



Sustainability Statement & Energy Strategy

**Former Bartons Infant School, North Bersted,
PO22 9BH**

West Sussex Property Development LLP

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1. Executive Summary

This Sustainability Statement and Energy Strategy has been prepared by Waterstone Design in relation to the development at Former Bartons Infant School, North Bersted, PO22 9BH to satisfy the requirements of Arun District Council for Sustainability and Energy.

- The development will be subject to incoming Part L 2021 Building Regulations
- The proposed strategy for the scheme delivers an exceptional 'fabric first' approach utilising highly efficient U-Values which surpass incoming Part L 2021 standards
- All dwellings on site will be 'gas free' and supply energy efficiently through a renewable energy source - Air Source Heat Pump (ASHP)
- Preliminary calculations show that scheme demonstrates a carbon emission reduction (CO₂) of 42.99% over the Part L 2013 baseline which surpasses relevant planning policy requirements. Additionally, figures provided through SAP10 BETA Software outputs demonstrates a reduction of 68.52% against future Part L 2021 requirements
- The development will include passive design measure to ensure the proposal meets the Approved Document Part O regarding overheating
- All dwellings throughout the development will achieve a water efficiency standard to meet the optional standards of 110 l/person/day in line with Policy W DM1
- In accordance with the Arun Local Plan 2018, and the National Planning Policy Framework 2021, the development has been assessed in line with the recognised Energy Hierarchy to determine the most appropriate strategy to deliver a reduction in carbon dioxide emissions through on-site measures.
 1. **be lean:** use less energy and manage demand through fabric and servicing improvements and the incorporation of flexibility measures
 2. **be clean:** supply energy efficiently through the use of renewable sources
 3. **be green:** maximise opportunities for renewable energy by producing, storing, and using renewable energy on-site



2. Introduction

Waterstone Design Ltd has been commissioned by West Sussex Property Development LLP to produce an Sustainability Statement & Energy Strategy for the proposed redevelopment at Former Bartons Infant School, North Bersted, PO22 9BH and will comprise of 21 residential dwellings.

Arun District Council have numerous policies relating to Sustainability and Energy which encourage the preparation of an Energy Statement – these can be found within Arun Local Plan (2018) (<https://www.arun.gov.uk/download.cfm?doc=docm93jjm4n12844.pdf&ver=12984>).

To achieve the energy and sustainability objectives, a thorough analysis of local and national policy has been carried out to ensure the development is practical as well as feasible. The options are outlined in the following sections which also address the latest design information available to date.



3. Detailed Site Analysis

The site comprises the former infant school. The site is within the Bersted District with Arun District Council being the administrative authority. The site is allocated for housing in the Bersted Neighbourhood Plan.

The site allocation is for a minimum of 20 dwellings.





4. Planning Policy Context

This section looks into the current relevant policies that would need to be considered for the proposed development. This includes National, Regional and Local policies and Building Regulations which are summarised below:

4.1 National Planning Policy Framework 2021

The National Planning Policy Framework was updated in 2021 and outlines the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate, and necessary to do so. It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities. The NPPF was designed to consolidate all policy statements and guidance into a single and simpler framework, making the planning stage more user friendly.

Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):

- **an economic objective** – to help build a strong, responsive, and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation, and improved productivity; and by identifying and coordinating the provision of infrastructure.
- **a social objective** – to support strong, vibrant, and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and
- **an environmental objective** – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy

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



4.2 Arun Local Plan (2011-2031 (July 2018))

As part of the proposed development at Former Bartons Infant School, North Bersted, PO22 9BH the following policies will be addressed from the relevant sections within the Arun Local Plan (2018).

- **Policy W DM1: Water supply and quality:** To ensure that all new development of two dwellings or more are water efficient and reduce pressure on water abstraction sites, it must include measures that meet the optional standards of 110 l/person/day.
- **Policy ECC SP119: Adapting to climate change (13.5.5):** Development in the District must also be designed to mitigate against the impacts of climate change by reducing the emissions of greenhouse gas in line with the Energy Hierarchy. The Energy Hierarchy is a classification of energy options, prioritised to assist progress towards a more sustainable energy system.
- **Policy ECC SP2: Energy and climate change mitigation:** All new residential and commercial development (including conversions, extensions, and changes of use) will be expected to be energy efficient and to demonstrate how they will:
 - Achieve energy efficiency measures that reflect the current standards applicable at the time of submission;
 - Use design and layout to promote energy efficiency; and
 - Incorporate decentralised, renewable, and low carbon energy supply systems, for example small scale renewable energy systems such as solar panels.

All major developments must produce 10% of the total predicted energy requirements from renewable or low carbon energy generation on site, unless it can be demonstrated that this is unviable

4.3 Summary of Policies

The Arun Local Plan sets out policy requirements in relation to climate change – below is a summary of the requirements which relate to energy efficiency. These are to be addressed in accordance with the previously recognised requirements to ensure a robust, energy efficient scheme.

- All new build housing will achieve a minimum 10% CO2 reduction, compared to the Building Regulations Part L 2013 standard, through carbon saving technology and fabric improvements. This should be delivered through very high fabric standards, improved services, and low carbon technologies.
- Achieve water usage of no greater than 110 litres/person/day (lpd)
- Demonstrate accordance with the required Energy Hierarchy
- Commitment to reducing regulated CO2 emissions beyond Part L 2013 Approved Document L1A: Conservation of fuel and power in new dwellings (2013 edition with 2016 amendments)



5. Strategy Principles

In line with the principles and policies outlined within Section 4, the proposed Sustainability Statement & Energy Strategy will focus on the three key driving principles:

1. **be lean:** use less energy and manage demand during operation through fabric and servicing improvements and the incorporation of flexibility measures
2. **be clean:** exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly by connecting to district heating networks
3. **be green:** maximise opportunities for renewable energy by producing, storing, and using renewable energy on-site

For the purposes of this assessment and to satisfy the above principles, energy demands and CO₂ emissions for all-residential dwellings on site have been assessed for Building Regulation compliance against the current Building Regulations Part L1A (2013 edition with 2016 amendments) using the latest Standard Assessment Procedure 2012 and Stroma FSAP approved software. Baseline emissions have been derived from Target Emissions Rate (TER) as calculated under SAP methodology in accordance with Part L 2013.

Regulated CO₂ emission estimations (those associated with space and water heating, pumps, fans and lighting) are based on initial SAP calculation data taken from the proposed plan drawings.

It should be noted that whilst Part L 2013 CO₂ emissions performance is addressed accordingly as per policy, any potential future regulation performance has also been addressed through the use of the SAP 10 BETA software and calculations for individual house types.

Although this is not policy, the use of future software and regulations facilitates updated emission factors and ensures a transparent process for analysing a development against future performance. In particular, the approach has been developed to ensure the SAP 10 results can still be validated against supporting Part L 2013 SAP outputs.



6. Baseline CO2 Emissions

To coincide with local planning policy, the baseline emissions for the proposed development have been calculated for regulated CO2 emissions as per Part L1A 2013 (TER), this will allow an analysis of the CO2 performance of the proposed Sustainability Statement & Energy Strategy

The CO2 emissions are based on preliminary SAP calculations and demonstrate the potential energy and CO2 emission savings from the initial proposed measures for the development. It should be noted that these figures are assessed against SAP 10.0 emission factors.

Due to the development being at an early stage, final design stage SAP calculations will need to be completed in order to confirm the site CO2 emissions more accurately. For this current stage, SAP DER/TER worksheet outputs have been provided in Appendix E to evidence calculations.

Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	30.0	13.872



7. Demand Reduction – ‘Be Lean’

The initial priority of this Sustainability Statement & Energy Strategy is to reduce the CO₂ emissions as far as practically possibly through efficient design measures as per the ‘be lean’ approach of the energy hierarchy,

Energy efficiency measures such as excellent building fabric, efficient mechanical and electrical systems will be incorporated into the design to achieve this but also assist in surpassing the mandatory Target Fabric Energy Efficient (TFEE) as per Building Regulations.

Furthermore, by reducing energy demand this can be beneficial for future homeowners as energy costs in relation to space heating and water will see a reduction.

7.1 Passive Design

As mentioned above, numerous measures implemented throughout the development follows relevant policy regarding sustainable design in order to reduce energy demand and avoid potential overheating issues for homeowners.

The dwellings will incorporate various passive solar design measures such as openable windows which will deliver natural ventilation, dual or triple aspect providing cross ventilation throughout and utilise a glazing specification which will allow optimal daylight whilst reducing passive solar gains,

In addition to the natural ventilation, intermittent extract fans will be provided to ensure the rapid extraction of moisture and pollutants from all the wet rooms via ducting in compliance with Part F Building Regulations.

7.2 Building Fabric

To achieve compliance with Target Fabric Energy Efficiency (TFEE) targets, the following building fabric standards will be adopted. It is recognised that by utilising a superior fabric standard it can be an excellent cost-effective measure to reduce CO₂ emissions before any form of renewables are incorporated. As previously touched upon, a high standard of insulation throughout a dwelling can see a reduction in day to day running costs and reduce the reliance on renewable technology.

As previously mentioned, the scheme will be constructed to Part L 2021. The minimum building fabric standards are outlined below alongside the proposed residential fabric specification:

Element	Part L1A 2013	Part L 2021	Proposed Specification
Ground Floor	0.25 W/m ² K	0.13 W/m ² K	0.13 W/m ² K
External Wall	0.30 W/m ² K	0.18 W/m ² K	0.14 W/m ² K
Roofs	0.20 W/m ² K	0.11 W/m ² K	0.11 (joists) W/m ² K
Windows	2.0 W/m ² K	1.2 W/m ² K	1.2 W/m ² K
Doors	2.0 W/m ² K	1.0 W/m ² K	1.0 W/m ² K
Air Permeability	10 m ³ /h·m ² at 50 Pa	5 m ³ /h·m ² at 50 Pa	4 m ³ /h·m ² at 50 Pa
Thermal Bridging	0.15	Calculated	Calculated
Thermal Mass Parameter	N/A	Calculated	Calculated



7.3 Building Services

The energy demand from dwellings as well as sitewide CO₂ emissions can be reduced further through the use of high performance, efficient mechanical and electrical (M&E) design. In reference to this development, initial designs have proposed the following measures:

- 100% low-energy lighting
- Natural ventilation with intermittent extract fans
- Energy efficient Air Source Heat Pump (ASHP) heating system
- Effective controls for space heating and zoning
- Insulation of pipes servicing the heating demand.
- Energy efficient appliances

M&E System	Proposed Specification
Ventilation	Natural ventilation with intermittent extract fans
Space Heating	ASHP – Mitsubishi Ecodan (tbc)
Heating Controls	Time & temperature zone control
Heating Emitter	Underfloor heating and radiators
Water Heating	From main heating system
Cylinder Specification	210 litres (1.42 kWh/day) (tbc)
Lighting	100% low-energy

7.4 Energy Demand Reduction Results

With reference to the energy hierarchy, the energy efficiency performance of the building fabric has been maximised to reduce the energy demand for space heating. The results for this stage of the hierarchy demonstrate a 8% reduction (2.4 tonnes CO₂ per annum) in CO₂ emissions over the baseline is achieved through the 'be lean' approach utilising the SAP 10.0 emission factors. It is evident that the development can already significantly reduce carbon emissions considering no other form of technology or renewables have been implemented.

Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	30.0	13.872
After energy demand reduction (be lean)	27.6	13.872



Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: Savings from energy demand reduction	2.4	8%



8. Supply Energy Efficiently – ‘Be Clean’

For this report, the feasibility of connecting to existing opportunities to use low carbon energy, renewable energy and residual heat/cooling have been assessed.

Major development proposals should select energy systems in accordance with the following hierarchy:

1. Any new opportunities for providing or creating new heating/cooling networks.
2. The feasibility of connecting the development to existing heating / cooling / CHP networks where these already exist.
3. Opportunities for expansion of any proposed networks beyond the development area over time, and to plan for potential expansion.

Due to the size and scale of the proposed redevelopment, a community heating system has been investigated however deemed unviable – the main markets for CHP tend to be those with high heat requirements, for example flats or high-density housing. There is not a large amount of space on site where an energy centre or plant room can be located but the main factor is that any CHP installation would not justify the annual base load for the domestic energy demand on site which would reduce the efficiency of the CHP. In addition to this, high installation costs combined with maintenance would not only add to the initial build costs but also for the residents moving forward.

In relation to District Heating, this is also very expensive to install, therefore it would be more suited to densely concentrated developments, such as blocks of flats or larger developments.

It also states in **13.5.10** (Arun Local Plan) *“To promote the generation of renewable and low carbon energy, national guidance and planning legislation, advocate the use of a policy which stipulates a proportion of on-site energy generation to be derived from renewable or low carbon technologies.”* In respect of this, the current proposal is to provide all dwellings on site with individual, dedicated Air Source Heat Pumps (ASHP) to supply both heating and domestic hot water. This should be recognised as taking the initiative by including high levels of energy efficiency alongside a low carbon heating system (ASHP) which will be integral to the specification of the Future Homes Standard (2025).

Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	30.0	13.872
After energy demand reduction (be lean)	27.6	13.872
After heat network connection (be clean)	27.6	13.872



Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: Savings from energy demand reduction	2.4	8%
Be clean: Savings from heat network	0.0	0%



9. Use Renewable Energy – ‘Be Green’

Air Source Heat Pumps are considered to be the most suitable renewable energy technology for the scheme - these extract the ambient heat energy in outside air and use this for heating and the production of domestic hot water. Additionally, they are deemed most efficient when used in conjunction with well insulated properties – the dwellings will be built to standards which surpass Part L 2021 (see table in Section 7).

The following results demonstrates that the ASHP approach can provide the development with an additional 15.30 tonnes CO₂ per annum reduction in regulated CO₂ emissions per annum above the baseline CO₂ emissions.

It should be noted that whilst an assessment of other forms of renewable technology options has been undertaken (included within Appendix A), the above was deemed most suitable for the development so no other renewable energy technology is considered suitable for this development.

Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	30.0	13.872
After energy demand reduction (be lean)	27.6	13.872
After heat network connection (be clean)	27.6	13.872
After renewable energy (be green)	12.3	13.872

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: Savings from energy demand reduction	2.4	8%
Be clean: Savings from heat network	0.0	0%
Be green: Savings from renewable energy	15.3	51%



10. Conclusion

The proposed Sustainability Statement & Energy Strategy for the development is to reduce the overall energy demand as far as practically possible through implementation of energy efficiency measures and the incorporation of low carbon or renewable energy technology.

These measures have been adopted in order to comply with the National and Local Planning Policies as set out in the Arun Local Plan (2018) in line with Policy WDM1 and Policy ECC SP2.

All dwellings on the development will demonstrate compliance with Part L1A 2013 of the Building Regulations as well as Part L 2021 due to transitional arrangements affecting the scheme. The estimated site wide CO2 emissions have been calculated using SAP 2012 methodology for Part L1A 2013 and SAP 10 BETA software for Part L 2021 standards.

The design of the development surpasses any CO2 emission targets required for improvements over Part L1A 2013 of the Building Regulation Target Emission Rate (TER) in line with Policy ECC SP2 and producing the 10% of the total predicted energy requirements from renewable or low carbon energy generation on site. Furthermore, all dwellings on the development have been designed to consider best practice in water efficiency standards as per Policy WDM1 which will be achieve the optional standards of 110 l/person/day through the inclusion of water efficient fittings and appliances.

