

Sustainability & Energy Statement

Land at and rear of 240 Nine Mile Ride, Finchampstead

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4th September 2023



Table of Contents

Executive Summary	3
1.0 Introduction	4
2.0 Planning policies	5
3.0 Assessment methodology	9
4.0 Proposal	9
5.0 Energy Efficiency	10
5.1 Demand Reduction (Be Lean)	10
• Passive design measures	
• Active design measures	
5.2 Establishing Baseline Carbon Dioxide Emissions (GAS)	13
• SAP calculations	
5.3 Low-Carbon and Renewable Technologies (Be Clean and Be Green)	15
5.4 Summary of Calculations and Proposals for Low-carbon & Renewable Technologies	19
6.0 Climate Change Adaption and Water Resources	20
• Sustainable drainage systems (SuDs)	
• Water efficiency measures	
7.0 Materials and Waste	22
 Appendix 1:	 DER Worksheets for the Modelled Units based on Gas Baseline
Appendix 2:	DER Worksheets for the Modelled Units based on Heat Pumps

Executive Summary

This Sustainability and Energy Statement has been prepared in support of a reserved matters planning application for the construction of 26, 2, 3, and 4-bedroom terrace and detached houses and associated infrastructure, landscaping and demolition of existing dwellings (to consider appearance, landscaping, layout and scale) on land at and to the rear of 240 Nine Mile Ride, Finchampstead.

The adopted planning policy (CC05) requires a reduction in emissions of at least 10% through the installation of low-carbon and/or renewable technologies.

SAP calculations have been prepared for representative units based upon the construction specification set out within the report. When aggregated across similar unit types the calculations provide an assessment of the likely carbon dioxide emissions arising from the site and have allowed different systems to be tested.

The fabric insulation standards and the construction specification of the houses will exceed the minimum required by the Building Regulations. Whilst various technologies are considered appropriate it is proposed to install air source heat pumps into all house.

All units will benefit from renewable technologies.

In order to demonstrate the reduction from the installation of air source heat pumps a further set of SAP calculations have been prepared for the same modelled units but based on the installation of gas boilers.

These provide a baseline against which the air source heat pump SAP calculations can be compared.

The DER Worksheets for both options are attached as Appendices 1 and 2.

The carbon dioxide emissions and the reductions from the installation of air source heat pumps can be summarised as follows;

	Total Emissions	% Reduction
	kg CO ₂ per year	
Baseline (DER emissions based on gas boilers)	49,707	
Emissions after Heat pumps	10,744	78.39%

The water efficiency measures incorporated within the houses will ensure the water use is less than 105 litres per person per day (excluding 5 l/p/d for external water use) and achieves the enhanced standard required by the Building Regulations.

The proposals significantly exceed the requirements of the planning policy.

1.0 Introduction

This report has been commissioned by Elivia Homes Ltd and provides a Sustainability and Energy Statement in support of a reserved matters planning application for the construction of 26, 2, 3, and 4-bedroom terrace and detached houses and associated infrastructure, landscaping and demolition of existing dwellings (to consider appearance, landscaping, layout and scale) on land at and to the rear of 240 Nine Mile Ride, Finchampstead.

The report describes the methodology used in assessing the development and the initiatives proposed.

The houses have designed and will be constructed to reduce energy demand and carbon dioxide emissions.

The objective is to reduce the energy demand to an economic minimum by making investments in the parts of the buildings that have the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric.

Once cost-effective structures have been designed, low-carbon and renewable technologies have been considered to provide further emissions reductions.

The following hierarchy has been followed:

- Lean reduce demand and consumption
- Clean increase energy efficiency
- Green provide low carbon renewable energy sources

The report has been prepared by Ivan Ball of Bluesky Unlimited who are sustainability consultants.

2.0 Planning Policy Context

National Policy

The UK Government published its sustainable development strategy in 1999 entitled “A better quality of life: A strategy for sustainable development in the UK”. This sets out four main objectives for sustainable development in the UK:

- Social progress that recognises the needs of everyone.
- Effective protection of the environment.
- Prudent use of natural resources.
- Maintenance of high stable levels of economic growth and employment.

Sustainable Communities: Building for the Future, known colloquially as the Communities Plan was published in 2003. The Plan sets out a long-term programme of action for delivering sustainable communities in both urban and rural areas. It aims to tackle housing supply issues in parts of the country, low demand in other parts and the quality of our public spaces. The Communities Plan describes sustainable communities as: Active, inclusive and safe, well run, environmentally sensitive, well designed and built, well connected, thriving, well served and fair for everyone.

The most relevant national planning policy guidance on sustainability is set out in:

- National Planning Policy Framework - 2023

Paragraph 152 states;

“The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.”

Local Policy

Wokingham Borough Local Development Framework – Adopted Core Strategy Development Plan Document, January 2010

CP1 – Sustainable development

Planning permission will be granted for development proposals that:

- 1) Maintain or enhance the high quality of the environment;*
- 2) Minimise the emission of pollutants into the wider environment;*
- 3) Limit any adverse effects on water quality (including ground water);*
- 4) Ensure the provision of adequate drainage;*
- 5) Minimise the consumption and use of resources and provide for recycling;*
- 6) Incorporate facilities for recycling of water and waste to help reduce per capita water consumption;*
- 7) Avoid areas of best and most versatile agricultural land;*
- 8) Avoid areas where pollution (including noise) may impact upon the amenity of future occupiers;*
- 9) Avoid increasing (and where possible reduce) risks of or from all forms of flooding (including from groundwater);*
- 10) Provide attractive, functional, accessible, safe, secure and adaptable schemes;*
- 11) Demonstrate how they support opportunities for reducing the need to travel, particularly by private car in line with CP6; and*
- 12) Contribute towards the goal of reaching zero-carbon developments as soon as possible by:*
 - a) Including appropriate on-site renewable energy features; and*
 - b) Minimising energy and water consumption by measures including the use of appropriate layout and orientation, building form, design and construction, and design to take account of microclimate so as to minimise carbon dioxide emissions through giving careful consideration to how all aspects of development form.*

CP2 - Inclusive communities

To ensure that new development contributes to the provision of sustainable and inclusive communities (including the provision of community facilities) to meet long term needs, planning permission will be granted for proposals that address the requirements of:

- a) An ageing population, particularly in terms of housing, health and wellbeing;*
- b) Children, young people and families, including the co-ordination of services to meet their needs;*
- c) People with special needs, including those with a physical, sensory or learning disability or problems accessing services; and*
- d) The specific identified needs of minority groups in the borough, including Gypsies, Travellers and Travelling Showpeople and black and minority ethnic groups. Proposals for gypsies, travellers and travelling showpeople (including allocations in other Development Plan Documents) will demonstrate that:*

- i) *The site is located either within or close to the development limits of a settlement in policy CP9 in order to maximise the possibilities for social inclusion and sustainable patterns of living; and*
- ii) *The proposed site is not disproportionate to the scale of the existing settlement whether singly or cumulatively with any existing sites in the area.*

Wokingham Borough Development Plan – Adopted Managing Development Delivery Local Plan, February 2014

Policy CC01 – Presumption in Favour of Sustainable Development

- 1. *Planning applications that accord with the policies in the Development Plan for Wokingham Borough will be approved without delay, unless material considerations indicate otherwise.*
- 2. *Where there are no policies relevant to the application or relevant policies are out of date at the time of making the decision then the Council will grant permission unless material considerations indicate otherwise – taking into account whether:*
 - a. *Any adverse impacts of planning permission would significantly and demonstrably outweigh the benefits, when assessed against the policies in the National Planning Policy Framework (NPPF) taken as a whole; or*
 - b. *Specific policies in the National Planning Policy Framework indicate that development should be restricted.*

Policy CC04: Sustainable Design and Construction

Planning permission will only be granted for proposals that seek to deliver high quality sustainably designed and constructed developments by:

- 1. *In respect of all new homes:*
 - a) *Seeking to achieve the requirements of the full Code for Sustainable Homes Level 4;**
 - b) *Meet internal potable water consumption targets of 105 litres or less per person per day (as part of the requirement to meet full Code for Sustainable Homes Level 4).*

Policy CC05: Renewable energy and decentralised energy networks

- 1. *Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged*
- 2. *Planning permission will only be granted for proposals that deliver a minimum 10% reduction in carbon emissions through renewable energy or low carbon technology where the development is for:*
 - a) *Schemes of more than 10 dwellings (gross), or*
 - b) *Non-residential proposals of more than 1,000 sq m gross floorspace.*

3. *Proposals for renewable energy and decentralised energy works, including wind turbines, must demonstrate that:*
- a) They are appropriate in scale, location and technology type;*
 - b) Are compatible with the surrounding area, including the impact of noise and odour;*
 - c) Do not have a damaging impact on the local topography and landscape;*
 - d) There is no significant impact upon heritage assets, including views important to their setting;*
 - e) In the case of wind turbines, take account of their cumulative effect and properly reflect their increasing impact on the landscape and on local amenity.*

Sustainable Design and Construction SPD, 28th May 2010 and Companion Document to the Sustainable Design and Construction Supplementary Planning Document, 28th May 2010.

These documents have been used to inform this Sustainability and Energy Statement.

3.0 Assessment Methodology

The carbon dioxide emissions from the houses have been established using agreed building specifications and the detailed drawings for the development.

SAP calculations have been prepared for representative houses, the results from which have been aggregated across similar unit types in order to estimate the total emissions from the site.

Emission Factors

The CO₂ emission factors, where applicable, used throughout this report have been taken from the Building Regulation Approved Document L - 2021.

	kg CO ₂ /kWh
Grid supplied and displaced electricity	0.136
Mains gas	0.210

4.0 Proposal

The energy strategy within this Statement has been based on the following accommodation schedule.

Unit Type	Number	Area	Total Area
		m ²	m ²
2-Bedroom Terrace houses	5	84.4	422.0
3-Bedroom Detached house	1	109.5	109.5
3-Bedroom Terrace houses	4	123.3	493.2
3-Bedroom Detached houses	5	140.2	701.0
4-Bedroom Detached house	6	170.3	1,021.8
4-Bedroom Detached house	5	178.9	894.5
	26		3,642.0

5.0 Energy Efficiency

5.1 Demand Reduction (Be Lean and Be Clean)

Design

The energy performance of a building is affected by its design, construction and use and whilst occupant behaviour is beyond the remit of this statement, better design and construction methods can significantly reduce the life cycle emissions of a building and assist the occupant to reduce consumption.

Sustainable design is not just about incorporating renewable technologies; buildings should be designed at the outset to provide suitable environmental conditions for the occupants whilst also consuming as little energy as practical.

Passive Solar Gain

Passive measures include allowing for natural ventilation and exposed thermal mass coupled with high levels of insulation, air tightness and the control of solar gain.

The Site Plan shows all houses are positioned generally with either a north and south orientation or a west and east orientation. This maximises the benefit from solar gain and there are no homes with a solely northerly outlook.

All homes have access to direct sunlight at some point throughout the day.

Natural Daylighting

The orientation and the size of the windows have been optimised to maximise the amount of natural daylight and therefore reduce the demand for artificial lighting.

Efficient Building Fabric

Building Envelope

U-values of the building envelope must meet Building Regulations Part L (2021) standards and further improvements to U-values will reduce the home's heating requirements.

Ground floors will be insulated with 150mm 'Quinn Therm' PIR insulation or similar.

The modelling has been based upon the use of traditional load-bearing construction with external walls built with 102mm facing brickwork, 150mm fully filled cavities using Dritherm 32 insulation (or similar) and 100mm medium density blockwork internally.

Roofs (lofts) will be insulated with 450mm of mineral wool insulation comprising 150mm between joists and 300mm over.

Windows are proposed as double glazed with Low 'e' soft coat and argon filled.

It is proposed to set maximum limits for the elemental U-values as follows:

Element	Part L Limiting U-values	Proposed U-values	Proposed Improvement
	W/m ² K	W/m ² K	
Ground Floors	0.18	0.13	28%
External Walls	0.26	0.18	31%
Party Walls	0.20	0.00	100%
Roofs	0.16	0.10	38%
Windows	1.60	1.20	25%
External Doors	1.60	1.20	38%

Air Leakage

Large amounts of heat are lost in winter through air leakage from a building (also referred to as infiltration or air permeability) often through poor sealing of joints and openings in the building

The Building Regulations set a minimum standard for air permeability of 8 m³ of air per hour per m² of envelope area, at 50Pa. The homes will target a 38% improvement over Building Regulations and will seek to achieve a permeability of 5.0 m³/hr/m² or better.

Thermal Bridging

The significance of Thermal Bridging, as a potentially major source of fabric heat losses, is increasingly understood. Improving the U-values for the main building fabric without accurately addressing the Thermal Bridging is no longer an option and will not achieve the fabric energy efficiency and energy and CO₂ reduction targets set out in this strategy.

The thermal details for the buildings will be modelled at the detailed working drawing stage but for the purposes of this assessment the thermal details formulated by the Concrete Block Association have been used.

These will enable the buildings to achieve the higher energy efficiency requirements of the Building Regulations.

The bridging losses have been based upon the following values;

Reference	Location	PSI Value
		W/mK
E2	Other Lintels (including other steel lintels)	0.058
E3	Sill	0.036
E4	Jamb	0.023
E5	Ground Floor (Normal)	0.165
E6	Intermediate Floor in a Dwelling	0.002
E10	Eaves (Ceiling)	0.053
E12	Gable (Ceiling)	0.217
E14	Flat Roof	0.041
E16	Corner (normal)	0.041
E17	Corner (inverted)	-0.062
E18	Party Wall	0.037
E20	Exposed Floor	0.204

Ventilation

As a result of increasing thermal efficiency and air tightness, Building Regulations Approved Document F was also revised in 2021 to address the possibility of overheating and poor air quality. The ventilation to Cloakrooms, En-Suites and Bathrooms will be comprised of continuous extract ventilation as per System 3 criteria. This reduces the number of external penetrations required to the building envelope.

Active Design Measures will include;

Efficient Lighting and Controls

Throughout the scheme natural lighting will be optimised.

Part L of the Building Regulations requires all light fitting to have lamps with a minimum luminous efficacy of 80 light source lumens per circuit-watt.

Space Heating and Hot Water

The baseline SAP modelling has been based upon the use of a Vaillant gas boiler installed to each unit but the proposed specification is based upon the installation of Vaillant aroTHERM air source heat pumps installed to each house.

5.2 Establishing Baseline Carbon Dioxide Emissions - GAS

SAP calculations have been prepared for a 2-bedroom End-terrace house at 84.4 m², which are proposed as representative of all units of this floor area.

SAP calculations have been prepared for a 3-bedroom End-terrace house at 123.3 m², which are proposed as representative of all houses of this floor area.

SAP calculations have been prepared for a 3-bedroom detached house at 140.2 m², which are proposed as representative of all the detached houses of this floor area.

There is a single detached house at 109.5 m² and for the purposes of this assessment the emissions are assumed to be at a similar rate to the detached house at 140.2 m².

SAP calculations have been prepared for a 4-bedroom detached house at 178.9 m², which are proposed as representative of all the detached houses 170.3 m² and 178.9 m².

The DER Worksheets are attached as Appendix 1 but the emissions can be summarised as follows:

2-Bedroom End-terrace house – 84.4 m ²	CO ₂ DER
	kg/m ² /yr
Space heating	8.02
Water heating	5.92
Electricity for pumps, fans & lighting	0.33
Total	14.27

3-Bedroom End-terrace house – 123.3 m ²	CO ₂ DER
	kg/m ² /yr
Space heating	9.32
Water heating	4.35
Electricity for pumps, fans & lighting	0.27
Total	13.94

3-Bedroom Detached house – 140.2 m ²	CO ₂ DER
	kg/m ² /yr
Space heating	9.81
Water heating	3.92
Electricity for pumps, fans & lighting	0.24
Total	13.97

4-Bedroom Detached house – 178.9 m ²	CO ₂ DER
	kg/m ² /yr
Space heating	9.99
Water heating	3.10
Electricity for pumps, fans & lighting	0.21
Total	13.30

Using the above results, the total site CO₂ emissions from the site for the baseline scenario (GAS) can be calculated as follows;

	Area	CO ₂ DER
	m ²	kg/yr
2-Bedroom Terrace houses	422.0	6,022
3-Bedroom Terrace houses	493.2	6,875
3-Bedroom Detached houses	810.5	11,323
4-Bedroom Detached houses	1,916.3	25,487
Total	3,642.0	49,707

The baseline emissions from the site based on the installation of gas heating system to all units is calculated as **49,707 kg CO₂ per year**.

5.3 Low-Carbon and Renewable Technologies (Be Clean and Be Green)

The carbon dioxide emissions established above have been used to test the viability of various renewable and low carbon technologies as follows. This section determines the appropriateness of each renewable technology.

The Government's Renewable Obligation defines renewable energy in the UK. The identified technologies are;

- Small hydro-electric
- Landfill and sewage gas
- Onshore and offshore wind
- Biomass
- Tidal and wave power
- Geothermal power
- Solar

The use of landfill or sewage gas, offshore wind or any form of hydroelectric power is not suitable for the site due to its location. The remaining technologies are considered below;

Wind

Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall-mounted units for individual dwellings.

The Government wind speed database predicts local wind speeds at Nine Mile Ride to be 4.7 m/s at 10m above ground level and 5.5 m/s at 25m above ground level. This is below the level generally required for commercial investment in large wind turbines. In addition the land take, potential for noise and signal interference make a large wind turbine unsuitable for this development.

Roof mounted turbines could be used at the development to generate small but valuable amounts of renewable electricity but the small output and contribution to total emissions means any investment would be small and purely tokenism. In addition the use of wind turbines will have a detrimental aesthetic impact on the appearance of the development.

Combined Heat and Power and Community Heating

Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for use in buildings. The plant is essentially a small-scale electrical power station.

The production and transportation of electricity via the National Grid is very inefficient with over 65% of the energy produced at the power station being lost to the atmosphere and through transportation.

CHP units are generally gas fuelled and generate electricity with heat being a by-product. The heat is usually used to meet the hot water load, which is fairly consistent throughout the year.

Historically CO₂ savings have been achieved because gas has been used to generate electricity and gas has had a lower emissions factor than electricity. However, with the de-carbonisation of the electricity grid the benefit of CHP is negated.

CHP is not proposed.

Ground Source Heat Pumps

Sub soil temperatures are reasonably constant and predictable in the UK, providing a store of the sun's energy throughout the year. Below London the groundwater in the lower London aquifer is at a fairly constant temperature of 12° C. Ground source heat pumps (GSHP) extract this low-grade heat and convert it to usable heat for space heating.

GSHP operates on a similar principle to refrigerators, transferring heat from a cool place to a warmer place. They operate most efficiently when providing space heating at a low temperature, typically via under floor heating or with low temperature radiators.

Whilst the houses are set in private garden areas it is unlikely there will be sufficient external ground area to sustain a horizontal collection system and the installation of ground source heat pumps is likely to require the use of a bore hole collection system to each house.

The use of ground source heat pumps with bore-hole collection systems to the houses is feasible but would be an expensive option when compared with some other technologies.

Ground source heat pumps are not proposed.

Solar

(i) Solar Water Heating

Solar hot water panels use the sun's energy to directly heat water circulating through panels or pipes. The technology is simple and easily understood by purchasers.

Solar hot water heating panels are based generally around two types, which are available being 'flat plate collectors' and 'evacuated tubes'. Flat plate collectors can achieve an output of up to 1,124 kWh/annum (Schuco) and evacuated tubes can achieve outputs up to 1,365 kWh/annum (Riomay).

It is assumed solar panels could reduce the energy demand of the hot water requirements by 50%.

Assuming panels could be installed to all units the total reduction in emissions would be **6,881 kg CO₂ per year**, which equates to a reduction in total (DER) emissions of **13.84%**.

Whilst the installation of solar hot water heating panels would meet the requirements of the planning policy it is unlikely, they would allow the houses to achieve Building Regulation compliance using gas heating systems.

Solar hot water heating panels are not proposed.

(ii) Photovoltaics

Photovoltaic panels (PV) provide clean silent electricity. They generate electricity during most daylight conditions although they are most efficient when exposed to direct sunlight or are orientated to face plus or minus 30 degrees of due south.

PV panels can be integrated into many different aspects of a development including roofs, walls, shading devices or architectural panels. The panels typically have an electrical warranty of 20-25 years and an expected system lifespan of 25-40 years.

Whilst the installation of photovoltaic panels to the dwellings is feasible, it is calculated that a total of **106 x 400W** panels would be required to reduce emissions by the 10% required by the planning policy.

Photovoltaic panels are not proposed.

Air Source Heat Pumps (ASHP)

Air sourced heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps, however the initial heat energy is extracted from the external air rather than the ground. These heat pumps can be reversed to provide cooling to an area although this reduces the coefficient of performance of the pumps.

A further set of SAP calculations have been prepared for the units modelled above but with the benefit of an air source heat pump installed to each house. The DER Worksheets for the proposed specification are attached as Appendix 2 but the emissions can be summarised as follows:

2-Bedroom End-terrace house – 84.4 m ²	CO ₂ DER
	kg/m ² /yr
Space heating	1.62
Water heating	1.47
Electricity for pumps, fans & lighting	0.21
Total	3.30

3-Bedroom End-terrace house – 123.3 m ²	CO ₂ DER
	kg/m ² /yr
Space heating	1.64
Water heating	0.98
Electricity for pumps, fans & lighting	0.19
Total	2.81

3-Bedroom Detached house – 140.2 m ²	CO ₂ DER
	kg/m ² /yr
Space heating	1.48
Water heating	1.44
Electricity for pumps, fans & lighting	0.17
Total	3.09

4-Bedroom Detached house – 178.9 m ²	CO ₂ DER
	kg/m ² /yr
Space heating	1.56
Water heating	1.14
Electricity for pumps, fans & lighting	0.15
Total	2.85

Using the above results, the total site CO₂ emissions from the site for the proposed specification (HEAT PUMPS) can be calculated as follows;

	Area	CO ₂ DER
	m ²	kg/yr
2-Bedroom Terrace houses	422.0	1,393
3-Bedroom Terrace houses	493.2	1,386
3-Bedroom Detached houses	810.5	2,504
4-Bedroom Detached houses	1,916.3	5,461
Total	3,642.0	10,744

The emissions from the site based on the installation of air source heat pumps to all units is calculated as **10,744 kg CO₂ per year**.

The reduction in emissions as a result of the installation of heat pumps is therefore **38,963 kg CO₂ per year**, which equates to a reduction of **78.39%**.

5.4 Summary of Calculations and Proposals for Low-carbon and Renewable Technologies

The baseline carbon emissions based on the installation of gas heating systems are assessed as **49,707 kg CO₂ per year**.

The local planning policy requires a reduction in emissions of 10% through the installation of low-carbon and/or renewable technologies.

Various technologies are considered above and whilst wind turbines, combined heat and power, ground source heat pumps, flue-gas or waste-water heat recovery units are not considered appropriate the use of solar hot water heating, photovoltaic panels and air source heat pumps are considered feasible and appropriate (albeit the use of solar hot water heating and photovoltaic panels are not proposed).

Be Lean

The construction standards proposed include U-values, which demonstrate good practice and improve upon those required by the Building Regulations. Air tightness standards are targeted at a 38% improvement upon the minimum required by the Building Regulations.

Be Clean and Be Green

Various technologies are considered above and it is proposed to install air source heat pumps into all houses.

As a result of these installations the total emissions from the site are assessed as **10,744 kg CO₂ per year**.

The reduction in emissions from the installation of renewable technologies is therefore 38,963 kg CO₂ per year, which equates to a reduction of 78.39%.

The proposal significantly exceeds the emissions reduction target required by the planning policy.

6.0 Climate change adaption and Water resources

Sustainable Drainage Systems (SUDS)

The site lies within Flood Zone 1 and is classified as being of low risk.

Surface Water Management

The houses have private gardens and discretely located rainwater butts could be provided to store rainwater for use with landscaping maintenance.

Consideration has been given to the use of grey water recycling. However, customer's resistance to the appearance of the recycled water and the cost of the systems does not currently make them a viable option. They have therefore not been included in the proposals.

Water efficiency measures

In excess of 20% of the UK's water is used domestically with over 50% of this used for flushing WCs and washing (source: Environment Agency). The majority of this comes from drinking quality standard or potable water.

The water efficiency measures included will ensure that the water use target of 105 litres per person per day is achieved. This is the standard required by the planning policy.

Water efficient devices will be fully evaluated, and installed, wherever possible. The specification of such devices will be considered at detailed design stage and each will be subject to an evaluation based on technical performance, cost and market appeal, together with compliance with the water use regulations.

The following devices will be incorporated within the homes:

- water efficient taps
- water efficient toilets
- low output showers
- flow restrictors to manage water pressures to achieve optimum levels and
- water meters

Below is a typical specification, which would achieve the 110 Litres per person per year target (including five litres per person per day allowance for external water use). This is the equivalent of the 105 litres per person per day required by the planning policy.

