1Bed - North

Address : MF - 1Bed - North, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.35	(1a) x	2.5	(2a) =	125.87	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.35	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.87	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0 (9)
Additional infiltration	[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0 (12)
If no draught lobby, enter 0.05, else enter 0		0 (13)
Percentage of windows and doors draught stripped		0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.23 (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) =	0.2 (21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation: | 0.5 | (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) | 0.5 | (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 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= | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | (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			2.12	x 1.5 =	3.18			(26)
Windows			8.55	x1/[1/(1.2)+ 0.04] =	9.79			(27)
Walls Type1	23.14	8.55	14.59	x 0.18 =	2.63	14	204.26	(29)
Walls Type2	29.29	2.12	27.17	x 0.23 =	6.13	14	380.38	(29)
Walls Type3	13.99	0	13.99	x 0.2 =	2.86	14	195.86	(29)
Total area of elements, m²			66.42					(31)
Party wall			13.69	x 0 =	0	20	273.8	(32)
Party floor			50.35			40	2014	(32a)
Party ceiling			50.35			30	1510.5	(32b)
Internal wall **			90.55			9	814.95	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)   (26)…(30) + (32) = | 24.58 | (33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) = | 5393.75 | (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) = | 107.13 | (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 | 6.75 | (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) = | 31.34 | (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= | 20.85 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 52.19 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | 52.11 | | (39) |

Average = Sum(39)$_{1...12}$ /12=   52.11   (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 1.04 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | | (40) |

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   1.7   (42)
  if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
  if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   74.58   (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of

not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

| (44)m= | 82.04 | 79.06 | 76.08 | 73.09 | 70.11 | 67.13 | 67.13 | 70.11 | 73.09 | 76.08 | 79.06 | 82.04 | | (44) |

Total = Sum(44)$_{1...12}$ =   895.02   (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

| (45)m= | 121.67 | 106.41 | 109.81 | 95.73 | 91.86 | 79.27 | 73.45 | 84.29 | 85.29 | 99.4 | 108.5 | 117.83 | | (45) |

Total = Sum(45)$_{1...12}$ =   1173.51   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 18.25 | 15.96 | 16.47 | 14.36 | 13.78 | 11.89 | 11.02 | 12.64 | 12.79 | 14.91 | 16.28 | 17.67 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)

Temperature factor from Table 2b   0   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)

 b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)

If community heating see section 4.3

Volume factor from Table 2a   1.03   (52)

Temperature factor from Table 2b   0.6   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)

 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m)

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3 — **0** (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	176.94	156.34	165.08	149.23	147.13	132.76	128.73	139.56	138.79	154.68	162	173.11	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	176.94	156.34	165.08	149.23	147.13	132.76	128.73	139.56	138.79	154.68	162	173.11	

Output from water heater (annual)₁...₁₂ **1824.35** (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.68	75.32	80.73	74.63	74.76	69.15	68.64	72.25	71.16	77.27	78.87	83.4	(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=	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.35	11.85	9.64	7.3	5.46	4.61	4.98	6.47	8.68	11.02	12.87	13.72	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	148.14	149.68	145.81	137.56	127.15	117.36	110.83	109.29	113.16	121.41	131.82	141.61	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(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=	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	-68.02	(71)

Water heating gains (Table 5)

(72)m=	113.81	112.09	108.51	103.65	100.49	96.04	92.26	97.11	98.83	103.86	109.55	112.1	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	323.81	322.13	312.46	297.01	281.6	266.52	256.57	261.37	269.18	284.8	302.74	315.93	(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)	
Northwest 0.9x	0.77	x	8.55	x	11.28	x	0.55	x	0.8	=	29.42	(81)
Northwest 0.9x	0.77	x	8.55	x	22.97	x	0.55	x	0.8	=	59.88	(81)

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Northwest 0.9x	0.77	x	8.55	x	41.38	x	0.55	x	0.8	=	107.88	(81)
Northwest 0.9x	0.77	x	8.55	x	67.96	x	0.55	x	0.8	=	177.17	(81)
Northwest 0.9x	0.77	x	8.55	x	91.35	x	0.55	x	0.8	=	238.14	(81)
Northwest 0.9x	0.77	x	8.55	x	97.38	x	0.55	x	0.8	=	253.89	(81)
Northwest 0.9x	0.77	x	8.55	x	91.1	x	0.55	x	0.8	=	237.51	(81)
Northwest 0.9x	0.77	x	8.55	x	72.63	x	0.55	x	0.8	=	189.34	(81)
Northwest 0.9x	0.77	x	8.55	x	50.42	x	0.55	x	0.8	=	131.45	(81)
Northwest 0.9x	0.77	x	8.55	x	28.07	x	0.55	x	0.8	=	73.17	(81)
Northwest 0.9x	0.77	x	8.55	x	14.2	x	0.55	x	0.8	=	37.01	(81)
Northwest 0.9x	0.77	x	8.55	x	9.21	x	0.55	x	0.8	=	24.02	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	29.42	59.88	107.88	177.17	238.14	253.89	237.51	189.34	131.45	73.17	37.01	24.02	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	353.22	382	420.34	474.18	519.74	520.41	494.08	450.72	400.63	357.98	339.75	339.95	(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, $h_{1,m}$ (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.96	0.94	0.91	0.84	0.72	0.56	0.44	0.49	0.7	0.87	0.94	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.11	19.31	19.68	20.18	20.61	20.86	20.95	20.93	20.72	20.19	19.57	19.06	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	20.05	(88)

Utilisation factor for gains for rest of dwelling, $h_{2,m}$ (see Table 9a)

(89)m=	0.95	0.93	0.9	0.81	0.68	0.5	0.35	0.4	0.64	0.85	0.93	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.53	17.81	18.35	19.04	19.62	19.93	20.02	20.01	19.78	19.08	18.19	17.46	(90)

fLA = Living area ÷ (4) =   0.42   (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.19	18.44	18.91	19.52	20.03	20.32	20.41	20.39	20.18	19.54	18.77	18.13	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.19	18.44	18.91	19.52	20.03	20.32	20.41	20.39	20.18	19.54	18.77	18.13	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.93	0.92	0.88	0.8	0.67	0.52	0.38	0.43	0.65	0.83	0.91	0.94	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	329.53	349.82	368.94	378.89	350.52	269.75	190.05	195.76	261.15	298.27	309.16	319.09	(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)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	725.12	705.4	646.52	553.35	434.15	297.97	198.62	208.12	316.66	465.99	607.91	725.67		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	294.32	238.95	206.52	125.61	62.22	0	0	0	0	124.78	215.1	302.49		

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =	1569.99	(98)

Space heating requirement in kWh/m²/year	31.18	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)

Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)

Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)

Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)

Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating
kWh/year

Annual space heating requirement		1569.99	

Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1648.49	(307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308

Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1824.35	

If DHW from community scheme:

Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1915.57	(310a)

Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	35.64	(313)

Cooling System Energy Efficiency Ratio		0	(314)

Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside	37.17	(330a)

warm air heating system fans	0	(330b)

pump for solar water heating	0	(330g)

Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	37.17	(331)

Energy for lighting (calculated in Appendix L)	235.69	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		280	(367a)

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CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	660.62	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	18.5	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	679.12	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			679.12	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	19.29	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	122.32	(379)
Total CO2, kg/year	sum of (376)…(382) =			820.73	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			16.3	(384)
EI rating (section 14)				88.47	(385)

DER WorkSheet: New dwelling design stage

Property Address: MF - 1Bed - South

Address : MF - 1Bed - South, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.25	(1a) x	2.5	(2a) =	125.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.25	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.62	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5	=	3.18			(26)
Windows			8.55	x1/[1/(1.2)+ 0.04]	=	9.79			(27)
Walls Type1	23.19	8.55	14.64	x 0.18	=	2.64	14	204.96	(29)
Walls Type2	12.4	2.12	10.28	x 0.23	=	2.32	14	143.92	(29)
Walls Type3	14	0	14	x 0.2	=	2.86	14	196	(29)
Total area of elements, m²			49.59						(31)
Party wall			30.53	x 0	=	0	20	610.6	(32)
Party floor			50.25				40	2010	(32a)
Party ceiling			50.25				30	1507.5	(32b)
Internal wall **			90.21				9	811.89	(32c)

* 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) =

20.78	(33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =

5484.87	(34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) =

109.15	(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

5.96	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) =

26.75	(37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

| (38)m= | 20.81 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 47.56 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | 47.48 | | |

Average = Sum(39)$_{1...12}$ /12=   47.48   (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 0.95 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | | |

Average = Sum(40)$_{1...12}$ /12=   0.94   (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

---

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   1.7   (42)
   if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
   if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   74.51   (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of

not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

| (44)m= | 81.97 | 78.99 | 76.01 | 73.02 | 70.04 | 67.06 | 67.06 | 70.04 | 73.02 | 76.01 | 78.99 | 81.97 | | |

Total = Sum(44)$_{1...12}$ =   894.18   (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

| (45)m= | 121.55 | 106.31 | 109.7 | 95.64 | 91.77 | 79.19 | 73.38 | 84.21 | 85.21 | 99.31 | 108.4 | 117.72 | | |

Total = Sum(45)$_{1...12}$ =   1172.41   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 18.23 | 15.95 | 16.46 | 14.35 | 13.77 | 11.88 | 11.01 | 12.63 | 12.78 | 14.9 | 16.26 | 17.66 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)

Temperature factor from Table 2b   0   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)
 b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)

If community heating see section 4.3

Volume factor from Table 2a   1.03   (52)

Temperature factor from Table 2b   0.6   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)

 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

DER WorkSheet: New dwelling design stage

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= | 176.83 | 156.24 | 164.98 | 149.14 | 147.05 | 132.69 | 128.66 | 139.48 | 138.71 | 154.58 | 161.9 | 172.99 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| (64)m= | 176.83 | 156.24 | 164.98 | 149.14 | 147.05 | 132.69 | 128.66 | 139.48 | 138.71 | 154.58 | 161.9 | 172.99 | |

Output from water heater (annual)$_{1…12}$ | 1823.25 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

| (65)m= | 84.64 | 75.29 | 80.7 | 74.6 | 74.74 | 69.13 | 68.62 | 72.22 | 71.13 | 77.24 | 78.84 | 83.36 | (65) |

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| (67)m= | 13.32 | 11.83 | 9.62 | 7.28 | 5.44 | 4.6 | 4.97 | 6.46 | 8.66 | 11 | 12.84 | 13.69 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| (68)m= | 147.88 | 149.42 | 145.55 | 137.32 | 126.93 | 117.16 | 110.63 | 109.1 | 112.97 | 121.2 | 131.59 | 141.36 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| (69)m= | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | 31.49 | (69) |

Pumps and fans gains (Table 5a)

| (70)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| (71)m= | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | -67.9 | (71) |

Water heating gains (Table 5)

| (72)m= | 113.76 | 112.04 | 108.47 | 103.61 | 100.45 | 96.01 | 92.23 | 97.07 | 98.79 | 103.82 | 109.5 | 112.05 | (72) |

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| (73)m= | 323.42 | 321.75 | 312.1 | 296.67 | 281.28 | 266.23 | 256.3 | 261.09 | 268.88 | 284.48 | 302.39 | 315.56 | (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)	
Southeast 0.9x	0.77	x	8.55	x	36.79	x	0.55	x	0.8	=	95.92	(77)
Southeast 0.9x	0.77	x	8.55	x	62.67	x	0.55	x	0.8	=	163.39	(77)