This report has demonstrated how the development proposals contribute to minimising CO2 emissions in accordance with the required energy hierarchy principles:

- be lean: use less energy – ‘Fabric First’ through highly efficient U-Values
- Be clean: supply energy efficiently – renewable energy sources
- be green: use renewable technology – Air Source Heat Pump (ASHP) to provide space heating and water

Energy Hierarchy	Energy Strategy Proposals
be lean: use less energy and manage demand during operation through fabric and servicing improvements and the incorporation of flexibility measures	Building Fabric • Deliver a high-performance building fabric • U-Values which surpass incoming Part L 2021 standards • Reduction of thermal bridging through calculations
	Passive Design • Optimised orientation/layout for passive design features • Balance glazing to reduce solar gains alongside openable windows to reduce the risk of overheating
	Energy Efficiency • Energy efficient lighting and controls • Energy efficient heating controls • Appropriate energy metering and monitoring • Provision of energy efficient appliance



be clean: supply energy efficiently (once an assessment has been carried out) through Renewable energy sources	Energy Efficient Energy Supply • CHP/District Heating has been disregarded due to the size and nature of development • Not included in a Heat Network Area
be green: maximise opportunities for renewable energy by producing, storing, and using renewable energy on-site	Renewable Energy • Individual dedicated Air Source Heat Pumps (ASHP) to provide Space and Water heating to all dwellings throughout the development • 'No gas' low-carbon heating for homes – 2025 stepping-stone

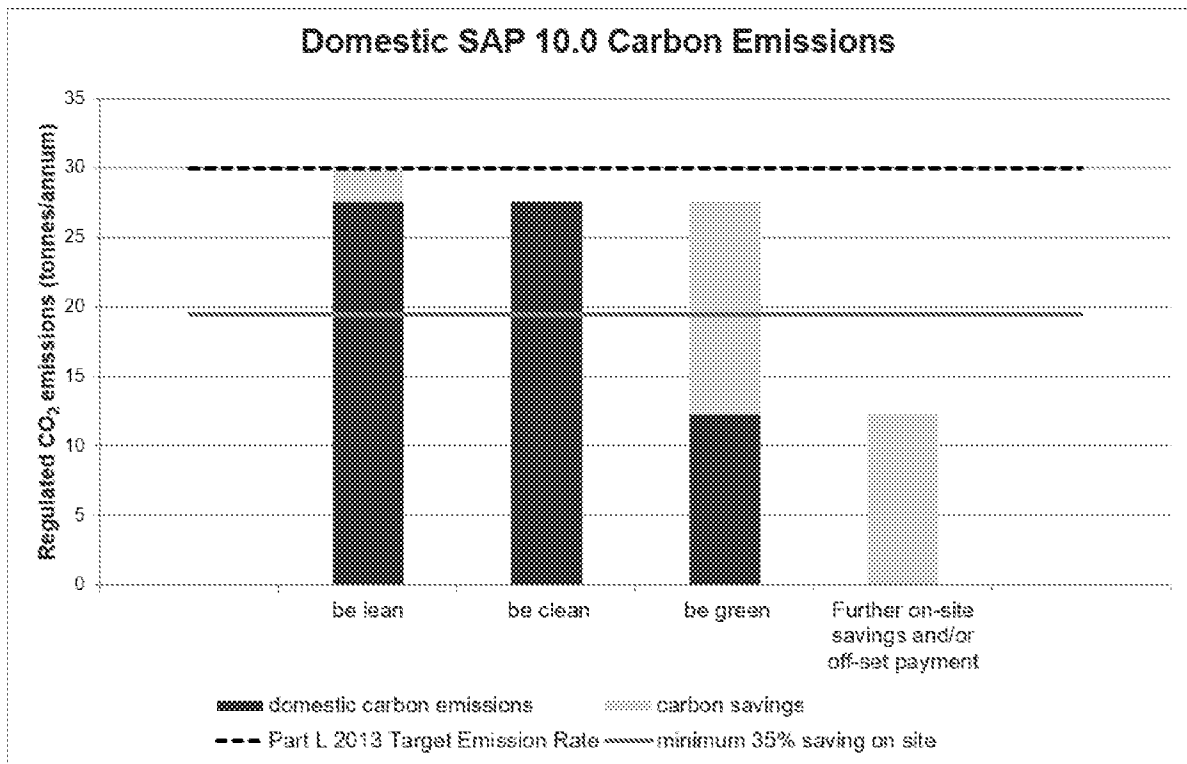
10.1 Overall CO2 Emissions

The overall reduction in regulated CO2 emissions for the proposed development Former Bartons Infant School, North Bersted, PO22 9BH can be seen in the table below. This also outlines the percentage reduction after each stage of the energy hierarchy has been implement into the design of the scheme.

As previously mentioned, the development is achieving a 42.99% improvement over Part L1A 2013 baseline emissions (TER) which can be seen in 'Block Compliance Worksheet: Sitewide' (Appendix C) however the figures seen below are in line with the SAP 10.0 emission factors and demonstrate a 59% improvement over baseline emissions.

The results below are calculated using the 'GLA Carbon Emissions Reporting Spreadsheet', however figures taken from SAP 10 BETA Software demonstrate a 68.52% reduction (Appendix D).

	Total regulated emissions (Tonnes CO ₂ / year)	CO ₂ savings (Tonnes CO ₂ / year)	Percentage savings (%)
Part L 2013 baseline	30.0	0	
Be lean	27.6	2.4	8%
Be clean	27.6	0.0	0%
Be green	12.3	15.3	51%
Total Savings		17.7	59%





Appendix A - Assessment of Renewable Options

Wind Turbines

Wind energy can be a cost-effective form of renewable energy generation, producing zero CO₂ emissions and available in a wide range of sizes and outputs. There are two main types of wind turbine; the most common type is the horizontal axis type, which allows the turbine to rotate according to wind direction on top of a large tower. Vertical axis turbines are also available and are better suited to urban locations. Both types drive a generator, either directly or indirectly via a gearbox, energy can either be stored in batteries or converted from direct current (DC) to alternating current (AC) which can then be fed to the grid.

The national wind speed database indicates an average wind speed for the site ranging from 3.8-5.6m/s at 10-45m above ground level. Typically, large wind turbines are considered viable where wind speed exceeds 7m/s, however turbines will operate from wind speeds of 4m/s and still produce useful amounts of energy, but due to the location the uneven and turbulent wind patterns that can be expected to occur near buildings, the effective operational time is likely to be limited.

Additionally, due to noise, vibration, reflected light and shadow flicker it is not best practice to locate in close proximity to residential areas.

Wind turbines are therefore not practically feasible for this development.

Biomass

Biomass can be burnt directly to provide heat using wood from forests, urban tree pruning and farmed coppices, or as a liquid biofuel (bio-diesel). Biomass systems are becoming more common in the UK market, although they are used widely throughout Europe, where there is plentiful supply of potential fuel.

Biomass systems are technically carbon neutral; however, the fuel can only be called renewable energy if it has been sourced from a sustainable location. To avoid secondary CO₂ emissions, the fuel should be sourced locally.

There are three types of wood burning boiler - logs, woodchips and wood pellets. Wood logs are the most readily available, generally produced as a by-product from forestry and woodland from tree surgery and wind damage. However, wood log boilers tend to be used to serve domestic systems. Wood chips have high moisture content and are generally made from almost any spare wood. However, wood chip boilers are only 50% efficient and tend to suffer from blockages to the feed to the boiler, and hence we would be cautious about their use on this site. Storage space requirement is also high due to the irregularity of the chips.

Wood pellets are made from dry waste wood, such as used pallets and off-cuts/sawdust from furniture manufacturers. The waste wood is compressed into uniform, high density pellets that are easier to transport, handle and store than other forms of wood fuel.

Biomass combustion systems are generally more mechanically complex than conventional boiler heating systems, especially when it comes to delivery, fuel storage, handling and combustion. The complexity is necessary because of the different combustion characteristics of biomass, compared to conventional fossil fuel systems. This increased complexity would yield a higher capital cost, compared to a conventional system.



These systems would require a more frequent maintenance plan than a conventional system, and more attention to fire insurance premiums, air quality standards, disposal options and general safety issues. To minimise NOx emissions, the boilers must have individual flues designed to take the emissions above the surrounding buildings and ensure the dilution of particulates and NOx.

Biomass technology has been discounted in this instance, as it is not considered viable for a heat network to be installed and there will not be sufficient space to accommodate boiler plant or fuel store.

Solar Thermal

Solar thermal water heating is an efficient energy source, which can cater for a large portion of the hot water load, subject to the type of development, location, and the heating and hot water strategy. A south facing highly efficient evacuated tube solar array will provide approximately 520kWh/year of hot water. Although benefit is limited by the amount of energy demand, any heat generated that goes unused is simply wasted.

Although Solar thermal could provide a carbon reduction by providing hot water from renewable means, as photovoltaic technology is considered to provide a greater reduction in carbon emissions, and so makes better use of the available roof area.

Solar thermal technology is discounted for this development.

Ground Source Heat Pumps (GSHP)

In the UK, the ground keeps a constant temperature of approximately 11-12 degrees centigrade through the year. Because of the ground's high thermal mass, it stores radiant heat from the sun during the summer. Ground source heat pumps can transfer this heat from the ground to the building using a glycol solution, to provide space heating and domestic hot water. Although these systems will be 100% electrically loaded, they produce approximately 3-4 times more energy than they consume.

The use of horizontal ground source heat pumps is inhibited because of the areas required for the horizontal ground loop system. The site would also be difficult to accommodate a vertical borehole system, in regard to safe working area and lack of open available space.

Ground Source Heat Pumps have therefore been discounted based on these constraints.



Wind Turbines

Wind energy can be a cost-effective form of renewable energy generation, producing zero CO₂ emissions and available in a wide range of sizes and outputs. There are two main types of wind turbine; the most common type is the horizontal axis type, which allows the turbine to rotate according to wind direction on top of a large tower. Vertical axis turbines are also available and are better suited to urban locations. Both types drive a generator, either directly or indirectly via a gearbox, energy can either be stored in batteries or converted from direct current (DC) to alternating current (AC) which can then be fed to the grid.

The national wind speed database indicates an average wind speed for the site ranging from 3.8-5.6m/s at 10-45m above ground level. Typically, large wind turbines are considered viable where wind speed exceeds 7m/s, however turbines will operate from wind speeds of 4m/s and still produce useful amounts of energy, but due to the location the uneven and turbulent wind patterns that can be expected to occur near buildings, the effective operational time is likely to be limited.

Additionally, due to noise, vibration, reflected light and shadow flicker it is not best practice to locate in close proximity to residential areas.

Wind turbines are therefore not practically feasible for this development.

Biomass

Biomass can be burnt directly to provide heat using wood from forests, urban tree pruning and farmed coppices, or as a liquid biofuel (bio-diesel). Biomass systems are becoming more common in the UK market, although they are used widely throughout Europe, where there is plentiful supply of potential fuel.

Biomass systems are technically carbon neutral; however, the fuel can only be called renewable energy if it has been sourced from a sustainable location. To avoid secondary CO₂ emissions, the fuel should be sourced locally.

There are three types of wood burning boiler - logs, woodchips and wood pellets. Wood logs are the most readily available, generally produced as a by-product from forestry and woodland from tree surgery and wind damage. However, wood log boilers tend to be used to serve domestic systems. Wood chips have high moisture content and are generally made from almost any spare wood. However, wood chip boilers are only 50% efficient and tend to suffer from blockages to the feed to the boiler, and hence we would be cautious about their use on this site. Storage space requirement is also high due to the irregularity of the chips.

Wood pellets are made from dry waste wood, such as used pallets and off-cuts/sawdust from furniture manufacturers. The waste wood is compressed into uniform, high density pellets that are easier to transport, handle and store than other forms of wood fuel.

Biomass combustion systems are generally more mechanically complex than conventional boiler heating systems, especially when it comes to delivery, fuel storage, handling and combustion. The complexity is necessary because of the different combustion characteristics of biomass, compared to conventional fossil fuel systems. This increased complexity would yield a higher capital cost, compared to a conventional system.

These systems would require a more frequent maintenance plan than a conventional system, and more attention to fire insurance premiums, air quality standards, disposal options and general safety issues. To minimise NO_x emissions, the boilers must have individual flues designed to take the emissions above the surrounding buildings and ensure the dilution of particulates and NO_x.



Biomass technology has been discounted in this instance, as it is not considered viable for a heat network to be installed and there will not be sufficient space to accommodate boiler plant or fuel store.

Solar Thermal

Solar thermal water heating is an efficient energy source, which can cater for a large portion of the hot water load, subject to the type of development, location and the heating and hot water strategy. A south facing highly efficient evacuated tube solar array will provide approximately 520kWh/year of hot water. Although benefit is limited by the amount of energy demand, any heat generated that goes unused is simply wasted.

Although Solar thermal could provide a carbon reduction by providing hot water from renewable means, as photovoltaic technology is considered to provide a greater reduction in carbon emissions, and so makes better use of the available roof area.

Solar thermal technology is discounted for this development.

Ground Source Heat Pumps (GSHP)

In the UK, the ground keeps a constant temperature of approximately 11-12 degrees centigrade through the year. Because of the ground's high thermal mass, it stores radiant heat from the sun during the summer. Ground source heat pumps can transfer this heat from the ground, to the building using a glycol solution, to provide space heating and domestic hot water. Although these systems will be 100% electrically loaded, they produce approximately 3-4 times more energy than they consume.

The use of horizontal ground source heat pumps is inhibited because of the areas required for the horizontal ground loop system. The site would also be difficult to accommodate a vertical borehole system, in regards to safe working area and lack of open available space.

Ground Source Heat Pumps have therefore been discounted based on these constraints.



Appendix B – Part G Water Calculator



PART G - WATER EFFICIENCY CALCULATOR

Project Ref:	D2490 - NORTH BERSTED
Project Name:	NORTH BERSTED
Date:	24/02/2022
Assessor:	JOSHUA COLLETT
Notes:	Please see detailed calculations for specifications and details of flow restrictors

				HOUSE - 110 LPD	
Installation type	Unit of measure	(2) Use factor	(3) Fixed use (litres/person/ day)	(1) Capacity/ flow rate	Litres/person/ day = [(1) (2)] + (3)
WCs (multiple fittings)	Average effective flushing volume (litres)	4.42	0.00	4.66	20.60
Taps (excluding kitchen/utility room taps)	Flow rate (litres/minute)	1.58	1.58	6.00	11.06
Bath (where shower also present)	Capacity to overflow (litres)	0.11	0.00	170.00	18.70
Shower (where bath also present)	Flow rate (litres/minute)	4.37	0.00	8.00	34.96
Bath only	Capacity to overflow (litres)	0.50	0.00	0.00	0.00
Shower only	Flow rate (litres/minute)	5.60	0.00	0.00	0.00
Kitchen/utility room sink taps	Flow rate (litres/minute)	0.44	10.36	6.00	13.00
Washing machine	Washing machine installed?	2.10	0.00	No	17.16
	Litres/kg dry load			8.17	
Dishwasher	Dishwasher installed?	3.60	0.00	No	4.50
	Litres/place setting			1.25	
Waste disposal unit	Waste disposal installed?	3.08	0.00	No	0.00
	Litres/use			0.00	
Water softener	Water softener installed?	1.00	0.00	No	0.00
	Litres/person/day			0.00	
(5)	Total calculated use = (Sum column 4)			119.97	
(6)	Contribution from greywater (litres/person/day) from Table 4.6				
(7)	Contribution from rainwater (litres/person/day) from Table 5.5				
(8)	Normalisation factor			0.91	
(9)	Total water consumption = [(5) - (6) - (7)] ÷ (8) (CSH)			109.2	
(10)	External water use			5	
(11)	Total water consumption = (9) + (10) (litres/person/day) (Part G)			114.2	

This calculation sheet has been developed in accordance with the methodology stated within Building Regulations Approved Document G 2015 (2016 Amendments) Appendix A. Please refer to this document for specific guidance of how flow rates are to be derived.