Schedule of Appliance Water Consumption		
Appliance	Flow rate or capacity	Total Litres
WC	6/3 litres dual flush	17.64
Basin	2.0 litres/min.	4.74
Shower	9.0 litres/min	39.33
Bath	175 litres	19.25
Sink	5.0 litres/min	12.56
Washing Machine	6.75 litres/kg	14.18
Dishwasher	1.25 litres/places	4.50
		112.20
	Normalisation Factor	0.91
Total Internal Water Consumption		102.10
External Water Use		5.00
Total Water Consumption		107.10

7.0 Materials and Waste

The BRE Green Guide to Specification is a simple guide for design professionals. The guide provides environmental impact, cost and replacement interval information for a wide range of commonly used building specifications over a notional 60-year building life. The construction specification will prioritise materials within ratings A+, A or B.

Preference will be given to the use of local materials & suppliers where viable to reduce the transport distances and to support the local economy. A full evaluation of these suppliers will be undertaken at the next stage of design.

In addition, timber would be sourced, where practical, certified by PEFC or an equivalent approved certification body and all site timber used within the construction process would be recycled.

All insulation materials to will have a zero ozone depleting potential

Construction waste

Targets will be set to promote resource efficiency in accordance with guidance from WRAP, Envirowise, BRE and DEFRA.

The overarching principle of waste management is that waste should be treated or disposed of within the region where it is produced.

Construction operations generate waste materials as a result of general handling losses and surpluses. These wastes can be reduced through appropriate selection of the construction method, good site management practices and spotting opportunities to avoid creating unnecessary waste.

The Construction Strategy will explore these issues, some of which are set out below:

- Proper handling and storage of all materials to avoid damage.
- Efficient purchasing arrangements to minimise over ordering.
- Segregation of construction waste to maximise potential for reuse/recycling.
- Suppliers who collect and reuse/recycle packaging materials

Appendix 1 – DER Worksheets for the Modelled Units based on Gas Baseline

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 10

Software Version:

Version: 1.0.0.37

Property Address: Nine Mile Ride 2BH 84 END GAS

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	42.2 (1a) x	2.4 (2a) =	101.28 (3a)
First floor	42.2 (1b) x	2.4 (2b) =	101.28 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	84.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	202.56 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ 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)
-chimneys/flues attached to closed fire	0 +	0 +	0 =	0 x 10 =	0 (6c)
-flues attached to solid fuel boiler	0 +	0 +	0 =	0 x 20 =	0 (6d)
-flues attached to other heater	0 +	0 +	0 =	0 x 35 =	0 (6e)
Number of blocked chimneys				0 x 20 =	0 (6f)
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, fans, PSVs, etc. [(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.1 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>	
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 <i>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</i>	0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0 (12)
If no draught lobby, enter 0.05, else enter 0	0 (13)
Percentage of windows and doors draught stripped	0 (14)
Window infiltration 0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>	
Number of sides sheltered	2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor (21) = (18) x (20) =	0.3 (21)

DER WorkSheet: New dwelling design stage

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35
--	------	------	------	------	------	------	------	------	-----	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)
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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			2.21	x 1.2	= 2.652		(26)
Windows Type 1			1.62	x1/[1/(1.2)+ 0.04]	= 1.85		(27)
Windows Type 2			0.71	x1/[1/(1.2)+ 0.04]	= 0.81		(27)
Windows Type 3			3.78	x1/[1/(1.2)+ 0.04]	= 4.33		(27)
Windows Type 4			0.71	x1/[1/(1.2)+ 0.04]	= 0.81		(27)
Windows Type 5			1.44	x1/[1/(1.2)+ 0.04]	= 1.65		(27)
Windows Type 6			0.82	x1/[1/(1.2)+ 0.04]	= 0.94		(27)
Windows Type 7			0.82	x1/[1/(1.2)+ 0.04]	= 0.94		(27)
Windows Type 8			1.44	x1/[1/(1.2)+ 0.04]	= 1.65		(27)
Windows Type 9			0.82	x1/[1/(1.2)+ 0.04]	= 0.94		(27)
Floor			42.2	x 0.13	= 5.486		(28)
Walls	88.85	15.08	73.77	x 0.18	= 13.28		(29)
Roof	42.2	0	42.2	x 0.1	= 4.22		(30)

DER WorkSheet: New dwelling design stage

Total area of elements, m² 173.25 (31)

Party wall 39.19 x 0 = 0 (32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 40.37 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 15025.44 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.15 (36)

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

Total fabric heat loss (33) + (36) = 53.52 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	38.2	38.01	37.83	36.98	36.82	36.07	36.07	35.94	36.36	36.82	37.14	37.48	(38)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	91.72	91.53	91.35	90.5	90.34	89.6	89.6	89.46	89.88	90.34	90.66	91	
Average = Sum(39) _{1...12} /12=												90.5	(39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.09	1.08	1.08	1.07	1.07	1.06	1.06	1.06	1.06	1.07	1.07	1.08	
Average = Sum(40) _{1...12} /12=												1.07	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.54 (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(42c)m=	42.79	41.24	39.68	38.12	36.57	35.01	35.01	36.57	38.12	39.68	41.24	42.79	

Annual average hot water usage in litres per day Vd,average (from Appendix J) 117.46 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	43.57	42.01	40.45	38.87	37.3	35.72	35.72	37.28	38.85	40.42	42.02	43.6	
Total = Sum(44) _{1...12} =												475.79	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	184.46	164.54	173.22	151.8	147.97	129.27	119.19	133.8	132.86	153.38	168.79	183.23	
Total = Sum(45) _{1...12} =												1842.51	(45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	27.67	24.68	25.98	22.77	22.2	19.39	17.88	20.07	19.93	23.01	25.32	27.48	(46)

DER WorkSheet: New dwelling design stage

Water storage loss:

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

If Heat network and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If Heat network see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) - Vs] ÷ (47), else (57)m = (56)m

where Vs is V_{ww} from Appendix G3 or (H12) from Appendix H (as applicable)

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

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

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

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

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

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

(61)m= 22.84 20.59 22.72 21.88 22.55 21.74 22.4 22.49 21.8 22.63 22.02 22.83 (61)

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

(62)m= 207.3 185.12 195.94 173.69 170.52 151 141.59 156.28 154.66 176 190.81 206.06 (62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating)

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

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m= (63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m= 207.3 185.12 195.94 173.69 170.52 151 141.59 156.28 154.66 176 190.81 206.06 Output from water heater (annual)_{1...12} 2108.98 (64)

if (64)m < 0 then set to 0

Energy 0 0 0 0 0 0 0 0 0 0 0 0 (64a)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 x (45)m + (46)m + 0.8 x ((46)m - (57)m - (59)m)] 0 (64a)

(65)m= 67.04 59.85 63.28 55.95 54.84 48.42 45.23 50.11 49.63 56.66 61.63 66.63 (65)

DER WorkSheet: New dwelling design stage

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

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=	127.05	127.05	127.05	127.05	127.05	127.05	127.05	127.05	127.05	127.05	127.05	127.05	(66)

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

(67)m=	7.35	6.53	5.31	4.02	3.01	2.54	2.74	3.56	4.78	6.08	7.09	7.56	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	228.39	230.76	224.79	212.07	196.02	180.94	170.86	168.49	174.47	187.18	203.23	218.31	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	(71)
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Water heating gains (Table 5)

(72)m=	90.11	89.07	85.05	77.7	73.71	67.24	60.8	67.35	68.93	76.15	85.59	89.56	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	389.97	390.48	379.27	357.91	336.85	314.84	298.52	303.52	312.29	333.52	360.03	379.55	(73)
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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 m ²		Flux Table 6a		g_ Table 6b		FF Table 6c	=	Gains (W)		
North	0.9x	0.77	x	1.62	x	10.63	x	0.63	x	0.7	=	5.26	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68	(74)
North	0.9x	0.77	x	0.82	x	10.63	x	0.63	x	0.7	=	2.66	(74)
North	0.9x	0.77	x	1.62	x	20.32	x	0.63	x	0.7	=	10.06	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94	(74)
North	0.9x	0.77	x	0.82	x	20.32	x	0.63	x	0.7	=	5.09	(74)
North	0.9x	0.77	x	1.62	x	34.53	x	0.63	x	0.7	=	17.1	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	0.82	x	34.53	x	0.63	x	0.7	=	8.65	(74)
North	0.9x	0.77	x	1.62	x	55.46	x	0.63	x	0.7	=	27.46	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	0.82	x	55.46	x	0.63	x	0.7	=	13.9	(74)
North	0.9x	0.77	x	1.62	x	74.72	x	0.63	x	0.7	=	36.99	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	0.82	x	74.72	x	0.63	x	0.7	=	18.72	(74)
North	0.9x	0.77	x	1.62	x	79.99	x	0.63	x	0.7	=	39.6	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	0.82	x	79.99	x	0.63	x	0.7	=	20.04	(74)
North	0.9x	0.77	x	1.62	x	74.68	x	0.63	x	0.7	=	36.97	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	0.82	x	74.68	x	0.63	x	0.7	=	18.71	(74)
North	0.9x	0.77	x	1.62	x	59.25	x	0.63	x	0.7	=	29.33	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	0.82	x	59.25	x	0.63	x	0.7	=	14.85	(74)
North	0.9x	0.77	x	1.62	x	41.52	x	0.63	x	0.7	=	20.55	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	0.82	x	41.52	x	0.63	x	0.7	=	10.4	(74)
North	0.9x	0.77	x	1.62	x	24.19	x	0.63	x	0.7	=	11.98	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	0.82	x	24.19	x	0.63	x	0.7	=	6.06	(74)
North	0.9x	0.77	x	1.62	x	13.12	x	0.63	x	0.7	=	6.49	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	0.82	x	13.12	x	0.63	x	0.7	=	3.29	(74)
North	0.9x	0.77	x	1.62	x	8.86	x	0.63	x	0.7	=	4.39	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	0.82	x	8.86	x	0.63	x	0.7	=	2.22	(74)
East	0.9x	0.77	x	0.71	x	19.64	x	0.63	x	0.7	=	8.52	(76)
East	0.9x		x		x		x		x		=		(76)
East	0.9x	0.77	x	0.71	x	38.42	x	0.63	x	0.7	=	16.67	(76)
East	0.9x	0.77	x	0.82	x	38.42	x	0.63	x	0.7	=	9.63	(76)
East	0.9x	0.77	x	0.71	x	63.27	x	0.63	x	0.7	=	27.46	(76)
East	0.9x	0.77	x	0.82	x	63.27	x	0.63	x	0.7	=	15.86	(76)
East	0.9x	0.77	x	0.71	x	92.28	x	0.63	x	0.7	=	40.05	(76)
East	0.9x	0.77	x	0.82	x	92.28	x	0.63	x	0.7	=	23.13	(76)
East	0.9x	0.77	x	0.71	x	113.09	x	0.63	x	0.7	=	49.08	(76)
East	0.9x	0.77	x	0.82	x	113.09	x	0.63	x	0.7	=	28.34	(76)
East	0.9x	0.77	x	0.71	x	115.77	x	0.63	x	0.7	=	50.24	(76)
East	0.9x	0.77	x	0.82	x	115.77	x	0.63	x	0.7	=	29.01	(76)
East	0.9x	0.77	x	0.71	x	110.22	x	0.63	x	0.7	=	47.83	(76)
East	0.9x	0.77	x	0.82	x	110.22	x	0.63	x	0.7	=	27.62	(76)
East	0.9x	0.77	x	0.71	x	94.68	x	0.63	x	0.7	=	41.09	(76)
East	0.9x	0.77	x	0.82	x	94.68	x	0.63	x	0.7	=	23.73	(76)
East	0.9x	0.77	x	0.71	x	73.59	x	0.63	x	0.7	=	31.94	(76)
East	0.9x	0.77	x	0.82	x	73.59	x	0.63	x	0.7	=	18.44	(76)
East	0.9x	0.77	x	0.71	x	45.59	x	0.63	x	0.7	=	19.78	(76)
East	0.9x	0.77	x	0.82	x	45.59	x	0.63	x	0.7	=	11.42	(76)
East	0.9x	0.77	x	0.71	x	24.49	x	0.63	x	0.7	=	10.63	(76)
East	0.9x	0.77	x	0.82	x	24.49	x	0.63	x	0.7	=	6.14	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	0.71	x	16.15	x	0.63	x	0.7	=	7.01	(76)
East	0.9x	0.77	x	0.82	x	16.15	x	0.63	x	0.7	=	4.05	(76)
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	0.71	x	46.75	x	0.63	x	0.7	=	10.14	(78)
South	0.9x	0.77	x	0.82	x	46.75	x	0.63	x	0.7	=	11.72	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	0.71	x	76.57	x	0.63	x	0.7	=	16.61	(78)
South	0.9x	0.77	x	0.82	x	76.57	x	0.63	x	0.7	=	19.19	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	0.71	x	97.53	x	0.63	x	0.7	=	21.16	(78)
South	0.9x	0.77	x	0.82	x	97.53	x	0.63	x	0.7	=	24.44	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	0.71	x	110.23	x	0.63	x	0.7	=	23.92	(78)
South	0.9x	0.77	x	0.82	x	110.23	x	0.63	x	0.7	=	27.63	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	0.71	x	114.87	x	0.63	x	0.7	=	24.93	(78)
South	0.9x		x		x		x		x		=		(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	0.71	x	110.55	x	0.63	x	0.7	=	23.99	(78)
South	0.9x	0.77	x	0.82	x	110.55	x	0.63	x	0.7	=	27.7	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	0.71	x	108.01	x	0.63	x	0.7	=	23.44	(78)
South	0.9x	0.77	x	0.82	x	108.01	x	0.63	x	0.7	=	27.07	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	0.71	x	104.89	x	0.63	x	0.7	=	22.76	(78)
South	0.9x	0.77	x	0.82	x	104.89	x	0.63	x	0.7	=	26.29	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	0.71	x	101.89	x	0.63	x	0.7	=	22.11	(78)
South	0.9x	0.77	x	0.82	x	101.89	x	0.63	x	0.7	=	25.53	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	0.71	x	82.59	x	0.63	x	0.7	=	17.92	(78)
South	0.9x	0.77	x	0.82	x	82.59	x	0.63	x	0.7	=	20.7	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	0.71	x	55.42	x	0.63	x	0.7	=	12.02	(78)
South	0.9x	0.77	x	0.82	x	55.42	x	0.63	x	0.7	=	13.89	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	0.71	x	40.4	x	0.63	x	0.7	=	8.77	(78)
South	0.9x	0.77	x	0.82	x	40.4	x	0.63	x	0.7	=	10.12	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	122.5	208.35	285.46	356.34	402.98	402.15	386.82	351.45	309.79	230.26	146.64	104.9	(83)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	512.47	598.83	664.73	714.26	739.84	716.98	685.34	654.97	622.08	563.78	506.67	484.45	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.89	0.74	0.56	0.61	0.84	0.97	1	1	(86)

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

(87)m=	19.69	19.87	20.14	20.47	20.77	20.94	20.99	20.98	20.87	20.5	20.03	19.66	(87)
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(88)m=	20.01	20.01	20.02	20.02	20.03	20.03	20.03	20.03	20.03	20.03	20.02	20.02	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.95	0.85	0.65	0.45	0.49	0.77	0.96	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.48	18.71	19.06	19.48	19.82	20	20.03	20.03	19.94	19.51	18.92	18.44	(90)
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fLA = Living area ÷ (4) =

0.13 (91)

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

(92)m=	18.63	18.86	19.19	19.6	19.94	20.12	20.15	20.15	20.06	19.64	19.06	18.59	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.63	18.86	19.19	19.6	19.94	20.12	20.15	20.15	20.06	19.64	19.06	18.59	(93)
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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.94	0.84	0.66	0.46	0.5	0.77	0.95	0.99	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	510.26	592.91	649.19	670.79	624.72	471.12	315.18	330.67	481.04	536.88	501.87	482.87	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m]

(97)m=	1314.37	1277.64	1159.39	968.59	744.27	494.16	317.98	335.23	535.55	816.22	1084.04	1309.71	(97)
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DER WorkSheet: New dwelling design stage

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(97a)m=	598.25	460.14	379.58	214.42	88.94	0	0	0	0	207.83	419.16	615.17	
Total per year (kWh/year) = Sum(97a) _{1...5,9...12} =													2983.49 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total per year (kWh/year) = Sum(97b) _{1...5,9...12} =													0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	598.25	460.14	379.58	214.42	88.94	0	0	0	0	207.83	419.16	615.17	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =													2983.49 (98)

Space heating requirement in kWh/m ² /year	35.35 (99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0 (201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1 (202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1 (204)
Efficiency of main space heating system 1		92.6 (206)
Efficiency of secondary/supplementary heating system, %		0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

598.25	460.14	379.58	214.42	88.94	0	0	0	0	207.83	419.16	615.17	
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(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

646.06	496.91	409.92	231.55	96.05	0	0	0	0	224.44	452.65	664.33		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												3221.92	(211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(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)

207.3	185.12	195.94	173.69	170.52	151	141.59	156.28	154.66	176	190.81	206.06	
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Efficiency of water heater 87.3 (216)

(217)m=	89.44	89.35	89.19	88.88	88.27	87.3	87.3	87.3	87.3	88.85	89.27	89.45	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=	231.79	207.19	219.69	195.42	193.17	172.97	162.19	179.02	177.16	198.1	213.74	230.35	
Total = Sum(219a) _{1...12} =													2380.79 (219)

Annual totals

Space heating fuel used, main system 1 kWh/year kWh/year 3221.92

Water heating fuel used kWh/year 2380.79

Electricity for pumps, fans and electric keep-hot

central heating pump: 30 (230c)

DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
Electricity for lighting		129.88	(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	0.21	= 676.6 (261)
Space heating (secondary)	(215) x	0.136	= 0 (263)
Water heating	(219) x	0.21	= 499.97 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1176.57 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	= 10.2 (267)
Electricity for lighting	(232) x	0.136	= 17.66 (268)
Total CO2, kg/year		sum of (265)...(271) =	1204.43 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	14.27 (273)
El rating (section 14)			88 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Software Name: Stroma FSAP 10

Stroma Number:

Software Version:

Version: 1.0.0.37

Property Address: Nine Mile Ride 3BH 123 END GAS

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	49.62 (1a)	x	2.4 (2a)	=	119.09 (3a)
First floor	73.68 (1b)	x	2.4 (2b)	=	176.83 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	123.3 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	295.92 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m ³ 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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0 (6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0 (6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0 (6e)
Number of blocked chimneys							0	x 20 =	0 (6f)
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, fans, PSVs, etc. [(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.1 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>	
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 <i>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</i>	0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0 (12)
If no draught lobby, enter 0.05, else enter 0	0 (13)
Percentage of windows and doors draught stripped	0 (14)
Window infiltration 0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>	
Number of sides sheltered	2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor (21) = (18) x (20) =	0.3 (21)

DER WorkSheet: New dwelling design stage

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35
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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)
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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)
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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)
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(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)
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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			2.21	x 1.2	= 2.652		(26)
Windows Type 1			1.62	x1/[1/(1.2)+ 0.04]	= 1.85		(27)
Windows Type 2			0.92	x1/[1/(1.2)+ 0.04]	= 1.05		(27)
Windows Type 3			0.71	x1/[1/(1.2)+ 0.04]	= 0.81		(27)
Windows Type 4			3.78	x1/[1/(1.2)+ 0.04]	= 4.33		(27)
Windows Type 5			1.44	x1/[1/(1.2)+ 0.04]	= 1.65		(27)
Windows Type 6			1.44	x1/[1/(1.2)+ 0.04]	= 1.65		(27)
Windows Type 7			1.44	x1/[1/(1.2)+ 0.04]	= 1.65		(27)
Windows Type 8			0.71	x1/[1/(1.2)+ 0.04]	= 0.81		(27)
Windows Type 9			0.82	x1/[1/(1.2)+ 0.04]	= 0.94		(27)
Floor Type 1			49.62	x 0.13	= 6.4506		(28)
Floor Type 2			24.06	x 0.15	= 3.609		(28)
Walls	124.29	18.68	105.61	x 0.18	= 19.01		(29)

DER WorkSheet: New dwelling design stage

Roof	73.68	0	73.68	x	0.1	=	7.37			(30)
Total area of elements, m ²			271.65							(31)
Party wall			46.18	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U)	(26)...(30) + (32) =	57.95	(33)
Heat capacity Cm = S(A x k)	((28)...(30) + (32) + (32a)...(32e) =	19513.86	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		18.75	(36)
---	--	-------	------

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

Total fabric heat loss	(33) + (36) =	76.7	(37)
Ventilation heat loss calculated monthly	(38)m = 0.33 x (25)m x (5)		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	55.91	55.63	55.36	54.1	53.86	52.76	52.76	52.55	53.18	53.86	54.34	54.84	(38)

Heat transfer coefficient, W/K											(39)m = (37) + (38)m		
(39)m=	132.61	132.33	132.06	130.8	130.56	129.46	129.46	129.25	129.88	130.56	131.04	131.54	
Average = Sum(39) _{1...12} /12=												130.8	(39)

Heat loss parameter (HLP), W/m²K											(40)m = (39)m ÷ (4)		
(40)m=	1.08	1.07	1.07	1.06	1.06	1.05	1.05	1.05	1.05	1.06	1.06	1.07	
Average = Sum(40) _{1...12} /12=												1.06	(40)

Number of days in month (Table 1a)													
(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	2.88	(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		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)													
(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)													
(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)													
(42c)m=	46.39	44.71	43.02	41.33	39.65	37.96	37.96	39.65	41.33	43.02	44.71	46.39	

Annual average hot water usage in litres per day Vd,average (from Appendix J)	127.35	(43)
---	--------	------

Hot water usage in litres per day for each month $V_{d,m} = (42a) + (42b) + (42c)$														
(44)m=	47.17	45.48	43.79	42.07	40.37	38.67	38.66	40.36	42.05	43.76	45.49	47.2		
Total = Sum(44) _{1...12} =													515.08	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)													
(45)m=	199.99	178.39	187.8	164.58	160.43	140.15	129.23	145.06	144.05	166.29	183	198.65	
Total = Sum(45) _{1...12} =												1997.61	(45)

DER WorkSheet: New dwelling design stage

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

(46)m=

30	26.76	28.17	24.69	24.06	21.02	19.38	21.76	21.61	24.94	27.45	29.8
----	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

 (46)

Water storage loss:

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

0

 (47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

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

0

 (48)

Temperature factor from Table 2b

0

 (49)

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

0

 (50)

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

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

0

 (51)

If Heat network see section 4.3

Volume factor from Table 2a

0

 (52)

Temperature factor from Table 2b

0

 (53)

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

0

 (54)

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

0

 (55)

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

(56)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) - Vs] ÷ (47), else (57)m = (56)m

where Vs is V_{ww} from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (57)

Primary circuit loss (annual) from Table 3

0

 (58)

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

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

(59)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (59)

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

(61)m=

23	20.72	22.86	22	22.66	21.83	22.49	22.59	21.9	22.75	22.16	22.99
----	-------	-------	----	-------	-------	-------	-------	------	-------	-------	-------

 (61)

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

(62)m=

222.99	199.11	210.66	186.58	183.09	161.98	151.71	167.64	165.95	189.04	205.16	221.64
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating)

(63a)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=

--	--	--	--	--	--	--	--	--	--	--	--

 (63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63c)

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

(63b)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63b)

Output from water heater

(64)m=

222.99	199.11	210.66	186.58	183.09	161.98	151.71	167.64	165.95	189.04	205.16	221.64
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Output from water heater (annual) _{1...12}	2265.55
---	---------

 (64)

if (64)m < 0 then set to 0

DER WorkSheet: New dwelling design stage

Energy	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$ 0 (64a)

(65)m= 72.25 64.49 68.16 60.22 59.01 52.06 48.59 53.88 53.37 60.98 66.39 71.8 (65)

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

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=	143.76	143.76	143.76	143.76	143.76	143.76	143.76	143.76	143.76	143.76	143.76	143.76	(66)

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

(67)m=	9.61	8.54	6.95	5.26	3.93	3.32	3.59	4.66	6.26	7.94	9.27	9.88	(67)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(68)m=	289.45	292.45	284.88	268.77	248.43	229.31	216.54	213.54	221.11	237.22	257.56	276.68	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	(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=	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	(71)
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

(72)m=	97.1	95.97	91.61	83.64	79.31	72.3	65.31	72.42	74.13	81.96	92.21	96.5	(72)
--------	------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	------	------