Southeast 0.9x	0.77	x	8.55	x	85.75	x	0.55	x	0.8	=	223.56	(77)
Southeast 0.9x	0.77	x	8.55	x	106.25	x	0.55	x	0.8	=	277.01	(77)
Southeast 0.9x	0.77	x	8.55	x	119.01	x	0.55	x	0.8	=	310.27	(77)
Southeast 0.9x	0.77	x	8.55	x	118.15	x	0.55	x	0.8	=	308.02	(77)
Southeast 0.9x	0.77	x	8.55	x	113.91	x	0.55	x	0.8	=	296.97	(77)
Southeast 0.9x	0.77	x	8.55	x	104.39	x	0.55	x	0.8	=	272.15	(77)
Southeast 0.9x	0.77	x	8.55	x	92.85	x	0.55	x	0.8	=	242.07	(77)
Southeast 0.9x	0.77	x	8.55	x	69.27	x	0.55	x	0.8	=	180.59	(77)
Southeast 0.9x	0.77	x	8.55	x	44.07	x	0.55	x	0.8	=	114.89	(77)
Southeast 0.9x	0.77	x	8.55	x	31.49	x	0.55	x	0.8	=	82.09	(77)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	95.92	163.39	223.56	277.01	310.27	308.02	296.97	272.15	242.07	180.59	114.89	82.09	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	419.35	485.14	535.66	573.67	591.55	574.25	553.26	533.24	510.95	465.07	417.29	397.65	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)   21   (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.93	0.9	0.84	0.76	0.64	0.49	0.37	0.39	0.57	0.78	0.9	0.94	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.54	19.81	20.15	20.5	20.77	20.92	20.98	20.97	20.87	20.53	19.97	19.47	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.13	20.13	20.13	20.13	20.13	20.13	20.13	20.13	20.13	20.13	20.13	20.13	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.88	0.82	0.73	0.6	0.44	0.3	0.33	0.52	0.75	0.88	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.19	18.57	19.04	19.52	19.88	20.06	20.11	20.11	20.01	19.58	18.8	18.09	(90)

fLA = Living area ÷ (4) =   0.42   (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.76	19.09	19.5	19.93	20.25	20.42	20.48	20.47	20.37	19.97	19.29	18.67	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.76	19.09	19.5	19.93	20.25	20.42	20.48	20.47	20.37	19.97	19.29	18.67	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.9	0.87	0.81	0.72	0.6	0.46	0.33	0.35	0.53	0.74	0.87	0.92	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	379.49	419.96	433.51	414.68	356.53	261.29	180.11	188.08	272.26	344.85	361.1	364.04	(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)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	687.59	673.71	617.42	523.75	406.02	276.48	184.03	193.25	297.8	445.07	578.83	686.84		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	229.23	170.51	136.83	78.53	36.82	0	0	0	0	74.56	156.77	240.16		(98)

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = **1123.42** (98)

Space heating requirement in kWh/m²/year **22.36** (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump | 1 | (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = | 1 | (304a)

Factor for control and charging method (Table 4c(3)) for community heating system | 1 | (305)

Distribution loss factor (Table 12c) for community heating system | 1.05 | (306)

Space heating **kWh/year**

Annual space heating requirement | 1123.42

Space heat from Community heat pump (98) x (304a) x (305) x (306) = | 1179.59 | (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0 | (308)

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = | 0 | (309)

Water heating

Annual water heating requirement | 1823.25

If DHW from community scheme:
Water heat from Community heat pump (64) x (303a) x (305) x (306) = | 1914.41 | (310a)

Electricity used for heat distribution 0.01 × [(307a)…(307e) + (310a)…(310e)] = | 30.94 | (313)

Cooling System Energy Efficiency Ratio | 0 | (314)

Space cooling (if there is a fixed cooling system, if not enter 0) = (107) ÷ (314) = | 0 | (315)

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 37.1 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = | 37.1 | (331)

Energy for lighting (calculated in Appendix L) | 235.22 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year

CO2 from other sources of space and water heating (not CHP)
Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel* | 280 | (367a)

DER WorkSheet: New dwelling design stage

CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	573.49	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	16.06	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	589.55	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			589.55	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	19.25	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	122.08	(379)
Total CO2, kg/year	sum of (376)…(382) =			730.88	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			14.54	(384)
EI rating (section 14)				89.72	(385)

DER WorkSheet: New dwelling design stage

Assessor Name: Matt Fitzpatrick   **Stroma Number:** STRO003572

Software Name: Stroma FSAP 2012   **Software Version:** Version: 1.0.5.6

Property Address: MF - 2Bed - North East

Address : MF - 2Bed - North East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =		0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =		0	(6b)
Number of intermittent fans							0	x 10 =		0	(7a)
Number of passive vents							0	x 10 =		0	(7b)
Number of flueless gas fires							0	x 40 =		0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Total area of elements, m²			50.63					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Party ceiling			71.72			30	2151.6	(32b)
Internal wall **			142.3			9	1280.7	(32c)

* 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) =

25.04	(33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =

7629.5	(34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) =

106.38	(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

8.06	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) =

33.1	(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= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 62.8 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 |

Average = Sum(39)$_{1...12}$ /12=   62.69   (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 0.88 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 |

Average = Sum(40)$_{1...12}$ /12=   0.87   (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   2.29   (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   88.52   (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 |

Total = Sum(44)$_{1...12}$ =   1062.24   (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 |

Total = Sum(45)$_{1...12}$ =   1392.76   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)

Temperature factor from Table 2b   0   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)
If community heating see section 4.3
Volume factor from Table 2a   1.03   (52)
Temperature factor from Table 2b   0.6   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)
 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

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Primary circuit loss (annual) from Table 3 .... | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.9	x	11.28	x	0.55	x	0.8	=	13.42	(75)
Northeast 0.9x	0.77	x	3.9	x	22.97	x	0.55	x	0.8	=	27.31	(75)

Northeast	0.9x	0.77	x	3.9	x	41.38	x	0.55	x	0.8	=	49.21	(75)
Northeast	0.9x	0.77	x	3.9	x	67.96	x	0.55	x	0.8	=	80.81	(75)
Northeast	0.9x	0.77	x	3.9	x	91.35	x	0.55	x	0.8	=	108.63	(75)
Northeast	0.9x	0.77	x	3.9	x	97.38	x	0.55	x	0.8	=	115.81	(75)
Northeast	0.9x	0.77	x	3.9	x	91.1	x	0.55	x	0.8	=	108.34	(75)
Northeast	0.9x	0.77	x	3.9	x	72.63	x	0.55	x	0.8	=	86.37	(75)
Northeast	0.9x	0.77	x	3.9	x	50.42	x	0.55	x	0.8	=	59.96	(75)
Northeast	0.9x	0.77	x	3.9	x	28.07	x	0.55	x	0.8	=	33.38	(75)
Northeast	0.9x	0.77	x	3.9	x	14.2	x	0.55	x	0.8	=	16.88	(75)
Northeast	0.9x	0.77	x	3.9	x	9.21	x	0.55	x	0.8	=	10.96	(75)
Northwest	0.9x	0.77	x	9.61	x	11.28	x	0.55	x	0.8	=	33.06	(81)
Northwest	0.9x	0.77	x	9.61	x	22.97	x	0.55	x	0.8	=	67.3	(81)
Northwest	0.9x	0.77	x	9.61	x	41.38	x	0.55	x	0.8	=	121.25	(81)
Northwest	0.9x	0.77	x	9.61	x	67.96	x	0.55	x	0.8	=	199.13	(81)
Northwest	0.9x	0.77	x	9.61	x	91.35	x	0.55	x	0.8	=	267.67	(81)
Northwest	0.9x	0.77	x	9.61	x	97.38	x	0.55	x	0.8	=	285.36	(81)
Northwest	0.9x	0.77	x	9.61	x	91.1	x	0.55	x	0.8	=	266.95	(81)
Northwest	0.9x	0.77	x	9.61	x	72.63	x	0.55	x	0.8	=	212.82	(81)
Northwest	0.9x	0.77	x	9.61	x	50.42	x	0.55	x	0.8	=	147.75	(81)
Northwest	0.9x	0.77	x	9.61	x	28.07	x	0.55	x	0.8	=	82.24	(81)
Northwest	0.9x	0.77	x	9.61	x	14.2	x	0.55	x	0.8	=	41.6	(81)
Northwest	0.9x	0.77	x	9.61	x	9.21	x	0.55	x	0.8	=	27	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	46.48	94.61	170.46	279.94	376.3	401.17	375.29	299.18	207.71	115.62	58.48	37.96		(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	447	493.17	556.53	645.88	721.86	727.02	688.27	617.83	536.64	464.89	431.12	428.06		(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=	0.96	0.95	0.91	0.82	0.68	0.51	0.39	0.44	0.68	0.87	0.95	0.97	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.37	19.57	19.94	20.4	20.75	20.93	20.98	20.96	20.82	20.35	19.78	19.31	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.94	0.9	0.8	0.64	0.46	0.32	0.37	0.62	0.85	0.94	0.96	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.99	18.28	18.8	19.45	19.91	20.12	20.17	20.16	20.01	19.4	18.58	17.91	(90)

fLA = Living area ÷ (4) = | 0.31 (91)

DER WorkSheet: New dwelling design stage

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.41	18.68	19.15	19.74	20.17	20.37	20.42	20.41	20.26	19.69	18.95	18.34		(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.41	18.68	19.15	19.74	20.17	20.37	20.42	20.41	20.26	19.69	18.95	18.34		(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=	0.94	0.92	0.88	0.78	0.64	0.47	0.34	0.39	0.63	0.84	0.92	0.95		(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	421.67	455.52	489.2	506.38	460.19	341.94	234.53	243.3	336.76	388.71	396.94	406.36		(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	886.31	863.52	793.18	679.6	531.12	361.7	239.63	251.48	385.93	569.95	742.73	886.42		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	345.69	274.17	226.16	124.72	52.78	0	0	0	0	134.84	248.98	357.16		(98)

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =

Total per year (kWh/year) = Sum(98)1...5,9...12 =	1764.5	(98)

Space heating requirement in kWh/m²/year

24.6	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0	(301)

Fraction of space heat from community system 1 – (301) =

1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump

1	(303a)

Fraction of total space heat from Community heat pump   (302) x (303a) =

1	(304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1	(305)

Distribution loss factor (Table 12c) for community heating system

1.05	(306)

Space heating   **kWh/year**

Annual space heating requirement

1764.5	

Space heat from Community heat pump   (98) x (304a) x (305) x (306) =

1852.73	(307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0	(308

Space heating requirement from secondary/supplementary system   (98) x (301) x 100 ÷ (308) =

0	(309)

Water heating

Annual water heating requirement

2043.6	

If DHW from community scheme:
Water heat from Community heat pump   (64) x (303a) x (305) x (306) =

2145.78	(310a)

Electricity used for heat distribution   0.01 × [(307a)...(307e) + (310a)...(310e)] =

39.99	(313)

Cooling System Energy Efficiency Ratio

0	(314)

Space cooling (if there is a fixed cooling system, if not enter 0)   = (107) ÷ (314) =

0	(315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		52.46	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	52.46	(331)
Energy for lighting (calculated in Appendix L)		317.29	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	741.15	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	20.75	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	761.9	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			761.9	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	27.23	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	164.67	(379)
Total CO2, kg/year	sum of (376)…(382) =			953.8	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			13.3	(384)
EI rating (section 14)				89.05	(385)

DER WorkSheet: New dwelling design stage

Assessor Name: Matt Fitzpatrick   **Stroma Number:** STRO003572

Software Name: Stroma FSAP 2012   **Software Version:** Version: 1.0.5.6

Property Address: MF - 2Bed - North West

Address : MF - 2Bed - North West, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Total area of elements, m²			50.63					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Party ceiling			71.72			30	2151.6	(32b)
Internal wall **			142.3			9	1280.7	(32c)

* 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) =

25.04	(33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =

7629.5	(34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) =

106.38	(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

8.06	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) =

33.1	(37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 62.8 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | | |

Average = Sum(39)$_{1...12}$ /12=   62.69   (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 0.88 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | | |

Average = Sum(40)$_{1...12}$ /12=   0.87   (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   2.29   (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   88.52   (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | |

Total = Sum(44)$_{1...12}$ =   1062.24   (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | |

Total = Sum(45)$_{1...12}$ =   1392.76   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)

Temperature factor from Table 2b   0   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)

 b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)

If community heating see section 4.3

Volume factor from Table 2a   1.03   (52)

Temperature factor from Table 2b   0.6   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)

 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest 0.9x	0.77	x	3.9	x	36.79		0.55	x	0.8	=	43.75	(79)
Southwest 0.9x	0.77	x	3.9	x	62.67		0.55	x	0.8	=	74.53	(79)