Appendix C – Block Compliance WorkSheet: Part L 2013

Block Compliance WorkSheet: Sitewide

Input Details

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP **Software Version:** Version: 1.0.5.51

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
2B3P	17.34	28.64	48.2	56.6	71.0806
2B4P	15.82	27.02	45.8	53.8	81.1803
3B4P	14.67	26.28	45.5	53.8	89.3112
3B5P	13.68	25.37	44.6	52.9	98.8625

Calculation Summary

Total Floor Area	340.43
Average TER	26.68
Average DER	15.21
Average DFEE	45.87
Average TFEE	54.12
Compliance	Pass
% Improvement DER TER	42.99
% Improvement DFEE TFEE	15.24



Appendix D – Block Compliance WorkSheet: Part L 2021

Block Compliance WorkSheet: Part L 2021 (BETA)

Input Details

Assessor Name: **Stroma Number:**
Software Name: Stroma FSAP **Software Version:** Version: 1.0.0.37

Calculation Results

Dwelling	DER	TER	DFEE	TFEE	TFA
2B3P	4.28	13.09	41.7	43.8	71.0806
2B4P	3.88	12.08	40	42	81.1803
3B4P	3.6	11.59	39.9	41.7	89.3112
3B5P	3.34	11.02	39.4	41.1	98.8625

Calculation Summary

Total Floor Area	340.43
Average TER	11.85
Average DER	3.73
Average DFEE	40.15
Average TFEE	42.04
Compliance	Pass
% Improvement DER TER	68.52
% Improvement DFEE TFEE	4.5



Appendix E – SAP DER & TER Worksheets (Part L 2013 & 2021)

DER WorkSheet: New dwelling design stage

Use Details

Assessor Name:

Software Name: Stroma FSAP 2012

Stroma Number:

Software Version:

Version: 1.0.5.51

Property Address: 2B3P

Address : 2B3P

1. Overall dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	35.54 (1a)	×	2.6 (2a)	=	92.4 (3a)
First floor	35.54 (1b)	×	2.8 (2b)	=	99.51 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.08 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	191.92 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 (6a)
Number of open flues	0	+	0	=	0 (6b)
Number of intermittent fans				4	× 10 = 40 (7a)
Number of passive vents				0	× 10 = 0 (7b)
Number of flueless gas fires				0	× 40 = 0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	+	(5) =	0.21 (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]×0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction				0 (11)
<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>				
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 × (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)				0.46 (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 × (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor			(21) = (18) × (20) =	0.39 (21)
Infiltration rate modified for monthly wind speed				

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

	0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46
--	-----	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(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
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(24c)

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

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

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

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

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

(25)

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			2.17	1	2.17		(26)
Windows Type 1			2.3	$\times 1/[1/(1.2) + 0.04]$	2.63		(27)
Windows Type 2			1.21	$\times 1/[1/(1.2) + 0.04]$	1.39		(27)
Windows Type 3			3.18	$\times 1/[1/(1.2) + 0.04]$	3.64		(27)
Windows Type 4			0.63	$\times 1/[1/(1.2) + 0.04]$	0.72		(27)
Windows Type 5			1.2	$\times 1/[1/(1.2) + 0.04]$	1.37		(27)
Windows Type 6			1.8	$\times 1/[1/(1.2) + 0.04]$	2.06		(27)
Windows Type 7			1.8	$\times 1/[1/(1.2) + 0.04]$	2.06		(27)
Windows Type 8			1.2	$\times 1/[1/(1.2) + 0.04]$	1.37		(27)
Windows Type 9			0.63	$\times 1/[1/(1.2) + 0.04]$	0.72		(27)
Floor			35.54031	0.13	4.620241	75	2665.523 (28)
Walls Type1	44.95	9.49	35.46	0.14	4.96	60	2127.53 (29)
Walls Type2	48.41	6.63	41.78	0.14	5.85	60	2506.58 (29)
Roof	35.54	0	35.54	0.11	3.91	9	319.86 (30)
Total area of elements, m²			164.44				(31)
Party wall			36.39	0	0	45	1637.334 (32)
Internal wall **			102.3			39	3989.68 (32c)

DER WorkSheet: New dwelling design stage

Internal wall **	126.43	9	1137.881 (32c)
Internal floor	35.54	18	639.7256 (32d)
Internal ceiling	35.54	9	319.8628 (32e)

* 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) =	37.49 (33)
Heat capacity Cm = S(A x k)	((28)...(30) + (32) + (32a)...(32e) =	15343.98 (34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	215.87 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K	14.6 (36)
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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	52.09 (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=	39.48	39.18	38.88	37.48	37.22	36.01	36.01	35.78	36.47	37.22	37.75	38.3	(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=	91.57	91.27	90.97	89.57	89.31	88.1	88.1	87.87	88.56	89.31	89.84	90.39	
Average = Sum(39) ÷ 12 =	89.57 (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=	1.29	1.28	1.28	1.26	1.26	1.24	1.24	1.24	1.25	1.26	1.26	1.27	
Average = Sum(40) ÷ 12 =	1.26 (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 requirements

Assumed occupancy, N	2.27 (42)
----------------------	-----------

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

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.16 (43)
---	------------

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	96.98	93.45	89.92	86.4	82.87	79.35	79.35	82.87	86.4	89.92	93.45	96.98	
(44)m=													
Total = Sum(44) ÷ 12 =	1057.94 (44)												

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	143.82	125.78	129.8	113.16	108.58	93.7	86.82	99.63	100.82	117.5	128.26	139.28	
Total = Sum(45) ÷ 12 =	1387.13 (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=	21.57	18.87	19.47	16.97	16.29	14.05	13.02	14.94	15.12	17.62	19.24	20.89	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	210 (47)
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If community heating and no tank in dwelling, enter 110 litres in (47)

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

DER WorkSheet: New dwelling design stage

Water storage loss:

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

1.42 (48)

Temperature factor from Table 2b

0.54 (49)

Energy lost from water storage, kWh/year

(48) × (49) =

0.77 (50)

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

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

0 (51)

If community heating see section 4.3

Volume factor from Table 2a

0 (52)

Temperature factor from Table 2b

0 (53)

Energy lost from water storage, kWh/year

(47) × (51) × (52) × (53) =

0 (54)

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

0.77 (55)

Water storage loss calculated for each month

((56)m = (55) × (41)m

(56)m= 23.77 21.47 23.77 23 23.77 23 23.77 23.77 23 23.77 23 23.77 (56)

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

(57)m= 23.77 21.47 23.77 23 23.77 23 23.77 23.77 23 23.77 23 23.77 (57)

Primary circuit loss (annual) from Table 3

0 (58)

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

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

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

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

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

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

(62)m= 190.85 168.26 176.83 158.67 155.61 139.21 133.86 146.66 146.34 164.53 173.77 186.31 (62)

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

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

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

Output from water heater

(64)m= 190.85 168.26 176.83 158.67 155.61 139.21 133.86 146.66 146.34 164.53 173.77 186.31

Output from water heater (annual) 1...12

1940.9 (64)

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

(65)m= 85.45 75.81 80.78 74.04 73.73 67.57 66.49 70.75 69.94 76.69 79.06 83.94 (65)

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

5 Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6

(66)

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

(67)m= 17.98 15.97 12.98 9.83 7.35 6.2 6.7 8.71 11.69 14.85 17.33 18.48 (67)

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

(68)m= 199.81 201.88 196.65 185.53 171.49 158.29 149.48 147.41 152.63 163.75 177.79 190.99 (68)

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

(69)m= 34.36 34.36 34.36 34.36 34.36 34.36 34.36 34.36 34.36 34.36 34.36 34.36 (69)

Pumps and fans gains (Table 5a)

(70)m= 0 0 0 0 0 0 0 0 0 0 0 0 (70)

DER WorkSheet: New dwelling design stage

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

(71)m=	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	(71)
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Water heating gains (Table 5)

(72)m=	114.85	112.81	108.58	102.83	99.1	93.84	89.37	95.1	97.13	103.08	109.8	112.82	(72)
--------	--------	--------	--------	--------	------	-------	-------	------	-------	--------	-------	--------	------

Total internal gains =

Total internal gains =												$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$	
$(73)m=$	389.71	387.74	375.3	355.27	335.02	315.42	302.64	308.3	318.54	338.77	362.01	379.36	(73)

6. Solar gains

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

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g _o Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.21	x	10.63	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	3.18	x	10.63	x	0.63	x	0.7	=	10.33	(74)
North	0.9x	0.77	x	1.8	x	10.63	x	0.63	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	1.2	x	10.63	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	1.21	x	20.32	x	0.63	x	0.7	=	7.51	(74)
North	0.9x	0.77	x	3.18	x	20.32	x	0.63	x	0.7	=	19.75	(74)
North	0.9x	0.77	x	1.8	x	20.32	x	0.63	x	0.7	=	11.18	(74)
North	0.9x	0.77	x	1.2	x	20.32	x	0.63	x	0.7	=	7.45	(74)
North	0.9x	0.77	x	1.21	x	34.53	x	0.63	x	0.7	=	12.77	(74)
North	0.9x	0.77	x	3.18	x	34.53	x	0.63	x	0.7	=	33.56	(74)
North	0.9x	0.77	x	1.8	x	34.53	x	0.63	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.2	x	34.53	x	0.63	x	0.7	=	12.68	(74)
North	0.9x	0.77	x	1.21	x	55.46	x	0.63	x	0.7	=	28.51	(74)
North	0.9x	0.77	x	3.18	x	55.46	x	0.63	x	0.7	=	53.9	(74)
North	0.9x	0.77	x	1.8	x	55.46	x	0.63	x	0.7	=	30.51	(74)
North	0.9x	0.77	x	1.2	x	55.46	x	0.63	x	0.7	=	20.34	(74)
North	0.9x	0.77	x	1.21	x	74.72	x	0.63	x	0.7	=	27.63	(74)
North	0.9x	0.77	x	3.18	x	74.72	x	0.63	x	0.7	=	72.61	(74)
North	0.9x	0.77	x	1.8	x	74.72	x	0.63	x	0.7	=	41.1	(74)
North	0.9x	0.77	x	1.2	x	74.72	x	0.63	x	0.7	=	27.4	(74)
North	0.9x	0.77	x	1.21	x	79.99	x	0.63	x	0.7	=	29.58	(74)
North	0.9x	0.77	x	3.18	x	79.99	x	0.63	x	0.7	=	77.73	(74)
North	0.9x	0.77	x	1.8	x	79.99	x	0.63	x	0.7	=	44	(74)
North	0.9x	0.77	x	1.2	x	79.99	x	0.63	x	0.7	=	29.33	(74)
North	0.9x	0.77	x	1.21	x	74.68	x	0.63	x	0.7	=	27.61	(74)
North	0.9x	0.77	x	3.18	x	74.68	x	0.63	x	0.7	=	72.57	(74)
North	0.9x	0.77	x	1.8	x	74.68	x	0.63	x	0.7	=	41.08	(74)
North	0.9x	0.77	x	1.2	x	74.68	x	0.63	x	0.7	=	27.39	(74)
North	0.9x	0.77	x	1.21	x	59.25	x	0.63	x	0.7	=	21.91	(74)
North	0.9x	0.77	x	3.18	x	59.25	x	0.63	x	0.7	=	57.58	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.8	x	59.25	x	0.63	x	0.7	=	32.59	(74)
North	0.9x	0.77	x	1.2	x	59.25	x	0.63	x	0.7	=	21.73	(74)
North	0.9x	0.77	x	1.21	x	41.52	x	0.63	x	0.7	=	15.35	(74)
North	0.9x	0.77	x	3.18	x	41.52	x	0.63	x	0.7	=	40.35	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.63	x	0.7	=	22.84	(74)
North	0.9x	0.77	x	1.2	x	41.52	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	1.21	x	24.19	x	0.63	x	0.7	=	8.95	(74)
North	0.9x	0.77	x	3.18	x	24.19	x	0.63	x	0.7	=	23.51	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.63	x	0.7	=	13.31	(74)
North	0.9x	0.77	x	1.2	x	24.19	x	0.63	x	0.7	=	8.87	(74)
North	0.9x	0.77	x	1.21	x	13.12	x	0.63	x	0.7	=	4.85	(74)
North	0.9x	0.77	x	3.18	x	13.12	x	0.63	x	0.7	=	12.75	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.63	x	0.7	=	7.22	(74)
North	0.9x	0.77	x	1.2	x	13.12	x	0.63	x	0.7	=	4.81	(74)
North	0.9x	0.77	x	1.21	x	8.86	x	0.63	x	0.7	=	3.28	(74)
North	0.9x	0.77	x	3.18	x	8.86	x	0.63	x	0.7	=	8.61	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.63	x	0.7	=	4.88	(74)
North	0.9x	0.77	x	1.2	x	8.86	x	0.63	x	0.7	=	3.25	(74)
South	0.9x	0.77	x	2.3	x	46.75	x	0.63	x	0.7	=	32.86	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	2.3	x	76.57	x	0.63	x	0.7	=	53.82	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	2.3	x	97.53	x	0.63	x	0.7	=	68.56	(78)
South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)
South	0.9x	0.77	x	2.3	x	110.23	x	0.63	x	0.7	=	77.48	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	2.3	x	114.87	x	0.63	x	0.7	=	80.74	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	2.3	x	110.55	x	0.63	x	0.7	=	77.71	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	2.3	x	108.01	x	0.63	x	0.7	=	75.92	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	2.3	x	104.89	x	0.63	x	0.7	=	73.73	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	2.3	x	101.89	x	0.63	x	0.7	=	71.62	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	2.3	x	82.59	x	0.63	x	0.7	=	58.05	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	2.3	x	55.42	x	0.63	x	0.7	=	38.95	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.49	(78)
South	0.9x	0.77	x	2.3	x	40.4	x	0.63	x	0.7	=	28.4	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)
West	0.9x	0.77	x	0.63	x	19.64	x	0.63	x	0.7	=	3.78	(80)
West	0.9x	0.77	x	0.63	x	19.64	x	0.63	x	0.7	=	3.78	(80)
West	0.9x	0.77	x	0.63	x	38.42	x	0.63	x	0.7	=	7.4	(80)
West	0.9x	0.77	x	0.63	x	38.42	x	0.63	x	0.7	=	7.4	(80)
West	0.9x	0.77	x	0.63	x	63.27	x	0.63	x	0.7	=	12.18	(80)
West	0.9x	0.77	x	0.63	x	63.27	x	0.63	x	0.7	=	12.18	(80)
West	0.9x	0.77	x	0.63	x	92.28	x	0.63	x	0.7	=	17.77	(80)
West	0.9x	0.77	x	0.63	x	92.28	x	0.63	x	0.7	=	17.77	(80)
West	0.9x	0.77	x	0.63	x	113.09	x	0.63	x	0.7	=	23.77	(80)
West	0.9x	0.77	x	0.63	x	113.09	x	0.63	x	0.7	=	23.77	(80)
West	0.9x	0.77	x	0.63	x	115.77	x	0.63	x	0.7	=	22.29	(80)
West	0.9x	0.77	x	0.63	x	115.77	x	0.63	x	0.7	=	22.29	(80)
West	0.9x	0.77	x	0.63	x	110.22	x	0.63	x	0.7	=	21.22	(80)
West	0.9x	0.77	x	0.63	x	110.22	x	0.63	x	0.7	=	21.22	(80)
West	0.9x	0.77	x	0.63	x	94.68	x	0.63	x	0.7	=	18.23	(80)
West	0.9x	0.77	x	0.63	x	94.68	x	0.63	x	0.7	=	18.23	(80)
West	0.9x	0.77	x	0.63	x	73.59	x	0.63	x	0.7	=	14.17	(80)
West	0.9x	0.77	x	0.63	x	73.59	x	0.63	x	0.7	=	14.17	(80)
West	0.9x	0.77	x	0.63	x	45.59	x	0.63	x	0.7	=	8.78	(80)
West	0.9x	0.77	x	0.63	x	45.59	x	0.63	x	0.7	=	8.78	(80)
West	0.9x	0.77	x	0.63	x	24.49	x	0.63	x	0.7	=	4.72	(80)
West	0.9x	0.77	x	0.63	x	24.49	x	0.63	x	0.7	=	4.72	(80)
West	0.9x	0.77	x	0.63	x	16.15	x	0.63	x	0.7	=	3.11	(80)
West	0.9x	0.77	x	0.63	x	16.15	x	0.63	x	0.7	=	3.11	(80)