Total internal gains =

(73)m=	465.3	466.09	452.57	426.8	400.8	374.06	354.56	359.74	370.62	396.25	428.16	452.19	(73)
--------	-------	--------	--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	1.62	x	19.64	x	0.63	x	0.7	=	9.72	(76)
East	0.9x	0.77	x	0.92	x	19.64	x	0.63	x	0.7	=	5.52	(76)
East	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	17.29	(76)
East	0.9x	0.77	x	0.71	x	19.64	x	0.63	x	0.7	=	4.26	(76)
East	0.9x	0.77	x	0.82	x	19.64	x	0.63	x	0.7	=	4.92	(76)
East	0.9x	0.77	x	1.62	x	38.42	x	0.63	x	0.7	=	19.02	(76)
East	0.9x	0.77	x	0.92	x	38.42	x	0.63	x	0.7	=	10.8	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	33.82	(76)
East	0.9x	0.77	x	0.71	x	38.42	x	0.63	x	0.7	=	8.34	(76)
East	0.9x	0.77	x	0.82	x	38.42	x	0.63	x	0.7	=	9.63	(76)
East	0.9x	0.77	x	1.62	x	63.27	x	0.63	x	0.7	=	31.33	(76)
East	0.9x	0.77	x	0.92	x	63.27	x	0.63	x	0.7	=	17.79	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	55.69	(76)
East	0.9x	0.77	x	0.71	x	63.27	x	0.63	x	0.7	=	13.73	(76)
East	0.9x	0.77	x	0.82	x	63.27	x	0.63	x	0.7	=	15.86	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	1.62	x	92.28	x	0.63	x	0.7	=	45.69	(76)
East	0.9x	0.77	x	0.92	x	92.28	x	0.63	x	0.7	=	25.95	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	81.22	(76)
East	0.9x	0.77	x	0.71	x	92.28	x	0.63	x	0.7	=	20.02	(76)
East	0.9x	0.77	x	0.82	x	92.28	x	0.63	x	0.7	=	23.13	(76)
East	0.9x	0.77	x	1.62	x	113.09	x	0.63	x	0.7	=	55.99	(76)
East	0.9x	0.77	x	0.92	x	113.09	x	0.63	x	0.7	=	31.8	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	99.54	(76)
East	0.9x	0.77	x	0.71	x	113.09	x	0.63	x	0.7	=	24.54	(76)
East	0.9x	0.77	x	0.82	x	113.09	x	0.63	x	0.7	=	28.34	(76)
East	0.9x	0.77	x	1.62	x	115.77	x	0.63	x	0.7	=	57.32	(76)
East	0.9x	0.77	x	0.92	x	115.77	x	0.63	x	0.7	=	32.55	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	101.9	(76)
East	0.9x	0.77	x	0.71	x	115.77	x	0.63	x	0.7	=	25.12	(76)
East	0.9x	0.77	x	0.82	x	115.77	x	0.63	x	0.7	=	29.01	(76)
East	0.9x	0.77	x	1.62	x	110.22	x	0.63	x	0.7	=	54.57	(76)
East	0.9x	0.77	x	0.92	x	110.22	x	0.63	x	0.7	=	30.99	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	97.01	(76)
East	0.9x	0.77	x	0.71	x	110.22	x	0.63	x	0.7	=	23.92	(76)
East	0.9x	0.77	x	0.82	x	110.22	x	0.63	x	0.7	=	27.62	(76)
East	0.9x		x		x		x		x		=		(76)
East	0.9x	0.77	x	0.92	x	94.68	x	0.63	x	0.7	=	26.62	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	83.33	(76)
East	0.9x	0.77	x	0.71	x	94.68	x	0.63	x	0.7	=	20.54	(76)
East	0.9x	0.77	x	0.82	x	94.68	x	0.63	x	0.7	=	23.73	(76)
East	0.9x	0.77	x	1.62	x	73.59	x	0.63	x	0.7	=	36.43	(76)
East	0.9x	0.77	x	0.92	x	73.59	x	0.63	x	0.7	=	20.69	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	64.77	(76)
East	0.9x	0.77	x	0.71	x	73.59	x	0.63	x	0.7	=	15.97	(76)
East	0.9x	0.77	x	0.82	x	73.59	x	0.63	x	0.7	=	18.44	(76)
East	0.9x	0.77	x	1.62	x	45.59	x	0.63	x	0.7	=	22.57	(76)
East	0.9x	0.77	x	0.92	x	45.59	x	0.63	x	0.7	=	12.82	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	40.13	(76)
East	0.9x	0.77	x	0.71	x	45.59	x	0.63	x	0.7	=	9.89	(76)
East	0.9x	0.77	x	0.82	x	45.59	x	0.63	x	0.7	=	11.42	(76)
East	0.9x	0.77	x	1.62	x	24.49	x	0.63	x	0.7	=	12.12	(76)
East	0.9x	0.77	x	0.92	x	24.49	x	0.63	x	0.7	=	6.89	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	21.55	(76)
East	0.9x	0.77	x	0.71	x	24.49	x	0.63	x	0.7	=	5.31	(76)
East	0.9x	0.77	x	0.82	x	24.49	x	0.63	x	0.7	=	6.14	(76)
East	0.9x	0.77	x	1.62	x	16.15	x	0.63	x	0.7	=	8	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	0.92	x	16.15	x	0.63	x	0.7	=	4.54	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	14.22	(76)
East	0.9x	0.77	x	0.71	x	16.15	x	0.63	x	0.7	=	3.5	(76)
East	0.9x	0.77	x	0.82	x	16.15	x	0.63	x	0.7	=	4.05	(76)
West	0.9x	0.77	x	0.71	x	19.64	x	0.63	x	0.7	=	8.52	(80)
West	0.9x	0.77	x	3.78	x	19.64	x	0.63	x	0.7	=	22.69	(80)
West	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	17.29	(80)
West	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(80)
West	0.9x	0.77	x	0.71	x	38.42	x	0.63	x	0.7	=	16.67	(80)
West	0.9x	0.77	x	3.78	x	38.42	x	0.63	x	0.7	=	44.38	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	33.82	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(80)
West	0.9x	0.77	x	0.71	x	63.27	x	0.63	x	0.7	=	27.46	(80)
West	0.9x	0.77	x	3.78	x	63.27	x	0.63	x	0.7	=	73.09	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	55.69	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(80)
West	0.9x	0.77	x	0.71	x	92.28	x	0.63	x	0.7	=	40.05	(80)
West	0.9x	0.77	x	3.78	x	92.28	x	0.63	x	0.7	=	106.6	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	81.22	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	3.78	x	113.09	x	0.63	x	0.7	=	130.65	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	99.54	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(80)
West	0.9x	0.77	x	0.71	x	115.77	x	0.63	x	0.7	=	50.24	(80)
West	0.9x	0.77	x	3.78	x	115.77	x	0.63	x	0.7	=	133.74	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	101.9	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(80)
West	0.9x	0.77	x	0.71	x	110.22	x	0.63	x	0.7	=	47.83	(80)
West	0.9x	0.77	x	3.78	x	110.22	x	0.63	x	0.7	=	127.33	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	97.01	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(80)
West	0.9x	0.77	x	0.71	x	94.68	x	0.63	x	0.7	=	41.09	(80)
West	0.9x	0.77	x	3.78	x	94.68	x	0.63	x	0.7	=	109.37	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	83.33	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(80)
West	0.9x	0.77	x	0.71	x	73.59	x	0.63	x	0.7	=	31.94	(80)
West	0.9x	0.77	x	3.78	x	73.59	x	0.63	x	0.7	=	85.01	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	64.77	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(80)
West	0.9x	0.77	x	0.71	x	45.59	x	0.63	x	0.7	=	19.78	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	3.78	x	45.59	x	0.63	x	0.7	=	52.67	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	40.13	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(80)
West	0.9x	0.77	x	0.71	x	24.49	x	0.63	x	0.7	=	10.63	(80)
West	0.9x	0.77	x	3.78	x	24.49	x	0.63	x	0.7	=	28.29	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	21.55	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(80)
West	0.9x	0.77	x	0.71	x	16.15	x	0.63	x	0.7	=	7.01	(80)
West	0.9x	0.77	x	3.78	x	16.15	x	0.63	x	0.7	=	18.66	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	14.22	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	98.86	193.39	318.48	464.49	569.25	582.72	554.78	476.55	370.41	229.47	123.26	81.3	(83)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------	------

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

(84)m=	564.16	659.48	771.05	891.29	970.05	956.79	909.34	836.29	741.02	625.72	551.43	533.49	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.98	0.92	0.78	0.61	0.67	0.91	0.99	1	1	(86)

(87)m=	19.55	19.7	19.99	20.37	20.72	20.93	20.98	20.97	20.8	20.35	19.88	19.52	(87)
--------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

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

(88)m=	20.02	20.02	20.02	20.03	20.03	20.04	20.04	20.04	20.04	20.03	20.03	20.03	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	0.99	0.97	0.89	0.69	0.48	0.55	0.86	0.99	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(90)m=	18.3	18.5	18.87	19.36	19.78	20	20.04	20.03	19.89	19.34	18.73	18.27	(90)
--------	------	------	-------	-------	-------	----	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.12

(91)

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

(92)m=	18.45	18.65	19	19.48	19.89	20.11	20.15	20.15	20	19.46	18.87	18.42	(92)
--------	-------	-------	----	-------	-------	-------	-------	-------	----	-------	-------	-------	------

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

(93)m=	18.45	18.65	19	19.48	19.89	20.11	20.15	20.15	20	19.46	18.87	18.42	(93)
--------	-------	-------	----	-------	-------	-------	-------	-------	----	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.96	0.88	0.7	0.5	0.57	0.86	0.98	1	1	(94)
--------	---	---	------	------	------	-----	-----	------	------	------	---	---	------

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

(95)m=	563.48	657.56	763.86	859.44	854.63	669.24	453.81	473.19	635.21	614.92	549.99	533.02	(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)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

DER WorkSheet: New dwelling design stage

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]$

(97)m=

1876.36	1819.15	1651.28	1384.33	1069.15	712.84	459.55	484.07	765.88	1156.59	1542.51	1870.87
---------	---------	---------	---------	---------	--------	--------	--------	--------	---------	---------	---------

 (97)

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(97a)m=

976.78	780.59	660.25	377.92	159.6	0	0	0	0	403	714.61	995.36
--------	--------	--------	--------	-------	---	---	---	---	-----	--------	--------

Total per year (kWh/year) = $\text{Sum}(97a)_{1...5,9...12} =$

5068.12

 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

Total per year (kWh/year) = $\text{Sum}(97b)_{1...5,9...12} =$

0

 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=

976.78	780.59	660.25	377.92	159.6	0	0	0	0	403	714.61	995.36
--------	--------	--------	--------	-------	---	---	---	---	-----	--------	--------

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

5068.12

 (98)

Space heating requirement in kWh/m²/year

41.1

 (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) = $(202) \times [1 - (203)] =$

1

 (204)

Efficiency of main space heating system 1

92.6

 (206)

Efficiency of secondary/supplementary heating system, %

0

 (208)

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

 kWh/year

976.78	780.59	660.25	377.92	159.6	0	0	0	0	403	714.61	995.36
--------	--------	--------	--------	-------	---	---	---	---	-----	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

1054.84	842.96	713.01	408.13	172.36	0	0	0	0	435.21	771.72	1074.91
---------	--------	--------	--------	--------	---	---	---	---	--------	--------	---------

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

5473.13

 (211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

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

0

 (215)

Water heating

Output from water heater (calculated above)

222.99	199.11	210.66	186.58	183.09	161.98	151.71	167.64	165.95	189.04	205.16	221.64
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

87.3

 (216)

(217)m=

89.65	89.6	89.48	89.22	88.63	87.3	87.3	87.3	87.3	89.25	89.54	89.66
-------	------	-------	-------	-------	------	------	------	------	-------	-------	-------

 (217)

Fuel for water heating, kWh/month

(219)m = $(64)m \times 100 \div (217)m$

(219)m=

248.74	222.23	235.43	209.12	206.58	185.54	173.78	192.03	190.09	211.8	229.14	247.21
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

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

2551.69

 (219)

Annual totals

Space heating fuel used, main system 1

5473.13

 kWh/year

Water heating fuel used

2551.69

 kWh/year

Electricity for pumps, fans and electric keep-hot

DER WorkSheet: New dwelling design stage

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		169.8	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.21	=	1149.36 (261)
Space heating (secondary)	(215) x	0.136	=	0 (263)
Water heating	(219) x	0.21	=	535.86 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1685.21 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	10.2 (267)
Electricity for lighting	(232) x	0.136	=	23.09 (268)
Total CO2, kg/year		sum of (265)...(271) =		1718.51 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.94 (273)
El rating (section 14)				86 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 10

Software Version:

Version: 1.0.0.37

Property Address: Nine Mile Ride 3BH 140 DET GAS

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	58.01 (1a)	x	2.4 (2a)	=	139.22 (3a)
First floor	82.01 (1b)	x	2.4 (2b)	=	196.82 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	140.02 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	336.05 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m ³ 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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0 (6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0 (6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0 (6e)
Number of blocked chimneys							0	x 20 =	0 (6f)
Number of intermittent fans							4	x 10 =	40 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues, fans, PSVs, etc. [(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.12 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>	
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 <i>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</i>	0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0 (12)
If no draught lobby, enter 0.05, else enter 0	0 (13)
Percentage of windows and doors draught stripped	0 (14)
Window infiltration 0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.37 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>	
Number of sides sheltered	2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor (21) = (18) x (20) =	0.31 (21)

DER WorkSheet: New dwelling design stage

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.4	0.39	0.38	0.35	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37
--	-----	------	------	------	------	-----	-----	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.21	x 1.2	= 2.652		(26)
Windows Type 1			1.37	x1/[1/(1.2)+ 0.04]	= 1.57		(27)
Windows Type 2			1.22	x1/[1/(1.2)+ 0.04]	= 1.4		(27)
Windows Type 3			2.16	x1/[1/(1.2)+ 0.04]	= 2.47		(27)
Windows Type 4			5.25	x1/[1/(1.2)+ 0.04]	= 6.01		(27)
Windows Type 5			1.22	x1/[1/(1.2)+ 0.04]	= 1.4		(27)
Windows Type 6			1.92	x1/[1/(1.2)+ 0.04]	= 2.2		(27)
Windows Type 7			1.09	x1/[1/(1.2)+ 0.04]	= 1.25		(27)
Windows Type 8			0.82	x1/[1/(1.2)+ 0.04]	= 0.94		(27)
Windows Type 9			1.92	x1/[1/(1.2)+ 0.04]	= 2.2		(27)
Floor Type 1			58.01	x 0.13	= 7.541299		(28)
Floor Type 2			24	x 0.15	= 3.6		(28)
Walls	174.6	24.94	149.66	x 0.18	= 26.94		(29)

DER WorkSheet: New dwelling design stage

Roof

 ×

 =

 (30)

Total area of elements, m²

 (31)

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

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

Fabric heat loss, W/K = S (A × U) (26)...(30) + (32) =

 (33)

Heat capacity Cm = S(A × k) ((28)...(30) + (32) + (32a)...(32e) =

 (34)

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

 (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 × Y) calculated using Appendix K

 (36)

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

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

 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	64.32	63.97	63.63	62.05	61.75	60.37	60.37	60.12	60.9	61.75	62.35	62.98	(38)

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

(39)m=	157.81	157.47	157.13	155.54	155.25	153.86	153.86	153.61	154.4	155.25	155.85	156.47	
	Average = Sum(39) _{1...12} /12=											<table border="1" style="display: inline-table; width: 80px; text-align: center;">155.54</table>	(39)

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

(40)m=	1.13	1.12	1.12	1.11	1.11	1.1	1.1	1.1	1.1	1.11	1.11	1.12	
	Average = Sum(40) _{1...12} /12=											<table border="1" style="display: inline-table; width: 80px; text-align: center;">1.11</table>	(40)

Number of days in month (Table 1a)

		Feb	Mar	Apr	May	Jun		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

 (42)

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

if TFA ≤ 13.9, N = 1

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81
---------	------	------	------	------	------	------	-----	------	------	------	------	------

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	46.85	45.14	43.44	41.74	40.03	38.33	38.33	40.03	41.74	43.44	45.14	46.85
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Annual average hot water usage in litres per day Vd,average (from Appendix J)

 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	47.62	45.91	44.2	42.48	40.76	39.04	39.03	40.74	42.46	44.18	45.92	47.65	
	Total = Sum(44) _{1...12} =											<table border="1" style="display: inline-table; width: 80px; text-align: center;">520.01</table>	(44)

Energy content of hot water used = 4.18 × Vd,m × nm × DTm / 3600 kWh/month (from Appendix J)

(45)m=	201.94	180.12	189.63	166.18	161.99	141.51	130.48	146.47	145.45	167.91	184.78	200.58	
	Total = Sum(45) _{1...12} =											<table border="1" style="display: inline-table; width: 80px; text-align: center;">2017.06</table>	(45)

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

(46)m=	30.29	27.02	28.45	24.93	24.3	21.23	19.57	21.97	21.82	25.19	27.72	30.09	(46)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

DER WorkSheet: New dwelling design stage

Water storage loss:

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

If Heat network 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): (48)

Temperature factor from Table 2b (49)

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

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

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

If Heat network see section 4.3

Volume factor from Table 2a (52)

Temperature factor from Table 2b (53)

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

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

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

(56)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) - Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(57)

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

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

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

(59)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(59)

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

(61)m=

26.2	23.64	26.14	25.25	26.06	25.18	25.99	26.03	25.21	26.1	25.31	26.19
------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------

(61)

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

(62)m=

228.13	203.76	215.77	191.43	188.05	166.69	156.48	172.5	170.66	194.01	210.09	226.78
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating)

(63a)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=

--	--	--	--	--	--	--	--	--	--	--	--

(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(63c)

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

(63b)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(63b)

Output from water heater

(64)m=

228.13	203.76	215.77	191.43	188.05	166.69	156.48	172.5	170.66	194.01	210.09	226.78
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

(64)

Output from water heater (annual)_{1...12} 2324.36

if (64)m < 0 then set to 0

Energy

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(64a)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m]$ (64a)

(65)m=

73.69	65.8	69.59	61.57	60.38	53.35	49.88	55.21	54.66	62.35	67.77	73.24
-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(65)

DER WorkSheet: New dwelling design stage

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	145.86	145.86	145.86	145.86	145.86	145.86	145.86	145.86	145.86	145.86	145.86	145.86	(66)

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

(67)m=	9.97	8.85	7.2	5.45	4.08	3.44	3.72	4.83	6.49	8.23	9.61	10.25	(67)
--------	------	------	-----	------	------	------	------	------	------	------	------	-------	------

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

(68)m=	309.43	312.65	304.55	287.33	265.58	245.15	231.49	228.28	236.37	253.6	275.34	295.78	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

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

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

Pumps and fans gains (Table 5a)

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

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

(71)m=	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	(71)
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

(72)m=	99.05	97.92	93.53	85.51	81.15	74.1	67.05	74.21	75.92	83.81	94.12	98.44	(72)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	488.21	489.18	475.04	448.05	420.57	392.44	372.02	377.08	388.54	415.4	448.83	474.23	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

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

Orientation:	Access Factor	Area			Flux			g_			FF			Gains	
	Table 6d		m²		Table 6a		Table 6b		Table 6c				(W)		
East	0.9x	0.77	x	5.25	x	19.64	x	0.63	x	0.7	=	31.51	(76)		
East	0.9x	0.77	x	1.22	x	19.64	x	0.63	x	0.7	=	7.32	(76)		
East	0.9x	0.77	x	1.92	x	19.64	x	0.63	x	0.7	=	34.57	(76)		
East	0.9x	0.77	x	5.25	x	38.42	x	0.63	x	0.7	=	61.64	(76)		
East	0.9x	0.77	x	1.22	x	38.42	x	0.63	x	0.7	=	14.33	(76)		
East	0.9x	0.77	x	1.92	x	38.42	x	0.63	x	0.7	=	67.63	(76)		
East	0.9x	0.77	x	5.25	x	63.27	x	0.63	x	0.7	=	101.52	(76)		
East	0.9x	0.77	x	1.22	x	63.27	x	0.63	x	0.7	=	23.59	(76)		
East	0.9x	0.77	x	1.92	x	63.27	x	0.63	x	0.7	=	111.38	(76)		
East	0.9x	0.77	x	5.25	x	92.28	x	0.63	x	0.7	=	148.06	(76)		
East	0.9x	0.77	x	1.22	x	92.28	x	0.63	x	0.7	=	34.41	(76)		
East	0.9x	0.77	x	1.92	x	92.28	x	0.63	x	0.7	=	162.44	(76)		
East	0.9x	0.77	x	5.25	x	113.09	x	0.63	x	0.7	=	181.45	(76)		
East	0.9x	0.77	x	1.22	x	113.09	x	0.63	x	0.7	=	42.17	(76)		
East	0.9x	0.77	x	1.92	x	113.09	x	0.63	x	0.7	=	199.08	(76)		
East	0.9x	0.77	x	5.25	x	115.77	x	0.63	x	0.7	=	185.75	(76)		
East	0.9x	0.77	x	1.22	x	115.77	x	0.63	x	0.7	=	43.16	(76)		