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Southwest 0.9x	0.77	x	3.9	x	85.75		0.55	x	0.8	=	101.98	(79)
Southwest 0.9x	0.77	x	3.9	x	106.25		0.55	x	0.8	=	126.35	(79)
Southwest 0.9x	0.77	x	3.9	x	119.01		0.55	x	0.8	=	141.53	(79)
Southwest 0.9x	0.77	x	3.9	x	118.15		0.55	x	0.8	=	140.5	(79)
Southwest 0.9x	0.77	x	3.9	x	113.91		0.55	x	0.8	=	135.46	(79)
Southwest 0.9x	0.77	x	3.9	x	104.39		0.55	x	0.8	=	124.14	(79)
Southwest 0.9x	0.77	x	3.9	x	92.85		0.55	x	0.8	=	110.42	(79)
Southwest 0.9x	0.77	x	3.9	x	69.27		0.55	x	0.8	=	82.37	(79)
Southwest 0.9x	0.77	x	3.9	x	44.07		0.55	x	0.8	=	52.41	(79)
Southwest 0.9x	0.77	x	3.9	x	31.49		0.55	x	0.8	=	37.44	(79)
Northwest 0.9x	0.77	x	9.61	x	11.28	x	0.55	x	0.8	=	33.06	(81)
Northwest 0.9x	0.77	x	9.61	x	22.97	x	0.55	x	0.8	=	67.3	(81)
Northwest 0.9x	0.77	x	9.61	x	41.38	x	0.55	x	0.8	=	121.25	(81)
Northwest 0.9x	0.77	x	9.61	x	67.96	x	0.55	x	0.8	=	199.13	(81)
Northwest 0.9x	0.77	x	9.61	x	91.35	x	0.55	x	0.8	=	267.67	(81)
Northwest 0.9x	0.77	x	9.61	x	97.38	x	0.55	x	0.8	=	285.36	(81)
Northwest 0.9x	0.77	x	9.61	x	91.1	x	0.55	x	0.8	=	266.95	(81)
Northwest 0.9x	0.77	x	9.61	x	72.63	x	0.55	x	0.8	=	212.82	(81)
Northwest 0.9x	0.77	x	9.61	x	50.42	x	0.55	x	0.8	=	147.75	(81)
Northwest 0.9x	0.77	x	9.61	x	28.07	x	0.55	x	0.8	=	82.24	(81)
Northwest 0.9x	0.77	x	9.61	x	14.2	x	0.55	x	0.8	=	41.6	(81)
Northwest 0.9x	0.77	x	9.61	x	9.21	x	0.55	x	0.8	=	27	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

| (83)m= | 76.82 | 141.83 | 223.23 | 325.48 | 409.2 | 425.87 | 402.41 | 336.96 | 258.17 | 164.62 | 94.01 | 64.45 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| (84)m= | 477.34 | 540.39 | 609.29 | 691.42 | 754.76 | 751.72 | 715.39 | 655.61 | 587.1 | 513.88 | 466.65 | 454.55 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) → 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.96	0.93	0.89	0.8	0.66	0.5	0.37	0.42	0.64	0.85	0.93	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| (87)m= | 19.44 | 19.67 | 20.03 | 20.46 | 20.77 | 20.93 | 20.98 | 20.97 | 20.85 | 20.43 | 19.85 | 19.37 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| (88)m= | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | 20.19 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| (89)m= | 0.95 | 0.93 | 0.88 | 0.77 | 0.62 | 0.44 | 0.31 | 0.35 | 0.58 | 0.82 | 0.92 | 0.96 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| (90)m= | 18.08 | 18.42 | 18.93 | 19.52 | 19.94 | 20.13 | 20.18 | 20.17 | 20.04 | 19.5 | 18.68 | 17.99 | (90) |

fLA = Living area ÷ (4) = 0.31 (91)

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Mean internal temperature (for the whole dwelling) = fLA ✕ T1 + (1 – fLA) ✕ T2

| (92)m= | 18.5 | 18.8 | 19.27 | 19.81 | 20.2 | 20.38 | 20.42 | 20.42 | 20.29 | 19.78 | 19.05 | 18.42 | | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m= | 18.5 | 18.8 | 19.27 | 19.81 | 20.2 | 20.38 | 20.42 | 20.42 | 20.29 | 19.78 | 19.05 | 18.42 | | (93) |

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.93	0.91	0.86	0.76	0.62	0.46	0.33	0.37	0.59	0.81	0.91	0.94		(94)

Useful gains, hmGm , W = (94)m x (84)m

| (95)m= | 446.05 | 490.51 | 522.17 | 525.99 | 467.37 | 343.82 | 235.16 | 244.74 | 346.67 | 414.39 | 423.07 | 428.15 | | (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= | 891.9 | 871.56 | 800.71 | 683.9 | 532.58 | 362.05 | 239.74 | 251.75 | 387.92 | 575.7 | 748.73 | 891.4 | | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| (98)m= | 331.71 | 256.06 | 207.23 | 113.7 | 48.51 | 0 | 0 | 0 | 0 | 120.02 | 234.48 | 344.66 | | (98) |

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = | 1656.37 | (98)

Space heating requirement in kWh/m²/year | 23.09 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump | 1 | (303a)

Fraction of total space heat from Community heat pump   (302) x (303a) = | 1 | (304a)

Factor for control and charging method (Table 4c(3)) for community heating system | 1 | (305)

Distribution loss factor (Table 12c) for community heating system | 1.05 | (306)

Space heating   **kWh/year**

Annual space heating requirement | 1656.37 |

Space heat from Community heat pump   (98) x (304a) x (305) x (306) = | 1739.18 | (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0 | (308)

Space heating requirement from secondary/supplementary system   (98) x (301) x 100 ÷ (308) = | 0 | (309)

Water heating

Annual water heating requirement | 2043.6 |

If DHW from community scheme:
Water heat from Community heat pump   (64) x (303a) x (305) x (306) = | 2145.78 | (310a)

Electricity used for heat distribution   0.01 × [(307a)…(307e) + (310a)…(310e)] = | 38.85 | (313)

Cooling System Energy Efficiency Ratio | 0 | (314)

Space cooling (if there is a fixed cooling system, if not enter 0)   = (107) ÷ (314) = | 0 | (315)

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Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	52.46	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year =(330a) + (330b) + (330g) =	52.46	(331)
Energy for lighting (calculated in Appendix L)	317.29	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) If there is CHP using two fuels repeat (363) to (366) for the second fuel			280	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	720.11	(367)
Electrical energy for heat distribution [(313) x	0.52	=	20.16	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)		=	740.27	(373)
CO2 associated with space heating (secondary) (309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x	0.52	=	0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			740.27	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x	0.52	=	27.23	(378)
CO2 associated with electricity for lighting (332))) x	0.52	=	164.67	(379)

Total CO2, kg/year sum of (376)…(382) =	932.17	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =	13	(384)
EI rating (section 14)	89.3	(385)

DER WorkSheet: New dwelling design stage

Assessor Name: Matt Fitzpatrick **Stroma Number:** STRO003572

Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.6

Property Address: MF - 2Bed - South East

Address : MF - 2Bed - South East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(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=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
   if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=
0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Total area of elements, m²			50.63					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Party ceiling			71.72			30	2151.6	(32b)
Internal wall **			142.3			9	1280.7	(32c)

* 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) =

25.04	(33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =

7629.5	(34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) =

106.38	(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

8.06	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) =

33.1	(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= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

| (39)m= | 62.8 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 |

Average = Sum(39)$_{1...12}$ /12= 62.69 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

| (40)m= | 0.88 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 |

Average = Sum(40)$_{1...12}$ /12= 0.87 (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   2.29   (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   88.52   (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 |

Total = Sum(44)$_{1...12}$ = 1062.24 (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 |

Total = Sum(45)$_{1...12}$ = 1392.76 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)

Temperature factor from Table 2b   0   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)

 b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)

If community heating see section 4.3

Volume factor from Table 2a   1.03   (52)

Temperature factor from Table 2b   0.6   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)

 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

DER WorkSheet: New dwelling design stage

Primary circuit loss (annual) from Table 3 $\boxed{0}$ (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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂ $\boxed{2043.6}$ (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.9	x	11.28	x	0.55	x	0.8	=	13.42	(75)
Northeast 0.9x	0.77	x	3.9	x	22.97	x	0.55	x	0.8	=	27.31	(75)

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Northeast 0.9x	0.77	x	3.9	x	41.38	x	0.55	x	0.8	=	49.21	(75)
Northeast 0.9x	0.77	x	3.9	x	67.96	x	0.55	x	0.8	=	80.81	(75)
Northeast 0.9x	0.77	x	3.9	x	91.35	x	0.55	x	0.8	=	108.63	(75)
Northeast 0.9x	0.77	x	3.9	x	97.38	x	0.55	x	0.8	=	115.81	(75)
Northeast 0.9x	0.77	x	3.9	x	91.1	x	0.55	x	0.8	=	108.34	(75)
Northeast 0.9x	0.77	x	3.9	x	72.63	x	0.55	x	0.8	=	86.37	(75)
Northeast 0.9x	0.77	x	3.9	x	50.42	x	0.55	x	0.8	=	59.96	(75)
Northeast 0.9x	0.77	x	3.9	x	28.07	x	0.55	x	0.8	=	33.38	(75)
Northeast 0.9x	0.77	x	3.9	x	14.2	x	0.55	x	0.8	=	16.88	(75)
Northeast 0.9x	0.77	x	3.9	x	9.21	x	0.55	x	0.8	=	10.96	(75)
Southeast 0.9x	0.77	x	9.61	x	36.79	x	0.55	x	0.8	=	107.82	(77)
Southeast 0.9x	0.77	x	9.61	x	62.67	x	0.55	x	0.8	=	183.65	(77)
Southeast 0.9x	0.77	x	9.61	x	85.75	x	0.55	x	0.8	=	251.28	(77)
Southeast 0.9x	0.77	x	9.61	x	106.25	x	0.55	x	0.8	=	311.35	(77)
Southeast 0.9x	0.77	x	9.61	x	119.01	x	0.55	x	0.8	=	348.73	(77)
Southeast 0.9x	0.77	x	9.61	x	118.15	x	0.55	x	0.8	=	346.21	(77)
Southeast 0.9x	0.77	x	9.61	x	113.91	x	0.55	x	0.8	=	333.79	(77)
Southeast 0.9x	0.77	x	9.61	x	104.39	x	0.55	x	0.8	=	305.89	(77)
Southeast 0.9x	0.77	x	9.61	x	92.85	x	0.55	x	0.8	=	272.08	(77)
Southeast 0.9x	0.77	x	9.61	x	69.27	x	0.55	x	0.8	=	202.97	(77)
Southeast 0.9x	0.77	x	9.61	x	44.07	x	0.55	x	0.8	=	129.14	(77)
Southeast 0.9x	0.77	x	9.61	x	31.49	x	0.55	x	0.8	=	92.27	(77)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	121.23	210.96	300.49	392.16	457.36	462.02	442.12	392.26	332.04	236.35	146.02	103.23	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	521.76	609.52	686.55	758.1	802.93	787.87	755.11	710.91	660.98	585.62	518.66	493.33	(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=	0.95	0.91	0.86	0.77	0.63	0.48	0.36	0.39	0.59	0.8	0.92	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.53	19.8	20.16	20.53	20.8	20.94	20.98	20.98	20.88	20.52	19.95	19.46	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.94	0.9	0.84	0.74	0.59	0.43	0.29	0.33	0.53	0.77	0.9	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.22	18.61	19.11	19.62	19.97	20.13	20.18	20.17	20.07	19.62	18.83	18.12	(90)

fLA = Living area ÷ (4) = | 0.31 | (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.63	18.98	19.43	19.9	20.23	20.38	20.43	20.42	20.32	19.9	19.18	18.53		(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.63	18.98	19.43	19.9	20.23	20.38	20.43	20.42	20.32	19.9	19.18	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=	0.92	0.88	0.82	0.73	0.59	0.44	0.31	0.35	0.54	0.76	0.88	0.93		(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	480.37	538.2	565.76	551.45	476.71	346.26	235.93	246.41	357.96	446.9	459	459.03		(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=	899.78	882.5	810.58	689.41	534.46	362.51	239.88	252.05	390.13	582.87	756.98	898.48		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	312.04	231.37	182.14	99.34	42.96	0	0	0	0	101.16	214.54	326.95		(98)

Total per year (kWh/year) = Sum(98)₁...5,9...12 =   **1510.5**   (98)

Space heating requirement in kWh/m²/year   **21.06**   (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none   **0**   (301)

Fraction of space heat from community system 1 – (301) =   **1**   (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump   **1**   (303a)

Fraction of total space heat from Community heat pump   (302) x (303a) =   **1**   (304a)

Factor for control and charging method (Table 4c(3)) for community heating system   **1**   (305)

Distribution loss factor (Table 12c) for community heating system   **1.05**   (306)

Space heating   **kWh/year**
Annual space heating requirement   **1510.5**

Space heat from Community heat pump   (98) x (304a) x (305) x (306) =   **1586.02**   (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)   **0**   (308

Space heating requirement from secondary/supplementary system   (98) x (301) x 100 ÷ (308) =   **0**   (309)