Solar gains in watts, calculated for each month

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

(83)m= 107.3 184.71 260.33 339.35 398.36 404.29 386.05 340.17 287.13 205.95 128.82 91.67 (83)

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

(84)m= 497.01 572.45 635.63 694.63 733.37 719.71 688.69 648.46 605.67 544.72 490.83 471.04 (84)

DER WorkSheet: New dwelling design stage

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.94	0.85	0.7	0.54	0.59	0.81	0.95	0.99	0.99	(86)

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

(87)m=	19.82	19.96	20.18	20.46	20.71	20.87	20.92	20.91	20.8	20.49	20.1	19.8	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.85	19.85	19.86	19.87	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.86	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.92	0.81	0.61	0.41	0.46	0.73	0.93	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.28	18.49	18.81	19.23	19.56	19.75	19.79	19.79	19.68	19.27	18.72	18.26	(90)
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fLA = Living area ÷ (4) = 0.15 (91)

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

(92)m=	18.51	18.7	19.01	19.41	19.73	19.91	19.95	19.95	19.85	19.45	18.92	18.49	(92)
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Apply adjustment to the mean internal temperature from Table 4c, where appropriate

(93)m=	18.51	18.7	19.01	19.41	19.73	19.91	19.95	19.95	19.85	19.45	18.92	18.49	(93)
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8. Space heating requirement

Set T1 to the mean internal temperature obtained at step 11 of Table 9b, so that T1m=(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	
(94)m=	0.99	0.98	0.96	0.91	0.8	0.61	0.42	0.47	0.73	0.92	0.98	0.99	(94)

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

(95)m=	491.04	560.05	608.87	629.98	585.1	438.42	290.77	304.68	443.43	502.96	480	466.43	(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 = [(93)m – (96)m]

(97)m=	1300.98	1259.91	1138.08	941.37	717.06	468.15	295.55	312.17	509.06	790.49	1062.02	1291.68	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	602.59	470.3	393.73	224.2	98.18	0	0	0	0	213.92	419.05	613.98	(98)
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Total per year (kWh/year) = Sum(98)1..12 = 3035.95 (98)

Space heating requirement in kWh/m²/year 42.71 (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		221.94	(206)
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
Space heating requirement (calculated above)													
	602.59	470.3	393.73	224.2	98.18	0	0	0	0	213.92	419.05	613.98	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)													
	271.51	211.91	177.41	101.02	44.24	0	0	0	0	96.39	188.81	276.64	
Total (kWh/year) = Sum(211) _{1..5,10...12} =													1367.93 (211)
Space heating fuel (secondary), kWh/month													
= {[(98)m x (201)] } x 100 ÷ (208)													
(215)m =	0	0	0	0	0	0	0	0	0	0	0	0	
Total (kWh/year) = Sum(215) _{1..5,10...12} =													0 (215)
Water heating													
Output from water heater (calculated above)													
	190.85	168.26	176.83	158.67	155.61	139.21	133.86	146.66	146.34	164.53	173.77	186.31	
Efficiency of water heater													281.48 (216)
(217)m =	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m =	67.8	59.78	62.82	56.37	55.28	49.46	47.55	52.1	51.99	58.45	61.73	66.19	
Total = Sum(219a) _{1..12} =													689.52 (219)
Annual totals													
Space heating fuel used, main system 1													1367.93 (219)
Water heating fuel used													689.52 (219)
Electricity for pumps, fans and electric keep-hot													
Total electricity for the above, kWh/year													0 (231)
Electricity for lighting													317.48 (232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													2374.91 (338)

12a CO2 emissions - Individual heating systems including air-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519	709.96 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.519	357.86 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1067.82 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	0 (267)
Electricity for lighting	(232) x	0.519	164.76 (268)
Total CO2, kg/year	sum of (265)...(271) =		1232.58 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =		17.34 (273)
El rating (section 14)			86 (274)

TER WorkSheet: New dwelling design stage

Base Details

Assessor Name:

Software Name: Stroma FSAP 2012

Stroma Number:

Software Version:

Version: 1.0.5.51

Property Address: 2B3P

Address : 2B3P

1. Overall dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	35.54 (1a)	×	2.6 (2a)	=	92.4 (3a)
First floor	35.54 (1b)	×	2.8 (2b)	=	99.51 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.08 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	191.92 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 (6a)
Number of open flues	0	+	0	=	0 (6b)
Number of intermittent fans				3	× 10 = 30 (7a)
Number of passive vents				0	× 10 = 0 (7b)
Number of flueless gas fires				0	× 40 = 0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	+	(5) =	0.16 (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]×0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction				0 (11)
<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>				
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 × (14) + 100] =	0 (15)
Infiltration rate			(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area				5 (17)
If based on air permeability value, then (18) = [(17) + 20]÷(8), otherwise (18) = (16)				0.41 (18)
<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 × (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor			(21) = (18) × (20) =	0.35 (21)
Infiltration rate modified for monthly wind speed				

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

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

	0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(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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(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
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(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
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(24c)

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

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

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

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

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

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			2.17	1	2.17		(26)
Windows Type 1			2.3	$\times 1/[1/(1.4) + 0.04]$	3.05		(27)
Windows Type 2			1.21	$\times 1/[1/(1.4) + 0.04]$	1.6		(27)
Windows Type 3			3.18	$\times 1/[1/(1.4) + 0.04]$	4.22		(27)
Windows Type 4			0.63	$\times 1/[1/(1.4) + 0.04]$	0.84		(27)
Windows Type 5			1.2	$\times 1/[1/(1.4) + 0.04]$	1.59		(27)
Windows Type 6			1.8	$\times 1/[1/(1.4) + 0.04]$	2.39		(27)
Windows Type 7			1.8	$\times 1/[1/(1.4) + 0.04]$	2.39		(27)
Windows Type 8			1.2	$\times 1/[1/(1.4) + 0.04]$	1.59		(27)
Windows Type 9			0.63	$\times 1/[1/(1.4) + 0.04]$	0.84		(27)
Floor			35.54031	0.13	4.620241		(28)
Walls Type1	44.95	9.49	35.46	0.18	6.38		(29)
Walls Type2	48.41	6.63	41.78	0.18	7.52		(29)
Roof	35.54	0	35.54	0.13	4.62		(30)
Total area of elements, m²			164.44				(31)
Party wall			36.39	0	0		(32)
Internal wall **			102.3				(32c)

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Internal wall **	126.43		(32c)
Internal floor	35.54		(32d)
Internal ceiling	35.54		(32e)

* 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) =	43.81	(33)
Heat capacity Cm = S(A x k)	((28)...(30) + (32) + (32a)...(32e) =	15343.98	(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	9.23	(36)
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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	53.04	(37)
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Ventilation heat loss calculated monthly	(38)m = 0.33 x (25)m x (5)	
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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.81	37.57	37.33	36.24	36.03	35.08	35.08	34.9	35.44	36.03	36.45	36.88	(38)

Heat transfer coefficient, W/K	(39)m = (37) + (38)m	
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(39)m=	90.85	90.61	90.38	89.28	89.07	88.12	88.12	87.94	88.49	89.07	89.49	89.92		
	Average = Sum(39) / 12=												89.26	(39)

Heat loss parameter (HLP), W/m²K	(40)m = (39)m ÷ (4)	
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(40)m=	1.28	1.27	1.27	1.26	1.25	1.24	1.24	1.24	1.24	1.25	1.26	1.27		
	Average = Sum(40) / 12 =												1.26	(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 requirements

Assumed occupancy, N	2.27	(42)
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if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.16	(43)
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Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)													
(44) $m=$	96.98	93.45	89.92	86.4	82.87	79.35	79.35	82.87	86.4	89.92	93.45	96.98	
Total = Sum(44) $_{1..12}$ =												1057.94	(44)

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

(45)m=	143.82	125.78	129.8	113.16	108.58	93.7	86.82	99.63	100.82	117.5	128.26	139.28		
Total = Sum(45) _{1..12} =													1387.13	(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=	21.57	18.87	19.47	16.97	16.29	14.05	13.02	14.94	15.12	17.62	19.24	20.89	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	150	(47)
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If community heating and no tank in dwelling, enter 110 litres in (47)

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

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Water storage loss:

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

1.7 (48)

Temperature factor from Table 2b

0.54 (49)

Energy lost from water storage, kWh/year

(48) × (49) =

0.92 (50)

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

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

0 (51)

If community heating see section 4.3

Volume factor from Table 2a

0 (52)

Temperature factor from Table 2b

0 (53)

Energy lost from water storage, kWh/year

(47) × (51) × (52) × (53) =

0 (54)

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

0.92 (55)

Water storage loss calculated for each month

((56)m = (55) × (41)m

(56)m= 28.48 25.73 28.48 27.57 28.48 27.57 28.48 28.48 27.57 28.48 27.57 28.48 (56)

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

(57)m= 28.48 25.73 28.48 27.57 28.48 27.57 28.48 28.48 27.57 28.48 27.57 28.48 (57)

Primary circuit loss (annual) from Table 3

0 (58)

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

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

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

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

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

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

(62)m= 195.56 172.52 181.54 163.24 160.33 143.77 138.57 151.38 150.9 169.24 178.33 191.02 (62)

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

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

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

Output from water heater

(64)m= 195.56 172.52 181.54 163.24 160.33 143.77 138.57 151.38 150.9 169.24 178.33 191.02

Output from water heater (annual) 1996.4 (64)

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

(65)m= 89.22 79.21 84.55 77.69 77.5 71.22 70.27 74.52 73.58 80.46 82.71 87.71 (65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6

(66)

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

(67)m= 17.98 15.97 12.98 9.83 7.35 6.2 6.7 8.71 11.69 14.85 17.33 18.48 (67)

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

(68)m= 199.81 201.88 196.65 185.53 171.49 158.29 149.48 147.41 152.63 163.75 177.79 190.99 (68)

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

(69)m= 34.36 34.36 34.36 34.36 34.36 34.36 34.36 34.36 34.36 34.36 34.36 34.36 (69)

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=	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	(71)
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Water heating gains (Table 5)

(72)m=	119.91	117.88	113.65	107.9	104.17	98.91	94.44	100.17	102.2	108.15	114.87	117.89	(72)
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Total internal gains =

(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	397.78	395.8	383.37	363.34	343.09	323.49	310.71	316.37	326.61	346.83	370.08	387.43	(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 m ²		Flux Table 6a		g _u Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.21	x	10.63	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	3.18	x	10.63	x	0.63	x	0.7	=	10.33	(74)
North	0.9x	0.77	x	1.8	x	10.63	x	0.63	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	1.2	x	10.63	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	1.21	x	20.32	x	0.63	x	0.7	=	7.51	(74)
North	0.9x	0.77	x	3.18	x	20.32	x	0.63	x	0.7	=	19.75	(74)
North	0.9x	0.77	x	1.8	x	20.32	x	0.63	x	0.7	=	11.18	(74)
North	0.9x	0.77	x	1.2	x	20.32	x	0.63	x	0.7	=	7.45	(74)
North	0.9x	0.77	x	1.21	x	34.53	x	0.63	x	0.7	=	12.77	(74)
North	0.9x	0.77	x	3.18	x	34.53	x	0.63	x	0.7	=	33.56	(74)
North	0.9x	0.77	x	1.8	x	34.53	x	0.63	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.2	x	34.53	x	0.63	x	0.7	=	12.68	(74)
North	0.9x	0.77	x	1.21	x	55.46	x	0.63	x	0.7	=	28.51	(74)
North	0.9x	0.77	x	3.18	x	55.46	x	0.63	x	0.7	=	53.9	(74)
North	0.9x	0.77	x	1.8	x	55.46	x	0.63	x	0.7	=	30.51	(74)
North	0.9x	0.77	x	1.2	x	55.46	x	0.63	x	0.7	=	20.34	(74)
North	0.9x	0.77	x	1.21	x	74.72	x	0.63	x	0.7	=	27.63	(74)
North	0.9x	0.77	x	3.18	x	74.72	x	0.63	x	0.7	=	72.61	(74)
North	0.9x	0.77	x	1.8	x	74.72	x	0.63	x	0.7	=	41.1	(74)
North	0.9x	0.77	x	1.2	x	74.72	x	0.63	x	0.7	=	27.4	(74)
North	0.9x	0.77	x	1.21	x	79.99	x	0.63	x	0.7	=	29.58	(74)
North	0.9x	0.77	x	3.18	x	79.99	x	0.63	x	0.7	=	77.73	(74)
North	0.9x	0.77	x	1.8	x	79.99	x	0.63	x	0.7	=	44	(74)
North	0.9x	0.77	x	1.2	x	79.99	x	0.63	x	0.7	=	29.33	(74)
North	0.9x	0.77	x	1.21	x	74.68	x	0.63	x	0.7	=	27.61	(74)
North	0.9x	0.77	x	3.18	x	74.68	x	0.63	x	0.7	=	72.57	(74)
North	0.9x	0.77	x	1.8	x	74.68	x	0.63	x	0.7	=	41.08	(74)
North	0.9x	0.77	x	1.2	x	74.68	x	0.63	x	0.7	=	27.39	(74)
North	0.9x	0.77	x	1.21	x	59.25	x	0.63	x	0.7	=	21.91	(74)
North	0.9x	0.77	x	3.18	x	59.25	x	0.63	x	0.7	=	57.58	(74)

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North	0.9x	0.77	x	1.8	x	59.25	x	0.63	x	0.7	=	32.59	(74)
North	0.9x	0.77	x	1.2	x	59.25	x	0.63	x	0.7	=	21.73	(74)
North	0.9x	0.77	x	1.21	x	41.52	x	0.63	x	0.7	=	15.35	(74)
North	0.9x	0.77	x	3.18	x	41.52	x	0.63	x	0.7	=	40.35	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.63	x	0.7	=	22.84	(74)
North	0.9x	0.77	x	1.2	x	41.52	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	1.21	x	24.19	x	0.63	x	0.7	=	8.95	(74)
North	0.9x	0.77	x	3.18	x	24.19	x	0.63	x	0.7	=	23.51	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.63	x	0.7	=	13.31	(74)
North	0.9x	0.77	x	1.2	x	24.19	x	0.63	x	0.7	=	8.87	(74)
North	0.9x	0.77	x	1.21	x	13.12	x	0.63	x	0.7	=	4.85	(74)
North	0.9x	0.77	x	3.18	x	13.12	x	0.63	x	0.7	=	12.75	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.63	x	0.7	=	7.22	(74)
North	0.9x	0.77	x	1.2	x	13.12	x	0.63	x	0.7	=	4.81	(74)
North	0.9x	0.77	x	1.21	x	8.86	x	0.63	x	0.7	=	3.28	(74)
North	0.9x	0.77	x	3.18	x	8.86	x	0.63	x	0.7	=	8.61	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.63	x	0.7	=	4.88	(74)
North	0.9x	0.77	x	1.2	x	8.86	x	0.63	x	0.7	=	3.25	(74)
South	0.9x	0.77	x	2.3	x	46.75	x	0.63	x	0.7	=	32.85	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	2.3	x	76.57	x	0.63	x	0.7	=	53.82	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	2.3	x	97.53	x	0.63	x	0.7	=	68.56	(78)
South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)
South	0.9x	0.77	x	2.3	x	110.23	x	0.63	x	0.7	=	77.48	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	2.3	x	114.87	x	0.63	x	0.7	=	80.74	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	2.3	x	110.55	x	0.63	x	0.7	=	77.71	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	2.3	x	108.01	x	0.63	x	0.7	=	75.92	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	2.3	x	104.89	x	0.63	x	0.7	=	73.73	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)