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	1.92	x	115.77	x	0.63	x	0.7	=	203.79	(76)
East	0.9x	0.77	x	5.25	x	110.22	x	0.63	x	0.7	=	176.84	(76)
East	0.9x	0.77	x	1.22	x	110.22	x	0.63	x	0.7	=	41.09	(76)
East	0.9x	0.77	x	1.92	x	110.22	x	0.63	x	0.7	=	194.02	(76)
East	0.9x	0.77	x	5.25	x	94.68	x	0.63	x	0.7	=	151.9	(76)
East	0.9x	0.77	x	1.22	x	94.68	x	0.63	x	0.7	=	35.3	(76)
East	0.9x	0.77	x	1.92	x	94.68	x	0.63	x	0.7	=	166.66	(76)
East	0.9x	0.77	x	5.25	x	73.59	x	0.63	x	0.7	=	118.07	(76)
East	0.9x	0.77	x	1.22	x	73.59	x	0.63	x	0.7	=	27.44	(76)
East	0.9x	0.77	x	1.92	x	73.59	x	0.63	x	0.7	=	129.54	(76)
East	0.9x	0.77	x	5.25	x	45.59	x	0.63	x	0.7	=	73.15	(76)
East	0.9x	0.77	x	1.22	x	45.59	x	0.63	x	0.7	=	17	(76)
East	0.9x	0.77	x	1.92	x	45.59	x	0.63	x	0.7	=	80.25	(76)
East	0.9x	0.77	x	5.25	x	24.49	x	0.63	x	0.7	=	39.29	(76)
East	0.9x	0.77	x	1.22	x	24.49	x	0.63	x	0.7	=	9.13	(76)
East	0.9x	0.77	x	1.92	x	24.49	x	0.63	x	0.7	=	43.11	(76)
East	0.9x	0.77	x	5.25	x	16.15	x	0.63	x	0.7	=	25.91	(76)
East	0.9x	0.77	x	1.22	x	16.15	x	0.63	x	0.7	=	6.02	(76)
East	0.9x	0.77	x	1.92	x	16.15	x	0.63	x	0.7	=	28.43	(76)
West	0.9x	0.77	x	1.37	x	19.64	x	0.63	x	0.7	=	8.22	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	2.16	x	19.64	x	0.63	x	0.7	=	12.97	(80)
West	0.9x	0.77	x	1.92	x	19.64	x	0.63	x	0.7	=	23.05	(80)
West	0.9x	0.77	x	1.09	x	19.64	x	0.63	x	0.7	=	6.54	(80)
West	0.9x	0.77	x	0.82	x	19.64	x	0.63	x	0.7	=	4.92	(80)
West	0.9x	0.77	x	1.37	x	38.42	x	0.63	x	0.7	=	16.09	(80)
West	0.9x	0.77	x	1.22	x	38.42	x	0.63	x	0.7	=	14.33	(80)
West	0.9x	0.77	x	2.16	x	38.42	x	0.63	x	0.7	=	25.36	(80)
West	0.9x	0.77	x	1.92	x	38.42	x	0.63	x	0.7	=	45.09	(80)
West	0.9x	0.77	x	1.09	x	38.42	x	0.63	x	0.7	=	12.8	(80)
West	0.9x	0.77	x	0.82	x	38.42	x	0.63	x	0.7	=	9.63	(80)
West	0.9x	0.77	x	1.37	x	63.27	x	0.63	x	0.7	=	26.49	(80)
West	0.9x	0.77	x	1.22	x	63.27	x	0.63	x	0.7	=	23.59	(80)
West	0.9x	0.77	x	2.16	x	63.27	x	0.63	x	0.7	=	41.77	(80)
West	0.9x	0.77	x	1.92	x	63.27	x	0.63	x	0.7	=	74.25	(80)
West	0.9x	0.77	x	1.09	x	63.27	x	0.63	x	0.7	=	21.08	(80)
West	0.9x	0.77	x	0.82	x	63.27	x	0.63	x	0.7	=	15.86	(80)
West	0.9x	0.77	x	1.37	x	92.28	x	0.63	x	0.7	=	38.64	(80)
West	0.9x	0.77	x	1.22	x	92.28	x	0.63	x	0.7	=	34.41	(80)
West	0.9x	0.77	x	2.16	x	92.28	x	0.63	x	0.7	=	60.92	(80)
West	0.9x	0.77	x	1.92	x	92.28	x	0.63	x	0.7	=	108.3	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	1.09	x	92.28	x	0.63	x	0.7	=	30.74	(80)
West	0.9x	0.77	x	0.82	x	92.28	x	0.63	x	0.7	=	23.13	(80)
West	0.9x	0.77	x	1.37	x	113.09	x	0.63	x	0.7	=	47.35	(80)
West	0.9x	0.77	x	1.22	x	113.09	x	0.63	x	0.7	=	42.17	(80)
West	0.9x	0.77	x	2.16	x	113.09	x	0.63	x	0.7	=	74.66	(80)
West	0.9x	0.77	x	1.92	x	113.09	x	0.63	x	0.7	=	132.72	(80)
West	0.9x	0.77	x	1.09	x	113.09	x	0.63	x	0.7	=	37.67	(80)
West	0.9x	0.77	x	0.82	x	113.09	x	0.63	x	0.7	=	28.34	(80)
West	0.9x	0.77	x	1.37	x	115.77	x	0.63	x	0.7	=	48.47	(80)
West	0.9x	0.77	x	1.22	x	115.77	x	0.63	x	0.7	=	43.16	(80)
West	0.9x	0.77	x	2.16	x	115.77	x	0.63	x	0.7	=	76.42	(80)
West	0.9x	0.77	x	1.92	x	115.77	x	0.63	x	0.7	=	135.86	(80)
West	0.9x	0.77	x	1.09	x	115.77	x	0.63	x	0.7	=	38.57	(80)
West	0.9x	0.77	x	0.82	x	115.77	x	0.63	x	0.7	=	29.01	(80)
West	0.9x	0.77	x	1.37	x	110.22	x	0.63	x	0.7	=	46.15	(80)
West	0.9x	0.77	x	1.22	x	110.22	x	0.63	x	0.7	=	41.09	(80)
West	0.9x	0.77	x	2.16	x	110.22	x	0.63	x	0.7	=	72.76	(80)
West	0.9x	0.77	x	1.92	x	110.22	x	0.63	x	0.7	=	129.35	(80)
West	0.9x	0.77	x	1.09	x	110.22	x	0.63	x	0.7	=	36.72	(80)
West	0.9x	0.77	x	0.82	x	110.22	x	0.63	x	0.7	=	27.62	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	1.22	x	94.68	x	0.63	x	0.7	=	35.3	(80)
West	0.9x	0.77	x	2.16	x	94.68	x	0.63	x	0.7	=	62.5	(80)
West	0.9x	0.77	x	1.92	x	94.68	x	0.63	x	0.7	=	111.11	(80)
West	0.9x	0.77	x	1.09	x	94.68	x	0.63	x	0.7	=	31.54	(80)
West	0.9x	0.77	x	0.82	x	94.68	x	0.63	x	0.7	=	23.73	(80)
West	0.9x	0.77	x	1.37	x	73.59	x	0.63	x	0.7	=	30.81	(80)
West	0.9x	0.77	x	1.22	x	73.59	x	0.63	x	0.7	=	27.44	(80)
West	0.9x	0.77	x	2.16	x	73.59	x	0.63	x	0.7	=	48.58	(80)
West	0.9x	0.77	x	1.92	x	73.59	x	0.63	x	0.7	=	86.36	(80)
West	0.9x	0.77	x	1.09	x	73.59	x	0.63	x	0.7	=	24.51	(80)
West	0.9x	0.77	x	0.82	x	73.59	x	0.63	x	0.7	=	18.44	(80)
West	0.9x	0.77	x	1.37	x	45.59	x	0.63	x	0.7	=	19.09	(80)
West	0.9x	0.77	x	1.22	x	45.59	x	0.63	x	0.7	=	17	(80)
West	0.9x	0.77	x	2.16	x	45.59	x	0.63	x	0.7	=	30.09	(80)
West	0.9x	0.77	x	1.92	x	45.59	x	0.63	x	0.7	=	53.5	(80)
West	0.9x	0.77	x	1.09	x	45.59	x	0.63	x	0.7	=	15.19	(80)
West	0.9x	0.77	x	0.82	x	45.59	x	0.63	x	0.7	=	11.42	(80)
West	0.9x	0.77	x	1.37	x	24.49	x	0.63	x	0.7	=	10.25	(80)
West	0.9x	0.77	x	1.22	x	24.49	x	0.63	x	0.7	=	9.13	(80)
West	0.9x	0.77	x	2.16	x	24.49	x	0.63	x	0.7	=	16.17	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	1.92	x	24.49	x	0.63	x	0.7	=	28.74	(80)
West	0.9x	0.77	x	1.09	x	24.49	x	0.63	x	0.7	=	8.16	(80)
West	0.9x	0.77	x	0.82	x	24.49	x	0.63	x	0.7	=	6.14	(80)
West	0.9x	0.77	x	1.37	x	16.15	x	0.63	x	0.7	=	6.76	(80)
West	0.9x	0.77	x	1.22	x	16.15	x	0.63	x	0.7	=	6.02	(80)
West	0.9x	0.77	x	2.16	x	16.15	x	0.63	x	0.7	=	10.66	(80)
West	0.9x	0.77	x	1.92	x	16.15	x	0.63	x	0.7	=	18.95	(80)
West	0.9x	0.77	x	1.09	x	16.15	x	0.63	x	0.7	=	5.38	(80)
West	0.9x	0.77	x	0.82	x	16.15	x	0.63	x	0.7	=	4.05	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	136.43	266.89	439.53	641.03	785.61	804.21	765.64	657.67	511.19	316.69	170.12	112.2	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	624.64	756.07	914.58	1089.08	1206.18	1196.65	1137.66	1034.75	899.73	732.09	618.95	586.42	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.75	0.58	0.65	0.9	0.99	1	1	(86)

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

(87)m=	19.45	19.63	19.95	20.37	20.73	20.93	20.99	20.97	20.8	20.31	19.81	19.43	(87)
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(88)m=	19.98	19.98	19.98	19.99	19.99	20	20	20	20	19.99	19.99	19.99	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.66	0.46	0.53	0.84	0.99	1	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.15	18.38	18.79	19.32	19.75	19.96	20	19.99	19.85	19.26	18.61	18.12	(90)
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fLA = Living area ÷ (4) =

0.12 (91)

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

(92)m=	18.32	18.54	18.93	19.45	19.87	20.08	20.12	20.12	19.97	19.4	18.76	18.29	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.32	18.54	18.93	19.45	19.87	20.08	20.12	20.12	19.97	19.4	18.76	18.29	(93)
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8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.96	0.86	0.67	0.47	0.54	0.84	0.98	1	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	623.94	753.72	904.53	1041.29	1035.52	798.01	535.67	559.03	757.17	718.31	617.37	585.95	(95)
--------	--------	--------	--------	---------	---------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	2211.9	2147.5	1953.41	1641.55	1268.81	843.34	541.66	570.79	905.96	1365.49	1817.71	2204.31	(97)
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DER WorkSheet: New dwelling design stage

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(97a)m=	1181.44	936.62	780.36	432.19	173.56	0	0	0	0	481.5	864.24	1204.06	
Total per year (kWh/year) = Sum(97a) _{1...5,9...12} =													6053.98 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total per year (kWh/year) = Sum(97b) _{1...5,9...12} =													0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	1181.44	936.62	780.36	432.19	173.56	0	0	0	0	481.5	864.24	1204.06	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =													6053.98 (98)

Space heating requirement in kWh/m²/year

43.24 (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) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

92.6 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

1181.44	936.62	780.36	432.19	173.56	0	0	0	0	481.5	864.24	1204.06
---------	--------	--------	--------	--------	---	---	---	---	-------	--------	---------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

1275.85	1011.47	842.73	466.73	187.44	0	0	0	0	519.98	933.31	1300.28		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												6537.78	(211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

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

Water heating

Output from water heater (calculated above)

228.13	203.76	215.77	191.43	188.05	166.69	156.48	172.5	170.66	194.01	210.09	226.78
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Efficiency of water heater

87.3 (216)

(217)m=

89.72	89.67	89.56	89.29	88.67	87.3	87.3	87.3	87.3	89.35	89.62	89.73
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Fuel for water heating, kWh/month

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	254.28	227.24	240.94	214.39	212.08	190.94	179.24	197.6	195.48	217.14	234.43	252.74	
Total = Sum(219a) _{1...12} =													2616.51 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

6537.78

Water heating fuel used

2616.51

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
Electricity for lighting		176.05	(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	0.21	1372.93 (261)
Space heating (secondary)	(215) x	0.136	0 (263)
Water heating	(219) x	0.21	549.47 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1922.4 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	10.2 (267)
Electricity for lighting	(232) x	0.136	23.94 (268)
Total CO2, kg/year		sum of (265)...(271) =	1956.54 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	13.97 (273)
El rating (section 14)			86 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 10

Software Version:

Version: 1.0.0.37

Property Address: Nine Mile Ride 4BH 179 DET GAS

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	87.32 (1a)	x	2.4 (2a)	=	209.57 (3a)
First floor	91.58 (1b)	x	2.4 (2b)	=	219.79 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	178.9 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	429.36 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m ³ 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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0 (6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0 (6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0 (6e)
Number of blocked chimneys							0	x 20 =	0 (6f)
Number of intermittent fans							4	x 10 =	40 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues, fans, PSVs, etc. [(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.09 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>	
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 <i>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</i>	0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0 (12)
If no draught lobby, enter 0.05, else enter 0	0 (13)
Percentage of windows and doors draught stripped	0 (14)
Window infiltration 0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.34 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>	
Number of sides sheltered	2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor (21) = (18) x (20) =	0.29 (21)

DER WorkSheet: New dwelling design stage

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34
--	------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)
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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)
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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)
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(24d)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors Type 1			2.21	x 1.2	= 2.652		(26)
Doors Type 2			2.21	x 1.2	= 2.652		(26)
Windows Type 1			1.37	x 1/[1/(1.2)+ 0.04] =	1.57		(27)
Windows Type 2			1.22	x 1/[1/(1.2)+ 0.04] =	1.4		(27)
Windows Type 3			2.16	x 1/[1/(1.2)+ 0.04] =	2.47		(27)
Windows Type 4			5.25	x 1/[1/(1.2)+ 0.04] =	6.01		(27)
Windows Type 5			1.22	x 1/[1/(1.2)+ 0.04] =	1.4		(27)
Windows Type 6			2.16	x 1/[1/(1.2)+ 0.04] =	2.47		(27)
Windows Type 7			1.92	x 1/[1/(1.2)+ 0.04] =	2.2		(27)
Windows Type 8			1.09	x 1/[1/(1.2)+ 0.04] =	1.25		(27)
Windows Type 9			0.82	x 1/[1/(1.2)+ 0.04] =	0.94		(27)
Windows Type 10			1.92	x 1/[1/(1.2)+ 0.04] =	2.2		(27)
Windows Type 11			1.09	x 1/[1/(1.2)+ 0.04] =	1.25		(27)

DER WorkSheet: New dwelling design stage

Windows Type 12			3.78	$\times 1/[1/(1.2) + 0.04] =$	4.33			(27)
Floor Type 1			87.32	$\times$	0.13	$=$	11.3516	(28)
Floor Type 2			21.69	$\times$	0.15	$=$	3.2535	(28)
Walls	203.52	33.08	170.44	$\times$	0.18	$=$	30.68	(29)
Roof Type1	91.58	0	91.58	$\times$	0.1	$=$	9.16	(30)
Roof Type2	19.34	0	19.34	$\times$	0.13	$=$	2.51	(30)
Total area of elements, m ²			423.45					(31)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ 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) =	95.08	(33)
Heat capacity Cm = S(A x k)	((28)...(30) + (32) + (32a)...(32e) =	18207.48	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		22.61	(36)
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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	117.69	(37)
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Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	80.64	80.26	79.89	78.14	77.81	76.28	76.28	76	76.87	77.81	78.47	79.17	(38)

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

(39)													
	Average = Sum(39) _{1...12} /12=											195.82	(39)

Heat loss parameter (HLP), W/m²K

(40)m=	1.11	1.11	1.1	1.09	1.09	1.08	1.08	1.08	1.09	1.09	1.1	1.1	
	Average = Sum(40) _{1...12} /12=											1.09	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N 2.97 (42)

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

if TFA <= 13.9, N = 1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	
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Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	
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Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	47.46	45.74	44.01	42.29	40.56	38.83	38.83	40.56	42.29	44.01	45.74	47.46	
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Annual average hot water usage in litres per day Vd,average (from Appendix J) 130.28 (43)

DER WorkSheet: New dwelling design stage

Hot water usage in litres per day for each month $V_{d,m} = (42a) + (42b) + (42c)$

(44)m=	48.24	46.51	44.78	43.03	41.29	39.54	39.54	41.27	43.01	44.75	46.52	48.27		
Total = Sum(44) _{1...12} =													526.74	(44)

Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (from Appendix J)

(45)m=	204.6	182.5	192.13	168.37	164.12	143.38	132.2	148.4	147.37	170.12	187.21	203.23		
Total = Sum(45) _{1...12} =													2043.63	(45)

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

(46)m=	30.69	27.37	28.82	25.26	24.62	21.51	19.83	22.26	22.1	25.52	28.08	30.48		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
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If Heat network 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)
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Temperature factor from Table 2b	0	(49)
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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
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b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
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If Heat network see section 4.3

Volume factor from Table 2a	0	(52)
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Temperature factor from Table 2b	0	(53)
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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
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Enter (50) or (54) in (55)	0	(55)
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Water storage loss calculated for each month $(56)_m = (55) \times (41)_m$ $(56)_m = (55) \times (41)_m$

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, $(57)_m = (56)_m \times [(47) - V_s] \div (47)$, else $(57)_m = (56)_m$

where V_s is V_{ww} from Appendix G3 or (H12) from Appendix H (as applicable)

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

Primary circuit loss (annual) from Table 3	0	(58)
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Primary circuit loss calculated for each month $(59)_m = (58) \div 365 \times (41)_m$

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

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

Combi loss calculated for each month $(61)_m = (60) \div 365 \times (41)_m$

(61)m=	26.21	23.65	26.15	25.26	26.07	25.19	26	26.04	25.22	26.1	25.32	26.2		(61)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	------	-------	------	--	------

Total heat required for water heating calculated for each month $(62)_m = 0.85 \times (45)_m + (46)_m + (57)_m + (59)_m + (61)_m$

(62)m=	230.8	206.15	218.28	193.63	190.19	168.56	158.2	174.44	172.58	196.23	212.54	229.43		(62)
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WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating)

(63a)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63a)
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PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=														(63b)
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FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63c)
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Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)

(63b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63b)
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Output from water heater

(64)m=	230.8	206.15	218.28	193.63	190.19	168.56	158.2	174.44	172.58	196.23	212.54	229.43		
Output from water heater (annual) _{1...12}													2351.03	(64)

DER WorkSheet: New dwelling design stage

if (64)m < 0 then set to 0

Energy	0	0	0	0	0	0	0	0	0	0	0	0	
Heat gains from water heating, kWh/month	$0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$												0 (64a)
(65)m=	74.58	66.59	70.42	62.3	61.09	53.97	50.46	55.85	55.3	63.09	68.58	74.12	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	148.72	148.72	148.72	148.72	148.72	148.72	148.72	148.72	148.72	148.72	148.72	148.72	(66)

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

(67)m=	11.23	9.97	8.11	6.14	4.59	3.87	4.19	5.44	7.3	9.27	10.82	11.54	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	350.52	354.16	344.99	325.48	300.85	277.7	262.23	258.59	267.76	287.27	311.9	335.06	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	(71)
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Water heating gains (Table 5)

(72)m=	100.24	99.1	94.65	86.52	82.11	74.96	67.82	75.07	76.81	84.8	95.25	99.63	(72)
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Total internal gains =

	(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m												
(73)m=	532.61	533.84	518.37	488.76	458.16	427.15	404.85	409.72	422.49	451.96	488.59	516.84	(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 m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	5.25	x	19.64	x	0.63	x	0.7	=	31.51 (76)
East	0.9x	0.77	x	1.22	x	19.64	x	0.63	x	0.7	=	7.32 (76)
East	0.9x	0.77	x	2.16	x	19.64	x	0.63	x	0.7	=	12.97 (76)
East	0.9x	0.77	x	1.92	x	19.64	x	0.63	x	0.7	=	11.52 (76)
East	0.9x	0.77	x	1.09	x	19.64	x	0.63	x	0.7	=	6.54 (76)
East	0.9x	0.77	x	3.78	x	19.64	x	0.63	x	0.7	=	22.69 (76)
East	0.9x	0.77	x	5.25	x	38.42	x	0.63	x	0.7	=	61.64 (76)
East	0.9x	0.77	x	1.22	x	38.42	x	0.63	x	0.7	=	14.33 (76)
East	0.9x	0.77	x	2.16	x	38.42	x	0.63	x	0.7	=	25.36 (76)
East	0.9x	0.77	x	1.92	x	38.42	x	0.63	x	0.7	=	22.54 (76)
East	0.9x	0.77	x	1.09	x	38.42	x	0.63	x	0.7	=	12.8 (76)
East	0.9x	0.77	x	3.78	x	38.42	x	0.63	x	0.7	=	44.38 (76)
East	0.9x	0.77	x	5.25	x	63.27	x	0.63	x	0.7	=	101.52 (76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	1.22	x	63.27	x	0.63	x	0.7	=	23.59	(76)
East	0.9x	0.77	x	2.16	x	63.27	x	0.63	x	0.7	=	41.77	(76)
East	0.9x	0.77	x	1.92	x	63.27	x	0.63	x	0.7	=	37.13	(76)
East	0.9x	0.77	x	1.09	x	63.27	x	0.63	x	0.7	=	21.08	(76)
East	0.9x	0.77	x	3.78	x	63.27	x	0.63	x	0.7	=	73.09	(76)
East	0.9x	0.77	x	5.25	x	92.28	x	0.63	x	0.7	=	148.06	(76)
East	0.9x	0.77	x	1.22	x	92.28	x	0.63	x	0.7	=	34.41	(76)
East	0.9x	0.77	x	2.16	x	92.28	x	0.63	x	0.7	=	60.92	(76)
East	0.9x	0.77	x	1.92	x	92.28	x	0.63	x	0.7	=	54.15	(76)
East	0.9x	0.77	x	1.09	x	92.28	x	0.63	x	0.7	=	30.74	(76)
East	0.9x	0.77	x	3.78	x	92.28	x	0.63	x	0.7	=	106.6	(76)
East	0.9x	0.77	x	5.25	x	113.09	x	0.63	x	0.7	=	181.45	(76)
East	0.9x	0.77	x	1.22	x	113.09	x	0.63	x	0.7	=	42.17	(76)
East	0.9x	0.77	x	2.16	x	113.09	x	0.63	x	0.7	=	74.66	(76)
East	0.9x	0.77	x	1.92	x	113.09	x	0.63	x	0.7	=	66.36	(76)
East	0.9x	0.77	x	1.09	x	113.09	x	0.63	x	0.7	=	37.67	(76)
East	0.9x	0.77	x	3.78	x	113.09	x	0.63	x	0.7	=	130.65	(76)
East	0.9x	0.77	x	5.25	x	115.77	x	0.63	x	0.7	=	185.75	(76)
East	0.9x	0.77	x	1.22	x	115.77	x	0.63	x	0.7	=	43.16	(76)
East	0.9x	0.77	x	2.16	x	115.77	x	0.63	x	0.7	=	76.42	(76)
East	0.9x		x		x		x		x		=		(76)
East	0.9x	0.77	x	1.09	x	115.77	x	0.63	x	0.7	=	38.57	(76)
East	0.9x	0.77	x	3.78	x	115.77	x	0.63	x	0.7	=	133.74	(76)
East	0.9x	0.77	x	5.25	x	110.22	x	0.63	x	0.7	=	176.84	(76)
East	0.9x	0.77	x	1.22	x	110.22	x	0.63	x	0.7	=	41.09	(76)
East	0.9x	0.77	x	2.16	x	110.22	x	0.63	x	0.7	=	72.76	(76)
East	0.9x	0.77	x	1.92	x	110.22	x	0.63	x	0.7	=	64.67	(76)
East	0.9x	0.77	x	1.09	x	110.22	x	0.63	x	0.7	=	36.72	(76)
East	0.9x	0.77	x	3.78	x	110.22	x	0.63	x	0.7	=	127.33	(76)
East	0.9x	0.77	x	5.25	x	94.68	x	0.63	x	0.7	=	151.9	(76)
East	0.9x	0.77	x	1.22	x	94.68	x	0.63	x	0.7	=	35.3	(76)
East	0.9x	0.77	x	2.16	x	94.68	x	0.63	x	0.7	=	62.5	(76)
East	0.9x	0.77	x	1.92	x	94.68	x	0.63	x	0.7	=	55.55	(76)
East	0.9x	0.77	x	1.09	x	94.68	x	0.63	x	0.7	=	31.54	(76)
East	0.9x	0.77	x	3.78	x	94.68	x	0.63	x	0.7	=	109.37	(76)
East	0.9x	0.77	x	5.25	x	73.59	x	0.63	x	0.7	=	118.07	(76)
East	0.9x	0.77	x	1.22	x	73.59	x	0.63	x	0.7	=	27.44	(76)
East	0.9x	0.77	x	2.16	x	73.59	x	0.63	x	0.7	=	48.58	(76)
East	0.9x	0.77	x	1.92	x	73.59	x	0.63	x	0.7	=	43.18	(76)
East	0.9x	0.77	x	1.09	x	73.59	x	0.63	x	0.7	=	24.51	(76)
East	0.9x	0.77	x	3.78	x	73.59	x	0.63	x	0.7	=	85.01	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	5.25	x	45.59	x	0.63	x	0.7	=	73.15	(76)
East	0.9x	0.77	x	1.22	x	45.59	x	0.63	x	0.7	=	17	(76)
East	0.9x	0.77	x	2.16	x	45.59	x	0.63	x	0.7	=	30.09	(76)
East	0.9x	0.77	x	1.92	x	45.59	x	0.63	x	0.7	=	26.75	(76)
East	0.9x	0.77	x	1.09	x	45.59	x	0.63	x	0.7	=	15.19	(76)
East	0.9x	0.77	x	3.78	x	45.59	x	0.63	x	0.7	=	52.67	(76)
East	0.9x	0.77	x	5.25	x	24.49	x	0.63	x	0.7	=	39.29	(76)
East	0.9x	0.77	x	1.22	x	24.49	x	0.63	x	0.7	=	9.13	(76)
East	0.9x	0.77	x	2.16	x	24.49	x	0.63	x	0.7	=	16.17	(76)
East	0.9x	0.77	x	1.92	x	24.49	x	0.63	x	0.7	=	14.37	(76)
East	0.9x	0.77	x	1.09	x	24.49	x	0.63	x	0.7	=	8.16	(76)
East	0.9x	0.77	x	3.78	x	24.49	x	0.63	x	0.7	=	28.29	(76)
East	0.9x	0.77	x	5.25	x	16.15	x	0.63	x	0.7	=	25.91	(76)
East	0.9x	0.77	x	1.22	x	16.15	x	0.63	x	0.7	=	6.02	(76)
East	0.9x	0.77	x	2.16	x	16.15	x	0.63	x	0.7	=	10.66	(76)
East	0.9x	0.77	x	1.92	x	16.15	x	0.63	x	0.7	=	9.48	(76)
East	0.9x	0.77	x	1.09	x	16.15	x	0.63	x	0.7	=	5.38	(76)
East	0.9x	0.77	x	3.78	x	16.15	x	0.63	x	0.7	=	18.66	(76)
South	0.9x	0.77	x	0.82	x	46.75	x	0.63	x	0.7	=	23.43	(78)
South	0.9x	0.77	x	0.82	x	76.57	x	0.63	x	0.7	=	38.38	(78)
South	0.9x		x		x		x		x		=		(78)
South	0.9x	0.77	x	0.82	x	110.23	x	0.63	x	0.7	=	55.25	(78)
South	0.9x	0.77	x	0.82	x	114.87	x	0.63	x	0.7	=	57.57	(78)
South	0.9x	0.77	x	0.82	x	110.55	x	0.63	x	0.7	=	55.41	(78)
South	0.9x	0.77	x	0.82	x	108.01	x	0.63	x	0.7	=	54.14	(78)
South	0.9x	0.77	x	0.82	x	104.89	x	0.63	x	0.7	=	52.57	(78)
South	0.9x	0.77	x	0.82	x	101.89	x	0.63	x	0.7	=	51.07	(78)
South	0.9x	0.77	x	0.82	x	82.59	x	0.63	x	0.7	=	41.39	(78)
South	0.9x	0.77	x	0.82	x	55.42	x	0.63	x	0.7	=	27.78	(78)
South	0.9x	0.77	x	0.82	x	40.4	x	0.63	x	0.7	=	20.25	(78)
West	0.9x	0.77	x	1.37	x	19.64	x	0.63	x	0.7	=	8.22	(80)
West	0.9x	0.77	x	1.22	x	19.64	x	0.63	x	0.7	=	7.32	(80)
West	0.9x	0.77	x	2.16	x	19.64	x	0.63	x	0.7	=	12.97	(80)
West	0.9x	0.77	x	1.92	x	19.64	x	0.63	x	0.7	=	34.57	(80)
West	0.9x	0.77	x	1.09	x	19.64	x	0.63	x	0.7	=	6.54	(80)
West	0.9x	0.77	x	1.37	x	38.42	x	0.63	x	0.7	=	16.09	(80)
West	0.9x	0.77	x	1.22	x	38.42	x	0.63	x	0.7	=	14.33	(80)
West	0.9x	0.77	x	2.16	x	38.42	x	0.63	x	0.7	=	25.36	(80)
West	0.9x	0.77	x	1.92	x	38.42	x	0.63	x	0.7	=	67.63	(80)
West	0.9x	0.77	x	1.09	x	38.42	x	0.63	x	0.7	=	12.8	(80)
West	0.9x	0.77	x	1.37	x	63.27	x	0.63	x	0.7	=	26.49	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	1.22	x	63.27	x	0.63	x	0.7	=	23.59	(80)
West	0.9x	0.77	x	2.16	x	63.27	x	0.63	x	0.7	=	41.77	(80)
West	0.9x	0.77	x	1.92	x	63.27	x	0.63	x	0.7	=	111.38	(80)
West	0.9x	0.77	x	1.09	x	63.27	x	0.63	x	0.7	=	21.08	(80)
West	0.9x	0.77	x	1.37	x	92.28	x	0.63	x	0.7	=	38.64	(80)
West	0.9x	0.77	x	1.22	x	92.28	x	0.63	x	0.7	=	34.41	(80)
West	0.9x	0.77	x	2.16	x	92.28	x	0.63	x	0.7	=	60.92	(80)
West	0.9x	0.77	x	1.92	x	92.28	x	0.63	x	0.7	=	162.44	(80)
West	0.9x	0.77	x	1.09	x	92.28	x	0.63	x	0.7	=	30.74	(80)
West	0.9x	0.77	x	1.37	x	113.09	x	0.63	x	0.7	=	47.35	(80)
West	0.9x	0.77	x	1.22	x	113.09	x	0.63	x	0.7	=	42.17	(80)
West	0.9x	0.77	x	2.16	x	113.09	x	0.63	x	0.7	=	74.66	(80)
West	0.9x	0.77	x	1.92	x	113.09	x	0.63	x	0.7	=	199.08	(80)
West	0.9x	0.77	x	1.09	x	113.09	x	0.63	x	0.7	=	37.67	(80)
West	0.9x	0.77	x	1.37	x	115.77	x	0.63	x	0.7	=	48.47	(80)
West	0.9x	0.77	x	1.22	x	115.77	x	0.63	x	0.7	=	43.16	(80)
West	0.9x	0.77	x	2.16	x	115.77	x	0.63	x	0.7	=	76.42	(80)
West	0.9x	0.77	x	1.92	x	115.77	x	0.63	x	0.7	=	203.79	(80)
West	0.9x	0.77	x	1.09	x	115.77	x	0.63	x	0.7	=	38.57	(80)
West	0.9x	0.77	x	1.37	x	110.22	x	0.63	x	0.7	=	46.15	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	2.16	x	110.22	x	0.63	x	0.7	=	72.76	(80)
West	0.9x	0.77	x	1.92	x	110.22	x	0.63	x	0.7	=	194.02	(80)
West	0.9x	0.77	x	1.09	x	110.22	x	0.63	x	0.7	=	36.72	(80)
West	0.9x	0.77	x	1.37	x	94.68	x	0.63	x	0.7	=	39.64	(80)
West	0.9x	0.77	x	1.22	x	94.68	x	0.63	x	0.7	=	35.3	(80)
West	0.9x	0.77	x	2.16	x	94.68	x	0.63	x	0.7	=	62.5	(80)
West	0.9x	0.77	x	1.92	x	94.68	x	0.63	x	0.7	=	166.66	(80)
West	0.9x	0.77	x	1.09	x	94.68	x	0.63	x	0.7	=	31.54	(80)
West	0.9x	0.77	x	1.37	x	73.59	x	0.63	x	0.7	=	30.81	(80)
West	0.9x	0.77	x	1.22	x	73.59	x	0.63	x	0.7	=	27.44	(80)
West	0.9x	0.77	x	2.16	x	73.59	x	0.63	x	0.7	=	48.58	(80)
West	0.9x	0.77	x	1.92	x	73.59	x	0.63	x	0.7	=	129.54	(80)
West	0.9x	0.77	x	1.09	x	73.59	x	0.63	x	0.7	=	24.51	(80)
West	0.9x	0.77	x	1.37	x	45.59	x	0.63	x	0.7	=	19.09	(80)
West	0.9x	0.77	x	1.22	x	45.59	x	0.63	x	0.7	=	17	(80)
West	0.9x	0.77	x	2.16	x	45.59	x	0.63	x	0.7	=	30.09	(80)
West	0.9x	0.77	x	1.92	x	45.59	x	0.63	x	0.7	=	80.25	(80)
West	0.9x	0.77	x	1.09	x	45.59	x	0.63	x	0.7	=	15.19	(80)
West	0.9x	0.77	x	1.37	x	24.49	x	0.63	x	0.7	=	10.25	(80)
West	0.9x	0.77	x	1.22	x	24.49	x	0.63	x	0.7	=	9.13	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	2.16	x	24.49	x	0.63	x	0.7	=	16.17	(80)
West	0.9x	0.77	x	1.92	x	24.49	x	0.63	x	0.7	=	43.11	(80)
West	0.9x	0.77	x	1.09	x	24.49	x	0.63	x	0.7	=	8.16	(80)
West	0.9x	0.77	x	1.37	x	16.15	x	0.63	x	0.7	=	6.76	(80)
West	0.9x	0.77	x	1.22	x	16.15	x	0.63	x	0.7	=	6.02	(80)
West	0.9x	0.77	x	2.16	x	16.15	x	0.63	x	0.7	=	10.66	(80)
West	0.9x	0.77	x	1.92	x	16.15	x	0.63	x	0.7	=	28.43	(80)
West	0.9x	0.77	x	1.09	x	16.15	x	0.63	x	0.7	=	5.38	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	185.62	355.64	571.37	817.27	991.46	1011.4	964.28	834.37	658.74	417.85	230	153.62	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	------