Water heating
Annual water heating requirement   **2043.6**

If DHW from community scheme:
Water heat from Community heat pump   (64) x (303a) x (305) x (306) =   **2145.78**   (310a)

Electricity used for heat distribution   0.01 × [(307a)…(307e) + (310a)…(310e)] =   **37.32**   (313)

Cooling System Energy Efficiency Ratio   **0**   (314)

Space cooling (if there is a fixed cooling system, if not enter 0)   = (107) ÷ (314) =   **0**   (315)

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Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 52.46 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year | =(330a) + (330b) + (330g) = | 52.46 | (331)

Energy for lighting (calculated in Appendix L) | 317.29 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) _If there is CHP using two fuels repeat (363) to (366) for the second fuel_			280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	= 691.72	(367)
Electrical energy for heat distribution	[(313) x	0.52	= 19.37	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		= 711.08	(373)
CO2 associated with space heating (secondary)	(309) x	0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	= 0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =		711.08	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	= 27.23	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	= 164.67	(379)
Total CO2, kg/year	sum of (376)…(382) =		902.99	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =		12.59	(384)
EI rating (section 14)			89.63	(385)

DER WorkSheet: New dwelling design stage

Property Address: MF - 2Bed - South West

Address : MF - 2Bed - South West , Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 = 0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) = 0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

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=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=
0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Total area of elements, m²			50.63					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Party ceiling			71.72			30	2151.6	(32b)
Internal wall **			142.3			9	1280.7	(32c)

* 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) =

25.04	(33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =

7629.5	(34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) =

106.38	(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

8.06	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) =

33.1	(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= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 62.8 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | 62.68 | | |

Average = Sum(39)$_{1...12}$ /12= **62.69**   (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 0.88 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | | |

Average = Sum(40)$_{1...12}$ /12= **0.87**   (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   **2.29**   (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   **88.52**   (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | |

Total = Sum(44)$_{1...12}$ =   **1062.24**   (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | |

Total = Sum(45)$_{1...12}$ =   **1392.76**   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   **0**   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   **0**   (48)

Temperature factor from Table 2b   **0**   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   **110**   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   **0.02**   (51)
If community heating see section 4.3
Volume factor from Table 2a   **1.03**   (52)
Temperature factor from Table 2b   **0.6**   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   **1.03**   (54)
 Enter (50) or (54) in (55)   **1.03**   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	9.61	x	36.79	x	0.55	x	0.8	=	107.82	(77)
Southeast 0.9x	0.77	x	9.61	x	62.67	x	0.55	x	0.8	=	183.65	(77)

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Direction							
Southeast 0.9x	0.77	x 9.61	x 85.75	x 0.55	x 0.8	= 251.28	(77)
Southeast 0.9x	0.77	x 9.61	x 106.25	x 0.55	x 0.8	= 311.35	(77)
Southeast 0.9x	0.77	x 9.61	x 119.01	x 0.55	x 0.8	= 348.73	(77)
Southeast 0.9x	0.77	x 9.61	x 118.15	x 0.55	x 0.8	= 346.21	(77)
Southeast 0.9x	0.77	x 9.61	x 113.91	x 0.55	x 0.8	= 333.79	(77)
Southeast 0.9x	0.77	x 9.61	x 104.39	x 0.55	x 0.8	= 305.89	(77)
Southeast 0.9x	0.77	x 9.61	x 92.85	x 0.55	x 0.8	= 272.08	(77)
Southeast 0.9x	0.77	x 9.61	x 69.27	x 0.55	x 0.8	= 202.97	(77)
Southeast 0.9x	0.77	x 9.61	x 44.07	x 0.55	x 0.8	= 129.14	(77)
Southeast 0.9x	0.77	x 9.61	x 31.49	x 0.55	x 0.8	= 92.27	(77)
Southwest 0.9x	0.77	x 3.9	x 36.79	0.55	x 0.8	= 43.75	(79)
Southwest 0.9x	0.77	x 3.9	x 62.67	0.55	x 0.8	= 74.53	(79)
Southwest 0.9x	0.77	x 3.9	x 85.75	0.55	x 0.8	= 101.98	(79)
Southwest 0.9x	0.77	x 3.9	x 106.25	0.55	x 0.8	= 126.35	(79)
Southwest 0.9x	0.77	x 3.9	x 119.01	0.55	x 0.8	= 141.53	(79)
Southwest 0.9x	0.77	x 3.9	x 118.15	0.55	x 0.8	= 140.5	(79)
Southwest 0.9x	0.77	x 3.9	x 113.91	0.55	x 0.8	= 135.46	(79)
Southwest 0.9x	0.77	x 3.9	x 104.39	0.55	x 0.8	= 124.14	(79)
Southwest 0.9x	0.77	x 3.9	x 92.85	0.55	x 0.8	= 110.42	(79)
Southwest 0.9x	0.77	x 3.9	x 69.27	0.55	x 0.8	= 82.37	(79)
Southwest 0.9x	0.77	x 3.9	x 44.07	0.55	x 0.8	= 52.41	(79)
Southwest 0.9x	0.77	x 3.9	x 31.49	0.55	x 0.8	= 37.44	(79)

Solar gains in watts, calculated for each month $(83)m = Sum(74)m \ldots (82)m$

(83)m=	151.57	258.18	353.26	437.7	490.26	486.72	469.25	430.03	382.5	285.35	181.55	129.71	(83)

Total gains – internal and solar $(84)m = (73)m + (83)m$, watts

(84)m=	552.09	656.74	739.32	803.64	835.83	812.57	782.23	748.68	711.44	634.61	554.19	519.82	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) — 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.94	0.9	0.84	0.74	0.61	0.47	0.34	0.37	0.55	0.78	0.9	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.6	19.89	20.23	20.57	20.82	20.94	20.98	20.98	20.9	20.58	20.02	19.52	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	20.19	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.93	0.88	0.82	0.71	0.57	0.41	0.28	0.31	0.5	0.74	0.89	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.31	18.73	19.21	19.67	19.99	20.14	20.18	20.17	20.09	19.69	18.92	18.2	(90)

fLA = Living area ÷ (4) = 0.31 (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 − fLA) × T2

(92)m=	18.71	19.09	19.53	19.95	20.24	20.39	20.43	20.42	20.34	19.97	19.26	18.61	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.71	19.09	19.53	19.95	20.24	20.39	20.43	20.42	20.34	19.97	19.26	18.61	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.91	0.87	0.8	0.71	0.58	0.43	0.3	0.33	0.51	0.73	0.87	0.92	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	502.86	568.38	592.51	566.81	482.36	347.73	236.38	247.32	363.97	465.99	481.96	479.41	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	904.96	889.41	816.57	692.69	535.58	362.78	239.97	252.21	391.28	587.01	762.23	903.15	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m − (95)m] x (41)m

(98)m=	299.16	215.73	166.7	90.63	39.59	0	0	0	0	90.04	201.79	315.27	(98)

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1...5,9...12} = 1418.91 \quad (98)$$

Space heating requirement in kWh/m²/year — 19.78 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none — 0 (301)

Fraction of space heat from community system 1 – (301) = — 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump — 1 (303a)

Fraction of total space heat from Community heat pump — (302) x (303a) = — 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system — 1 (305)

Distribution loss factor (Table 12c) for community heating system — 1.05 (306)

Space heating — **kWh/year**

Annual space heating requirement — 1418.91

Space heat from Community heat pump — (98) x (304a) x (305) x (306) = — 1489.85 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) — 0 (308)

Space heating requirement from secondary/supplementary system — (98) x (301) x 100 ÷ (308) = — 0 (309)

Water heating
Annual water heating requirement — 2043.6

If DHW from community scheme:
Water heat from Community heat pump — (64) x (303a) x (305) x (306) = — 2145.78 (310a)

Electricity used for heat distribution — 0.01 × [(307a)…(307e) + (310a)…(310e)] = — 36.36 (313)

Cooling System Energy Efficiency Ratio — 0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0) — = (107) ÷ (314) = — 0 (315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside | 52.46 | (330a)

warm air heating system fans | 0 | (330b)

pump for solar water heating | 0 | (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = | 52.46 | (331)

Energy for lighting (calculated in Appendix L) | 317.29 | (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*			280	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.52 =	673.89	(367)
Electrical energy for heat distribution [(313) x		0.52 =	18.87	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)		=	692.76	(373)
CO2 associated with space heating (secondary) (309) x		0 =	0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.52 =	0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			692.76	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52 =	27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52 =	164.67	(379)

Total CO2, kg/year   sum of (376)…(382) = | 884.66 | (383)

Dwelling CO2 Emission Rate   (383) ÷ (4) = | 12.33 | (384)

EI rating (section 14) | 89.84 | (385)

DER WorkSheet: New dwelling design stage

Assessor Name:	Matt Fitzpatrick	**Stroma Number:**	STRO003572
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.6

Property Address: TF - 1Bed - North

Address : TF - 1Bed - North, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.35	(1a) x	2.5	(2a) =	125.87	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.35	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.87	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	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=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=
0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5	=	3.18			(26)
Windows			8.55	x1/[1/(1.2)+ 0.04]	=	9.79			(27)
Walls Type1	23.14	8.55	14.59	x 0.18	=	2.63	14	204.26	(29)
Walls Type2	29.29	2.12	27.17	x 0.23	=	6.13	14	380.38	(29)
Walls Type3	13.99	0	13.99	x 0.2	=	2.86	14	195.86	(29)
Roof	50.35	0	50.35	x 0.13	=	6.55	9	453.15	(30)
Total area of elements, m²			116.77						(31)
Party wall			13.69	x 0	=	0	20	273.8	(32)
Party floor			50.35				40	2014	(32a)
Internal wall **			90.55				9	814.95	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	31.13	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	4336.4	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	86.13	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		13.65	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	44.78	(37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

| (38)m= | 20.85 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | 20.77 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 65.63 | 65.55 | 65.55 | 65.55 | 65.55 | 65.55 | 65.55 | 65.55 | 65.55 | 65.55 | 65.55 | 65.55 | | |

Average = Sum(39)$_{1...12}$ /12=   65.55   (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | | |

Average = Sum(40)$_{1...12}$ /12=   1.3   (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   1.7   (42)
   if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
   if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   74.58   (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of
not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

| (44)m= | 82.04 | 79.06 | 76.08 | 73.09 | 70.11 | 67.13 | 67.13 | 70.11 | 73.09 | 76.08 | 79.06 | 82.04 | | |

Total = Sum(44)$_{1...12}$ =   895.02   (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

| (45)m= | 121.67 | 106.41 | 109.81 | 95.73 | 91.86 | 79.27 | 73.45 | 84.29 | 85.29 | 99.4 | 108.5 | 117.83 | | |

Total = Sum(45)$_{1...12}$ =   1173.51   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 18.25 | 15.96 | 16.47 | 14.36 | 13.78 | 11.89 | 11.02 | 12.64 | 12.79 | 14.91 | 16.28 | 17.67 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)

Temperature factor from Table 2b   0   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)
If community heating see section 4.3
Volume factor from Table 2a   1.03   (52)
Temperature factor from Table 2b   0.6   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)
 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| (59)m= | 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= | 176.94 | 156.34 | 165.08 | 149.23 | 147.13 | 132.76 | 128.73 | 139.56 | 138.79 | 154.68 | 162 | 173.11 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| (64)m= | 176.94 | 156.34 | 165.08 | 149.23 | 147.13 | 132.76 | 128.73 | 139.56 | 138.79 | 154.68 | 162 | 173.11 | |

Output from water heater (annual)₁...₁₂ | 1824.35 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

| (65)m= | 84.68 | 75.32 | 80.73 | 74.63 | 74.76 | 69.15 | 68.64 | 72.25 | 71.16 | 77.27 | 78.87 | 83.4 | (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=	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	85.02	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| (67)m= | 13.35 | 11.85 | 9.64 | 7.3 | 5.46 | 4.61 | 4.98 | 6.47 | 8.68 | 11.02 | 12.87 | 13.72 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| (68)m= | 148.14 | 149.68 | 145.81 | 137.56 | 127.15 | 117.36 | 110.83 | 109.29 | 113.16 | 121.41 | 131.82 | 141.61 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| (69)m= | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 | 31.5 | (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= | -68.02 | -68.02 | -68.02 | -68.02 | -68.02 | -68.02 | -68.02 | -68.02 | -68.02 | -68.02 | -68.02 | -68.02 | (71) |