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South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	2.3	x	101.89	x	0.63	x	0.7	=	71.62	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	2.3	x	82.59	x	0.63	x	0.7	=	58.05	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	2.3	x	55.42	x	0.63	x	0.7	=	38.95	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.49	(78)
South	0.9x	0.77	x	2.3	x	40.4	x	0.63	x	0.7	=	28.4	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)
West	0.9x	0.77	x	0.63	x	19.64	x	0.63	x	0.7	=	3.78	(80)
West	0.9x	0.77	x	0.63	x	19.64	x	0.63	x	0.7	=	3.78	(80)
West	0.9x	0.77	x	0.63	x	38.42	x	0.63	x	0.7	=	7.4	(80)
West	0.9x	0.77	x	0.63	x	38.42	x	0.63	x	0.7	=	7.4	(80)
West	0.9x	0.77	x	0.63	x	63.27	x	0.63	x	0.7	=	12.18	(80)
West	0.9x	0.77	x	0.63	x	63.27	x	0.63	x	0.7	=	12.18	(80)
West	0.9x	0.77	x	0.63	x	92.28	x	0.63	x	0.7	=	17.77	(80)
West	0.9x	0.77	x	0.63	x	92.28	x	0.63	x	0.7	=	17.77	(80)
West	0.9x	0.77	x	0.63	x	113.09	x	0.63	x	0.7	=	21.77	(80)
West	0.9x	0.77	x	0.63	x	113.09	x	0.63	x	0.7	=	21.77	(80)
West	0.9x	0.77	x	0.63	x	115.77	x	0.63	x	0.7	=	22.29	(80)
West	0.9x	0.77	x	0.63	x	115.77	x	0.63	x	0.7	=	22.29	(80)
West	0.9x	0.77	x	0.63	x	110.22	x	0.63	x	0.7	=	21.22	(80)
West	0.9x	0.77	x	0.63	x	110.22	x	0.63	x	0.7	=	21.22	(80)
West	0.9x	0.77	x	0.63	x	94.68	x	0.63	x	0.7	=	18.23	(80)
West	0.9x	0.77	x	0.63	x	94.68	x	0.63	x	0.7	=	18.23	(80)
West	0.9x	0.77	x	0.63	x	73.59	x	0.63	x	0.7	=	14.17	(80)
West	0.9x	0.77	x	0.63	x	73.59	x	0.63	x	0.7	=	14.17	(80)
West	0.9x	0.77	x	0.63	x	45.59	x	0.63	x	0.7	=	8.78	(80)
West	0.9x	0.77	x	0.63	x	45.59	x	0.63	x	0.7	=	8.78	(80)
West	0.9x	0.77	x	0.63	x	24.49	x	0.63	x	0.7	=	4.72	(80)
West	0.9x	0.77	x	0.63	x	24.49	x	0.63	x	0.7	=	4.72	(80)
West	0.9x	0.77	x	0.63	x	16.15	x	0.63	x	0.7	=	3.11	(80)
West	0.9x	0.77	x	0.63	x	16.15	x	0.63	x	0.7	=	3.11	(80)

Solar gains in watts, calculated for each month

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

(83)m= 107.3 184.71 260.33 339.35 398.36 404.29 386.05 340.17 287.13 205.95 128.82 91.67 (83)

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

(84)m= 505.08 580.51 643.7 702.69 741.44 727.77 696.76 656.53 613.74 552.79 498.89 479.11 (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	0.59	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=	19.69	19.86	20.12	20.46	20.76	20.94	20.99	20.98	20.86	20.49	20.03	19.66
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(87)

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

(88)m=	19.86	19.86	19.86	19.88	19.88	19.89	19.89	19.89	19.88	19.88	19.87	19.87
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(88)

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

(89)m=	0.99	0.99	0.97	0.93	0.82	0.61	0.41	0.46	0.74	0.94	0.99	1
--------	------	------	------	------	------	------	------	------	------	------	------	---

(89)

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

(90)m=	18.14	18.38	18.76	19.26	19.64	19.85	19.88	19.88	19.78	19.3	18.64	18.1
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

(90)

fLA = Living area ÷ (4) =

0.15

(91)

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

(92)m=	18.36	18.6	18.96	19.43	19.81	20.01	20.05	20.04	19.94	19.48	18.84	18.33
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(92)

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

(93)m=	18.36	18.6	18.96	19.43	19.81	20.01	20.05	20.04	19.94	19.48	18.84	18.33
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(93)

8. Space heating requirements

Set T1 to the mean internal temperature obtained at step 11 of Table 9b, so that T1m=(92)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm

(94)m=	0.99	0.98	0.97	0.92	0.81	0.62	0.43	0.48	0.75	0.94	0.98	0.99
--------	------	------	------	------	------	------	------	------	------	------	------	------

(94)

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

(95)m=	500.87	571.24	622.24	646.68	603.13	452.19	300.27	314.88	458.74	517.14	490.74	475.93
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(95)

Monthly average external temperature from Table 8

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

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

(97)m=	1277.76	1241.34	1126.49	940.47	722.33	476.48	303.66	320.43	516.6	790.53	1051.04	1270.83
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(97)

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

(98)m=	578.01	450.31	375.16	211.53	88.68	0	0	0	0	203.41	403.41	591.41
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

Total per year (kWh/year) = Sum(98)1..12 =

2901.92

(98)

Space heating requirement in kWh/m²/year

40.83

(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0

(201)

Fraction of space heat from main system(s)

(202) = 1 – (201) =

1

(202)

Fraction of total heating from main system 1

(204) = (202) × [1 – (203)] =

1

(204)

Efficiency of main space heating system 1

93.5

(206)

Efficiency of secondary/supplementary heating system, %

0

(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	578.01	450.31	375.16	211.53	88.68	0	0	0	0	203.41	403.41	591.41	
(211)m = {[[(98)m x (204)] } x 100 ÷ (206) (211)													
	618.19	481.61	401.24	226.24	94.85	0	0	0	0	217.55	431.46	632.53	
Total (kWh/year) =Sum(211) _{1, 5, 10, ..., 12} =													3103.66 (211)
Space heating fuel (secondary), kWh/month = {[[(98)m x (201)] } x 100 ÷ (208)													
(215)m =	0	0	0	0	0	0	0	0	0	0	0	0	
Total (kWh/year) =Sum(215) _{1, 5, 10, ..., 12} =													0 (215)
Water heating													
Output from water heater (calculated above)													
	195.56	172.52	181.54	163.24	160.33	143.77	138.57	151.38	150.9	169.24	178.33	191.02	
Efficiency of water heater													79.8 (216)
(217)m =	87.53	87.26	86.71	85.51	83.31	79.8	79.8	79.8	79.8	85.31	86.93	87.63	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m =	223.42	197.71	209.37	190.91	192.45	180.17	173.65	189.69	189.09	198.4	205.15	217.99	
Total = Sum(219a) _{1, 12} =													2367.99 (219)
Annual totals													
Space heating fuel used, main system 1													3103.66 kWh/year
Water heating fuel used													2367.99 kWh/year
Electricity for pumps, fans and electric keep-hot													
central heating pump:													30 (230c)
boiler with a fan-assisted flue:													45 (230e)
Total electricity for the above, kWh/year													75 sum of (230a)...(230g) = (231)
Electricity for lighting													317.46 (232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =													5864.1 (338)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	670.39 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.216	511.49 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1181.87 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	38.93 (267)
Electricity for lighting	(232) x	0.519	164.76 (268)
Total CO2, kg/year	sum of (265)...(271) =		1385.56 (272)

TER = 28.64 (273)

DRAFT

DER WorkSheet: New dwelling design stage

Use Details

Assessor Name:

Software Name: Stroma FSAP 2012

Stroma Number:

Software Version:

Version: 1.0.5.51

Property Address: 2B4P

Address : 2B4P

1. Overall dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	40.59 (1a)	x	2.6 (2a)	=	105.53 (3a)
First floor	40.59 (1b)	x	2.8 (2b)	=	113.65 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	81.18 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	219.19 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				4	40 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	+ (5) =	0.18 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
If both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) + 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) + 20]x(8), otherwise (18) = (16)			0.43 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.37 (21)
Infiltration rate modified for monthly wind speed			

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

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

	0.47	0.46	0.45	0.4	0.4	0.35	0.35	0.34	0.37	0.4	0.41	0.43
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(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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(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
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(24c)

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

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

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

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

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

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			2.17	1	2.17		(26)
Windows Type 1			2.36	$\times 1/[1/(1.2) + 0.04]$	2.7		(27)
Windows Type 2			0.63	$\times 1/[1/(1.2) + 0.04]$	0.72		(27)
Windows Type 3			0.96	$\times 1/[1/(1.2) + 0.04]$	1.1		(27)
Windows Type 4			3.18	$\times 1/[1/(1.2) + 0.04]$	3.64		(27)
Windows Type 5			1.2	$\times 1/[1/(1.2) + 0.04]$	1.37		(27)
Windows Type 6			1.8	$\times 1/[1/(1.2) + 0.04]$	2.06		(27)
Windows Type 7			1.8	$\times 1/[1/(1.2) + 0.04]$	2.06		(27)
Windows Type 8			1.2	$\times 1/[1/(1.2) + 0.04]$	1.37		(27)
Floor			40.59015	0.13	5.276719	75	3044.261 (28)
Walls Type1	47.29	9.3	37.99	0.14	5.32	60	2279.48 (29)
Walls Type2	50.93	6	44.93	0.14	6.29	60	2695.75 (29)
Roof	40.59	0	40.59	0.11	4.46	9	365.31 (30)
Total area of elements, m²			179.4				(31)
Party wall			42.46	0	0	45	1910.709 (32)
Internal wall **			102.3			39	3989.68 (32c)
Internal wall **			126.43			9	1137.881 (32c)

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Internal floor	40.59	18	730.6227 (32d)
Internal ceiling	40.59	9	365.3113 (32e)

* 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) (28) ... (30) + (32) = 38.55 (33)

Heat capacity Cm = S(A x k) ((28) ... (30) + (32) + (32a) ... (32e) = 16519.01 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 203.49 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 15.05 (36)

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

Total fabric heat loss (33) + (36) = 53.61 (37)

Ventilation heat loss calculated monthly (35)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	44.11	43.8	43.5	42.08	41.81	40.58	40.58	40.35	41.05	41.81	42.35	42.91	(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=	97.72	97.41	97.11	95.69	95.42	94.18	94.18	93.95	94.66	95.42	95.96	96.52	
	Average = Sum(39) _{1..12} / 12 = 95.68 (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=	1.2	1.2	1.2	1.18	1.18	1.16	1.16	1.16	1.17	1.18	1.18	1.19	
	Average = Sum(40) _{1..12} / 12 = 1.18 (40)												

Number of days in month (Table 1a)

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

Assumed occupancy, N 2.48 (42)

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

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 93.22 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	102.54	98.81	95.08	91.35	87.62	83.89	83.89	87.62	91.35	95.08	98.81	102.54	
	Total = Sum(44) _{1..12} = 1118.59 (44)												

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	152.06	132.99	137.24	119.65	114.8	99.07	91.8	105.34	106.6	124.23	135.61	147.26	
	Total = Sum(45) _{1..12} = 1466.65 (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=	22.81	19.95	20.59	17.95	17.22	14.86	13.77	15.8	15.99	18.63	20.34	22.09	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

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

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

Water storage loss:

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a) If manufacturer's declared loss factor is known (kWh/day): 1.42 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) × (49) = 0.77 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.77 (55)

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

(56)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(56)
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If cylinder contains dedicated solar storage, (57)m = (56)m × [(50) – (H11)] + (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(57)
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Primary circuit loss (annual) from Table 3 0 (58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

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

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

(62)m=	199.09	175.47	184.27	165.16	161.84	144.58	138.83	152.37	152.12	171.26	181.12	194.3	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

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

Output from water heater

(64)m=	199.09	175.47	184.27	165.16	161.84	144.58	138.83	152.37	152.12	171.26	181.12	194.3	(64)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

Output from water heater (annual) 2020.43 (64)

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

(65)m=	88.19	78.21	83.26	76.2	75.8	69.35	68.15	72.65	71.86	78.93	81.5	86.59	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5 Internal gains (see Table 5a and 5b)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	(66)

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

(67)m=	20.59	18.29	14.88	11.26	8.42	7.11	7.68	9.98	13.4	17.01	19.86	21.17	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	221.89	224.19	218.39	206.04	190.44	175.79	166	163.7	169.5	181.85	197.44	212.1	(68)
--------	--------	--------	--------	--------	--------	--------	-----	-------	-------	--------	--------	-------	------

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

(69)m=	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	(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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DER WorkSheet: New dwelling design stage

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

(71)m=	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	118.53	116.38	111.91	105.83	101.88	96.32	91.6	97.65	99.8	106.09	113.2	116.39	(72)
--------	--------	--------	--------	--------	--------	-------	------	-------	------	--------	-------	--------	------

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=	421.29	419.13	405.44	383.4	361.02	339.49	325.55	331.6	342.97	365.23	390.77	409.92	(73)
--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	--------	--------	------