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

(84)m=	718.22	889.48	1089.74	1306.03	1449.62	1438.55	1369.13	1244.1	1081.23	869.82	718.59	670.46	(84)
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7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	1	0.98	0.92	0.77	0.6	0.68	0.92	0.99	1	1	(86)

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

(87)m=	19.43	19.61	19.92	20.34	20.71	20.92	20.98	20.97	20.79	20.29	19.78	19.41	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

(88)m=	19.99	20	20	20.01	20.01	20.01	20.01	20.02	20.01	20.01	20	20	(88)
--------	-------	----	----	-------	-------	-------	-------	-------	-------	-------	----	----	------

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

(89)m=	1	1	0.99	0.97	0.88	0.69	0.48	0.55	0.86	0.99	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(90)m=	18.14	18.37	18.77	19.3	19.74	19.96	20.01	20	19.84	19.25	18.6	18.11	(90)
--------	-------	-------	-------	------	-------	-------	-------	----	-------	-------	------	-------	------

fLA = Living area ÷ (4) =

0.1

(91)

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

(92)m=	18.27	18.49	18.88	19.4	19.83	20.06	20.1	20.1	19.94	19.35	18.71	18.23	(92)
--------	-------	-------	-------	------	-------	-------	------	------	-------	-------	-------	-------	------

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

(93)m=	18.27	18.49	18.88	19.4	19.83	20.06	20.1	20.1	19.94	19.35	18.71	18.23	(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	1	0.99	0.96	0.88	0.69	0.49	0.56	0.86	0.99	1	1	(94)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(95)m=	717.73	887.56	1080.61	1258.9	1269.66	993.69	670.89	699.19	929.87	857.24	717.4	670.14	(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)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

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

(97)m=	2769.76	2690.1	2446.55	2056.71	1590.23	1058.79	679.53	716.22	1135.48	1710.38	2277.83	2762.7	(97)
--------	---------	--------	---------	---------	---------	---------	--------	--------	---------	---------	---------	--------	------

DER WorkSheet: New dwelling design stage

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(97a)m=	1526.71	1211.31	1016.26	574.43	238.51	0	0	0	0	634.74	1123.51	1556.87	
Total per year (kWh/year) = Sum(97a) _{1...5,9...12} =													7882.32 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total per year (kWh/year) = Sum(97b) _{1...5,9...12} =													0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	1526.71	1211.31	1016.26	574.43	238.51	0	0	0	0	634.74	1123.51	1556.87	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =													7882.32 (98)

Space heating requirement in kWh/m ² /year	44.06 (99)
---	------------

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

Space heating:

Fraction of space heat from secondary/supplementary system	0 (201)
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Fraction of space heat from main system(s)	(202) = 1 – (201) =	1 (202)
--	---------------------	---------

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

Efficiency of main space heating system 1	92.6 (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)

1526.71	1211.31	1016.26	574.43	238.51	0	0	0	0	634.74	1123.51	1556.87
---------	---------	---------	--------	--------	---	---	---	---	--------	---------	---------

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

1648.71	1308.11	1097.47	620.33	257.57	0	0	0	0	685.46	1213.29	1681.28		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												8512.22	(211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 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)

230.8	206.15	218.28	193.63	190.19	168.56	158.2	174.44	172.58	196.23	212.54	229.43
-------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

Efficiency of water heater	87.3 (216)
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(217)m=	89.81	89.77	89.67	89.45	88.89	87.3	87.3	87.3	87.3	89.5	89.73	89.82	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=	257	229.65	243.42	216.46	213.96	193.09	181.22	199.81	197.69	219.25	236.87	255.44	
Total = Sum(219a) _{1...12} =													2643.86 (219)

Annual totals

Space heating fuel used, main system 1	8512.22
--	---------

Water heating fuel used	2643.86
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Electricity for pumps, fans and electric keep-hot

central heating pump:	30 (230c)
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DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
Electricity for lighting		198.27	(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	0.21	= 1787.57 (261)
Space heating (secondary)	(215) x	0.136	= 0 (263)
Water heating	(219) x	0.21	= 555.21 (264)
Space and water heating	(261) + (262) + (263) + (264) =		2342.78 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	= 10.2 (267)
Electricity for lighting	(232) x	0.136	= 26.96 (268)
Total CO2, kg/year		sum of (265)...(271) =	2379.94 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	13.3 (273)
El rating (section 14)			86 (274)

Appendix 2 – DER Worksheets for the Modelled Units based on Heat Pumps

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Software Name: Stroma FSAP 10

Stroma Number:

Software Version:

Version: 1.0.0.37

Property Address: Nine Mile Ride 2BH 84 END ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	42.2	(1a) x	2.4	(2a) =	101.28
First floor	42.2	(1b) x	2.4	(2b) =	101.28
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	84.4	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	202.56

2. Ventilation rate:

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0
Number of open flues	0	+	0	+	0	=	0	x 20 =	0
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0
Number of blocked chimneys							0	x 20 =	0
Number of intermittent fans							2	x 10 =	20
Number of passive vents							0	x 10 =	0
Number of flueless gas fires							0	x 40 =	0

Air changes per hour

Infiltration due to chimneys, flues, fans, PSVs, etc. [(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.1	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>		
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 <i>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</i>	0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
If no draught lobby, enter 0.05, else enter 0	0	(13)
Percentage of windows and doors draught stripped	0	(14)
Window infiltration 0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>		
Number of sides sheltered	2	(19)
Shelter factor (20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor (21) = (18) x (20) =	0.3	(21)

DER WorkSheet: New dwelling design stage

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35
--	------	------	------	------	------	------	------	------	-----	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

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

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

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

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

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

(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.21	x 1.2	= 2.652		(26)
Windows Type 1			1.62	x1/[1/(1.2)+ 0.04]	= 1.85		(27)
Windows Type 2			0.71	x1/[1/(1.2)+ 0.04]	= 0.81		(27)
Windows Type 3			3.78	x1/[1/(1.2)+ 0.04]	= 4.33		(27)
Windows Type 4			0.71	x1/[1/(1.2)+ 0.04]	= 0.81		(27)
Windows Type 5			1.44	x1/[1/(1.2)+ 0.04]	= 1.65		(27)
Windows Type 6			0.82	x1/[1/(1.2)+ 0.04]	= 0.94		(27)
Windows Type 7			0.82	x1/[1/(1.2)+ 0.04]	= 0.94		(27)
Windows Type 8			1.44	x1/[1/(1.2)+ 0.04]	= 1.65		(27)
Windows Type 9			0.82	x1/[1/(1.2)+ 0.04]	= 0.94		(27)
Floor			42.2	x 0.13	= 5.486		(28)
Walls	88.85	15.08	73.77	x 0.18	= 13.28		(29)
Roof	42.2	0	42.2	x 0.1	= 4.22		(30)

DER WorkSheet: New dwelling design stage

Total area of elements, m² 173.25 (31)

Party wall 39.19 x 0 = 0 (32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 40.37 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 15025.44 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.15 (36)

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

Total fabric heat loss (33) + (36) = 53.52 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	38.2	38.01	37.83	36.98	36.82	36.07	36.07	35.94	36.36	36.82	37.14	37.48	(38)

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

(39)m=	91.72	91.53	91.35	90.5	90.34	89.6	89.6	89.46	89.88	90.34	90.66	91	
Average = Sum(39) _{1...12} /12=												90.5	(39)

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

(40)m=	1.09	1.08	1.08	1.07	1.07	1.06	1.06	1.06	1.06	1.07	1.07	1.08	
Average = Sum(40) _{1...12} /12=												1.07	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.54 (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

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	
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Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	
---------	------	------	------	------	------	------	-----	------	------	------	------	------	--

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	42.79	41.24	39.68	38.12	36.57	35.01	35.01	36.57	38.12	39.68	41.24	42.79	
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Annual average hot water usage in litres per day Vd,average (from Appendix J) 117.46 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	43.57	42.01	40.45	38.87	37.3	35.72	35.72	37.28	38.85	40.42	42.02	43.6	
Total = Sum(44) _{1...12} =												475.79	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	184.46	164.54	173.22	151.8	147.97	129.27	119.19	133.8	132.86	153.38	168.79	183.23	
Total = Sum(45) _{1...12} =												1842.51	(45)

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

(46)m=	27.67	24.68	25.98	22.77	22.2	19.39	17.88	20.07	19.93	23.01	25.32	27.48	(46)
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DER WorkSheet: New dwelling design stage

Water storage loss:

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

 (47)

If Heat network 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):

 (48)

Temperature factor from Table 2b

 (49)

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

 (50)

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

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

 (51)

If Heat network see section 4.3

Volume factor from Table 2a

 (52)

Temperature factor from Table 2b

 (53)

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

 (54)

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

 (55)

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

(56)m=

 (56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) - Vs] ÷ (47), else (57)m = (56)m

where Vs is V_{ww} from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=

 (57)

Primary circuit loss (annual) from Table 3

 (58)

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

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

(59)m=

 (59)

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

(61)m=

 (61)

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

(62)m=

 (62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating)

(63a)m=

 (63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=

 (63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=

 (63c)

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

(63b)m=

 (63b)

Output from water heater

(64)m=

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

 (64)

if (64)m < 0 then set to 0

Energy

 (64a)

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

 (64a)

(65)m=

 (65)

DER WorkSheet: New dwelling design stage

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

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=	127.05	127.05	127.05	127.05	127.05	127.05	127.05	127.05	127.05	127.05	127.05	127.05	(66)

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

(67)m=	7.35	6.53	5.31	4.02	3.01	2.54	2.74	3.56	4.78	6.08	7.09	7.56	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	228.39	230.76	224.79	212.07	196.02	180.94	170.86	168.49	174.47	187.18	203.23	218.31	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	(69)
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Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	-101.64	(71)
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Water heating gains (Table 5)

(72)m=	129.05	128.02	124.03	116.72	112.74	106.31	99.88	106.41	107.97	115.16	124.56	128.5	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	425.91	426.43	415.25	393.93	372.89	350.9	334.6	339.58	348.34	369.53	396	415.49	(73)
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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 m ²	Flux Table 6a			g_ Table 6b	FF Table 6c			Gains (W)	
North	0.9x	0.77	x	1.62	x	10.63	x	0.63	x	0.7	=	5.26	(74)
North	0.9x	0.77	x	1.44	x	10.63	x	0.63	x	0.7	=	4.68	(74)
North	0.9x	0.77	x	0.82	x	10.63	x	0.63	x	0.7	=	2.66	(74)
North	0.9x	0.77	x	1.62	x	20.32	x	0.63	x	0.7	=	10.06	(74)
North	0.9x	0.77	x	1.44	x	20.32	x	0.63	x	0.7	=	8.94	(74)
North	0.9x	0.77	x	0.82	x	20.32	x	0.63	x	0.7	=	5.09	(74)
North	0.9x	0.77	x	1.62	x	34.53	x	0.63	x	0.7	=	17.1	(74)
North	0.9x	0.77	x	1.44	x	34.53	x	0.63	x	0.7	=	15.2	(74)
North	0.9x	0.77	x	0.82	x	34.53	x	0.63	x	0.7	=	8.65	(74)
North	0.9x	0.77	x	1.62	x	55.46	x	0.63	x	0.7	=	27.46	(74)
North	0.9x	0.77	x	1.44	x	55.46	x	0.63	x	0.7	=	24.41	(74)
North	0.9x	0.77	x	0.82	x	55.46	x	0.63	x	0.7	=	13.9	(74)
North	0.9x	0.77	x	1.62	x	74.72	x	0.63	x	0.7	=	36.99	(74)
North	0.9x	0.77	x	1.44	x	74.72	x	0.63	x	0.7	=	32.88	(74)
North	0.9x	0.77	x	0.82	x	74.72	x	0.63	x	0.7	=	18.72	(74)
North	0.9x	0.77	x	1.62	x	79.99	x	0.63	x	0.7	=	39.6	(74)
North	0.9x	0.77	x	1.44	x	79.99	x	0.63	x	0.7	=	35.2	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	0.82	x	79.99	x	0.63	x	0.7	=	20.04	(74)
North	0.9x	0.77	x	1.62	x	74.68	x	0.63	x	0.7	=	36.97	(74)
North	0.9x	0.77	x	1.44	x	74.68	x	0.63	x	0.7	=	32.86	(74)
North	0.9x	0.77	x	0.82	x	74.68	x	0.63	x	0.7	=	18.71	(74)
North	0.9x	0.77	x	1.62	x	59.25	x	0.63	x	0.7	=	29.33	(74)
North	0.9x	0.77	x	1.44	x	59.25	x	0.63	x	0.7	=	26.07	(74)
North	0.9x	0.77	x	0.82	x	59.25	x	0.63	x	0.7	=	14.85	(74)
North	0.9x	0.77	x	1.62	x	41.52	x	0.63	x	0.7	=	20.55	(74)
North	0.9x	0.77	x	1.44	x	41.52	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	0.82	x	41.52	x	0.63	x	0.7	=	10.4	(74)
North	0.9x	0.77	x	1.62	x	24.19	x	0.63	x	0.7	=	11.98	(74)
North	0.9x	0.77	x	1.44	x	24.19	x	0.63	x	0.7	=	10.65	(74)
North	0.9x	0.77	x	0.82	x	24.19	x	0.63	x	0.7	=	6.06	(74)
North	0.9x	0.77	x	1.62	x	13.12	x	0.63	x	0.7	=	6.49	(74)
North	0.9x	0.77	x	1.44	x	13.12	x	0.63	x	0.7	=	5.77	(74)
North	0.9x	0.77	x	0.82	x	13.12	x	0.63	x	0.7	=	3.29	(74)
North	0.9x	0.77	x	1.62	x	8.86	x	0.63	x	0.7	=	4.39	(74)
North	0.9x	0.77	x	1.44	x	8.86	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	0.82	x	8.86	x	0.63	x	0.7	=	2.22	(74)
East	0.9x	0.77	x	0.71	x	19.64	x	0.63	x	0.7	=	8.52	(76)
East	0.9x		x		x		x		x		=		(76)
East	0.9x	0.77	x	0.71	x	38.42	x	0.63	x	0.7	=	16.67	(76)
East	0.9x	0.77	x	0.82	x	38.42	x	0.63	x	0.7	=	9.63	(76)
East	0.9x	0.77	x	0.71	x	63.27	x	0.63	x	0.7	=	27.46	(76)
East	0.9x	0.77	x	0.82	x	63.27	x	0.63	x	0.7	=	15.86	(76)
East	0.9x	0.77	x	0.71	x	92.28	x	0.63	x	0.7	=	40.05	(76)
East	0.9x	0.77	x	0.82	x	92.28	x	0.63	x	0.7	=	23.13	(76)
East	0.9x	0.77	x	0.71	x	113.09	x	0.63	x	0.7	=	49.08	(76)
East	0.9x	0.77	x	0.82	x	113.09	x	0.63	x	0.7	=	28.34	(76)
East	0.9x	0.77	x	0.71	x	115.77	x	0.63	x	0.7	=	50.24	(76)
East	0.9x	0.77	x	0.82	x	115.77	x	0.63	x	0.7	=	29.01	(76)
East	0.9x	0.77	x	0.71	x	110.22	x	0.63	x	0.7	=	47.83	(76)
East	0.9x	0.77	x	0.82	x	110.22	x	0.63	x	0.7	=	27.62	(76)
East	0.9x	0.77	x	0.71	x	94.68	x	0.63	x	0.7	=	41.09	(76)
East	0.9x	0.77	x	0.82	x	94.68	x	0.63	x	0.7	=	23.73	(76)
East	0.9x	0.77	x	0.71	x	73.59	x	0.63	x	0.7	=	31.94	(76)
East	0.9x	0.77	x	0.82	x	73.59	x	0.63	x	0.7	=	18.44	(76)
East	0.9x	0.77	x	0.71	x	45.59	x	0.63	x	0.7	=	19.78	(76)
East	0.9x	0.77	x	0.82	x	45.59	x	0.63	x	0.7	=	11.42	(76)
East	0.9x	0.77	x	0.71	x	24.49	x	0.63	x	0.7	=	10.63	(76)
East	0.9x	0.77	x	0.82	x	24.49	x	0.63	x	0.7	=	6.14	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	0.71	x	16.15	x	0.63	x	0.7	=	7.01	(76)
East	0.9x	0.77	x	0.82	x	16.15	x	0.63	x	0.7	=	4.05	(76)
South	0.9x	0.77	x	3.78	x	46.75	x	0.63	x	0.7	=	54.01	(78)
South	0.9x	0.77	x	0.71	x	46.75	x	0.63	x	0.7	=	10.14	(78)
South	0.9x	0.77	x	0.82	x	46.75	x	0.63	x	0.7	=	11.72	(78)
South	0.9x	0.77	x	1.44	x	46.75	x	0.63	x	0.7	=	20.57	(78)
South	0.9x	0.77	x	3.78	x	76.57	x	0.63	x	0.7	=	88.45	(78)
South	0.9x	0.77	x	0.71	x	76.57	x	0.63	x	0.7	=	16.61	(78)
South	0.9x	0.77	x	0.82	x	76.57	x	0.63	x	0.7	=	19.19	(78)
South	0.9x	0.77	x	1.44	x	76.57	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	3.78	x	97.53	x	0.63	x	0.7	=	112.67	(78)
South	0.9x	0.77	x	0.71	x	97.53	x	0.63	x	0.7	=	21.16	(78)
South	0.9x	0.77	x	0.82	x	97.53	x	0.63	x	0.7	=	24.44	(78)
South	0.9x	0.77	x	1.44	x	97.53	x	0.63	x	0.7	=	42.92	(78)
South	0.9x	0.77	x	3.78	x	110.23	x	0.63	x	0.7	=	127.34	(78)
South	0.9x	0.77	x	0.71	x	110.23	x	0.63	x	0.7	=	23.92	(78)
South	0.9x	0.77	x	0.82	x	110.23	x	0.63	x	0.7	=	27.63	(78)
South	0.9x	0.77	x	1.44	x	110.23	x	0.63	x	0.7	=	48.51	(78)
South	0.9x	0.77	x	3.78	x	114.87	x	0.63	x	0.7	=	132.7	(78)
South	0.9x	0.77	x	0.71	x	114.87	x	0.63	x	0.7	=	24.93	(78)
South	0.9x		x		x		x		x		=		(78)
South	0.9x	0.77	x	1.44	x	114.87	x	0.63	x	0.7	=	50.55	(78)
South	0.9x	0.77	x	3.78	x	110.55	x	0.63	x	0.7	=	127.71	(78)
South	0.9x	0.77	x	0.71	x	110.55	x	0.63	x	0.7	=	23.99	(78)
South	0.9x	0.77	x	0.82	x	110.55	x	0.63	x	0.7	=	27.7	(78)
South	0.9x	0.77	x	1.44	x	110.55	x	0.63	x	0.7	=	48.65	(78)
South	0.9x	0.77	x	3.78	x	108.01	x	0.63	x	0.7	=	124.78	(78)
South	0.9x	0.77	x	0.71	x	108.01	x	0.63	x	0.7	=	23.44	(78)
South	0.9x	0.77	x	0.82	x	108.01	x	0.63	x	0.7	=	27.07	(78)
South	0.9x	0.77	x	1.44	x	108.01	x	0.63	x	0.7	=	47.53	(78)
South	0.9x	0.77	x	3.78	x	104.89	x	0.63	x	0.7	=	121.18	(78)
South	0.9x	0.77	x	0.71	x	104.89	x	0.63	x	0.7	=	22.76	(78)
South	0.9x	0.77	x	0.82	x	104.89	x	0.63	x	0.7	=	26.29	(78)
South	0.9x	0.77	x	1.44	x	104.89	x	0.63	x	0.7	=	46.16	(78)
South	0.9x	0.77	x	3.78	x	101.89	x	0.63	x	0.7	=	117.7	(78)
South	0.9x	0.77	x	0.71	x	101.89	x	0.63	x	0.7	=	22.11	(78)
South	0.9x	0.77	x	0.82	x	101.89	x	0.63	x	0.7	=	25.53	(78)
South	0.9x	0.77	x	1.44	x	101.89	x	0.63	x	0.7	=	44.84	(78)
South	0.9x	0.77	x	3.78	x	82.59	x	0.63	x	0.7	=	95.4	(78)
South	0.9x	0.77	x	0.71	x	82.59	x	0.63	x	0.7	=	17.92	(78)
South	0.9x	0.77	x	0.82	x	82.59	x	0.63	x	0.7	=	20.7	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.44	x	82.59	x	0.63	x	0.7	=	36.34	(78)
South	0.9x	0.77	x	3.78	x	55.42	x	0.63	x	0.7	=	64.02	(78)
South	0.9x	0.77	x	0.71	x	55.42	x	0.63	x	0.7	=	12.02	(78)
South	0.9x	0.77	x	0.82	x	55.42	x	0.63	x	0.7	=	13.89	(78)
South	0.9x	0.77	x	1.44	x	55.42	x	0.63	x	0.7	=	24.39	(78)
South	0.9x	0.77	x	3.78	x	40.4	x	0.63	x	0.7	=	46.67	(78)
South	0.9x	0.77	x	0.71	x	40.4	x	0.63	x	0.7	=	8.77	(78)
South	0.9x	0.77	x	0.82	x	40.4	x	0.63	x	0.7	=	10.12	(78)
South	0.9x	0.77	x	1.44	x	40.4	x	0.63	x	0.7	=	17.78	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	122.5	208.35	285.46	356.34	402.98	402.15	386.82	351.45	309.79	230.26	146.64	104.9	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	548.41	634.78	700.71	750.27	775.87	753.05	721.42	691.03	658.12	599.79	542.64	520.39	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.71	0.54	0.58	0.82	0.96	0.99	1	(86)