Water heating gains (Table 5)

| (72)m= | 113.81 | 112.09 | 108.51 | 103.65 | 100.49 | 96.04 | 92.26 | 97.11 | 98.83 | 103.86 | 109.55 | 112.1 | (72) |

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| (73)m= | 323.81 | 322.13 | 312.46 | 297.01 | 281.6 | 266.52 | 256.57 | 261.37 | 269.18 | 284.8 | 302.74 | 315.93 | (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)	
Northwest 0.9x	0.77	x	8.55	x	11.28	x	0.55	x	0.8	=	29.42	(81)
Northwest 0.9x	0.77	x	8.55	x	22.97	x	0.55	x	0.8	=	59.88	(81)

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Northwest 0.9x	0.77	x	8.55	x	41.38	x	0.55	x	0.8	=	107.88	(81)
Northwest 0.9x	0.77	x	8.55	x	67.96	x	0.55	x	0.8	=	177.17	(81)
Northwest 0.9x	0.77	x	8.55	x	91.35	x	0.55	x	0.8	=	238.14	(81)
Northwest 0.9x	0.77	x	8.55	x	97.38	x	0.55	x	0.8	=	253.89	(81)
Northwest 0.9x	0.77	x	8.55	x	91.1	x	0.55	x	0.8	=	237.51	(81)
Northwest 0.9x	0.77	x	8.55	x	72.63	x	0.55	x	0.8	=	189.34	(81)
Northwest 0.9x	0.77	x	8.55	x	50.42	x	0.55	x	0.8	=	131.45	(81)
Northwest 0.9x	0.77	x	8.55	x	28.07	x	0.55	x	0.8	=	73.17	(81)
Northwest 0.9x	0.77	x	8.55	x	14.2	x	0.55	x	0.8	=	37.01	(81)
Northwest 0.9x	0.77	x	8.55	x	9.21	x	0.55	x	0.8	=	24.02	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	29.42	59.88	107.88	177.17	238.14	253.89	237.51	189.34	131.45	73.17	37.01	24.02	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	353.22	382	420.34	474.18	519.74	520.41	494.08	450.72	400.63	357.98	339.75	339.95	(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=	0.94	0.93	0.9	0.84	0.74	0.61	0.49	0.54	0.73	0.87	0.93	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.21	18.44	18.91	19.56	20.18	20.63	20.84	20.79	20.42	19.65	18.82	18.15	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	19.84	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.94	0.92	0.89	0.82	0.7	0.54	0.39	0.44	0.67	0.84	0.92	0.94	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.15	16.48	17.15	18.07	18.93	19.5	19.73	19.69	19.26	18.21	17.03	16.06	(90)

fLA = Living area ÷ (4) =   0.42   (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.01	17.3	17.89	18.7	19.45	19.98	20.2	20.16	19.74	18.81	17.78	16.94	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.01	17.3	17.89	18.7	19.45	19.98	20.2	20.16	19.74	18.81	17.78	16.94	(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=	0.91	0.89	0.86	0.79	0.68	0.55	0.42	0.47	0.66	0.82	0.89	0.92	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	321.09	340.65	359.66	372.91	354.54	285.62	209.59	212.26	265.21	291.88	300.99	311.06	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	834.32	812.79	746.56	642.05	508.19	352.4	235.75	246.17	369.88	538.42	700.06	834.83		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	381.84	317.28	287.85	193.78	114.32	0	0	0	0	183.43	287.33	389.69

	Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =	2155.51	(98)

Space heating requirement in kWh/m²/year — 42.81 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.
Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none — 0 (301)

Fraction of space heat from community system 1 – (301) = — 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump — 1 (303a)

Fraction of total space heat from Community heat pump — (302) x (303a) = — 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system — 1 (305)

Distribution loss factor (Table 12c) for community heating system — 1.05 (306)

Space heating — **kWh/year**

Annual space heating requirement — 2155.51

Space heat from Community heat pump — (98) x (304a) x (305) x (306) = — 2263.29 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) — 0 (308)

Space heating requirement from secondary/supplementary system — (98) x (301) x 100 ÷ (308) = — 0 (309)

Water heating

Annual water heating requirement — 1824.35

If DHW from community scheme:
Water heat from Community heat pump — (64) x (303a) x (305) x (306) = — 1915.57 (310a)

Electricity used for heat distribution — 0.01 × [(307a)...(307e) + (310a)...(310e)] = — 41.79 (313)

Cooling System Energy Efficiency Ratio — 0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0) — = (107) ÷ (314) = — 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside — 37.17 (330a)

warm air heating system fans — 0 (330b)

pump for solar water heating — 0 (330g)

Total electricity for the above, kWh/year — =(330a) + (330b) + (330g) = — 37.17 (331)

Energy for lighting (calculated in Appendix L) — 235.69 (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*			280 (367a)

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CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	774.58	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	21.69	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	796.27	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			796.27	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	19.29	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	122.32	(379)
Total CO2, kg/year	sum of (376)…(382) =			937.88	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			18.63	(384)
EI rating (section 14)				86.82	(385)

DER WorkSheet: New dwelling design stage

Property Address: TF - 1Bed - South

Address : TF - 1Bed - South, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.25	(1a) x	2.5	(2a) =	125.62	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.25	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		125.62	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total			m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =		0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =		0	(6b)
Number of intermittent fans							0	x 10 =		0	(7a)
Number of passive vents							0	x 10 =		0	(7b)
Number of flueless gas fires							0	x 40 =		0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 = 0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) = 0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

| | | | | | | | | | | | | 0.5 | (23a) |

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a) | 0.5 | (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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows			8.55	x1/[1/(1.2)+ 0.04] =	9.79			(27)
Walls Type1	23.19	8.55	14.64	x 0.18 =	2.64	14	204.96	(29)
Walls Type2	12.4	2.12	10.28	x 0.23 =	2.32	14	143.92	(29)
Walls Type3	14	0	14	x 0.2 =	2.86	14	196	(29)
Roof	50.25	0	50.25	x 0.13 =	6.53	9	452.25	(30)
Total area of elements, m²			99.84					(31)
Party wall			30.53	x 0 =	0	20	610.6	(32)
Party floor			50.25			40	2010	(32a)
Internal wall **			90.21			9	811.89	(32c)

* 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) =	27.32	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	4429.62	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	88.15	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		13.06	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	40.38	(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= | 20.81 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | 20.73 | | (38) |

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

| (39)m= | 61.19 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 | 61.11 | | |

Average = Sum(39)$_{1...12}$ /12=   61.11   (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

| (40)m= | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | | |

Average = Sum(40)$_{1...12}$ /12=   1.22   (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   1.7   (42)
   if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
   if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36   74.51   (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of
not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

| (44)m= | 81.97 | 78.99 | 76.01 | 73.02 | 70.04 | 67.06 | 67.06 | 70.04 | 73.02 | 76.01 | 78.99 | 81.97 | | |

Total = Sum(44)$_{1...12}$ =   894.18   (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

| (45)m= | 121.55 | 106.31 | 109.7 | 95.64 | 91.77 | 79.19 | 73.38 | 84.21 | 85.21 | 99.31 | 108.4 | 117.72 | | |

Total = Sum(45)$_{1...12}$ =   1172.41   (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 18.23 | 15.95 | 16.46 | 14.35 | 13.77 | 11.88 | 11.01 | 12.63 | 12.78 | 14.9 | 16.26 | 17.66 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)
Temperature factor from Table 2b   0   (49)
Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)
If community heating see section 4.3
Volume factor from Table 2a   1.03   (52)
Temperature factor from Table 2b   0.6   (53)
Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)
 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m)

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

   (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	176.83	156.24	164.98	149.14	147.05	132.69	128.66	139.48	138.71	154.58	161.9	172.99	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	176.83	156.24	164.98	149.14	147.05	132.69	128.66	139.48	138.71	154.58	161.9	172.99	

Output from water heater (annual)₁...₁₂ | 1823.25 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.64	75.29	80.7	74.6	74.74	69.13	68.62	72.22	71.13	77.24	78.84	83.36	(65)

   include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	84.87	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.32	11.83	9.62	7.28	5.44	4.6	4.97	6.46	8.66	11	12.84	13.69	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.88	149.42	145.55	137.32	126.93	117.16	110.63	109.1	112.97	121.2	131.59	141.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	31.49	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	-67.9	(71)

Water heating gains (Table 5)

(72)m=	113.76	112.04	108.47	103.61	100.45	96.01	92.23	97.07	98.79	103.82	109.5	112.05	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	323.42	321.75	312.1	296.67	281.28	266.23	256.3	261.09	268.88	284.48	302.39	315.56	(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)	
Southeast 0.9x	0.77	x	8.55	x	36.79	x	0.55	x	0.8	=	95.92	(77)
Southeast 0.9x	0.77	x	8.55	x	62.67	x	0.55	x	0.8	=	163.39	(77)

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Southeast	0.9x	0.77	x	8.55	x	85.75	x	0.55	x	0.8	=	223.56	(77)
Southeast	0.9x	0.77	x	8.55	x	106.25	x	0.55	x	0.8	=	277.01	(77)
Southeast	0.9x	0.77	x	8.55	x	119.01	x	0.55	x	0.8	=	310.27	(77)
Southeast	0.9x	0.77	x	8.55	x	118.15	x	0.55	x	0.8	=	308.02	(77)
Southeast	0.9x	0.77	x	8.55	x	113.91	x	0.55	x	0.8	=	296.97	(77)
Southeast	0.9x	0.77	x	8.55	x	104.39	x	0.55	x	0.8	=	272.15	(77)
Southeast	0.9x	0.77	x	8.55	x	92.85	x	0.55	x	0.8	=	242.07	(77)
Southeast	0.9x	0.77	x	8.55	x	69.27	x	0.55	x	0.8	=	180.59	(77)
Southeast	0.9x	0.77	x	8.55	x	44.07	x	0.55	x	0.8	=	114.89	(77)
Southeast	0.9x	0.77	x	8.55	x	31.49	x	0.55	x	0.8	=	82.09	(77)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	95.92	163.39	223.56	277.01	310.27	308.02	296.97	272.15	242.07	180.59	114.89	82.09	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	419.35	485.14	535.66	573.67	591.55	574.25	553.26	533.24	510.95	465.07	417.29	397.65	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.92	0.89	0.85	0.78	0.69	0.56	0.44	0.46	0.63	0.8	0.89	0.93	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.63	18.94	19.39	19.92	20.39	20.74	20.9	20.87	20.63	20.02	19.22	18.55	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.91	19.91	19.91	19.91	19.91	19.91	19.91	19.91	19.91	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.91	0.88	0.83	0.75	0.64	0.49	0.34	0.37	0.57	0.77	0.88	0.92	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.78	17.22	17.86	18.59	19.24	19.67	19.84	19.82	19.55	18.75	17.63	16.66	(90)

fLA = Living area ÷ (4) = | 0.42 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.55	17.94	18.5	19.15	19.72	20.12	20.28	20.26	20	19.28	18.3	17.45	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.55	17.94	18.5	19.15	19.72	20.12	20.28	20.26	20	19.28	18.3	17.45	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.88	0.85	0.8	0.73	0.63	0.5	0.38	0.4	0.57	0.75	0.85	0.89	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	370.72	411.87	429.24	419.3	374.27	289.04	207.89	215.12	292.43	346.65	354.05	355.47	(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)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	810.91	797.1	733.4	626.25	490.23	337.12	224.94	235.98	360.61	530.4	684.14	809.7		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	327.5	258.87	226.3	149.01	86.27	0	0	0	0	136.71	237.67	337.94		(98)

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ =	1760.27	(98)

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1760.27 (98)

Space heating requirement in kWh/m²/year	35.03	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)

Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating   **kWh/year**

Annual space heating requirement		1760.27	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1848.29	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		1823.25	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1914.41	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	37.63	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		37.1	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	37.1	(331)
Energy for lighting (calculated in Appendix L)		235.22	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year

CO2 from other sources of space and water heating (not CHP)

Efficiency of heat source 1 (%)	*If there is CHP using two fuels repeat (363) to (366) for the second fuel*	280	(367a)

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CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.52	=	697.44	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	19.53	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	716.97	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			716.97	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	19.25	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	122.08	(379)
Total CO2, kg/year	sum of (376)…(382) =			858.3	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			17.08	(384)
EI rating (section 14)				87.93	(385)