6. Solar gains

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

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g _l Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	0.96	x	10.63	x	0.63	x	0.7	=	3.12	(74)
North	0.9x	0.77	x	3.18	x	10.63	x	0.63	x	0.7	=	10.33	(74)
North	0.9x	0.77	x	1.8	x	10.63	x	0.63	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	1.2	x	10.63	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	0.96	x	20.32	x	0.63	x	0.7	=	5.96	(74)
North	0.9x	0.77	x	3.18	x	20.32	x	0.63	x	0.7	=	19.75	(74)
North	0.9x	0.77	x	1.8	x	20.32	x	0.63	x	0.7	=	11.18	(74)
North	0.9x	0.77	x	1.2	x	20.32	x	0.63	x	0.7	=	7.45	(74)
North	0.9x	0.77	x	0.96	x	34.53	x	0.63	x	0.7	=	10.13	(74)
North	0.9x	0.77	x	3.18	x	34.53	x	0.63	x	0.7	=	33.56	(74)
North	0.9x	0.77	x	1.8	x	34.53	x	0.63	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.2	x	34.53	x	0.63	x	0.7	=	12.68	(74)
North	0.9x	0.77	x	0.96	x	55.46	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.18	x	55.46	x	0.63	x	0.7	=	53.9	(74)
North	0.9x	0.77	x	1.8	x	55.46	x	0.63	x	0.7	=	30.51	(74)
North	0.9x	0.77	x	1.2	x	55.46	x	0.63	x	0.7	=	20.34	(74)
North	0.9x	0.77	x	0.96	x	74.72	x	0.63	x	0.7	=	21.92	(74)
North	0.9x	0.77	x	3.18	x	74.72	x	0.63	x	0.7	=	72.61	(74)
North	0.9x	0.77	x	1.8	x	74.72	x	0.63	x	0.7	=	41.1	(74)
North	0.9x	0.77	x	1.2	x	74.72	x	0.63	x	0.7	=	27.4	(74)
North	0.9x	0.77	x	0.96	x	79.99	x	0.63	x	0.7	=	23.47	(74)
North	0.9x	0.77	x	3.18	x	79.99	x	0.63	x	0.7	=	77.73	(74)
North	0.9x	0.77	x	1.8	x	79.99	x	0.63	x	0.7	=	44	(74)
North	0.9x	0.77	x	1.2	x	79.99	x	0.63	x	0.7	=	29.33	(74)
North	0.9x	0.77	x	0.96	x	74.68	x	0.63	x	0.7	=	21.91	(74)
North	0.9x	0.77	x	3.18	x	74.68	x	0.63	x	0.7	=	72.57	(74)
North	0.9x	0.77	x	1.8	x	74.68	x	0.63	x	0.7	=	41.08	(74)
North	0.9x	0.77	x	1.2	x	74.68	x	0.63	x	0.7	=	27.39	(74)
North	0.9x	0.77	x	0.96	x	59.25	x	0.63	x	0.7	=	17.38	(74)
North	0.9x	0.77	x	3.18	x	59.25	x	0.63	x	0.7	=	57.58	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.8	x	59.25	x	0.63	x	0.7	=	32.59	(74)
North	0.9x	0.77	x	1.2	x	59.25	x	0.63	x	0.7	=	21.73	(74)
North	0.9x	0.77	x	0.96	x	41.52	x	0.63	x	0.7	=	12.18	(74)
North	0.9x	0.77	x	3.18	x	41.52	x	0.63	x	0.7	=	40.35	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.63	x	0.7	=	22.84	(74)
North	0.9x	0.77	x	1.2	x	41.52	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	0.96	x	24.19	x	0.63	x	0.7	=	7.1	(74)
North	0.9x	0.77	x	3.18	x	24.19	x	0.63	x	0.7	=	23.51	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.63	x	0.7	=	13.31	(74)
North	0.9x	0.77	x	1.2	x	24.19	x	0.63	x	0.7	=	8.87	(74)
North	0.9x	0.77	x	0.96	x	13.12	x	0.63	x	0.7	=	3.85	(74)
North	0.9x	0.77	x	3.18	x	13.12	x	0.63	x	0.7	=	12.75	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.63	x	0.7	=	7.22	(74)
North	0.9x	0.77	x	1.2	x	13.12	x	0.63	x	0.7	=	4.81	(74)
North	0.9x	0.77	x	0.96	x	8.86	x	0.63	x	0.7	=	2.6	(74)
North	0.9x	0.77	x	3.18	x	8.86	x	0.63	x	0.7	=	8.61	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.63	x	0.7	=	4.88	(74)
North	0.9x	0.77	x	1.2	x	8.86	x	0.63	x	0.7	=	3.25	(74)
South	0.9x	0.77	x	2.36	x	46.75	x	0.63	x	0.7	=	33.72	(78)
South	0.9x	0.77	x	0.63	x	46.75	x	0.63	x	0.7	=	9	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	2.36	x	76.57	x	0.63	x	0.7	=	55.23	(78)
South	0.9x	0.77	x	0.63	x	76.57	x	0.63	x	0.7	=	14.74	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	2.36	x	97.53	x	0.63	x	0.7	=	70.35	(78)
South	0.9x	0.77	x	0.63	x	97.53	x	0.63	x	0.7	=	18.78	(78)
South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)
South	0.9x	0.77	x	2.36	x	110.23	x	0.63	x	0.7	=	79.51	(78)
South	0.9x	0.77	x	0.63	x	110.23	x	0.63	x	0.7	=	21.22	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	2.36	x	114.87	x	0.63	x	0.7	=	82.85	(78)
South	0.9x	0.77	x	0.63	x	114.87	x	0.63	x	0.7	=	22.12	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	2.36	x	110.55	x	0.63	x	0.7	=	79.73	(78)
South	0.9x	0.77	x	0.63	x	110.55	x	0.63	x	0.7	=	21.28	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	2.36	x	108.01	x	0.63	x	0.7	=	77.9	(78)
South	0.9x	0.77	x	0.63	x	108.01	x	0.63	x	0.7	=	20.8	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	2.36	x	104.89	x	0.63	x	0.7	=	75.65	(78)
South	0.9x	0.77	x	0.63	x	104.89	x	0.63	x	0.7	=	20.2	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	2.36	x	101.89	x	0.63	x	0.7	=	73.48	(78)
South	0.9x	0.77	x	0.63	x	101.89	x	0.63	x	0.7	=	19.62	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	2.36	x	82.59	x	0.63	x	0.7	=	59.56	(78)
South	0.9x	0.77	x	0.63	x	82.59	x	0.63	x	0.7	=	15.9	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	2.36	x	55.42	x	0.63	x	0.7	=	38.97	(78)
South	0.9x	0.77	x	0.63	x	55.42	x	0.63	x	0.7	=	10.67	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.49	(78)
South	0.9x	0.77	x	2.36	x	40.4	x	0.63	x	0.7	=	29.14	(78)
South	0.9x	0.77	x	0.63	x	40.4	x	0.63	x	0.7	=	7.78	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)

Solar gains in watts, calculated for each month

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

(83)m=	108.79	184.51	253.9	322.83	373.32	376.91	360.68	321.3	277.11	203.97	130.07	93.3	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	530.08	603.64	659.34	706.22	734.34	716.4	686.23	652.91	620.08	569.2	520.84	503.22	(84)
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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.88	0.73	0.57	0.62	0.83	0.96	0.99	0.99	(86)

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

(87)m=	19.83	19.96	20.17	20.44	20.69	20.86	20.92	20.91	20.79	20.48	20.1	19.81	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

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

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

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

(89)m=	0.99	0.98	0.97	0.93	0.83	0.65	0.45	0.5	0.76	0.94	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

DER WorkSheet: New dwelling design stage

(90)m=	18.35	18.54	18.85	19.25	19.59	19.8	19.85	19.85	19.73	19.32	18.78	18.33	(90)
fLA = Living area ÷ (4) =													(91)
0.14													

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

(92)m=	18.56	18.74	19.03	19.42	19.74	19.95	20	20	19.88	19.48	18.96	18.54	(92)
--------	-------	-------	-------	-------	-------	-------	----	----	-------	-------	-------	-------	------

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

(93)m=	18.56	18.74	19.03	19.42	19.74	19.95	20	20	19.88	19.48	18.96	18.54	(93)
--------	-------	-------	-------	-------	-------	-------	----	----	-------	-------	-------	-------	------

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	0.98	0.96	0.92	0.83	0.65	0.46	0.5	0.76	0.93	0.98	0.99	(94)
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Useful gains, hmGm, W = (94)m × (84)m

(95)m=	523.97	591.49	634.56	649.63	606.1	464.04	313.41	327.74	468.35	529.12	509.96	498.48	(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 × [(93)m – (96)m]

(97)m=	1393.13	1348.51	1217.2	1006.54	767.59	503.83	320.24	337.95	547.33	847.55	1138.36	1383.93	(97)
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Space heating requirement for each month, kWh/month = 0.024 × [(97)m – (95)m] × (41)m

(98)m=	646.66	508.72	433.49	256.98	120.15	0	0	0	0	236.91	452.45	658.78	(98)
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Total per year (kWh/year) = Sum(98)_{1..12} =

3314.13	(98)
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Space heating requirement in kWh/m²/year

40.82	(99)
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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)
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Efficiency of main space heating system 1

237.85	(206)
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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)

646.66	508.72	433.49	256.98	120.15	0	0	0	0	236.91	452.45	658.78
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

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

271.88	213.88	182.25	108.04	50.52	0	0	0	0	99.61	190.23	276.97
--------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------

Total (kWh/year) = Sum(211)_{1..12} =

1393.38	(211)
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Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 100 ÷ (208)

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

Total (kWh/year) = Sum(215)_{1..12} =

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

199.09	175.47	184.27	165.16	161.84	144.58	138.83	152.37	152.12	171.26	181.12	194.3
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Efficiency of water heater

281.48	(216)
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DER WorkSheet: New dwelling design stage

(217)m=	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	(217)
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	70.73	62.34	65.46	58.68	57.49	51.36	49.32	54.13	54.04	60.84	64.35	69.03	
Total = Sum(219a)...(219j) =												717.77	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

Electricity for lighting

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

For CO2 emissions - individual heating systems including air-to-airP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519	723.17 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.519	372.52 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1095.69 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	0 (267)
Electricity for lighting	(232) x	0.519	188.78 (268)
Total CO2, kg/year		sum of (265)...(271) =	1284.45 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	15.82 (273)
EI rating (section 14)			86 (274)

TER WorkSheet: New dwelling design stage

Use Details

Assessor Name:

Software Name: Stroma FSAP 2012

Stroma Number:

Software Version:

Version: 1.0.5.51

Property Address: 2B4P

Address : 2B4P

1. Overall dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	40.59 (1a)	×	2.6 (2a)	=	105.53 (3a)
First floor	40.59 (1b)	×	2.8 (2b)	=	113.65 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	81.18 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	219.19 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 (6a)
Number of open flues	0	+	0	=	0 (6b)
Number of intermittent fans				3	× 10 = 30 (7a)
Number of passive vents				0	× 10 = 0 (7b)
Number of flueless gas fires				0	× 40 = 0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	+	(5) =	0.14 (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]×0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction				0 (11)
<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>				
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 × (14) + 100] =	0 (15)
Infiltration rate			(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area				5 (17)
If based on air permeability value, then (18) = [(17) + 20]÷(8), otherwise (18) = (16)				0.39 (18)
<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 × (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor			(21) = (18) × (20) =	0.33 (21)
Infiltration rate modified for monthly wind speed				

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

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

(24a)

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

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

(24b)

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

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

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

(24c)

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

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

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

(24d)

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

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

(25)

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			2.17	1	2.17		(26)
Windows Type 1			2.36	$\times 1/[1/(1.4) + 0.04]$	3.13		(27)
Windows Type 2			0.63	$\times 1/[1/(1.4) + 0.04]$	0.84		(27)
Windows Type 3			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Windows Type 4			3.18	$\times 1/[1/(1.4) + 0.04]$	4.22		(27)
Windows Type 5			1.2	$\times 1/[1/(1.4) + 0.04]$	1.59		(27)
Windows Type 6			1.8	$\times 1/[1/(1.4) + 0.04]$	2.39		(27)
Windows Type 7			1.8	$\times 1/[1/(1.4) + 0.04]$	2.39		(27)
Windows Type 8			1.2	$\times 1/[1/(1.4) + 0.04]$	1.59		(27)
Floor			40.59015	0.13	5.276719		(28)
Walls Type1	47.29	9.3	37.99	0.18	6.84		(29)
Walls Type2	50.93	6	44.93	0.18	8.09		(29)
Roof	40.59	0	40.59	0.13	5.28		(30)
Total area of elements, m²			179.4				(31)
Party wall			42.46	0	0		(32)
Internal wall **			102.3				(32c)
Internal wall **			126.43				(32c)

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Internal floor	40.59		(32d)
Internal ceiling	40.59		(32e)

* 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) (28) ... (30) + (32) = 45.06 (33)

Heat capacity Cm = S(A x k) ((28) ... (30) + (32) + (32a) ... (32e) = 16519.01 (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 9.47 (36)

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

Total fabric heat loss (33) + (36) = 54.53 (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=	42.52	42.28	42.03	40.9	40.69	39.7	39.7	39.51	40.08	40.69	41.12	41.57	(38)

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

(39)m=	97.05	96.8	96.56	95.42	95.21	94.22	94.22	94.04	94.6	95.21	95.64	96.09	
													95.42 (39)

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

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

Number of days in month (Table 1a)

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

Assumed occupancy, N 2.48 (42)

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

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 93.22 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	102.54	98.81	95.08	91.35	87.62	83.89	83.89	87.62	91.35	95.08	98.81	102.54	
													1118.59 (44)

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

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

(45)m=	152.06	132.99	137.24	119.65	114.8	99.07	91.8	105.34	106.6	124.23	135.61	147.26	
													1466.65 (45)

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

(46)m=	22.81	19.95	20.59	17.95	17.22	14.86	13.77	15.8	15.99	18.63	20.34	22.09	(46)
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Water storage loss:

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

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

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

Water storage loss:

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a) If manufacturer's declared loss factor is known (kWh/day):		1.7	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	$(48) \times (49) =$	0.92	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	$(47) \times (51) \times (52) \times (53) =$	0	(54)
Enter (50) or (54) in (55)		0.92	(55)

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

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)
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If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] + (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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=	203.81	179.73	188.98	169.72	166.55	149.14	143.55	157.09	156.68	175.98	185.69	199.01	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

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

Output from water heater

(64)m=	203.81	179.73	188.98	169.72	166.55	149.14	143.55	157.09	156.68	175.98	185.69	199.01	
Output from water heater (annual) $\div 12$												2075.92	(64)

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

(65)m=	91.96	81.61	87.03	79.84	79.57	73	71.92	76.42	75.51	82.7	85.15	90.36	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5 Internal gains (see Table 5a and 5b)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	(66)

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

(67)m=	20.59	18.29	14.88	11.26	8.42	7.11	7.68	9.98	13.4	17.01	19.86	21.17	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	221.89	224.19	218.39	206.04	190.44	175.79	166	163.7	169.5	181.85	197.44	212.1	(68)
--------	--------	--------	--------	--------	--------	--------	-----	-------	-------	--------	--------	-------	------

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

(69)m=	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	(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=	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	(71)
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Water heating gains (Table 5)

(72)m=	123.6	121.45	116.97	110.89	106.95	101.39	96.67	102.72	104.87	111.16	118.27	121.45	(72)
--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=	429.36	427.2	413.51	391.47	369.08	347.56	333.62	339.67	351.04	373.3	398.84	417.99	(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 m ²		Flux Table 6a		g _l Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	0.96	x	10.63	x	0.63	x	0.7	=	3.12	(74)
North	0.9x	0.77	x	3.18	x	10.63	x	0.63	x	0.7	=	10.33	(74)
North	0.9x	0.77	x	1.8	x	10.63	x	0.63	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	1.2	x	10.63	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	0.96	x	20.32	x	0.63	x	0.7	=	5.96	(74)
North	0.9x	0.77	x	3.18	x	20.32	x	0.63	x	0.7	=	19.75	(74)
North	0.9x	0.77	x	1.8	x	20.32	x	0.63	x	0.7	=	11.18	(74)
North	0.9x	0.77	x	1.2	x	20.32	x	0.63	x	0.7	=	7.45	(74)
North	0.9x	0.77	x	0.96	x	34.53	x	0.63	x	0.7	=	10.13	(74)
North	0.9x	0.77	x	3.18	x	34.53	x	0.63	x	0.7	=	33.56	(74)
North	0.9x	0.77	x	1.8	x	34.53	x	0.63	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.2	x	34.53	x	0.63	x	0.7	=	12.68	(74)
North	0.9x	0.77	x	0.96	x	55.46	x	0.63	x	0.7	=	18.27	(74)
North	0.9x	0.77	x	3.18	x	55.46	x	0.63	x	0.7	=	53.9	(74)
North	0.9x	0.77	x	1.8	x	55.46	x	0.63	x	0.7	=	30.51	(74)
North	0.9x	0.77	x	1.2	x	55.46	x	0.63	x	0.7	=	20.34	(74)
North	0.9x	0.77	x	0.96	x	74.72	x	0.63	x	0.7	=	21.92	(74)
North	0.9x	0.77	x	3.18	x	74.72	x	0.63	x	0.7	=	72.61	(74)
North	0.9x	0.77	x	1.8	x	74.72	x	0.63	x	0.7	=	41.1	(74)
North	0.9x	0.77	x	1.2	x	74.72	x	0.63	x	0.7	=	27.4	(74)
North	0.9x	0.77	x	0.96	x	79.99	x	0.63	x	0.7	=	23.47	(74)
North	0.9x	0.77	x	3.18	x	79.99	x	0.63	x	0.7	=	77.73	(74)
North	0.9x	0.77	x	1.8	x	79.99	x	0.63	x	0.7	=	44	(74)
North	0.9x	0.77	x	1.2	x	79.99	x	0.63	x	0.7	=	29.33	(74)
North	0.9x	0.77	x	0.96	x	74.68	x	0.63	x	0.7	=	21.91	(74)
North	0.9x	0.77	x	3.18	x	74.68	x	0.63	x	0.7	=	72.57	(74)
North	0.9x	0.77	x	1.8	x	74.68	x	0.63	x	0.7	=	41.08	(74)
North	0.9x	0.77	x	1.2	x	74.68	x	0.63	x	0.7	=	27.39	(74)
North	0.9x	0.77	x	0.96	x	59.25	x	0.63	x	0.7	=	17.38	(74)
North	0.9x	0.77	x	3.18	x	59.25	x	0.63	x	0.7	=	57.58	(74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.8	x	59.25	x	0.63	x	0.7	=	32.59	(74)
North	0.9x	0.77	x	1.2	x	59.25	x	0.63	x	0.7	=	21.73	(74)
North	0.9x	0.77	x	0.96	x	41.52	x	0.63	x	0.7	=	12.18	(74)
North	0.9x	0.77	x	3.18	x	41.52	x	0.63	x	0.7	=	40.35	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.63	x	0.7	=	22.84	(74)
North	0.9x	0.77	x	1.2	x	41.52	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	0.96	x	24.19	x	0.63	x	0.7	=	7.1	(74)
North	0.9x	0.77	x	3.18	x	24.19	x	0.63	x	0.7	=	23.51	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.63	x	0.7	=	13.31	(74)
North	0.9x	0.77	x	1.2	x	24.19	x	0.63	x	0.7	=	8.87	(74)
North	0.9x	0.77	x	0.96	x	13.12	x	0.63	x	0.7	=	3.85	(74)
North	0.9x	0.77	x	3.18	x	13.12	x	0.63	x	0.7	=	12.75	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.63	x	0.7	=	7.22	(74)
North	0.9x	0.77	x	1.2	x	13.12	x	0.63	x	0.7	=	4.81	(74)
North	0.9x	0.77	x	0.96	x	8.86	x	0.63	x	0.7	=	2.6	(74)
North	0.9x	0.77	x	3.18	x	8.86	x	0.63	x	0.7	=	8.61	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.63	x	0.7	=	4.88	(74)
North	0.9x	0.77	x	1.2	x	8.86	x	0.63	x	0.7	=	3.25	(74)
South	0.9x	0.77	x	2.36	x	46.75	x	0.63	x	0.7	=	33.72	(78)
South	0.9x	0.77	x	0.63	x	46.75	x	0.63	x	0.7	=	9	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	28.72	(78)
South	0.9x	0.77	x	2.36	x	76.57	x	0.63	x	0.7	=	55.23	(78)
South	0.9x	0.77	x	0.63	x	76.57	x	0.63	x	0.7	=	14.74	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	2.36	x	97.53	x	0.63	x	0.7	=	70.35	(78)
South	0.9x	0.77	x	0.63	x	97.53	x	0.63	x	0.7	=	18.78	(78)
South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)
South	0.9x	0.77	x	2.36	x	110.23	x	0.63	x	0.7	=	79.51	(78)
South	0.9x	0.77	x	0.63	x	110.23	x	0.63	x	0.7	=	21.22	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	2.36	x	114.87	x	0.63	x	0.7	=	82.85	(78)
South	0.9x	0.77	x	0.63	x	114.87	x	0.63	x	0.7	=	22.12	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	2.36	x	110.55	x	0.63	x	0.7	=	79.73	(78)
South	0.9x	0.77	x	0.63	x	110.55	x	0.63	x	0.7	=	21.28	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	2.36	x	108.01	x	0.63	x	0.7	=	77.9	(78)
South	0.9x	0.77	x	0.63	x	108.01	x	0.63	x	0.7	=	20.8	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	2.36	x	104.89	x	0.63	x	0.7	=	75.65	(78)
South	0.9x	0.77	x	0.63	x	104.89	x	0.63	x	0.7	=	20.2	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	2.36	x	101.89	x	0.63	x	0.7	=	73.48	(78)
South	0.9x	0.77	x	0.63	x	101.89	x	0.63	x	0.7	=	19.62	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	2.36	x	82.59	x	0.63	x	0.7	=	59.56	(78)
South	0.9x	0.77	x	0.63	x	82.59	x	0.63	x	0.7	=	15.9	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	2.36	x	55.42	x	0.63	x	0.7	=	38.97	(78)
South	0.9x	0.77	x	0.63	x	55.42	x	0.63	x	0.7	=	10.67	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.49	(78)
South	0.9x	0.77	x	2.36	x	40.4	x	0.63	x	0.7	=	29.14	(78)
South	0.9x	0.77	x	0.63	x	40.4	x	0.63	x	0.7	=	7.78	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)