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

(87)m=	19.73	19.92	20.18	20.51	20.79	20.95	20.99	20.99	20.89	20.53	20.07	19.7	(87)
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(88)m=	20.01	20.01	20.02	20.02	20.03	20.03	20.03	20.03	20.03	20.03	20.02	20.02	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.83	0.62	0.42	0.47	0.74	0.95	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.54	18.77	19.11	19.52	19.84	20	20.03	20.03	19.96	19.56	18.97	18.5	(90)
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fLA = Living area ÷ (4) = 0.13 (91)

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

(92)m=	18.69	18.91	19.24	19.65	19.96	20.12	20.15	20.15	20.07	19.68	19.11	18.65	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.69	18.91	19.24	19.65	19.96	20.12	20.15	20.15	20.07	19.68	19.11	18.65	(93)
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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.97	0.93	0.83	0.63	0.44	0.48	0.75	0.94	0.99	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	545.24	626.81	680.74	696.72	640.26	475.57	315.85	331.77	491.01	564.49	535.81	518.06	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m]

(97)m=	1319.55	1282.69	1164.12	972.46	746.49	494.75	318.07	335.37	536.92	820.34	1089.05	1314.89	(97)
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DER WorkSheet: New dwelling design stage

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(97a)m=	576.09	440.75	359.64	198.54	79.04	0	0	0	0	190.35	398.33	592.84	
Total per year (kWh/year) = Sum(97a) _{1...5,9...12} =													2835.58 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total per year (kWh/year) = Sum(97b) _{1...5,9...12} =													0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	576.09	440.75	359.64	198.54	79.04	0	0	0	0	190.35	398.33	592.84	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =													2835.58 (98)

Space heating requirement in kWh/m ² /year	33.6 (99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0 (201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1 (202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1 (204)
Efficiency of main space heating system 1		281.56 (206)
Efficiency of secondary/supplementary heating system, %		0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

576.09	440.75	359.64	198.54	79.04	0	0	0	0	190.35	398.33	592.84
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(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

204.61	156.54	127.73	70.51	28.07	0	0	0	0	67.61	141.48	210.56		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												1007.11	(211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(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)

227.81	203.69	216.57	193.75	191.32	171.22	162.54	177.15	174.81	196.73	210.74	226.58
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater 258.21 (216)

(217)m=	258.21	258.21	258.21	258.21	258.21	258.21	258.21	258.21	258.21	258.21	258.21	258.21	(217)
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Fuel for water heating, kWh/month

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	88.23	78.89	83.88	75.04	74.1	66.31	62.95	68.61	67.7	76.19	81.62	87.75	
Total = Sum(219a) _{1...12} =													911.25 (219)

Annual totals

Space heating fuel used, main system 1 kWh/year 1007.11

Water heating fuel used kWh/year 911.25

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year sum of (230a)...(230g) = 0 (231)

DER WorkSheet: New dwelling design stage

Electricity for lighting

129.88

(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	0.136	=	136.97 (261)
Space heating (secondary)	(215) x	0.136	=	0 (263)
Water heating	(219) x	0.136	=	123.93 (264)
Space and water heating	(261) + (262) + (263) + (264) =			260.9 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	0 (267)
Electricity for lighting	(232) x	0.136	=	17.66 (268)
Total CO2, kg/year	sum of (265)...(271) =			278.56 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			3.3 (273)
El rating (section 14)				97 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Software Name: Stroma FSAP 10

Stroma Number:

Software Version:

Version: 1.0.0.37

Property Address: Nine Mile Ride 3BH 123 END ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	49.62 (1a)	x	2.4 (2a)	=	119.09 (3a)
First floor	73.68 (1b)	x	2.4 (2b)	=	176.83 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	123.3 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	295.92 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m ³ 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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0 (6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0 (6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0 (6e)
Number of blocked chimneys							0	x 20 =	0 (6f)
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, fans, PSVs, etc. [(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.1 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>	
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 <i>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</i>	0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0 (12)
If no draught lobby, enter 0.05, else enter 0	0 (13)
Percentage of windows and doors draught stripped	0 (14)
Window infiltration 0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.35 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>	
Number of sides sheltered	2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor (21) = (18) x (20) =	0.3 (21)

DER WorkSheet: New dwelling design stage

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35
--	------	------	------	------	------	------	------	------	-----	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.21	x 1.2	= 2.652		(26)
Windows Type 1			1.62	x1/[1/(1.2)+ 0.04]	= 1.85		(27)
Windows Type 2			0.92	x1/[1/(1.2)+ 0.04]	= 1.05		(27)
Windows Type 3			0.71	x1/[1/(1.2)+ 0.04]	= 0.81		(27)
Windows Type 4			3.78	x1/[1/(1.2)+ 0.04]	= 4.33		(27)
Windows Type 5			1.44	x1/[1/(1.2)+ 0.04]	= 1.65		(27)
Windows Type 6			1.44	x1/[1/(1.2)+ 0.04]	= 1.65		(27)
Windows Type 7			1.44	x1/[1/(1.2)+ 0.04]	= 1.65		(27)
Windows Type 8			0.71	x1/[1/(1.2)+ 0.04]	= 0.81		(27)
Windows Type 9			0.82	x1/[1/(1.2)+ 0.04]	= 0.94		(27)
Floor Type 1			49.62	x 0.13	= 6.4506		(28)
Floor Type 2			24.06	x 0.15	= 3.609		(28)
Walls	124.29	18.68	105.61	x 0.18	= 19.01		(29)

DER WorkSheet: New dwelling design stage

Roof	73.68	0	73.68	x	0.1	=	7.37			(30)
Total area of elements, m ²			271.65							(31)
Party wall			46.18	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U)	(26)...(30) + (32) =	57.95	(33)
Heat capacity Cm = S(A x k)	((28)...(30) + (32) + (32a)...(32e) =	19513.86	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		18.75	(36)
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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	76.7	(37)
Ventilation heat loss calculated monthly	(38)m = 0.33 x (25)m x (5)		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	55.91	55.63	55.36	54.1	53.86	52.76	52.76	52.55	53.18	53.86	54.34	54.84	(38)

Heat transfer coefficient, W/K											(39)m = (37) + (38)m		
(39)m=	132.61	132.33	132.06	130.8	130.56	129.46	129.46	129.25	129.88	130.56	131.04	131.54	
Average = Sum(39) _{1...12} /12=												130.8	(39)

Heat loss parameter (HLP), W/m ² K											(40)m = (39)m ÷ (4)		
(40)m=	1.08	1.07	1.07	1.06	1.06	1.05	1.05	1.05	1.05	1.06	1.06	1.07	
Average = Sum(40) _{1...12} /12=												1.06	(40)

Number of days in month (Table 1a)													
(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	2.88	(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		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)													
(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)													
(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)													
(42c)m=	46.39	44.71	43.02	41.33	39.65	37.96	37.96	39.65	41.33	43.02	44.71	46.39	

Annual average hot water usage in litres per day Vd,average (from Appendix J)	127.35	(43)
Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)		

(44)m=	47.17	45.48	43.79	42.07	40.37	38.67	38.66	40.36	42.05	43.76	45.49	47.2	
	Total = Sum(44) _{1...12} =											515.08	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	199.99	178.39	187.8	164.58	160.43	140.15	129.23	145.06	144.05	166.29	183	198.65	
	Total = Sum(45) _{1...12} =											1997.61	(45)

DER WorkSheet: New dwelling design stage

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

(46)m=

30	26.76	28.17	24.69	24.06	21.02	19.38	21.76	21.61	24.94	27.45	29.8
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 (46)

Water storage loss:

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

200

 (47)

If Heat network 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):

1.2

 (48)

Temperature factor from Table 2b

0.54

 (49)

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

0.65

 (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 Heat network 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)

0.65

 (55)

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

(56)m=

20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09
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 (56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) - Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=

20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (57)

Primary circuit loss (annual) from Table 3

0

 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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 x (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 x (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

243.34	217.54	231.16	206.53	203.78	182.1	172.58	188.41	186	209.64	224.95	242
--------	--------	--------	--------	--------	-------	--------	--------	-----	--------	--------	-----

 (62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating)

(63a)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=

--	--	--	--	--	--	--	--	--	--	--	--

 (63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63c)

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

(63b)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63b)

Output from water heater

(64)m=

243.34	217.54	231.16	206.53	203.78	182.1	172.58	188.41	186	209.64	224.95	242
--------	--------	--------	--------	--------	-------	--------	--------	-----	--------	--------	-----

Output from water heater (annual) _{1...12}	2508.02
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 (64)

if (64)m < 0 then set to 0

DER WorkSheet: New dwelling design stage

Energy	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$ 0 (64a)

(65)m= 101.18 90.64 97.13 88.28 88.02 80.16 77.65 82.91 81.46 89.97 94.41 100.73 (65)

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

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=	143.76	143.76	143.76	143.76	143.76	143.76	143.76	143.76	143.76	143.76	143.76	143.76	(66)

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

(67)m=	9.61	8.54	6.95	5.26	3.93	3.32	3.59	4.66	6.26	7.94	9.27	9.88	(67)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(68)m=	289.45	292.45	284.88	268.77	248.43	229.31	216.54	213.54	221.11	237.22	257.56	276.68	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	(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=	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	-115.01	(71)
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

(72)m=	135.99	134.88	130.54	122.62	118.31	111.34	104.37	111.44	113.13	120.93	131.12	135.39	(72)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Total internal gains =

(73)m=	501.18	502	488.5	462.77	436.8	410.1	390.62	395.77	406.63	432.22	464.08	488.08	(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)	
East	0.9x	0.77	x	1.62	x	19.64	x	0.63	x	0.7	=	9.72	(76)
East	0.9x	0.77	x	0.92	x	19.64	x	0.63	x	0.7	=	5.52	(76)
East	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	17.29	(76)
East	0.9x	0.77	x	0.71	x	19.64	x	0.63	x	0.7	=	4.26	(76)
East	0.9x	0.77	x	0.82	x	19.64	x	0.63	x	0.7	=	4.92	(76)
East	0.9x	0.77	x	1.62	x	38.42	x	0.63	x	0.7	=	19.02	(76)
East	0.9x	0.77	x	0.92	x	38.42	x	0.63	x	0.7	=	10.8	(76)
East	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	33.82	(76)
East	0.9x	0.77	x	0.71	x	38.42	x	0.63	x	0.7	=	8.34	(76)
East	0.9x	0.77	x	0.82	x	38.42	x	0.63	x	0.7	=	9.63	(76)
East	0.9x	0.77	x	1.62	x	63.27	x	0.63	x	0.7	=	31.33	(76)
East	0.9x	0.77	x	0.92	x	63.27	x	0.63	x	0.7	=	17.79	(76)
East	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	55.69	(76)
East	0.9x	0.77	x	0.71	x	63.27	x	0.63	x	0.7	=	13.73	(76)
East	0.9x	0.77	x	0.82	x	63.27	x	0.63	x	0.7	=	15.86	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	1.62	x	92.28	x	0.63	x	0.7	=	45.69	(76)
East	0.9x	0.77	x	0.92	x	92.28	x	0.63	x	0.7	=	25.95	(76)
East	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	81.22	(76)
East	0.9x	0.77	x	0.71	x	92.28	x	0.63	x	0.7	=	20.02	(76)
East	0.9x	0.77	x	0.82	x	92.28	x	0.63	x	0.7	=	23.13	(76)
East	0.9x	0.77	x	1.62	x	113.09	x	0.63	x	0.7	=	55.99	(76)
East	0.9x	0.77	x	0.92	x	113.09	x	0.63	x	0.7	=	31.8	(76)
East	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	99.54	(76)
East	0.9x	0.77	x	0.71	x	113.09	x	0.63	x	0.7	=	24.54	(76)
East	0.9x	0.77	x	0.82	x	113.09	x	0.63	x	0.7	=	28.34	(76)
East	0.9x	0.77	x	1.62	x	115.77	x	0.63	x	0.7	=	57.32	(76)
East	0.9x	0.77	x	0.92	x	115.77	x	0.63	x	0.7	=	32.55	(76)
East	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	101.9	(76)
East	0.9x	0.77	x	0.71	x	115.77	x	0.63	x	0.7	=	25.12	(76)
East	0.9x	0.77	x	0.82	x	115.77	x	0.63	x	0.7	=	29.01	(76)
East	0.9x	0.77	x	1.62	x	110.22	x	0.63	x	0.7	=	54.57	(76)
East	0.9x	0.77	x	0.92	x	110.22	x	0.63	x	0.7	=	30.99	(76)
East	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	97.01	(76)
East	0.9x	0.77	x	0.71	x	110.22	x	0.63	x	0.7	=	23.92	(76)
East	0.9x	0.77	x	0.82	x	110.22	x	0.63	x	0.7	=	27.62	(76)
East	0.9x		x		x		x		x		=		(76)
East	0.9x	0.77	x	0.92	x	94.68	x	0.63	x	0.7	=	26.62	(76)
East	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	83.33	(76)
East	0.9x	0.77	x	0.71	x	94.68	x	0.63	x	0.7	=	20.54	(76)
East	0.9x	0.77	x	0.82	x	94.68	x	0.63	x	0.7	=	23.73	(76)
East	0.9x	0.77	x	1.62	x	73.59	x	0.63	x	0.7	=	36.43	(76)
East	0.9x	0.77	x	0.92	x	73.59	x	0.63	x	0.7	=	20.69	(76)
East	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	64.77	(76)
East	0.9x	0.77	x	0.71	x	73.59	x	0.63	x	0.7	=	15.97	(76)
East	0.9x	0.77	x	0.82	x	73.59	x	0.63	x	0.7	=	18.44	(76)
East	0.9x	0.77	x	1.62	x	45.59	x	0.63	x	0.7	=	22.57	(76)
East	0.9x	0.77	x	0.92	x	45.59	x	0.63	x	0.7	=	12.82	(76)
East	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	40.13	(76)
East	0.9x	0.77	x	0.71	x	45.59	x	0.63	x	0.7	=	9.89	(76)
East	0.9x	0.77	x	0.82	x	45.59	x	0.63	x	0.7	=	11.42	(76)
East	0.9x	0.77	x	1.62	x	24.49	x	0.63	x	0.7	=	12.12	(76)
East	0.9x	0.77	x	0.92	x	24.49	x	0.63	x	0.7	=	6.89	(76)
East	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	21.55	(76)
East	0.9x	0.77	x	0.71	x	24.49	x	0.63	x	0.7	=	5.31	(76)
East	0.9x	0.77	x	0.82	x	24.49	x	0.63	x	0.7	=	6.14	(76)
East	0.9x	0.77	x	1.62	x	16.15	x	0.63	x	0.7	=	8	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	0.92	x	16.15	x	0.63	x	0.7	=	4.54	(76)
East	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	14.22	(76)
East	0.9x	0.77	x	0.71	x	16.15	x	0.63	x	0.7	=	3.5	(76)
East	0.9x	0.77	x	0.82	x	16.15	x	0.63	x	0.7	=	4.05	(76)
West	0.9x	0.77	x	0.71	x	19.64	x	0.63	x	0.7	=	8.52	(80)
West	0.9x	0.77	x	3.78	x	19.64	x	0.63	x	0.7	=	22.69	(80)
West	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	17.29	(80)
West	0.9x	0.77	x	1.44	x	19.64	x	0.63	x	0.7	=	8.64	(80)
West	0.9x	0.77	x	0.71	x	38.42	x	0.63	x	0.7	=	16.67	(80)
West	0.9x	0.77	x	3.78	x	38.42	x	0.63	x	0.7	=	44.38	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	33.82	(80)
West	0.9x	0.77	x	1.44	x	38.42	x	0.63	x	0.7	=	16.91	(80)
West	0.9x	0.77	x	0.71	x	63.27	x	0.63	x	0.7	=	27.46	(80)
West	0.9x	0.77	x	3.78	x	63.27	x	0.63	x	0.7	=	73.09	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	55.69	(80)
West	0.9x	0.77	x	1.44	x	63.27	x	0.63	x	0.7	=	27.85	(80)
West	0.9x	0.77	x	0.71	x	92.28	x	0.63	x	0.7	=	40.05	(80)
West	0.9x	0.77	x	3.78	x	92.28	x	0.63	x	0.7	=	106.6	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	81.22	(80)
West	0.9x	0.77	x	1.44	x	92.28	x	0.63	x	0.7	=	40.61	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	3.78	x	113.09	x	0.63	x	0.7	=	130.65	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	99.54	(80)
West	0.9x	0.77	x	1.44	x	113.09	x	0.63	x	0.7	=	49.77	(80)
West	0.9x	0.77	x	0.71	x	115.77	x	0.63	x	0.7	=	50.24	(80)
West	0.9x	0.77	x	3.78	x	115.77	x	0.63	x	0.7	=	133.74	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	101.9	(80)
West	0.9x	0.77	x	1.44	x	115.77	x	0.63	x	0.7	=	50.95	(80)
West	0.9x	0.77	x	0.71	x	110.22	x	0.63	x	0.7	=	47.83	(80)
West	0.9x	0.77	x	3.78	x	110.22	x	0.63	x	0.7	=	127.33	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	97.01	(80)
West	0.9x	0.77	x	1.44	x	110.22	x	0.63	x	0.7	=	48.51	(80)
West	0.9x	0.77	x	0.71	x	94.68	x	0.63	x	0.7	=	41.09	(80)
West	0.9x	0.77	x	3.78	x	94.68	x	0.63	x	0.7	=	109.37	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	83.33	(80)
West	0.9x	0.77	x	1.44	x	94.68	x	0.63	x	0.7	=	41.67	(80)
West	0.9x	0.77	x	0.71	x	73.59	x	0.63	x	0.7	=	31.94	(80)
West	0.9x	0.77	x	3.78	x	73.59	x	0.63	x	0.7	=	85.01	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	64.77	(80)
West	0.9x	0.77	x	1.44	x	73.59	x	0.63	x	0.7	=	32.39	(80)
West	0.9x	0.77	x	0.71	x	45.59	x	0.63	x	0.7	=	19.78	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	3.78	x	45.59	x	0.63	x	0.7	=	52.67	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	40.13	(80)
West	0.9x	0.77	x	1.44	x	45.59	x	0.63	x	0.7	=	20.06	(80)
West	0.9x	0.77	x	0.71	x	24.49	x	0.63	x	0.7	=	10.63	(80)
West	0.9x	0.77	x	3.78	x	24.49	x	0.63	x	0.7	=	28.29	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	21.55	(80)
West	0.9x	0.77	x	1.44	x	24.49	x	0.63	x	0.7	=	10.78	(80)
West	0.9x	0.77	x	0.71	x	16.15	x	0.63	x	0.7	=	7.01	(80)
West	0.9x	0.77	x	3.78	x	16.15	x	0.63	x	0.7	=	18.66	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	14.22	(80)
West	0.9x	0.77	x	1.44	x	16.15	x	0.63	x	0.7	=	7.11	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	98.86	193.39	318.48	464.49	569.25	582.72	554.78	476.55	370.41	229.47	123.26	81.3	(83)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------	------

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

(84)m=	600.04	695.39	806.98	927.26	1006.05	992.82	945.4	872.31	777.03	661.69	587.35	569.38	(84)
--------	--------	--------	--------	--------	---------	--------	-------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.91	0.76	0.59	0.65	0.9	0.99	1	1	(86)

(87)m=	19.58	19.73	20.02	20.4	20.74	20.93	20.99	20.98	20.82	20.38	19.91	19.55	(87)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	20.02	20.02	20.02	20.03	20.03	20.04	20.04	20.04	20.04	20.03	20.03	20.03	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	1	0.99	0.97	0.87	0.67	0.47	0.53	0.84	0.98	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(90)m=	18.34	18.54	18.91	19.4	19.8	20	20.04	20.03	19.9	19.38	18.77	18.31	(90)
--------	-------	-------	-------	------	------	----	-------	-------	------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.12

(91)

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

(92)m=	18.49	18.69	19.04	19.52	19.91	20.11	20.15	20.15	20.01	19.5	18.91	18.46	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(93)m=	18.49	18.69	19.04	19.52	19.91	20.11	20.15	20.15	20.01	19.5	18.91	18.46	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.96	0.87	0.68	0.48	0.54	0.84	0.98	1	1	(94)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(95)m=	599.09	692.82	797.88	889.04	873.77	675.4	454.86	475.23	651.76	647.43	585.31	568.69	(95)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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DER WorkSheet: New dwelling design stage

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]$

(97)m=

1881.58	1824.32	1656.31	1388.72	1071.92	713.65	459.69	484.34	768.23	1161.37	1547.65	1876.06
---------	---------	---------	---------	---------	--------	--------	--------	--------	---------	---------	---------

 (97)

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(97a)m=

954.17	760.37	638.67	359.77	147.42	0	0	0	0	382.37	692.88	972.68
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

Total per year (kWh/year) = Sum(97a)_{1...5,9...12} =

4908.34

 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

Total per year (kWh/year) = Sum(97b)_{1...5,9...12} =

0

 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=

954.17	760.37	638.67	359.77	147.42	0	0	0	0	382.37	692.88	972.68
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