DER WorkSheet: New dwelling design stage

Assessor Name: Matt Fitzpatrick   **Stroma Number:** STRO003572

Software Name: Stroma FSAP 2012   **Software Version:** Version: 1.0.5.6

Property Address: TF - 2Bed - North East

Address : TF - 2Bed - North East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 = 0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) = 0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:

	0.5	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

	0.5	(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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5	=	3.18			(26)
Windows Type 1			3.9	x1/[1/(1.2)+ 0.04]	=	4.47			(27)
Windows Type 2			9.61	x1/[1/(1.2)+ 0.04]	=	11			(27)
Walls Type1	46.63	13.51	33.12	x 0.18	=	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23	=	0.42	14	26.32	(29)
Roof	71.72	0	71.72	x 0.13	=	9.32	9	645.48	(30)
Total area of elements, m²			122.35						(31)
Party wall			41.92	x 0	=	0	20	838.4	(32)
Party floor			71.72				40	2868.8	(32a)
Internal wall **			142.3				9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	34.36	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6123.38	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	85.38	(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		15	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	49.35	(37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	29.7	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58		(38)

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

(39)m=	79.06	78.94	78.94	78.94	78.94	78.94	78.94	78.94	78.94	78.94	78.94	78.94		(39)

Average = Sum(39)$_{1...12}$ /12= **78.95** (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

(40)m=	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1		(40)

Average = Sum(40)$_{1...12}$ /12= **1.1** (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   **2.29**   (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   **88.52**   (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=	97.37	93.83	90.29	86.75	83.21	79.67	79.67	83.21	86.75	90.29	93.83	97.37		(44)

Total = Sum(44)$_{1...12}$ = **1062.24** (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=	144.4	126.29	130.32	113.62	109.02	94.08	87.17	100.03	101.23	117.97	128.78	139.84		(45)

Total = Sum(45)$_{1...12}$ = **1392.76** (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.66	18.94	19.55	17.04	16.35	14.11	13.08	15.01	15.18	17.7	19.32	20.98		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   **0**   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):   **0**   (48)

Temperature factor from Table 2b   **0**   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   **110**   (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)   **0.02**   (51)

If community heating see section 4.3

Volume factor from Table 2a   **1.03**   (52)

Temperature factor from Table 2b   **0.6**   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   **1.03**   (54)

Enter (50) or (54) in (55)   **1.03**   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

   (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

| (59)m= | 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= | 199.68 | 176.22 | 185.6 | 167.11 | 164.3 | 147.57 | 142.45 | 155.31 | 154.72 | 173.25 | 182.27 | 195.12 | (62) |

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| (64)m= | 199.68 | 176.22 | 185.6 | 167.11 | 164.3 | 147.57 | 142.45 | 155.31 | 154.72 | 173.25 | 182.27 | 195.12 | |

Output from water heater (annual)$_{1...12}$ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

| (65)m= | 92.23 | 81.93 | 87.55 | 80.57 | 80.47 | 74.08 | 73.21 | 77.48 | 76.45 | 83.45 | 85.61 | 90.72 | (65) |

   include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| (67)m= | 17.97 | 15.96 | 12.98 | 9.82 | 7.34 | 6.2 | 6.7 | 8.71 | 11.69 | 14.84 | 17.32 | 18.47 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| (68)m= | 201.28 | 203.37 | 198.1 | 186.9 | 172.75 | 159.46 | 150.58 | 148.49 | 153.75 | 164.96 | 179.1 | 192.4 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| (69)m= | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | 34.44 | (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= | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | -91.49 | (71) |

Water heating gains (Table 5)

| (72)m= | 123.97 | 121.93 | 117.68 | 111.91 | 108.16 | 102.88 | 98.4 | 104.14 | 106.19 | 112.16 | 118.91 | 121.93 | (72) |

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| (73)m= | 400.52 | 398.56 | 386.07 | 365.94 | 345.56 | 325.85 | 312.98 | 318.65 | 328.94 | 349.27 | 372.64 | 390.1 | (73) |

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.9	x	11.28	x	0.55	x	0.8	=	13.42	(75)
Northeast 0.9x	0.77	x	3.9	x	22.97	x	0.55	x	0.8	=	27.31	(75)

Northeast 0.9x	0.77	x	3.9	x	41.38	x	0.55	x	0.8	=	49.21	(75)
Northeast 0.9x	0.77	x	3.9	x	67.96	x	0.55	x	0.8	=	80.81	(75)
Northeast 0.9x	0.77	x	3.9	x	91.35	x	0.55	x	0.8	=	108.63	(75)
Northeast 0.9x	0.77	x	3.9	x	97.38	x	0.55	x	0.8	=	115.81	(75)
Northeast 0.9x	0.77	x	3.9	x	91.1	x	0.55	x	0.8	=	108.34	(75)
Northeast 0.9x	0.77	x	3.9	x	72.63	x	0.55	x	0.8	=	86.37	(75)
Northeast 0.9x	0.77	x	3.9	x	50.42	x	0.55	x	0.8	=	59.96	(75)
Northeast 0.9x	0.77	x	3.9	x	28.07	x	0.55	x	0.8	=	33.38	(75)
Northeast 0.9x	0.77	x	3.9	x	14.2	x	0.55	x	0.8	=	16.88	(75)
Northeast 0.9x	0.77	x	3.9	x	9.21	x	0.55	x	0.8	=	10.96	(75)
Northwest 0.9x	0.77	x	9.61	x	11.28	x	0.55	x	0.8	=	33.06	(81)
Northwest 0.9x	0.77	x	9.61	x	22.97	x	0.55	x	0.8	=	67.3	(81)
Northwest 0.9x	0.77	x	9.61	x	41.38	x	0.55	x	0.8	=	121.25	(81)
Northwest 0.9x	0.77	x	9.61	x	67.96	x	0.55	x	0.8	=	199.13	(81)
Northwest 0.9x	0.77	x	9.61	x	91.35	x	0.55	x	0.8	=	267.67	(81)
Northwest 0.9x	0.77	x	9.61	x	97.38	x	0.55	x	0.8	=	285.36	(81)
Northwest 0.9x	0.77	x	9.61	x	91.1	x	0.55	x	0.8	=	266.95	(81)
Northwest 0.9x	0.77	x	9.61	x	72.63	x	0.55	x	0.8	=	212.82	(81)
Northwest 0.9x	0.77	x	9.61	x	50.42	x	0.55	x	0.8	=	147.75	(81)
Northwest 0.9x	0.77	x	9.61	x	28.07	x	0.55	x	0.8	=	82.24	(81)
Northwest 0.9x	0.77	x	9.61	x	14.2	x	0.55	x	0.8	=	41.6	(81)
Northwest 0.9x	0.77	x	9.61	x	9.21	x	0.55	x	0.8	=	27	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

(83)m=	46.48	94.61	170.46	279.94	376.3	401.17	375.29	299.18	207.71	115.62	58.48	37.96		(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	447	493.17	556.53	645.88	721.86	727.02	688.27	617.83	536.64	464.89	431.12	428.06		(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=	0.95	0.94	0.9	0.83	0.71	0.57	0.45	0.51	0.71	0.87	0.94	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.51	18.75	19.21	19.84	20.39	20.75	20.9	20.86	20.55	19.85	19.07	18.45	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20	20	20	20	20	20	20	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.93	0.89	0.81	0.67	0.51	0.37	0.42	0.66	0.85	0.93	0.95	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.66	17.01	17.68	18.55	19.31	19.77	19.93	19.9	19.54	18.59	17.47	16.57	(90)

fLA = Living area ÷ (4) =   0.31   (91)

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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| (92)m= | 17.24 | 17.55 | 18.15 | 18.95 | 19.65 | 20.07 | 20.23 | 20.2 | 19.85 | 18.98 | 17.97 | 17.15 | | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m= | 17.24 | 17.55 | 18.15 | 18.95 | 19.65 | 20.07 | 20.23 | 20.2 | 19.85 | 18.98 | 17.97 | 17.15 | | (93) |

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.92	0.9	0.86	0.78	0.66	0.51	0.39	0.44	0.65	0.82	0.9	0.93	(94)

Useful gains, hmGm , W = (94)m x (84)m

| (95)m= | 411.37 | 444.05 | 477.92 | 502.36 | 474.84 | 372.79 | 265.8 | 270.9 | 347.64 | 381.55 | 386.86 | 396.67 | (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= | 1022.68 | 998.33 | 919.79 | 793.45 | 627.36 | 432.01 | 286.61 | 299.82 | 454.14 | 661.28 | 857.95 | 1022.63 | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| (98)m= | 454.81 | 372.47 | 328.75 | 209.59 | 113.47 | 0 | 0 | 0 | 0 | 208.11 | 339.19 | 465.71 | (98) |

Total per year (kWh/year) = Sum(98)₁...5,9...12 = | 2492.11 | (98)

Space heating requirement in kWh/m²/year | 34.75 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump | 1 | (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = | 1 | (304a)

Factor for control and charging method (Table 4c(3)) for community heating system | 1 | (305)

Distribution loss factor (Table 12c) for community heating system | 1.05 | (306)

Space heating | **kWh/year**

Annual space heating requirement | 2492.11

Space heat from Community heat pump (98) x (304a) x (305) x (306) = | 2616.72 | (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0 | (308)

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = | 0 | (309)

Water heating

Annual water heating requirement | 2043.6

If DHW from community scheme:
Water heat from Community heat pump (64) x (303a) x (305) x (306) = | 2145.78 | (310a)

Electricity used for heat distribution 0.01 × [(307a)...(307e) + (310a)...(310e)] = | 47.62 | (313)

Cooling System Energy Efficiency Ratio | 0 | (314)

Space cooling (if there is a fixed cooling system, if not enter 0) = (107) ÷ (314) = | 0 | (315)

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Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		52.46	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	52.46	(331)
Energy for lighting (calculated in Appendix L)		317.29	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	882.76	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	24.72	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	907.48	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				907.48	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	27.23	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	164.67	(379)
Total CO2, kg/year	sum of (376)…(382) =				1099.38	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				15.33	(384)
EI rating (section 14)					87.38	(385)

DER WorkSheet: New dwelling design stage

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Roof	71.72	0	71.72	x 0.13 =	9.32	9	645.48	(30)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Internal wall **			142.3			9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	34.36	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	6123.38	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	85.38	(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		15	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	49.35	(37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| (39)m= | 79.06 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 |

Average = Sum(39)$_{1...12}$ /12= 78.95 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| (40)m= | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |

Average = Sum(40)$_{1...12}$ /12= 1.1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   2.29   (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   88.52   (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 |

Total = Sum(44)$_{1...12}$ = 1062.24 (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 |

Total = Sum(45)$_{1...12}$ = 1392.76 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   0   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

 a) If manufacturer's declared loss factor is known (kWh/day):   0   (48)

Temperature factor from Table 2b   0   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   110   (50)

 b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)   0.02   (51)

If community heating see section 4.3

Volume factor from Table 2a   1.03   (52)

Temperature factor from Table 2b   0.6   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   1.03   (54)

 Enter (50) or (54) in (55)   1.03   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest 0.9x	0.77	x	3.9	x	36.79		0.55	x	0.8	=	43.75	(79)
Southwest 0.9x	0.77	x	3.9	x	62.67		0.55	x	0.8	=	74.53	(79)