Solar gains in watts, calculated for each month

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

(83)m=	108.79	184.51	253.9	322.83	373.32	376.91	360.68	321.3	277.11	203.97	130.07	93.3	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	538.14	611.71	667.41	714.29	742.41	724.47	694.3	660.97	628.15	577.26	528.91	511.29	(84)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.9	0.75	0.58	0.62	0.85	0.97	0.99	1	(86)

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

(87)m=	19.76	19.91	20.15	20.46	20.75	20.93	20.98	20.98	20.86	20.5	20.07	19.73	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

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

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

(89)m=	1	0.99	0.98	0.95	0.85	0.66	0.45	0.5	0.78	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)

TER WorkSheet: New dwelling design stage

(90)m=	18.28	18.5	18.85	19.3	19.69	19.9	19.95	19.94	19.84	19.37	18.75	18.25	(90)
fLA = Living area ÷ (4) =													(91)
0.14													

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

(92)m=	18.49	18.7	19.03	19.47	19.84	20.05	20.09	20.09	19.98	19.53	18.94	18.46	(92)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.49	18.7	19.03	19.47	19.84	20.05	20.09	20.09	19.98	19.53	18.94	18.46	(93)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

5. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.97	0.94	0.85	0.67	0.47	0.51	0.78	0.95	0.99	1	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, hmGm, W = (94)m × (84)m

(95)m=	534.76	604.32	650.62	670.74	630.38	482.66	324.89	340.31	488.94	546.97	522.22	508.75	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	1376.71	1335.83	1210.12	1008.47	774.78	513.41	329.11	347.04	556.41	850.41	1132.27	1369.84	(97)
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Space heating requirement for each month, kWh/month = 0.024 × [(97)m – (95)m] × (41)m

(98)m=	626.41	491.58	416.27	243.17	107.44	0	0	0	0	225.76	439.24	640.65	(98)
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98)_{1..12} =

3190.52	(98)
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Space heating requirement in kWh/m²/year

38.3	(99)
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Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

(202) = 1 – (201) =

1	(202)
---	-------

Fraction of total heating from main system 1

(204) = (202) × [1 – (203)] =

1	(204)
---	-------

Efficiency of main space heating system 1

93.5	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

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

Space heating requirement (calculated above)

626.41	491.58	416.27	243.17	107.44	0	0	0	0	225.76	439.24	640.65
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

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

669.96	525.75	445.21	260.07	114.9	0	0	0	0	241.46	469.77	685.19
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

Total (kWh/year) = Sum(211)_{1..12} =

3412.32	(211)
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Space heating fuel (secondary), kWh/month

= {[(98)m × (201)]} × 100 ÷ (208)

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

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

203.81	179.73	188.98	169.72	166.55	149.14	143.55	157.09	156.68	175.98	185.69	199.01
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Efficiency of water heater

79.8	(216)
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TER WorkSheet: New dwelling design stage

(217)m=	87.62	87.36	86.86	85.77	83.68	79.8	79.8	79.8	79.8	85.48	87.03	87.71	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	232.61	205.73	217.56	197.88	199.03	186.9	179.88	196.85	196.34	205.87	213.35	226.89	
Total = Sum{(219a)} _{i=1} ¹² =												2458.89	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75

(231)

Electricity for lighting

363.7

(232)

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

6309.91

(338)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	737.06 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.216	531.12 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1268.18 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	38.93 (267)
Electricity for lighting	(232) x	0.519	188.76 (268)
Total CO2, kg/year	sum of (265) ... (271) =		1495.87 (272)

TER =

27.02 (273)

DER WorkSheet: New dwelling design stage

Base Details

Assessor Name:

Software Name: Stroma FSAP 2012

Stroma Number:

Software Version:

Version: 1.0.5.51

Property Address: 3B4P

Address : 3B4P

1. Overall dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	44.66 (1a)	×	2.6 (2a)	=	116.1 (3a)
First floor	44.66 (1b)	×	2.8 (2b)	=	125.04 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	89.31 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	241.14 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 (6a)
Number of open flues	0	+	0	=	0 (6b)
Number of intermittent fans				4	× 10 = 40 (7a)
Number of passive vents				0	× 10 = 0 (7b)
Number of flueless gas fires				0	× 40 = 0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	+	(5) =	0.17 (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]×0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction				0 (11)
<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>				
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 × (14) + 100] =	0 (15)
Infiltration rate			(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area				5 (17)
If based on air permeability value, then (18) = [(17) + 20]÷(8), otherwise (18) = (16)				0.42 (18)
<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 × (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor			(21) = (18) × (20) =	0.35 (21)
Infiltration rate modified for monthly wind speed				

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

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

	0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	0.4	0.42
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(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
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(24c)

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

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

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

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

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

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			2.17	1	2.17		(26)
Windows Type 1			3.06	$\times 1/[1/(1.2) + 0.04]$	3.5		(27)
Windows Type 2			1.82	$\times 1/[1/(1.2) + 0.04]$	2.08		(27)
Windows Type 3			3.8	$\times 1/[1/(1.2) + 0.04]$	4.35		(27)
Windows Type 4			1.8	$\times 1/[1/(1.2) + 0.04]$	2.06		(27)
Windows Type 5			1.2	$\times 1/[1/(1.2) + 0.04]$	1.37		(27)
Windows Type 6			1.82	$\times 1/[1/(1.2) + 0.04]$	2.08		(27)
Windows Type 7			1.82	$\times 1/[1/(1.2) + 0.04]$	2.08		(27)
Floor			44.65562	0.13	5.805231	75	3349.172 (26)
Walls Type1	49.34	10.85	38.49	0.14	5.39	60	2309.26 (29)
Walls Type2	53.13	6.64	46.49	0.14	6.51	60	2789.57 (29)
Roof	44.66	0	44.66	0.11	4.91	9	401.9 (30)
Total area of elements, m²			191.78				(31)
Party wall			46.71	0	0	45	2101.95 (32)
Internal wall **			102.3			39	3989.68 (32c)
Internal wall **			126.43			9	1137.881 (32c)
Internal floor			44.66			18	803.8013 (32d)

DER WorkSheet: New dwelling design stage

Internal ceiling

44.66

9

401.9006 (32e)

* 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) =

42.33 (33)

Heat capacity Cm = S(A x k)

((28)...(30) + (32) + (32a)...(32e) =

17285.11 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

= (34) ÷ (4) =

193.54 (35)

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

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

15.62 (36)

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

Total fabric heat loss

(33) + (36) =

57.94 (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=	47.87	47.56	47.25	45.8	45.53	44.28	44.28	44.04	44.76	45.53	46.08	46.65

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=	105.81	105.5	105.19	103.75	103.48	102.22	102.22	101.99	102.7	103.48	104.02	104.6
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Average = Sum(39)...12 ÷

103.75 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1.18	1.18	1.18	1.16	1.16	1.14	1.14	1.14	1.15	1.16	1.16	1.17
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Average = Sum(40)...12 ÷

1.16 (40)

Number of days in month (Table 1a)

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

(41)

Assumed occupancy, N

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

2.62

(42)

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

96.33

(43)

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

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

(44)m=	105.97	102.11	98.26	94.41	90.55	86.7	86.7	90.55	94.41	98.26	102.11	105.97
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Total = Sum(44)...12 =

1156.01 (44)

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

(45)m=	157.15	137.44	141.83	123.65	118.64	102.38	94.87	108.87	110.17	128.39	140.14	152.19
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Total = Sum(45)...12 =

1515.71 (45)

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

(46)m=	23.57	20.62	21.27	18.55	17.8	15.36	14.23	16.33	16.52	19.26	21.02	22.83
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(46)

Water storage loss:

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

210

(47)

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

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

Water storage loss:

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

1.42

(48)

Temperature factor from Table 2b

0.54

(49)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(48) × (49) =	0.77	(50)										
b) If manufacturer's declared cylinder loss factor is not known:													
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)										
If community heating see section 4.3													
Volume factor from Table 2a		0	(52)										
Temperature factor from Table 2b		0	(53)										
Energy lost from water storage, kWh/year	(47) × (51) × (52) × (53) =	0	(54)										
Enter (50) or (54) in (55)		0.77	(55)										
Water storage loss calculated for each month	((56)m = (55) × (41)m												
(56)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m × [(50) – (H11)] + (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(57)
Primary circuit loss (annual) from Table 3	0												(58)
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m													
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)													
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m													
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m													
(62)m=	204.18	179.92	188.86	169.16	165.68	147.9	141.9	155.9	155.68	175.42	185.66	199.22	(62)
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)													
(add additional lines if FCHRS and/or WWHRS applies, see Appendix G)													
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
Output from water heater													
(64)m=	204.18	179.92	188.86	169.16	165.68	147.9	141.9	155.9	155.68	175.42	185.66	199.22	(64)
												Output from water heater (annual) 1...12	2069.49
Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]													
(65)m=	89.88	79.68	84.78	77.53	77.08	70.45	69.17	73.82	73.04	80.32	83.01	88.23	(65)
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating													
5. Internal heat gains (Table 5a)													
Metabolic gains (Table 5), Watts													
(66)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	21.83	19.39	15.77	11.94	8.92	7.53	8.14	10.58	14.2	18.03	21.05	22.44	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	237.8	240.27	234.05	220.82	204.1	188.4	177.91	175.44	181.66	194.9	211.61	227.31	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	(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=	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	(71)

DER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=	120.8	118.58	113.96	107.67	103.6	97.85	92.97	99.23	101.45	107.95	115.29	118.59	(72)
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Total internal gains =

$$\{66\}m + \{67\}m + \{68\}m + \{69\}m + \{70\}m + \{71\}m + \{72\}m$$

(73)m=	442.68	440.48	426.02	402.67	378.87	356.03	341.26	347.49	359.55	383.12	410.19	430.58	(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 m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
North	0.9x 0.77	1.82	10.63	0.63	0.7	5.91 (74)
North	0.9x 0.77	3.8	10.63	0.63	0.7	12.35 (74)
North	0.9x 0.77	1.82	10.63	0.63	0.7	5.91 (74)
North	0.9x 0.77	1.82	10.63	0.63	0.7	5.91 (74)
North	0.9x 0.77	1.82	20.32	0.63	0.7	11.3 (74)
North	0.9x 0.77	3.8	20.32	0.63	0.7	23.6 (74)
North	0.9x 0.77	1.82	20.32	0.63	0.7	11.3 (74)
North	0.9x 0.77	1.82	20.32	0.63	0.7	11.3 (74)
North	0.9x 0.77	1.82	34.53	0.63	0.7	19.21 (74)
North	0.9x 0.77	3.8	34.53	0.63	0.7	40.1 (74)
North	0.9x 0.77	1.82	34.53	0.63	0.7	19.21 (74)
North	0.9x 0.77	1.82	34.53	0.63	0.7	19.21 (74)
North	0.9x 0.77	1.82	55.46	0.63	0.7	30.85 (74)
North	0.9x 0.77	3.8	55.46	0.63	0.7	64.41 (74)
North	0.9x 0.77	1.82	55.46	0.63	0.7	30.85 (74)
North	0.9x 0.77	1.82	55.46	0.63	0.7	30.85 (74)
North	0.9x 0.77	1.82	74.72	0.63	0.7	41.56 (74)
North	0.9x 0.77	3.8	74.72	0.63	0.7	86.77 (74)
North	0.9x 0.77	1.82	74.72	0.63	0.7	41.56 (74)
North	0.9x 0.77	1.82	74.72	0.63	0.7	41.56 (74)
North	0.9x 0.77	1.82	79.99	0.63	0.7	44.49 (74)
North	0.9x 0.77	3.8	79.99	0.63	0.7	92.89 (74)
North	0.9x 0.77	1.82	79.99	0.63	0.7	44.49 (74)
North	0.9x 0.77	1.82	79.99	0.63	0.7	44.49 (74)
North	0.9x 0.77	1.82	74.68	0.63	0.7	41.54 (74)
North	0.9x 0.77	3.8	74.68	0.63	0.7	86.72 (74)
North	0.9x 0.77	1.82	74.68	0.63	0.7	41.54 (74)
North	0.9x 0.77	1.82	74.68	0.63	0.7	41.54 (74)
North	0.9x 0.77	1.82	59.25	0.63	0.7	32.95 (74)
North	0.9x 0.77	3.8	59.25	0.63	0.7	68.8 (74)
North	0.9x 0.77	1.82	59.25	0.63	0.7	32.95 (74)
North	0.9x 0.77	1.82	59.25	0.63	0.7	32.95 (74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.63	x	0.7	=	48.21	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.63	x	0.7	=	28.09	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.63	x	0.7	=	10.29	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
South	0.9x	0.77	x	3.06	x	46.75	x	0.63	x	0.7	=	43.72	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	3.06	x	76.57	x	0.63	x	0.7	=	71.6	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	3.06	x	97.53	x	0.63	x	0.7	=	91.21	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)
South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	3.06	x	110.23	x	0.63	x	0.7	=	103.09	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	3.06	x	114.87	x	0.63	x	0.7	=	107.42	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	3.06	x	110.55	x	0.63	x	0.7	=	103.38	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	3.06	x	108.01	x	0.63	x	0.7	=	101.01	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	3.06	x	104.89	x	0.63	x	0.7	=	98.09	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	3.06	x	101.89	x	0.63	x	0.7	=	95.28	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	3.06	x	82.59	x	0.63	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	3.06	x	55.42	x	0.63	x	0.7	=	51.82	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.49	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	3.06	x	40.4	x	0.63	x	0.7	=	37.78	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)