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

4908.34

 (98)

Space heating requirement in kWh/m²/year

39.81

 (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) = $(202) \times [1 - (203)] =$

1

 (204)

Efficiency of main space heating system 1

330.07

 (206)

Efficiency of secondary/supplementary heating system, %

0

 (208)

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

 kWh/year

954.17	760.37	638.67	359.77	147.42	0	0	0	0	382.37	692.88	972.68
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

289.08	230.37	193.5	109	44.66	0	0	0	0	115.85	209.92	294.69
--------	--------	-------	-----	-------	---	---	---	---	--------	--------	--------

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

1487.06

 (211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)]\} \times 100 \div (208)$
(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)

243.34	217.54	231.16	206.53	203.78	182.1	172.58	188.41	186	209.64	224.95	242
--------	--------	--------	--------	--------	-------	--------	--------	-----	--------	--------	-----

Efficiency of water heater

281.96

 (216)

(217)m=

281.96	281.96	281.96	281.96	281.96	281.96	281.96	281.96	281.96	281.96	281.96	281.96
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (217)

Fuel for water heating, kWh/month

(219)m = $(64)m \times 100 \div (217)m$
(219)m=

86.3	77.15	81.98	73.25	72.27	64.58	61.21	66.82	65.97	74.35	79.78	85.83
------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

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

889.5

 (219)

Annual totals

Space heating fuel used, main system 1

1487.06

 kWh/year

Water heating fuel used

889.5

 kWh/year

Electricity for pumps, fans and electric keep-hot

DER WorkSheet: New dwelling design stage

Total electricity for the above, kWh/year	sum of (230a)...(230g) =	0	(231)
Electricity for lighting		169.8	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.136	=	202.24	(261)
Space heating (secondary)	(215) x	0.136	=	0	(263)
Water heating	(219) x	0.136	=	120.97	(264)
Space and water heating	(261) + (262) + (263) + (264) =			323.21	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	0	(267)
Electricity for lighting	(232) x	0.136	=	23.09	(268)
Total CO2, kg/year		sum of (265)...(271) =		346.31	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		2.81	(273)
El rating (section 14)				97	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 10

Software Version:

Version: 1.0.0.37

Property Address: Nine Mile Ride 3BH 140 DET ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	58.01 (1a)	x	2.4 (2a)	=	139.22 (3a)
First floor	82.01 (1b)	x	2.4 (2b)	=	196.82 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	140.02 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	336.05 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m ³ 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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0 (6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0 (6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0 (6e)
Number of blocked chimneys							0	x 20 =	0 (6f)
Number of intermittent fans							4	x 10 =	40 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues, fans, PSVs, etc. [(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.12 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>	
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 <i>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</i>	0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0 (12)
If no draught lobby, enter 0.05, else enter 0	0 (13)
Percentage of windows and doors draught stripped	0 (14)
Window infiltration 0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.37 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>	
Number of sides sheltered	2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor (21) = (18) x (20) =	0.31 (21)

DER WorkSheet: New dwelling design stage

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.4	0.39	0.38	0.35	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37
--	-----	------	------	------	------	-----	-----	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

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

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

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

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

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

(24d)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.21	x 1.2	= 2.652		(26)
Windows Type 1			1.37	x1/[1/(1.2)+ 0.04]	= 1.57		(27)
Windows Type 2			1.22	x1/[1/(1.2)+ 0.04]	= 1.4		(27)
Windows Type 3			2.16	x1/[1/(1.2)+ 0.04]	= 2.47		(27)
Windows Type 4			5.25	x1/[1/(1.2)+ 0.04]	= 6.01		(27)
Windows Type 5			1.22	x1/[1/(1.2)+ 0.04]	= 1.4		(27)
Windows Type 6			1.92	x1/[1/(1.2)+ 0.04]	= 2.2		(27)
Windows Type 7			1.09	x1/[1/(1.2)+ 0.04]	= 1.25		(27)
Windows Type 8			0.82	x1/[1/(1.2)+ 0.04]	= 0.94		(27)
Windows Type 9			1.92	x1/[1/(1.2)+ 0.04]	= 2.2		(27)
Floor Type 1			58.01	x 0.13	= 7.541299		(28)
Floor Type 2			24	x 0.15	= 3.6		(28)
Walls	174.6	24.94	149.66	x 0.18	= 26.94		(29)

DER WorkSheet: New dwelling design stage

Roof 82.01 0 82.01 × 0.1 = 8.2 (30)

Total area of elements, m² 338.62 (31)

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

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

Fabric heat loss, W/K = S (A × U) (26)...(30) + (32) = 74.96 (33)

Heat capacity Cm = S(A × k) ((28)...(30) + (32) + (32a)...(32e) = 14548.44 (34)

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

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

Thermal bridges : S (L × Y) calculated using Appendix K 18.53 (36)

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

Total fabric heat loss (33) + (36) = 93.49 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	64.32	63.97	63.63	62.05	61.75	60.37	60.37	60.12	60.9	61.75	62.35	62.98	(38)

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

(39)m=	157.81	157.47	157.13	155.54	155.25	153.86	153.86	153.61	154.4	155.25	155.85	156.47	
	Average = Sum(39) _{1...12} /12=											155.54	(39)

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

(40)m=	1.13	1.12	1.12	1.11	1.11	1.1	1.1	1.1	1.1	1.11	1.11	1.12	
	Average = Sum(40) _{1...12} /12=											1.11	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.92 (42)

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

if TFA ≤ 13.9, N = 1

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0
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Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81
---------	------	------	------	------	------	------	-----	------	------	------	------	------

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	46.85	45.14	43.44	41.74	40.03	38.33	38.33	40.03	41.74	43.44	45.14	46.85
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Annual average hot water usage in litres per day Vd,average (from Appendix J) 128.59 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	47.62	45.91	44.2	42.48	40.76	39.04	39.03	40.74	42.46	44.18	45.92	47.65	
	Total = Sum(44) _{1...12} =											520.01	(44)

Energy content of hot water used = 4.18 × Vd,m × nm × DTm / 3600 kWh/month (from Appendix J)

(45)m=	201.94	180.12	189.63	166.18	161.99	141.51	130.48	146.47	145.45	167.91	184.78	200.58	
	Total = Sum(45) _{1...12} =											2017.06	(45)

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

(46)m=	30.29	27.02	28.45	24.93	24.3	21.23	19.57	21.97	21.82	25.19	27.72	30.09	(46)
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DER WorkSheet: New dwelling design stage

Water storage loss:

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

300

(47)

If Heat network 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):

1.2

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0.65

(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 Heat network 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)

0.65

(55)

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

(56)m=

20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09
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(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) - Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=

20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09
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(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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 x (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 x (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

245.29	219.28	232.98	208.13	205.34	183.47	173.84	189.82	187.4	211.26	226.73	243.93
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating)

(63a)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=

--	--	--	--	--	--	--	--	--	--	--	--

(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(63c)

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

(63b)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

(63b)

Output from water heater

(64)m=

245.29	219.28	232.98	208.13	205.34	183.47	173.84	189.82	187.4	211.26	226.73	243.93
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

Output from water heater (annual) 1...12

2527.48

(64)

if (64)m < 0 then set to 0

Energy

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

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

(65)m=

101.82	91.21	97.73	88.82	88.54	80.62	78.07	83.38	81.92	90.51	95	101.37
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(65)

DER WorkSheet: New dwelling design stage

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	145.86	145.86	145.86	145.86	145.86	145.86	145.86	145.86	145.86	145.86	145.86	145.86	(66)

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

(67)m=	9.97	8.85	7.2	5.45	4.08	3.44	3.72	4.83	6.49	8.23	9.61	10.25	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	309.43	312.65	304.55	287.33	265.58	245.15	231.49	228.28	236.37	253.6	275.34	295.78	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

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

Pumps and fans gains (Table 5a)

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

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

(71)m=	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	-116.68	(71)
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

(72)m=	136.86	135.74	131.36	123.36	119.01	111.97	104.93	112.07	113.78	121.65	131.95	136.26	(72)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(73)m=	523.02	523.99	509.87	482.89	455.42	427.31	406.9	411.94	423.4	450.25	483.66	509.04	(73)
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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 m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	0.77	x	5.25	x	19.64	x	0.63	x	0.7	=	31.51 (76)
East	0.9x	0.77	x	1.22	x	19.64	x	0.63	x	0.7	=	7.32 (76)
East	0.9x	0.77	x	1.92	x	19.64	x	0.63	x	0.7	=	34.57 (76)
East	0.9x	0.77	x	5.25	x	38.42	x	0.63	x	0.7	=	61.64 (76)
East	0.9x	0.77	x	1.22	x	38.42	x	0.63	x	0.7	=	14.33 (76)
East	0.9x	0.77	x	1.92	x	38.42	x	0.63	x	0.7	=	67.63 (76)
East	0.9x	0.77	x	5.25	x	63.27	x	0.63	x	0.7	=	101.52 (76)
East	0.9x	0.77	x	1.22	x	63.27	x	0.63	x	0.7	=	23.59 (76)
East	0.9x	0.77	x	1.92	x	63.27	x	0.63	x	0.7	=	111.38 (76)
East	0.9x	0.77	x	5.25	x	92.28	x	0.63	x	0.7	=	148.06 (76)
East	0.9x	0.77	x	1.22	x	92.28	x	0.63	x	0.7	=	34.41 (76)
East	0.9x	0.77	x	1.92	x	92.28	x	0.63	x	0.7	=	162.44 (76)
East	0.9x	0.77	x	5.25	x	113.09	x	0.63	x	0.7	=	181.45 (76)
East	0.9x	0.77	x	1.22	x	113.09	x	0.63	x	0.7	=	42.17 (76)
East	0.9x	0.77	x	1.92	x	113.09	x	0.63	x	0.7	=	199.08 (76)
East	0.9x	0.77	x	5.25	x	115.77	x	0.63	x	0.7	=	185.75 (76)
East	0.9x	0.77	x	1.22	x	115.77	x	0.63	x	0.7	=	43.16 (76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	1.92	x	115.77	x	0.63	x	0.7	=	203.79	(76)
East	0.9x	0.77	x	5.25	x	110.22	x	0.63	x	0.7	=	176.84	(76)
East	0.9x	0.77	x	1.22	x	110.22	x	0.63	x	0.7	=	41.09	(76)
East	0.9x	0.77	x	1.92	x	110.22	x	0.63	x	0.7	=	194.02	(76)
East	0.9x	0.77	x	5.25	x	94.68	x	0.63	x	0.7	=	151.9	(76)
East	0.9x	0.77	x	1.22	x	94.68	x	0.63	x	0.7	=	35.3	(76)
East	0.9x	0.77	x	1.92	x	94.68	x	0.63	x	0.7	=	166.66	(76)
East	0.9x	0.77	x	5.25	x	73.59	x	0.63	x	0.7	=	118.07	(76)
East	0.9x	0.77	x	1.22	x	73.59	x	0.63	x	0.7	=	27.44	(76)
East	0.9x	0.77	x	1.92	x	73.59	x	0.63	x	0.7	=	129.54	(76)
East	0.9x	0.77	x	5.25	x	45.59	x	0.63	x	0.7	=	73.15	(76)
East	0.9x	0.77	x	1.22	x	45.59	x	0.63	x	0.7	=	17	(76)
East	0.9x	0.77	x	1.92	x	45.59	x	0.63	x	0.7	=	80.25	(76)
East	0.9x	0.77	x	5.25	x	24.49	x	0.63	x	0.7	=	39.29	(76)
East	0.9x	0.77	x	1.22	x	24.49	x	0.63	x	0.7	=	9.13	(76)
East	0.9x	0.77	x	1.92	x	24.49	x	0.63	x	0.7	=	43.11	(76)
East	0.9x	0.77	x	5.25	x	16.15	x	0.63	x	0.7	=	25.91	(76)
East	0.9x	0.77	x	1.22	x	16.15	x	0.63	x	0.7	=	6.02	(76)
East	0.9x	0.77	x	1.92	x	16.15	x	0.63	x	0.7	=	28.43	(76)
West	0.9x	0.77	x	1.37	x	19.64	x	0.63	x	0.7	=	8.22	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	2.16	x	19.64	x	0.63	x	0.7	=	12.97	(80)
West	0.9x	0.77	x	1.92	x	19.64	x	0.63	x	0.7	=	23.05	(80)
West	0.9x	0.77	x	1.09	x	19.64	x	0.63	x	0.7	=	6.54	(80)
West	0.9x	0.77	x	0.82	x	19.64	x	0.63	x	0.7	=	4.92	(80)
West	0.9x	0.77	x	1.37	x	38.42	x	0.63	x	0.7	=	16.09	(80)
West	0.9x	0.77	x	1.22	x	38.42	x	0.63	x	0.7	=	14.33	(80)
West	0.9x	0.77	x	2.16	x	38.42	x	0.63	x	0.7	=	25.36	(80)
West	0.9x	0.77	x	1.92	x	38.42	x	0.63	x	0.7	=	45.09	(80)
West	0.9x	0.77	x	1.09	x	38.42	x	0.63	x	0.7	=	12.8	(80)
West	0.9x	0.77	x	0.82	x	38.42	x	0.63	x	0.7	=	9.63	(80)
West	0.9x	0.77	x	1.37	x	63.27	x	0.63	x	0.7	=	26.49	(80)
West	0.9x	0.77	x	1.22	x	63.27	x	0.63	x	0.7	=	23.59	(80)
West	0.9x	0.77	x	2.16	x	63.27	x	0.63	x	0.7	=	41.77	(80)
West	0.9x	0.77	x	1.92	x	63.27	x	0.63	x	0.7	=	74.25	(80)
West	0.9x	0.77	x	1.09	x	63.27	x	0.63	x	0.7	=	21.08	(80)
West	0.9x	0.77	x	0.82	x	63.27	x	0.63	x	0.7	=	15.86	(80)
West	0.9x	0.77	x	1.37	x	92.28	x	0.63	x	0.7	=	38.64	(80)
West	0.9x	0.77	x	1.22	x	92.28	x	0.63	x	0.7	=	34.41	(80)
West	0.9x	0.77	x	2.16	x	92.28	x	0.63	x	0.7	=	60.92	(80)
West	0.9x	0.77	x	1.92	x	92.28	x	0.63	x	0.7	=	108.3	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	1.09	x	92.28	x	0.63	x	0.7	=	30.74	(80)
West	0.9x	0.77	x	0.82	x	92.28	x	0.63	x	0.7	=	23.13	(80)
West	0.9x	0.77	x	1.37	x	113.09	x	0.63	x	0.7	=	47.35	(80)
West	0.9x	0.77	x	1.22	x	113.09	x	0.63	x	0.7	=	42.17	(80)
West	0.9x	0.77	x	2.16	x	113.09	x	0.63	x	0.7	=	74.66	(80)
West	0.9x	0.77	x	1.92	x	113.09	x	0.63	x	0.7	=	132.72	(80)
West	0.9x	0.77	x	1.09	x	113.09	x	0.63	x	0.7	=	37.67	(80)
West	0.9x	0.77	x	0.82	x	113.09	x	0.63	x	0.7	=	28.34	(80)
West	0.9x	0.77	x	1.37	x	115.77	x	0.63	x	0.7	=	48.47	(80)
West	0.9x	0.77	x	1.22	x	115.77	x	0.63	x	0.7	=	43.16	(80)
West	0.9x	0.77	x	2.16	x	115.77	x	0.63	x	0.7	=	76.42	(80)
West	0.9x	0.77	x	1.92	x	115.77	x	0.63	x	0.7	=	135.86	(80)
West	0.9x	0.77	x	1.09	x	115.77	x	0.63	x	0.7	=	38.57	(80)
West	0.9x	0.77	x	0.82	x	115.77	x	0.63	x	0.7	=	29.01	(80)
West	0.9x	0.77	x	1.37	x	110.22	x	0.63	x	0.7	=	46.15	(80)
West	0.9x	0.77	x	1.22	x	110.22	x	0.63	x	0.7	=	41.09	(80)
West	0.9x	0.77	x	2.16	x	110.22	x	0.63	x	0.7	=	72.76	(80)
West	0.9x	0.77	x	1.92	x	110.22	x	0.63	x	0.7	=	129.35	(80)
West	0.9x	0.77	x	1.09	x	110.22	x	0.63	x	0.7	=	36.72	(80)
West	0.9x	0.77	x	0.82	x	110.22	x	0.63	x	0.7	=	27.62	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	1.22	x	94.68	x	0.63	x	0.7	=	35.3	(80)
West	0.9x	0.77	x	2.16	x	94.68	x	0.63	x	0.7	=	62.5	(80)
West	0.9x	0.77	x	1.92	x	94.68	x	0.63	x	0.7	=	111.11	(80)
West	0.9x	0.77	x	1.09	x	94.68	x	0.63	x	0.7	=	31.54	(80)
West	0.9x	0.77	x	0.82	x	94.68	x	0.63	x	0.7	=	23.73	(80)
West	0.9x	0.77	x	1.37	x	73.59	x	0.63	x	0.7	=	30.81	(80)
West	0.9x	0.77	x	1.22	x	73.59	x	0.63	x	0.7	=	27.44	(80)
West	0.9x	0.77	x	2.16	x	73.59	x	0.63	x	0.7	=	48.58	(80)
West	0.9x	0.77	x	1.92	x	73.59	x	0.63	x	0.7	=	86.36	(80)
West	0.9x	0.77	x	1.09	x	73.59	x	0.63	x	0.7	=	24.51	(80)
West	0.9x	0.77	x	0.82	x	73.59	x	0.63	x	0.7	=	18.44	(80)
West	0.9x	0.77	x	1.37	x	45.59	x	0.63	x	0.7	=	19.09	(80)
West	0.9x	0.77	x	1.22	x	45.59	x	0.63	x	0.7	=	17	(80)
West	0.9x	0.77	x	2.16	x	45.59	x	0.63	x	0.7	=	30.09	(80)
West	0.9x	0.77	x	1.92	x	45.59	x	0.63	x	0.7	=	53.5	(80)
West	0.9x	0.77	x	1.09	x	45.59	x	0.63	x	0.7	=	15.19	(80)
West	0.9x	0.77	x	0.82	x	45.59	x	0.63	x	0.7	=	11.42	(80)
West	0.9x	0.77	x	1.37	x	24.49	x	0.63	x	0.7	=	10.25	(80)
West	0.9x	0.77	x	1.22	x	24.49	x	0.63	x	0.7	=	9.13	(80)
West	0.9x	0.77	x	2.16	x	24.49	x	0.63	x	0.7	=	16.17	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	1.92	x	24.49	x	0.63	x	0.7	=	28.74	(80)
West	0.9x	0.77	x	1.09	x	24.49	x	0.63	x	0.7	=	8.16	(80)
West	0.9x	0.77	x	0.82	x	24.49	x	0.63	x	0.7	=	6.14	(80)
West	0.9x	0.77	x	1.37	x	16.15	x	0.63	x	0.7	=	6.76	(80)
West	0.9x	0.77	x	1.22	x	16.15	x	0.63	x	0.7	=	6.02	(80)
West	0.9x	0.77	x	2.16	x	16.15	x	0.63	x	0.7	=	10.66	(80)
West	0.9x	0.77	x	1.92	x	16.15	x	0.63	x	0.7	=	18.95	(80)
West	0.9x	0.77	x	1.09	x	16.15	x	0.63	x	0.7	=	5.38	(80)
West	0.9x	0.77	x	0.82	x	16.15	x	0.63	x	0.7	=	4.05	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	136.43	266.89	439.53	641.03	785.61	804.21	765.64	657.67	511.19	316.69	170.12	112.2	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	659.45	790.88	949.41	1123.93	1241.03	1231.52	1172.54	1069.62	934.59	766.93	653.77	621.24	(84)
--------	--------	--------	--------	---------	---------	---------	---------	---------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.89	0.73	0.56	0.63	0.89	0.99	1	1	(86)

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

(87)m=	19.48	19.66	19.97	20.39	20.74	20.94	20.99	20.98	20.82	20.34	19.83	19.45	(87)
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(88)m=	19.98	19.98	19.98	19.99	19.99	20	20	20	20	19.99	19.99	19.99	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.85	0.64	0.44	0.51	0.83	0.98	1	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.19	18.42	18.82	19.35	19.77	19.96	20	19.99	19.86	19.3	18.65	18.16	(90)
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fLA = Living area ÷ (4) =

0.12 (91)

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

(92)m=	18.35	18.57	18.96	19.48	19.89	20.09	20.12	20.12	19.98	19.43	18.8	18.32	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.35	18.57	18.96	19.48	19.89	20.09	20.12	20.12	19.98	19.43	18.8	18.32	(93)
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8. Space heating requirement

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.95	0.85	0.65	0.46	0.52	0.83	0.98	1	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	658.51	787.9	937.3	1069.05	1052.4	803.06	536.52	560.76	772.36	749.71	651.66	620.58	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m]

(97)m=	2217.14	2152.7	1958.43	1645.83	1271.32	844.03	541.77	571.02	908.18	1370.28	1822.88	2209.53	(97)
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DER WorkSheet: New dwelling design stage

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(97a)m=	1159.63	917.15	759.72	415.28	162.88	0	0	0	0	461.71	843.28	1182.18	
Total per year (kWh/year) = Sum(97a) _{1...5,9...12} =													5901.81 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total per year (kWh/year) = Sum(97b) _{1...5,9...12} =													0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	1159.63	917.15	759.72	415.28	162.88	0	0	0	0	461.71	843.28	1182.18	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =													5901.81 (98)

Space heating requirement in kWh/m²/year

42.15 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 388.1 (206)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

1159.63	917.15	759.72	415.28	162.88	0	0	0	0	461.71	843.28	1182.18
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(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

298.8	236.32	195.75	107	41.97	0	0	0	0	118.97	217.29	304.61		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												1520.7	(211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(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)

245.29	219.28	232.98	208.13	205.34	183.47	173.84	189.82	187.4	211.26	226.73	243.93
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Efficiency of water heater 170.28 (216)

(217)m= (217)

170.28	170.28	170.28	170.28	170.28	170.28	170.28	170.28	170.28	170.28	170.28	170.28
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Fuel for water heating, kWh/month

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	144.05	128.77	136.82	122.23	120.59	107.74	102.09	111.48	110.05	124.07	133.15	143.26	
Total = Sum(219a) _{1...12} =													1484.31 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year kWh/year

1520.7

Water heating fuel used

1484.31

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year sum of (230a)...(230g) = 0 (231)

DER WorkSheet: New dwelling design stage

Electricity for lighting

176.05

(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	0.136	=	206.81 (261)
Space heating (secondary)	(215) x	0.136	=	0 (263)
Water heating	(219) x	0.136	=	201.87 (264)
Space and water heating	(261) + (262) + (263) + (264) =			408.68 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	0 (267)
Electricity for lighting	(232) x	0.136	=	23.94 (268)
Total CO2, kg/year	sum of (265)...(271) =			432.62 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			3.09 (273)
El rating (section 14)				97 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 10

Software Version:

Version: 1.0.0.37

Property Address: Nine Mile Ride 4BH 179 DET ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	87.32 (1a)	x	2.4 (2a)	=	209.57 (3a)
First floor	91.58 (1b)	x	2.4 (2b)	=	219.79 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	178.9 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	429.36 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m ³ 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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0 (6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0 (6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0 (6e)
Number of blocked chimneys							0	x 20 =	0 (6f)
Number of intermittent fans							4	x 10 =	40 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues, fans, PSVs, etc. [(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.09 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>	
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 <i>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</i>	0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0 (12)
If no draught lobby, enter 0.05, else enter 0	0 (13)
Percentage of windows and doors draught stripped	0 (14)
Window infiltration 0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.34 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>	
Number of sides sheltered	2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor (21) = (18) x (20) =	0.29 (21)

DER WorkSheet: New dwelling design stage

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34
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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
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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
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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
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(24d)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56
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3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors Type 1			2.21	x 1.2	= 2.652		(26)
Doors Type 2			2.21	x 1.2	= 2.652		(26)
Windows Type 1			1.37	x 1/[1/(1.2)+ 0.04] =	1.57		(27)
Windows Type 2			1.22	x 1/[1/(1.2)+ 0.04] =	1.4		(27)
Windows Type 3			2.16	x 1/[1/(1.2)+ 0.04] =	2.47		(27)
Windows Type 4			5.25	x 1/[1/(1.2)+ 0.04] =	6.01		(27)
Windows Type 5			1.22	x 1/[1/(1.2)+ 0.04] =	1.4		(27)
Windows Type 6			2.16	x 1/[1/(1.2)+ 0.04] =	2.47		(27)
Windows Type 7			1.92	x 1/[1/(1.2)+ 0.04] =	2.2		(27)
Windows Type 8			1.09	x 1/[1/(1.2)+ 0.04] =	1.25		(27)
Windows Type 9			0.82	x 1/[1/(1.2)+ 0.04] =	0.94		(27)
Windows Type 10			1.92	x 1/[1/(1.2)+ 0.04] =	2.2		(27)
Windows Type 11			1.09	x 1/[1/(1.2)+ 0.04] =	1.25		(27)