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Southwest 0.9x	0.77	x	3.9	x	85.75	0.55	x	0.8	=	101.98	(79)
Southwest 0.9x	0.77	x	3.9	x	106.25	0.55	x	0.8	=	126.35	(79)
Southwest 0.9x	0.77	x	3.9	x	119.01	0.55	x	0.8	=	141.53	(79)
Southwest 0.9x	0.77	x	3.9	x	118.15	0.55	x	0.8	=	140.5	(79)
Southwest 0.9x	0.77	x	3.9	x	113.91	0.55	x	0.8	=	135.46	(79)
Southwest 0.9x	0.77	x	3.9	x	104.39	0.55	x	0.8	=	124.14	(79)
Southwest 0.9x	0.77	x	3.9	x	92.85	0.55	x	0.8	=	110.42	(79)
Southwest 0.9x	0.77	x	3.9	x	69.27	0.55	x	0.8	=	82.37	(79)
Southwest 0.9x	0.77	x	3.9	x	44.07	0.55	x	0.8	=	52.41	(79)
Southwest 0.9x	0.77	x	3.9	x	31.49	0.55	x	0.8	=	37.44	(79)
Northwest 0.9x	0.77	x	9.61	x	11.28	x	0.55	x	0.8	=	33.06	(81)
Northwest 0.9x	0.77	x	9.61	x	22.97	x	0.55	x	0.8	=	67.3	(81)
Northwest 0.9x	0.77	x	9.61	x	41.38	x	0.55	x	0.8	=	121.25	(81)
Northwest 0.9x	0.77	x	9.61	x	67.96	x	0.55	x	0.8	=	199.13	(81)
Northwest 0.9x	0.77	x	9.61	x	91.35	x	0.55	x	0.8	=	267.67	(81)
Northwest 0.9x	0.77	x	9.61	x	97.38	x	0.55	x	0.8	=	285.36	(81)
Northwest 0.9x	0.77	x	9.61	x	91.1	x	0.55	x	0.8	=	266.95	(81)
Northwest 0.9x	0.77	x	9.61	x	72.63	x	0.55	x	0.8	=	212.82	(81)
Northwest 0.9x	0.77	x	9.61	x	50.42	x	0.55	x	0.8	=	147.75	(81)
Northwest 0.9x	0.77	x	9.61	x	28.07	x	0.55	x	0.8	=	82.24	(81)
Northwest 0.9x	0.77	x	9.61	x	14.2	x	0.55	x	0.8	=	41.6	(81)
Northwest 0.9x	0.77	x	9.61	x	9.21	x	0.55	x	0.8	=	27	(81)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

| (83)m= | 76.82 | 141.83 | 223.23 | 325.48 | 409.2 | 425.87 | 402.41 | 336.96 | 258.17 | 164.62 | 94.01 | 64.45 | | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| (84)m= | 477.34 | 540.39 | 609.29 | 691.42 | 754.76 | 751.72 | 715.39 | 655.61 | 587.1 | 513.88 | 466.65 | 454.55 | | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.94	0.92	0.89	0.81	0.7	0.56	0.44	0.49	0.68	0.85	0.92	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| (87)m= | 18.58 | 18.85 | 19.32 | 19.91 | 20.43 | 20.76 | 20.91 | 20.88 | 20.6 | 19.93 | 19.15 | 18.51 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| (88)m= | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| (89)m= | 0.94 | 0.91 | 0.87 | 0.79 | 0.66 | 0.5 | 0.35 | 0.4 | 0.62 | 0.82 | 0.91 | 0.94 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| (90)m= | 16.77 | 17.16 | 17.82 | 18.65 | 19.35 | 19.78 | 19.94 | 19.91 | 19.59 | 18.7 | 17.59 | 16.66 | (90) |

fLA = Living area ÷ (4) = | 0.31 | (91)

DER WorkSheet: New dwelling design stage

Mean internal temperature (for the whole dwelling) = fLA ⨯ T1 + (1 − fLA) ⨯ T2

(92)m=	17.33	17.68	18.28	19.04	19.68	20.09	20.24	20.21	19.9	19.08	18.07	17.24	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.33	17.68	18.28	19.04	19.68	20.09	20.24	20.21	19.9	19.08	18.07	17.24	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.91	0.89	0.84	0.76	0.64	0.5	0.37	0.42	0.62	0.8	0.88	0.92	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	434.93	478.31	511.47	524.65	485.17	376.66	267.64	274.54	362.31	408.93	412.47	417.67	(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=	1030	1009.01	930.25	800.23	630.3	433.01	287.05	300.71	458.24	669.72	865.94	1029.13	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m − (95)m] x (41)m

(98)m=	442.73	356.63	311.57	198.42	107.98	0	0	0	0	194.02	326.5	454.93	(98)

Total per year (kWh/year) = Sum(98)₁...5,9...12 =	2392.79	(98)

Space heating requirement in kWh/m²/year | 33.36 | (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)

Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)

Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)

Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)

Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating   **kWh/year**

Annual space heating requirement		2392.79	

Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2512.43	(307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308

Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		2043.6	

If DHW from community scheme:

Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2145.78	(310a)

Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	46.58	(313)

Cooling System Energy Efficiency Ratio		0	(314)

Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	52.46	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year =(330a) + (330b) + (330g) =	52.46	(331)
Energy for lighting (calculated in Appendix L)	317.29	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) *If there is CHP using two fuels repeat (363) to (366) for the second fuel*				280	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	863.43	(367)
Electrical energy for heat distribution [(313) x		0.52	=	24.18	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)			=	887.61	(373)
CO2 associated with space heating (secondary) (309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =				887.61	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52	=	27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52	=	164.67	(379)
Total CO2, kg/year sum of (376)…(382) =				1079.51	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =				15.05	(384)
EI rating (section 14)				87.61	(385)

DER WorkSheet: New dwelling design stage

Property Address: TF - 2Bed - South East

Address : TF - 2Bed - South East, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	4.65000009536743	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)   0.5 (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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0

(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Windows Type 2			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Roof	71.72	0	71.72	x 0.13 =	9.32	9	645.48	(30)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Internal wall **			142.3			9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)   (26)…(30) + (32) =   34.36 (33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) =   6123.38 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) =   85.38 (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   15 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) =   49.35 (37)

Ventilation heat loss calculated monthly   (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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| (38)m= | 29.7 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | 29.58 | | (38) |

Heat transfer coefficient, W/K $\qquad$ (39)m = (37) + (38)m

| (39)m= | 79.06 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | 78.94 | | |

Average = Sum(39)$_{1...12}$ /12= **78.95** (39)

Heat loss parameter (HLP), W/m²K $\qquad$ (40)m = (39)m ÷ (4)

| (40)m= | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | | |

Average = Sum(40)$_{1...12}$ /12= **1.1** (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N **2.29** (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 **88.52** (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= | 97.37 | 93.83 | 90.29 | 86.75 | 83.21 | 79.67 | 79.67 | 83.21 | 86.75 | 90.29 | 93.83 | 97.37 | | |

Total = Sum(44)$_{1...12}$ = **1062.24** (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= | 144.4 | 126.29 | 130.32 | 113.62 | 109.02 | 94.08 | 87.17 | 100.03 | 101.23 | 117.97 | 128.78 | 139.84 | | |

Total = Sum(45)$_{1...12}$ = **1392.76** (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

| (46)m= | 21.66 | 18.94 | 19.55 | 17.04 | 16.35 | 14.11 | 13.08 | 15.01 | 15.18 | 17.7 | 19.32 | 20.98 | | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel **0** (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day): **0** (48)
Temperature factor from Table 2b **0** (49)
Energy lost from water storage, kWh/year (48) x (49) = **110** (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day) **0.02** (51)
If community heating see section 4.3
Volume factor from Table 2a **1.03** (52)
Temperature factor from Table 2b **0.6** (53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = **1.03** (54)
 Enter (50) or (54) in (55) **1.03** (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

| (56)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (56) |

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

| (57)m= | 32.01 | 28.92 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | 32.01 | 30.98 | 32.01 | 30.98 | 32.01 | | (57) |

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
  (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

  include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.9	x	11.28	x	0.55	x	0.8	=	13.42	(75)
Northeast 0.9x	0.77	x	3.9	x	22.97	x	0.55	x	0.8	=	27.31	(75)

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Northeast 0.9x	0.77	x	3.9	x	41.38	x	0.55	x	0.8	=	49.21	(75)
Northeast 0.9x	0.77	x	3.9	x	67.96	x	0.55	x	0.8	=	80.81	(75)
Northeast 0.9x	0.77	x	3.9	x	91.35	x	0.55	x	0.8	=	108.63	(75)
Northeast 0.9x	0.77	x	3.9	x	97.38	x	0.55	x	0.8	=	115.81	(75)
Northeast 0.9x	0.77	x	3.9	x	91.1	x	0.55	x	0.8	=	108.34	(75)
Northeast 0.9x	0.77	x	3.9	x	72.63	x	0.55	x	0.8	=	86.37	(75)
Northeast 0.9x	0.77	x	3.9	x	50.42	x	0.55	x	0.8	=	59.96	(75)
Northeast 0.9x	0.77	x	3.9	x	28.07	x	0.55	x	0.8	=	33.38	(75)
Northeast 0.9x	0.77	x	3.9	x	14.2	x	0.55	x	0.8	=	16.88	(75)
Northeast 0.9x	0.77	x	3.9	x	9.21	x	0.55	x	0.8	=	10.96	(75)
Southeast 0.9x	0.77	x	9.61	x	36.79	x	0.55	x	0.8	=	107.82	(77)
Southeast 0.9x	0.77	x	9.61	x	62.67	x	0.55	x	0.8	=	183.65	(77)
Southeast 0.9x	0.77	x	9.61	x	85.75	x	0.55	x	0.8	=	251.28	(77)
Southeast 0.9x	0.77	x	9.61	x	106.25	x	0.55	x	0.8	=	311.35	(77)
Southeast 0.9x	0.77	x	9.61	x	119.01	x	0.55	x	0.8	=	348.73	(77)
Southeast 0.9x	0.77	x	9.61	x	118.15	x	0.55	x	0.8	=	346.21	(77)
Southeast 0.9x	0.77	x	9.61	x	113.91	x	0.55	x	0.8	=	333.79	(77)
Southeast 0.9x	0.77	x	9.61	x	104.39	x	0.55	x	0.8	=	305.89	(77)
Southeast 0.9x	0.77	x	9.61	x	92.85	x	0.55	x	0.8	=	272.08	(77)
Southeast 0.9x	0.77	x	9.61	x	69.27	x	0.55	x	0.8	=	202.97	(77)
Southeast 0.9x	0.77	x	9.61	x	44.07	x	0.55	x	0.8	=	129.14	(77)
Southeast 0.9x	0.77	x	9.61	x	31.49	x	0.55	x	0.8	=	92.27	(77)

Solar gains in watts, calculated for each month   (83)m = Sum(74)m …(82)m

| (83)m= | 121.23 | 210.96 | 300.49 | 392.16 | 457.36 | 462.02 | 442.12 | 392.26 | 332.04 | 236.35 | 146.02 | 103.23 | (83) |

Total gains – internal and solar (84)m = (73)m + (83)m , watts

| (84)m= | 521.76 | 609.52 | 686.55 | 758.1 | 802.93 | 787.87 | 755.11 | 710.91 | 660.98 | 585.62 | 518.66 | 493.33 | (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=	0.93	0.91	0.86	0.79	0.68	0.54	0.42	0.46	0.64	0.82	0.91	0.94	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

| (87)m= | 18.68 | 19 | 19.46 | 20 | 20.47 | 20.78 | 20.92 | 20.89 | 20.66 | 20.05 | 19.26 | 18.6 | (87) |

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

| (88)m= | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | (88) |

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

| (89)m= | 0.93 | 0.89 | 0.84 | 0.76 | 0.63 | 0.48 | 0.34 | 0.37 | 0.58 | 0.79 | 0.89 | 0.93 | (89) |

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

| (90)m= | 16.91 | 17.36 | 18.02 | 18.77 | 19.4 | 19.8 | 19.94 | 19.92 | 19.66 | 18.85 | 17.74 | 16.79 | (90) |

fLA = Living area ÷ (4) = | 0.31 | (91)

DER WorkSheet: New dwelling design stage

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

| (92)m= | 17.46 | 17.87 | 18.46 | 19.15 | 19.73 | 20.1 | 20.24 | 20.22 | 19.97 | 19.22 | 18.21 | 17.35 | | (92) |

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

| (93)m= | 17.46 | 17.87 | 18.46 | 19.15 | 19.73 | 20.1 | 20.24 | 20.22 | 19.97 | 19.22 | 18.21 | 17.35 | | (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= | 0.9 | 0.86 | 0.81 | 0.73 | 0.62 | 0.48 | 0.36 | 0.39 | 0.58 | 0.76 | 0.86 | 0.91 | | (94) |

Useful gains, hmGm , W = (94)m x (84)m

| (95)m= | 468.29 | 525.71 | 557.09 | 554.77 | 499.17 | 381.9 | 270.04 | 279.08 | 380.59 | 445.2 | 448.13 | 447.55 | | (95) |

Monthly average external temperature from Table 8

| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

| (97)m= | 1040.39 | 1023.82 | 944.42 | 809.3 | 634.24 | 434.35 | 287.63 | 301.81 | 463.23 | 680.78 | 877.07 | 1038.41 | | (97) |

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

| (98)m= | 425.65 | 334.73 | 288.18 | 183.26 | 100.49 | 0 | 0 | 0 | 0 | 175.27 | 308.84 | 439.6 | | |

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = **2256.01** (98)

Space heating requirement in kWh/m²/year **31.46** (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none | 0 | (301)

Fraction of space heat from community system 1 – (301) = | 1 | (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump | 1 | (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = | 1 | (304a)