DER WorkSheet: New dwelling design stage

Windows Type 12			3.78	$\times 1/[1/(1.2) + 0.04] =$	4.33			(27)
Floor Type 1			87.32	$\times$	0.13	$=$	11.3516	(28)
Floor Type 2			21.69	$\times$	0.15	$=$	3.2535	(28)
Walls	203.52	33.08	170.44	$\times$	0.18	$=$	30.68	(29)
Roof Type1	91.58	0	91.58	$\times$	0.1	$=$	9.16	(30)
Roof Type2	19.34	0	19.34	$\times$	0.13	$=$	2.51	(30)
Total area of elements, m ²			423.45					(31)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ 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) =	95.08	(33)
Heat capacity Cm = S(A x k)	((28)...(30) + (32) + (32a)...(32e) =	18207.48	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		22.61	(36)
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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	117.69	(37)
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Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	80.64	80.26	79.89	78.14	77.81	76.28	76.28	76	76.87	77.81	78.47	79.17	(38)

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

(39)													
	Average = Sum(39) _{1...12} /12=											195.82	(39)

Heat loss parameter (HLP), W/m²K

(40)m=	1.11	1.11	1.1	1.09	1.09	1.08	1.08	1.08	1.09	1.09	1.1	1.1	
	Average = Sum(40) _{1...12} /12=											1.09	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N 2.97 (42)

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

if TFA <= 13.9, N = 1

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	
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Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	
---------	------	------	------	------	------	------	-----	------	------	------	------	------	--

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	47.46	45.74	44.01	42.29	40.56	38.83	38.83	40.56	42.29	44.01	45.74	47.46	
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Annual average hot water usage in litres per day Vd,average (from Appendix J) 130.28 (43)

DER WorkSheet: New dwelling design stage

Hot water usage in litres per day for each month $V_{d,m} = (42a) + (42b) + (42c)$

(44)m=	48.24	46.51	44.78	43.03	41.29	39.54	39.54	41.27	43.01	44.75	46.52	48.27		
Total = Sum(44) _{1...12} =													526.74	(44)

Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (from Appendix J)

(45)m=	204.6	182.5	192.13	168.37	164.12	143.38	132.2	148.4	147.37	170.12	187.21	203.23		
Total = Sum(45) _{1...12} =													2043.63	(45)

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

(46)m=	30.69	27.37	28.82	25.26	24.62	21.51	19.83	22.26	22.1	25.52	28.08	30.48		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	300	(47)
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If Heat network 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):	1.2	(48)
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Temperature factor from Table 2b	0.54	(49)
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Energy lost from water storage, kWh/year	(48) x (49) =	0.65	(50)
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b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
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If Heat network see section 4.3

Volume factor from Table 2a	0	(52)
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Temperature factor from Table 2b	0	(53)
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Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
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Enter (50) or (54) in (55)	0.65	(55)
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Water storage loss calculated for each month $(56)_m = (55) \times (41)_m$ $(56)_m = (55) \times (41)_m$

(56)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS storage, $(57)_m = (56)_m \times [(47) - V_s] \div (47)$, else $(57)_m = (56)_m$

where V_s is V_{ww} from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(57)
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Primary circuit loss (annual) from Table 3	0	(58)
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Primary circuit loss calculated for each month $(59)_m = (58) \div 365 \times (41)_m$

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
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Combi loss calculated for each month $(61)_m = (60) \div 365 \times (41)_m$

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
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Total heat required for water heating calculated for each month $(62)_m = 0.85 \times (45)_m + (46)_m + (57)_m + (59)_m + (61)_m$

(62)m=	247.95	221.65	235.48	210.32	207.47	185.33	175.55	191.75	189.32	213.47	229.17	246.58		(62)
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WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating)

(63a)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63a)
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PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=														(63b)
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FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63c)
---------	---	---	---	---	---	---	---	---	---	---	---	---	--	-------

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

(63b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63b)
---------	---	---	---	---	---	---	---	---	---	---	---	---	--	-------

Output from water heater

(64)m=	247.95	221.65	235.48	210.32	207.47	185.33	175.55	191.75	189.32	213.47	229.17	246.58		
Output from water heater (annual) _{1...12}													2554.05	(64)

DER WorkSheet: New dwelling design stage

if (64)m < 0 then set to 0

Energy	0	0	0	0	0	0	0	0	0	0	0	0		
Heat gains from water heating, kWh/month	$0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (64)m + (59)m]$												0	(64a)
(65)m=	102.71	92	98.56	89.55	89.25	81.23	78.64	84.02	82.56	91.25	95.81	102.25		(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	148.72	148.72	148.72	148.72	148.72	148.72	148.72	148.72	148.72	148.72	148.72	148.72	(66)

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

(67)m=	11.23	9.97	8.11	6.14	4.59	3.87	4.19	5.44	7.3	9.27	10.82	11.54	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	350.52	354.16	344.99	325.48	300.85	277.7	262.23	258.59	267.76	287.27	311.9	335.06	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	37.87	(69)
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Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	-118.97	(71)
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Water heating gains (Table 5)

(72)m=	138.05	136.91	132.48	124.37	119.96	112.83	105.7	112.93	114.67	122.64	133.07	137.44	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	567.41	568.66	553.2	523.6	493.01	462.01	439.73	444.59	457.35	486.8	523.41	551.65	(73)
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6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m²	Flux Table 6a			g_ Table 6b	FF Table 6c			Gains (W)	
East	0.9x	0.77	x	5.25	x	19.64	x	0.63	x	0.7	=	31.51	(76)
East	0.9x	0.77	x	1.22	x	19.64	x	0.63	x	0.7	=	7.32	(76)
East	0.9x	0.77	x	2.16	x	19.64	x	0.63	x	0.7	=	12.97	(76)
East	0.9x	0.77	x	1.92	x	19.64	x	0.63	x	0.7	=	11.52	(76)
East	0.9x	0.77	x	1.09	x	19.64	x	0.63	x	0.7	=	6.54	(76)
East	0.9x	0.77	x	3.78	x	19.64	x	0.63	x	0.7	=	22.69	(76)
East	0.9x	0.77	x	5.25	x	38.42	x	0.63	x	0.7	=	61.64	(76)
East	0.9x	0.77	x	1.22	x	38.42	x	0.63	x	0.7	=	14.33	(76)
East	0.9x	0.77	x	2.16	x	38.42	x	0.63	x	0.7	=	25.36	(76)
East	0.9x	0.77	x	1.92	x	38.42	x	0.63	x	0.7	=	22.54	(76)
East	0.9x	0.77	x	1.09	x	38.42	x	0.63	x	0.7	=	12.8	(76)
East	0.9x	0.77	x	3.78	x	38.42	x	0.63	x	0.7	=	44.38	(76)
East	0.9x	0.77	x	5.25	x	63.27	x	0.63	x	0.7	=	101.52	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	1.22	x	63.27	x	0.63	x	0.7	=	23.59	(76)
East	0.9x	0.77	x	2.16	x	63.27	x	0.63	x	0.7	=	41.77	(76)
East	0.9x	0.77	x	1.92	x	63.27	x	0.63	x	0.7	=	37.13	(76)
East	0.9x	0.77	x	1.09	x	63.27	x	0.63	x	0.7	=	21.08	(76)
East	0.9x	0.77	x	3.78	x	63.27	x	0.63	x	0.7	=	73.09	(76)
East	0.9x	0.77	x	5.25	x	92.28	x	0.63	x	0.7	=	148.06	(76)
East	0.9x	0.77	x	1.22	x	92.28	x	0.63	x	0.7	=	34.41	(76)
East	0.9x	0.77	x	2.16	x	92.28	x	0.63	x	0.7	=	60.92	(76)
East	0.9x	0.77	x	1.92	x	92.28	x	0.63	x	0.7	=	54.15	(76)
East	0.9x	0.77	x	1.09	x	92.28	x	0.63	x	0.7	=	30.74	(76)
East	0.9x	0.77	x	3.78	x	92.28	x	0.63	x	0.7	=	106.6	(76)
East	0.9x	0.77	x	5.25	x	113.09	x	0.63	x	0.7	=	181.45	(76)
East	0.9x	0.77	x	1.22	x	113.09	x	0.63	x	0.7	=	42.17	(76)
East	0.9x	0.77	x	2.16	x	113.09	x	0.63	x	0.7	=	74.66	(76)
East	0.9x	0.77	x	1.92	x	113.09	x	0.63	x	0.7	=	66.36	(76)
East	0.9x	0.77	x	1.09	x	113.09	x	0.63	x	0.7	=	37.67	(76)
East	0.9x	0.77	x	3.78	x	113.09	x	0.63	x	0.7	=	130.65	(76)
East	0.9x	0.77	x	5.25	x	115.77	x	0.63	x	0.7	=	185.75	(76)
East	0.9x	0.77	x	1.22	x	115.77	x	0.63	x	0.7	=	43.16	(76)
East	0.9x	0.77	x	2.16	x	115.77	x	0.63	x	0.7	=	76.42	(76)
East	0.9x		x		x		x		x		=		(76)
East	0.9x	0.77	x	1.09	x	115.77	x	0.63	x	0.7	=	38.57	(76)
East	0.9x	0.77	x	3.78	x	115.77	x	0.63	x	0.7	=	133.74	(76)
East	0.9x	0.77	x	5.25	x	110.22	x	0.63	x	0.7	=	176.84	(76)
East	0.9x	0.77	x	1.22	x	110.22	x	0.63	x	0.7	=	41.09	(76)
East	0.9x	0.77	x	2.16	x	110.22	x	0.63	x	0.7	=	72.76	(76)
East	0.9x	0.77	x	1.92	x	110.22	x	0.63	x	0.7	=	64.67	(76)
East	0.9x	0.77	x	1.09	x	110.22	x	0.63	x	0.7	=	36.72	(76)
East	0.9x	0.77	x	3.78	x	110.22	x	0.63	x	0.7	=	127.33	(76)
East	0.9x	0.77	x	5.25	x	94.68	x	0.63	x	0.7	=	151.9	(76)
East	0.9x	0.77	x	1.22	x	94.68	x	0.63	x	0.7	=	35.3	(76)
East	0.9x	0.77	x	2.16	x	94.68	x	0.63	x	0.7	=	62.5	(76)
East	0.9x	0.77	x	1.92	x	94.68	x	0.63	x	0.7	=	55.55	(76)
East	0.9x	0.77	x	1.09	x	94.68	x	0.63	x	0.7	=	31.54	(76)
East	0.9x	0.77	x	3.78	x	94.68	x	0.63	x	0.7	=	109.37	(76)
East	0.9x	0.77	x	5.25	x	73.59	x	0.63	x	0.7	=	118.07	(76)
East	0.9x	0.77	x	1.22	x	73.59	x	0.63	x	0.7	=	27.44	(76)
East	0.9x	0.77	x	2.16	x	73.59	x	0.63	x	0.7	=	48.58	(76)
East	0.9x	0.77	x	1.92	x	73.59	x	0.63	x	0.7	=	43.18	(76)
East	0.9x	0.77	x	1.09	x	73.59	x	0.63	x	0.7	=	24.51	(76)
East	0.9x	0.77	x	3.78	x	73.59	x	0.63	x	0.7	=	85.01	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	5.25	x	45.59	x	0.63	x	0.7	=	73.15	(76)
East	0.9x	0.77	x	1.22	x	45.59	x	0.63	x	0.7	=	17	(76)
East	0.9x	0.77	x	2.16	x	45.59	x	0.63	x	0.7	=	30.09	(76)
East	0.9x	0.77	x	1.92	x	45.59	x	0.63	x	0.7	=	26.75	(76)
East	0.9x	0.77	x	1.09	x	45.59	x	0.63	x	0.7	=	15.19	(76)
East	0.9x	0.77	x	3.78	x	45.59	x	0.63	x	0.7	=	52.67	(76)
East	0.9x	0.77	x	5.25	x	24.49	x	0.63	x	0.7	=	39.29	(76)
East	0.9x	0.77	x	1.22	x	24.49	x	0.63	x	0.7	=	9.13	(76)
East	0.9x	0.77	x	2.16	x	24.49	x	0.63	x	0.7	=	16.17	(76)
East	0.9x	0.77	x	1.92	x	24.49	x	0.63	x	0.7	=	14.37	(76)
East	0.9x	0.77	x	1.09	x	24.49	x	0.63	x	0.7	=	8.16	(76)
East	0.9x	0.77	x	3.78	x	24.49	x	0.63	x	0.7	=	28.29	(76)
East	0.9x	0.77	x	5.25	x	16.15	x	0.63	x	0.7	=	25.91	(76)
East	0.9x	0.77	x	1.22	x	16.15	x	0.63	x	0.7	=	6.02	(76)
East	0.9x	0.77	x	2.16	x	16.15	x	0.63	x	0.7	=	10.66	(76)
East	0.9x	0.77	x	1.92	x	16.15	x	0.63	x	0.7	=	9.48	(76)
East	0.9x	0.77	x	1.09	x	16.15	x	0.63	x	0.7	=	5.38	(76)
East	0.9x	0.77	x	3.78	x	16.15	x	0.63	x	0.7	=	18.66	(76)
South	0.9x	0.77	x	0.82	x	46.75	x	0.63	x	0.7	=	23.43	(78)
South	0.9x	0.77	x	0.82	x	76.57	x	0.63	x	0.7	=	38.38	(78)
South	0.9x		x		x		x		x		=		(78)
South	0.9x	0.77	x	0.82	x	110.23	x	0.63	x	0.7	=	55.25	(78)
South	0.9x	0.77	x	0.82	x	114.87	x	0.63	x	0.7	=	57.57	(78)
South	0.9x	0.77	x	0.82	x	110.55	x	0.63	x	0.7	=	55.41	(78)
South	0.9x	0.77	x	0.82	x	108.01	x	0.63	x	0.7	=	54.14	(78)
South	0.9x	0.77	x	0.82	x	104.89	x	0.63	x	0.7	=	52.57	(78)
South	0.9x	0.77	x	0.82	x	101.89	x	0.63	x	0.7	=	51.07	(78)
South	0.9x	0.77	x	0.82	x	82.59	x	0.63	x	0.7	=	41.39	(78)
South	0.9x	0.77	x	0.82	x	55.42	x	0.63	x	0.7	=	27.78	(78)
South	0.9x	0.77	x	0.82	x	40.4	x	0.63	x	0.7	=	20.25	(78)
West	0.9x	0.77	x	1.37	x	19.64	x	0.63	x	0.7	=	8.22	(80)
West	0.9x	0.77	x	1.22	x	19.64	x	0.63	x	0.7	=	7.32	(80)
West	0.9x	0.77	x	2.16	x	19.64	x	0.63	x	0.7	=	12.97	(80)
West	0.9x	0.77	x	1.92	x	19.64	x	0.63	x	0.7	=	34.57	(80)
West	0.9x	0.77	x	1.09	x	19.64	x	0.63	x	0.7	=	6.54	(80)
West	0.9x	0.77	x	1.37	x	38.42	x	0.63	x	0.7	=	16.09	(80)
West	0.9x	0.77	x	1.22	x	38.42	x	0.63	x	0.7	=	14.33	(80)
West	0.9x	0.77	x	2.16	x	38.42	x	0.63	x	0.7	=	25.36	(80)
West	0.9x	0.77	x	1.92	x	38.42	x	0.63	x	0.7	=	67.63	(80)
West	0.9x	0.77	x	1.09	x	38.42	x	0.63	x	0.7	=	12.8	(80)
West	0.9x	0.77	x	1.37	x	63.27	x	0.63	x	0.7	=	26.49	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	1.22	x	63.27	x	0.63	x	0.7	=	23.59	(80)
West	0.9x	0.77	x	2.16	x	63.27	x	0.63	x	0.7	=	41.77	(80)
West	0.9x	0.77	x	1.92	x	63.27	x	0.63	x	0.7	=	111.38	(80)
West	0.9x	0.77	x	1.09	x	63.27	x	0.63	x	0.7	=	21.08	(80)
West	0.9x	0.77	x	1.37	x	92.28	x	0.63	x	0.7	=	38.64	(80)
West	0.9x	0.77	x	1.22	x	92.28	x	0.63	x	0.7	=	34.41	(80)
West	0.9x	0.77	x	2.16	x	92.28	x	0.63	x	0.7	=	60.92	(80)
West	0.9x	0.77	x	1.92	x	92.28	x	0.63	x	0.7	=	162.44	(80)
West	0.9x	0.77	x	1.09	x	92.28	x	0.63	x	0.7	=	30.74	(80)
West	0.9x	0.77	x	1.37	x	113.09	x	0.63	x	0.7	=	47.35	(80)
West	0.9x	0.77	x	1.22	x	113.09	x	0.63	x	0.7	=	42.17	(80)
West	0.9x	0.77	x	2.16	x	113.09	x	0.63	x	0.7	=	74.66	(80)
West	0.9x	0.77	x	1.92	x	113.09	x	0.63	x	0.7	=	199.08	(80)
West	0.9x	0.77	x	1.09	x	113.09	x	0.63	x	0.7	=	37.67	(80)
West	0.9x	0.77	x	1.37	x	115.77	x	0.63	x	0.7	=	48.47	(80)
West	0.9x	0.77	x	1.22	x	115.77	x	0.63	x	0.7	=	43.16	(80)
West	0.9x	0.77	x	2.16	x	115.77	x	0.63	x	0.7	=	76.42	(80)
West	0.9x	0.77	x	1.92	x	115.77	x	0.63	x	0.7	=	203.79	(80)
West	0.9x	0.77	x	1.09	x	115.77	x	0.63	x	0.7	=	38.57	(80)
West	0.9x	0.77	x	1.37	x	110.22	x	0.63	x	0.7	=	46.15	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	2.16	x	110.22	x	0.63	x	0.7	=	72.76	(80)
West	0.9x	0.77	x	1.92	x	110.22	x	0.63	x	0.7	=	194.02	(80)
West	0.9x	0.77	x	1.09	x	110.22	x	0.63	x	0.7	=	36.72	(80)
West	0.9x	0.77	x	1.37	x	94.68	x	0.63	x	0.7	=	39.64	(80)
West	0.9x	0.77	x	1.22	x	94.68	x	0.63	x	0.7	=	35.3	(80)
West	0.9x	0.77	x	2.16	x	94.68	x	0.63	x	0.7	=	62.5	(80)
West	0.9x	0.77	x	1.92	x	94.68	x	0.63	x	0.7	=	166.66	(80)
West	0.9x	0.77	x	1.09	x	94.68	x	0.63	x	0.7	=	31.54	(80)
West	0.9x	0.77	x	1.37	x	73.59	x	0.63	x	0.7	=	30.81	(80)
West	0.9x	0.77	x	1.22	x	73.59	x	0.63	x	0.7	=	27.44	(80)
West	0.9x	0.77	x	2.16	x	73.59	x	0.63	x	0.7	=	48.58	(80)
West	0.9x	0.77	x	1.92	x	73.59	x	0.63	x	0.7	=	129.54	(80)
West	0.9x	0.77	x	1.09	x	73.59	x	0.63	x	0.7	=	24.51	(80)
West	0.9x	0.77	x	1.37	x	45.59	x	0.63	x	0.7	=	19.09	(80)
West	0.9x	0.77	x	1.22	x	45.59	x	0.63	x	0.7	=	17	(80)
West	0.9x	0.77	x	2.16	x	45.59	x	0.63	x	0.7	=	30.09	(80)
West	0.9x	0.77	x	1.92	x	45.59	x	0.63	x	0.7	=	80.25	(80)
West	0.9x	0.77	x	1.09	x	45.59	x	0.63	x	0.7	=	15.19	(80)
West	0.9x	0.77	x	1.37	x	24.49	x	0.63	x	0.7	=	10.25	(80)
West	0.9x	0.77	x	1.22	x	24.49	x	0.63	x	0.7	=	9.13	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	2.16	x	24.49	x	0.63	x	0.7	=	16.17	(80)
West	0.9x	0.77	x	1.92	x	24.49	x	0.63	x	0.7	=	43.11	(80)
West	0.9x	0.77	x	1.09	x	24.49	x	0.63	x	0.7	=	8.16	(80)
West	0.9x	0.77	x	1.37	x	16.15	x	0.63	x	0.7	=	6.76	(80)
West	0.9x	0.77	x	1.22	x	16.15	x	0.63	x	0.7	=	6.02	(80)
West	0.9x	0.77	x	2.16	x	16.15	x	0.63	x	0.7	=	10.66	(80)
West	0.9x	0.77	x	1.92	x	16.15	x	0.63	x	0.7	=	28.43	(80)
West	0.9x	0.77	x	1.09	x	16.15	x	0.63	x	0.7	=	5.38	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	185.62	355.64	571.37	817.27	991.46	1011.4	964.28	834.37	658.74	417.85	230	153.62	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	753.03	924.3	1124.57	1340.87	1484.47	1473.41	1404.01	1278.96	1116.09	904.66	753.41	705.27	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

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

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	1	1	1	0.98	0.91	0.76	0.59	0.66	0.91	0.99	1	1	

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

(87)m=	19.45	19.63	19.95	20.36	20.72	20.93	20.98	20.97	20.8	20.31	19.81	19.43	(87)
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(88)m=	19.99	20	20	20.01	20.01	20.01	20.01	20.02	20.01	20.01	20	20	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.87	0.67	0.47	0.54	0.85	0.99	1	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.17	18.39	18.8	19.32	19.75	19.97	20.01	20	19.86	19.27	18.62	18.13	(90)
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fLA = Living area ÷ (4) = 0.1 (91)

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

(92)m=	18.29	18.52	18.91	19.43	19.85	20.06	20.1	20.1	19.95	19.37	18.74	18.26	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.29	18.52	18.91	19.43	19.85	20.06	20.1	20.1	19.95	19.37	18.74	18.26	(93)
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8. Space heating requirement

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.96	0.87	0.68	0.48	0.55	0.85	0.98	1	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	752.39	921.93	1113.84	1287.75	1288.14	999.65	671.93	701.28	946.68	889.38	751.87	704.84	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m]

(97)m=	2774.98	2695.28	2451.59	2061.13	1592.99	1059.61	679.67	716.5	1137.95	1715.25	2282.99	2767.89	(97)
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DER WorkSheet: New dwelling design stage

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(97a)m=	1504.81	1191.69	995.29	556.83	226.81	0	0	0	0	614.45	1102.41	1534.91	
Total per year (kWh/year) = Sum(97a) _{1...5,9...12} =													7727.19 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total per year (kWh/year) = Sum(97b) _{1...5,9...12} =													0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	1504.81	1191.69	995.29	556.83	226.81	0	0	0	0	614.45	1102.41	1534.91	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =													7727.19 (98)

Space heating requirement in kWh/m ² /year	43.19 (99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system	0 (201)
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Fraction of space heat from main system(s)	(202) = 1 – (201) =	1 (202)
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Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1 (204)
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Efficiency of main space heating system 1	376.12 (206)
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Efficiency of secondary/supplementary heating system, %	0 (208)
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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

1504.81	1191.69	995.29	556.83	226.81	0	0	0	0	614.45	1102.41	1534.91	
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(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

400.08	316.84	264.62	148.04	60.3	0	0	0	0	163.36	293.1	408.09		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												2054.43	(211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(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)

247.95	221.65	235.48	210.32	207.47	185.33	175.55	191.75	189.32	213.47	229.17	246.58	
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Efficiency of water heater	170.28 (216)
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(217)m=	170.28	170.28	170.28	170.28	170.28	170.28	170.28	170.28	170.28	170.28	170.28	170.28	(217)
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Fuel for water heating, kWh/month

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	145.61	130.17	138.29	123.52	121.84	108.84	103.1	112.61	111.18	125.37	134.58	144.81	
Total = Sum(219a) _{1...12} =													1499.91 (219)

Annual totals

Space heating fuel used, main system 1	2054.43
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Water heating fuel used	1499.91
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Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year	sum of (230a)...(230g) =	0 (231)
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DER WorkSheet: New dwelling design stage

Electricity for lighting

198.27

(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	0.136	=	279.4 (261)
Space heating (secondary)	(215) x	0.136	=	0 (263)
Water heating	(219) x	0.136	=	203.99 (264)
Space and water heating	(261) + (262) + (263) + (264) =			483.39 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	0 (267)
Electricity for lighting	(232) x	0.136	=	26.96 (268)
Total CO2, kg/year	sum of (265)...(271) =			510.36 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			2.85 (273)
El rating (section 14)				97 (274)