Factor for control and charging method (Table 4c(3)) for community heating system | 1 | (305)

Distribution loss factor (Table 12c) for community heating system | 1.05 | (306)

Space heating **kWh/year**

Annual space heating requirement | 2256.01 |

Space heat from Community heat pump (98) x (304a) x (305) x (306) = | 2368.81 | (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0 | (308

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = | 0 | (309)

Water heating

Annual water heating requirement | 2043.6 |

If DHW from community scheme:
Water heat from Community heat pump (64) x (303a) x (305) x (306) = | 2145.78 | (310a)

Electricity used for heat distribution 0.01 × [(307a)...(307e) + (310a)...(310e)] = | 45.15 | (313)

Cooling System Energy Efficiency Ratio | 0 | (314)

Space cooling (if there is a fixed cooling system, if not enter 0) = (107) ÷ (314) = | 0 | (315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		52.46	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	52.46	(331)
Energy for lighting (calculated in Appendix L)		317.29	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				280	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	836.81	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	23.43	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	860.24	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				860.24	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	27.23	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	164.67	(379)
Total CO2, kg/year	sum of (376)…(382) =				1052.14	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				14.67	(384)
EI rating (section 14)					87.92	(385)

DER WorkSheet: New dwelling design stage

Property Address: TF - 2Bed - South West

Address : TF - 2Bed - South West, Elmsleigh Road, TBA

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.72	(1a) x	2.5	(2a) =	179.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.72	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		179.3	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.65000009536743	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.23	(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) =	0.2	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.25	0.25	0.24	0.22	0.21	0.19	0.19	0.18	0.2	0.21	0.22	0.23

Calculate effective air change rate for the applicable case

If mechanical ventilation: | 0.5 | (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) | 0.5 | (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 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=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0

(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=

0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

(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			2.12	x 1.5 =	3.18			(26)
Windows Type 1			9.61	x1/[1/(1.2)+ 0.04] =	11			(27)
Windows Type 2			3.9	x1/[1/(1.2)+ 0.04] =	4.47			(27)
Walls Type1	46.63	13.51	33.12	x 0.18 =	5.96	14	463.68	(29)
Walls Type2	4	2.12	1.88	x 0.23 =	0.42	14	26.32	(29)
Roof	71.72	0	71.72	x 0.13 =	9.32	9	645.48	(30)
Total area of elements, m²			122.35					(31)
Party wall			41.92	x 0 =	0	20	838.4	(32)
Party floor			71.72			40	2868.8	(32a)
Internal wall **			142.3			9	1280.7	(32c)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)   (26)…(30) + (32) = | 34.36 | (33)

Heat capacity Cm = S(A x k)   ((28)…(30) + (32) + (32a)…(32e) = | 6123.38 | (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K   = (34) ÷ (4) = | 85.38 | (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 | 15 | (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss   (33) + (36) = | 49.35 | (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=	29.7	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58	29.58		(38)

Heat transfer coefficient, W/K   (39)m = (37) + (38)m

(39)m=	79.06	78.94	78.94	78.94	78.94	78.94	78.94	78.94	78.94	78.94	78.94	78.94		(39)

Average = Sum(39)₁...₁₂ /12= **78.95** (39)

Heat loss parameter (HLP), W/m²K   (40)m = (39)m ÷ (4)

(40)m=	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1		(40)

Average = Sum(40)₁...₁₂ /12= **1.1** (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N   **2.29**   (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   **88.52**   (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=	97.37	93.83	90.29	86.75	83.21	79.67	79.67	83.21	86.75	90.29	93.83	97.37		(44)

Total = Sum(44)₁...₁₂ = **1062.24** (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=	144.4	126.29	130.32	113.62	109.02	94.08	87.17	100.03	101.23	117.97	128.78	139.84		(45)

Total = Sum(45)₁...₁₂ = **1392.76** (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.66	18.94	19.55	17.04	16.35	14.11	13.08	15.01	15.18	17.7	19.32	20.98		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel   **0**   (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:
 a) If manufacturer's declared loss factor is known (kWh/day):   **0**   (48)

Temperature factor from Table 2b   **0**   (49)

Energy lost from water storage, kWh/year   (48) x (49) =   **110**   (50)
 b) If manufacturer's declared cylinder loss factor is not known:
Hot water storage loss factor from Table 2 (kWh/litre/day)   **0.02**   (51)
If community heating see section 4.3
Volume factor from Table 2a   **1.03**   (52)
Temperature factor from Table 2b   **0.6**   (53)

Energy lost from water storage, kWh/year   (47) x (51) x (52) x (53) =   **1.03**   (54)
 Enter (50) or (54) in (55)   **1.03**   (55)

Water storage loss calculated for each month   ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01		(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.68	176.22	185.6	167.11	164.3	147.57	142.45	155.31	154.72	173.25	182.27	195.12	

Output from water heater (annual)₁...₁₂ | 2043.6 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.23	81.93	87.55	80.57	80.47	74.08	73.21	77.48	76.45	83.45	85.61	90.72	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	114.36	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.97	15.96	12.98	9.82	7.34	6.2	6.7	8.71	11.69	14.84	17.32	18.47	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	201.28	203.37	198.1	186.9	172.75	159.46	150.58	148.49	153.75	164.96	179.1	192.4	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	34.44	(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=	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	-91.49	(71)

Water heating gains (Table 5)

(72)m=	123.97	121.93	117.68	111.91	108.16	102.88	98.4	104.14	106.19	112.16	118.91	121.93	(72)

Total internal gains =   (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	400.52	398.56	386.07	365.94	345.56	325.85	312.98	318.65	328.94	349.27	372.64	390.1	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	9.61	x	36.79	x	0.55	x	0.8	=	107.82	(77)
Southeast 0.9x	0.77	x	9.61	x	62.67	x	0.55	x	0.8	=	183.65	(77)

DER WorkSheet: New dwelling design stage

Orientation														Ref
Southeast	0.9x	0.77	x	9.61	x	85.75	x	0.55	x	0.8	=	251.28		(77)
Southeast	0.9x	0.77	x	9.61	x	106.25	x	0.55	x	0.8	=	311.35		(77)
Southeast	0.9x	0.77	x	9.61	x	119.01	x	0.55	x	0.8	=	348.73		(77)
Southeast	0.9x	0.77	x	9.61	x	118.15	x	0.55	x	0.8	=	346.21		(77)
Southeast	0.9x	0.77	x	9.61	x	113.91	x	0.55	x	0.8	=	333.79		(77)
Southeast	0.9x	0.77	x	9.61	x	104.39	x	0.55	x	0.8	=	305.89		(77)
Southeast	0.9x	0.77	x	9.61	x	92.85	x	0.55	x	0.8	=	272.08		(77)
Southeast	0.9x	0.77	x	9.61	x	69.27	x	0.55	x	0.8	=	202.97		(77)
Southeast	0.9x	0.77	x	9.61	x	44.07	x	0.55	x	0.8	=	129.14		(77)
Southeast	0.9x	0.77	x	9.61	x	31.49	x	0.55	x	0.8	=	92.27		(77)
Southwest	0.9x	0.77	x	3.9	x	36.79		0.55	x	0.8	=	43.75		(79)
Southwest	0.9x	0.77	x	3.9	x	62.67		0.55	x	0.8	=	74.53		(79)
Southwest	0.9x	0.77	x	3.9	x	85.75		0.55	x	0.8	=	101.98		(79)
Southwest	0.9x	0.77	x	3.9	x	106.25		0.55	x	0.8	=	126.35		(79)
Southwest	0.9x	0.77	x	3.9	x	119.01		0.55	x	0.8	=	141.53		(79)
Southwest	0.9x	0.77	x	3.9	x	118.15		0.55	x	0.8	=	140.5		(79)
Southwest	0.9x	0.77	x	3.9	x	113.91		0.55	x	0.8	=	135.46		(79)
Southwest	0.9x	0.77	x	3.9	x	104.39		0.55	x	0.8	=	124.14		(79)
Southwest	0.9x	0.77	x	3.9	x	92.85		0.55	x	0.8	=	110.42		(79)
Southwest	0.9x	0.77	x	3.9	x	69.27		0.55	x	0.8	=	82.37		(79)
Southwest	0.9x	0.77	x	3.9	x	44.07		0.55	x	0.8	=	52.41		(79)
Southwest	0.9x	0.77	x	3.9	x	31.49		0.55	x	0.8	=	37.44		(79)

Solar gains in watts, calculated for each month $(83)m = Sum(74)m \dots (82)m$

(83)m=	151.57	258.18	353.26	437.7	490.26	486.72	469.25	430.03	382.5	285.35	181.55	129.71	(83)

Total gains – internal and solar $(84)m = (73)m + (83)m$, watts

(84)m=	552.09	656.74	739.32	803.64	835.83	812.57	782.23	748.68	711.44	634.61	554.19	519.82	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) [21] (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.93	0.89	0.84	0.77	0.66	0.53	0.41	0.44	0.61	0.79	0.9	0.94	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.75	19.09	19.55	20.06	20.5	20.79	20.92	20.9	20.69	20.12	19.33	18.66	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20	20	20	20	20	20	20	20	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.88	0.82	0.74	0.62	0.47	0.33	0.36	0.55	0.76	0.88	0.93	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.01	17.5	18.14	18.85	19.44	19.81	19.95	19.93	19.7	18.95	17.84	16.88	(90)

fLA = Living area ÷ (4) = [0.31] (91)

DER WorkSheet: New dwelling design stage

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.55	17.99	18.58	19.22	19.77	20.11	20.25	20.23	20	19.31	18.3	17.43	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.55	17.99	18.58	19.22	19.77	20.11	20.25	20.23	20	19.31	18.3	17.43	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.89	0.85	0.79	0.71	0.61	0.47	0.35	0.38	0.55	0.74	0.85	0.9	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	490.3	556.25	585.98	573.75	508.03	385.2	271.5	281.72	391.22	467.59	471.29	467.36	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1047.27	1033.36	953.34	814.95	636.7	435.19	287.97	302.45	466.08	687.52	884.3	1044.58	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	414.38	320.61	273.31	173.66	95.73	0	0	0	0	163.63	297.37	429.45	(98)

Total per year (kWh/year) = Sum(98)₁...₅,₉...₁₂ = **2168.14** (98)

Space heating requirement in kWh/m²/year **30.23** (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none   0   (301)

Fraction of space heat from community system 1 – (301) =   1   (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump   1   (303a)

Fraction of total space heat from Community heat pump   (302) x (303a) =   1   (304a)

Factor for control and charging method (Table 4c(3)) for community heating system   1   (305)

Distribution loss factor (Table 12c) for community heating system   1.05   (306)

Space heating   **kWh/year**

Annual space heating requirement   2168.14

Space heat from Community heat pump   (98) x (304a) x (305) x (306) =   2276.55   (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)   0   (308

Space heating requirement from secondary/supplementary system   (98) x (301) x 100 ÷ (308) =   0   (309)

Water heating

Annual water heating requirement   2043.6

If DHW from community scheme:
Water heat from Community heat pump   (64) x (303a) x (305) x (306) =   2145.78   (310a)

Electricity used for heat distribution   0.01 × [(307a)...(307e) + (310a)...(310e)] =   44.22   (313)

Cooling System Energy Efficiency Ratio   0   (314)

Space cooling (if there is a fixed cooling system, if not enter 0)   = (107) ÷ (314) =   0   (315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside	52.46	(330a)
warm air heating system fans	0	(330b)
pump for solar water heating	0	(330g)
Total electricity for the above, kWh/year =(330a) + (330b) + (330g) =	52.46	(331)
Energy for lighting (calculated in Appendix L)	317.29	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) If there is CHP using two fuels repeat (363) to (366) for the second fuel			280	(367a)
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.52 =	819.71	(367)
Electrical energy for heat distribution [(313) x		0.52 =	22.95	(372)
Total CO2 associated with community systems (363)…(366) + (368)...(372)		=	842.66	(373)
CO2 associated with space heating (secondary) (309) x		0 =	0	(374)
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.52 =	0	(375)
Total CO2 associated with space and water heating (373) + (374) + (375) =			842.66	(376)
CO2 associated with electricity for pumps and fans within dwelling (331)) x		0.52 =	27.23	(378)
CO2 associated with electricity for lighting (332))) x		0.52 =	164.67	(379)

Total CO2, kg/year sum of (376)…(382) =		1034.56	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =		14.43	(384)
EI rating (section 14)		88.12	(385)