Solar gains in watts, calculated for each month

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

(83)m=	116.68	199.31	278.35	361.12	424.19	431.09	411.37	361.93	306.18	221.41	139.76	99.9	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	559.36	639.8	704.38	763.79	803.05	787.12	752.63	709.42	665.73	604.53	549.95	530.48	(84)
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7. Mean internal temperature (for living area)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.94	0.87	0.72	0.57	0.62	0.83	0.95	0.99	0.99	(86)

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

(87)m=	19.78	19.92	20.14	20.42	20.54	20.85	20.91	20.9	20.78	20.48	20.06	19.76	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.95	19.94	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.93	0.83	0.64	0.45	0.5	0.76	0.94	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	-----	------	------	------	------	------

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

(90)m=	18.3	18.5	18.82	19.24	19.59	19.81	19.86	19.85	19.73	19.3	18.74	18.28	(90)
--------	------	------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.15 (91)

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

(92)m=	18.52	18.71	19.01	19.41	19.75	19.96	20.01	20.01	19.88	19.46	18.93	18.49	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.52	18.71	19.01	19.41	19.75	19.96	20.01	20.01	19.88	19.46	18.93	18.49	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.92	0.82	0.64	0.45	0.5	0.76	0.93	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	-----	------	------	------	------	------

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

(95)m=	552.76	626.6	677.05	699.92	656.94	503.66	340.78	355.79	503.45	562.05	538.35	525.36	(95)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

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=	1504.17	1456.66	1315.95	1090.44	832.92	547.78	348.73	367.9	594.03	917.29	1230.52	1495.1	(97)
--------	---------	---------	---------	---------	--------	--------	--------	-------	--------	--------	---------	--------	------

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

(98)m=	707.85	557.8	475.34	281.18	130.92	0	0	0	0	264.3	498.36	721.49	
--------	--------	-------	--------	--------	--------	---	---	---	---	-------	--------	--------	--

Total per year (kWh/year) = $\text{Sum}(98)_{1..12} =$ 3637.24 (98)

Space heating requirement in kWh/m²/year

40.73 (99)

2a. Energy consumption – 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

258.99 (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)

707.85	557.8	475.34	281.18	130.92	0	0	0	0	264.3	498.36	721.49
--------	-------	--------	--------	--------	---	---	---	---	-------	--------	--------

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

273.31	215.37	183.53	108.56	50.55	0	0	0	0	102.05	192.42	278.57
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

Total (kWh/year) = $\text{Sum}(211)_{1..12} =$ 1404.37 (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	
---------	---	---	---	---	---	---	---	---	---	---	---	--

Total (kWh/year) = $\text{Sum}(215)_{1..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

204.18	179.92	188.86	169.16	165.68	147.9	141.9	155.9	155.68	175.42	185.66	199.22
--------	--------	--------	--------	--------	-------	-------	-------	--------	--------	--------	--------

Efficiency of water heater

281.48 (216)

(217)m=	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	(217)
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Fuel for water heating, kWh/month

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

(219)m=	72.54	63.92	67.09	60.1	58.86	52.54	50.41	55.38	55.31	62.32	65.96	70.78
---------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------

Total = $\text{Sum}(219a)_{1..12} =$ 735.2 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year 1404.37

Water heating fuel used

735.2

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 0 (231)

Electricity for lighting

385.53 (232)

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

2525.1 (338)

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

DER WorkSheet: New dwelling design stage

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	{211} ×	0.519	≡	728.87 {261}
Space heating (secondary)	{215} ×	0.519	≡	0 {263}
Water heating	{219} ×	0.519	≡	381.57 {264}
Space and water heating	{261} + {262} + {263} + {264} =			1110.44 {265}
Electricity for pumps, fans and electric keep-hot	{231} ×	0.519	≡	0 {267}
Electricity for lighting	{232} ×	0.519	≡	200.09 {268}
Total CO2, kg/year		sum of {265}...{271} ≡		1310.53 {272}
Dwelling CO2 Emission Rate		{272} ÷ {4} ≡		14.67 {273}
EI rating (section 14)				87 {274}

DRAFT

TER WorkSheet: New dwelling design stage

Use Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: 3B4P

Address : 3B4P

1. Overall dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	44.66 (1a)	x	2.6 (2a)	=	116.1 (3a)
First floor	44.66 (1b)	x	2.8 (2b)	=	125.04 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	89.31 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	241.14 (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)
Number of intermittent fans				3 x 10 =	30 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	+ (5) =	0.12 (8)
<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			0 (11)
<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>			
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]x(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) =		0.32 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.41	0.4	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.36	0.37
--	------	-----	------	------	------	-----	-----	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

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

(24a)

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

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

(24b)

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

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

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

(24c)

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

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

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

(24d)

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

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

(25)

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			2.17	1	2.17		(26)
Windows Type 1			3.06	$\times 1/[1/(1.4) + 0.04]$	4.06		(27)
Windows Type 2			1.82	$\times 1/[1/(1.4) + 0.04]$	2.41		(27)
Windows Type 3			3.8	$\times 1/[1/(1.4) + 0.04]$	5.04		(27)
Windows Type 4			1.8	$\times 1/[1/(1.4) + 0.04]$	2.39		(27)
Windows Type 5			1.2	$\times 1/[1/(1.4) + 0.04]$	1.59		(27)
Windows Type 6			1.82	$\times 1/[1/(1.4) + 0.04]$	2.41		(27)
Windows Type 7			1.82	$\times 1/[1/(1.4) + 0.04]$	2.41		(27)
Floor			44.65562	0.13	5.805231		(28)
Walls Type1	49.34	10.85	38.49	0.18	6.93		(29)
Walls Type2	53.13	6.64	46.49	0.18	8.37		(29)
Roof	44.66	0	44.66	0.13	5.81		(30)
Total area of elements, m²			191.78				(31)
Party wall			46.71	0	0		(32)
Internal wall **			102.3				(32c)
Internal wall **			126.43				(32c)
Internal floor			44.66				(32d)

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Internal ceiling

44.66

(32e)

* 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) =

49.39

(33)

Heat capacity Cm = S(A x k)

((26)...(30) + (32) + (32a)...(32e) =

17285.11

(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

9.77

(36)

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

Total fabric heat loss

(33) + (36) =

59.16

(37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

(38)m =

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
46.34	46.08	45.84	44.66	44.45	43.43	43.43	43.24	43.82	44.45	44.89	45.35

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m =

105.5	105.24	104.99	103.82	103.6	102.58	102.58	102.39	102.98	103.6	104.05	104.51
-------	--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------

Average = Sum(39)...12 ÷ 12 =

103.82

(39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m =

1.18	1.18	1.18	1.16	1.16	1.15	1.15	1.15	1.15	1.16	1.16	1.17
------	------	------	------	------	------	------	------	------	------	------	------

Average = Sum(40)...12 ÷ 12 =

1.16

(40)

Number of days in month (Table 1a)

(41)m =

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

(41)

Assumed occupancy, N

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

2.62

(42)

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

96.33

(43)

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

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

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

(44)m =

105.97	102.11	98.26	94.41	90.55	86.7	86.7	90.55	94.41	98.26	102.11	105.97
--------	--------	-------	-------	-------	------	------	-------	-------	-------	--------	--------

Total = Sum(44)...12 =

1156.01

(44)

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

(45)m =

157.15	137.44	141.83	123.65	118.64	102.38	94.87	108.87	110.17	128.39	140.14	152.19
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

Total = Sum(45)...12 =

1515.71

(45)

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

(46)m =

23.57	20.62	21.27	18.55	17.8	15.36	14.23	16.33	16.52	19.26	21.02	22.83
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(46)

Water storage loss:

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

150

(47)

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

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

Water storage loss:

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

1.7

(48)

Temperature factor from Table 2b

0.54

(49)

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Energy lost from water storage, kWh/year	(48) × (49) =	0.92	(50)										
b) If manufacturer's declared cylinder loss factor is not known:													
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)										
If community heating see section 4.3													
Volume factor from Table 2a		0	(52)										
Temperature factor from Table 2b		0	(53)										
Energy lost from water storage, kWh/year	(47) × (51) × (52) × (53) =	0	(54)										
Enter (50) or (54) in (55)		0.92	(55)										
Water storage loss calculated for each month	((56)m = (55) × (41)m												
(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m × [(50) – (H11)] + (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)
Primary circuit loss (annual) from Table 3	0												(58)
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m													
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)													
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m													
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m													
(62)m=	208.89	184.18	193.57	173.73	170.39	152.46	146.62	160.61	160.24	180.13	190.22	203.93	(62)
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)													
(add additional lines if FCHRS and/or WWHRS applies, see Appendix G)													
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
Output from water heater													
(64)m=	208.89	184.18	193.57	173.73	170.39	152.46	146.62	160.61	160.24	180.13	190.22	203.93	(64)
												Output from water heater (annual) =	2124.99
Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]													
(65)m=	93.65	83.09	88.55	81.18	80.85	74.1	72.94	77.6	76.69	84.09	86.66	92	(65)
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating													
5. Internal gains (see Table 5a)													
Metabolic gains (Table 5), Watts													
(66)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	21.83	19.39	15.77	11.94	8.92	7.53	8.14	10.58	14.2	18.03	21.05	22.44	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	237.8	240.27	234.05	220.82	204.1	188.4	177.91	175.44	181.66	194.9	211.61	227.31	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	(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=	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	(71)

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Water heating gains (Table 5)

(72)m=	125.87	123.65	119.03	112.74	108.66	102.92	98.04	104.29	106.52	113.02	120.36	123.66	(72)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

Total internal gains =

{(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	450.75	448.55	434.09	410.74	386.94	364.1	349.33	355.56	367.62	391.19	418.26	438.65	(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)
North	0.9x 0.77	1.82	10.63	0.63	0.7	5.91 (74)
North	0.9x 0.77	3.8	10.63	0.63	0.7	12.35 (74)
North	0.9x 0.77	1.82	10.63	0.63	0.7	5.91 (74)
North	0.9x 0.77	1.82	10.63	0.63	0.7	5.91 (74)
North	0.9x 0.77	1.82	20.32	0.63	0.7	11.3 (74)
North	0.9x 0.77	3.8	20.32	0.63	0.7	23.6 (74)
North	0.9x 0.77	1.82	20.32	0.63	0.7	11.3 (74)
North	0.9x 0.77	1.82	20.32	0.63	0.7	11.3 (74)
North	0.9x 0.77	1.82	34.53	0.63	0.7	19.21 (74)
North	0.9x 0.77	3.8	34.53	0.63	0.7	40.1 (74)
North	0.9x 0.77	1.82	34.53	0.63	0.7	19.21 (74)
North	0.9x 0.77	1.82	34.53	0.63	0.7	19.21 (74)
North	0.9x 0.77	1.82	55.46	0.63	0.7	30.85 (74)
North	0.9x 0.77	3.8	55.46	0.63	0.7	64.41 (74)
North	0.9x 0.77	1.82	55.46	0.63	0.7	30.85 (74)
North	0.9x 0.77	1.82	55.46	0.63	0.7	30.85 (74)
North	0.9x 0.77	1.82	74.72	0.63	0.7	41.56 (74)
North	0.9x 0.77	3.8	74.72	0.63	0.7	86.77 (74)
North	0.9x 0.77	1.82	74.72	0.63	0.7	41.56 (74)
North	0.9x 0.77	1.82	74.72	0.63	0.7	41.56 (74)
North	0.9x 0.77	1.82	79.99	0.63	0.7	44.49 (74)
North	0.9x 0.77	3.8	79.99	0.63	0.7	92.89 (74)
North	0.9x 0.77	1.82	79.99	0.63	0.7	44.49 (74)
North	0.9x 0.77	1.82	79.99	0.63	0.7	44.49 (74)
North	0.9x 0.77	1.82	74.68	0.63	0.7	41.54 (74)
North	0.9x 0.77	3.8	74.68	0.63	0.7	86.72 (74)
North	0.9x 0.77	1.82	74.68	0.63	0.7	41.54 (74)
North	0.9x 0.77	1.82	74.68	0.63	0.7	41.54 (74)
North	0.9x 0.77	1.82	59.25	0.63	0.7	32.95 (74)
North	0.9x 0.77	3.8	59.25	0.63	0.7	68.8 (74)
North	0.9x 0.77	1.82	59.25	0.63	0.7	32.95 (74)
North	0.9x 0.77	1.82	59.25	0.63	0.7	32.95 (74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.63	x	0.7	=	48.21	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.63	x	0.7	=	28.09	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.63	x	0.7	=	10.29	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
South	0.9x	0.77	x	3.06	x	46.75	x	0.63	x	0.7	=	43.72	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	3.06	x	76.57	x	0.63	x	0.7	=	71.6	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	3.06	x	97.53	x	0.63	x	0.7	=	91.21	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)
South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	3.06	x	110.23	x	0.63	x	0.7	=	103.09	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	3.06	x	114.87	x	0.63	x	0.7	=	107.42	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	3.06	x	110.55	x	0.63	x	0.7	=	103.38	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	3.06	x	108.01	x	0.63	x	0.7	=	101.01	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	3.06	x	104.89	x	0.63	x	0.7	=	98.09	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	3.06	x	101.89	x	0.63	x	0.7	=	95.28	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	3.06	x	82.59	x	0.63	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	3.06	x	55.42	x	0.63	x	0.7	=	51.82	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.49	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	3.06	x	40.4	x	0.63	x	0.7	=	37.78	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)

Solar gains in watts, calculated for each month

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

(83)m=	116.68	199.31	278.35	361.12	424.19	431.09	411.37	361.93	306.18	221.41	139.76	99.9	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------	------

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

(84)m=	567.43	647.86	712.44	771.86	811.12	795.19	760.7	717.49	673.8	612.6	558.01	538.55	(84)
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7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.8	0.75	0.58	0.63	0.86	0.97	0.99	1	(86)

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

(87)m=	19.75	19.9	20.14	20.46	20.75	20.93	20.99	20.98	20.86	20.49	20.07	19.72	(87)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.94	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.96	19.95	19.95	19.94	(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	0.5	0.78	0.96	0.99	1	(89)
--------	---	------	------	------	------	------	------	-----	------	------	------	---	------

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

(90)m=	18.27	18.5	18.85	19.31	19.7	19.92	19.96	19.95	19.84	19.37	18.75	18.24	(90)
--------	-------	------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.15

(91)

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

(92)m=	18.49	18.7	19.04	19.48	19.86	20.06	20.11	20.1	19.99	19.53	18.94	18.46	(92)
--------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(93)m=	18.49	18.7	19.04	19.48	19.86	20.06	20.11	20.1	19.99	19.53	18.94	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=	0.99	0.99	0.98	0.94	0.85	0.66	0.47	0.52	0.79	0.95	0.99	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	564.44	641.1	696.26	726.86	689.15	528.07	355.2	371.8	530.36	583.72	552.01	536.33	(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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TER WorkSheet: New dwelling design stage

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

(97)m=	1496.97	1452.59	1316.41	1098.56	844.94	560.47	359.63	379.15	606.61	925.28	1231.66	1490.18	(97)
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Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	693.81	545.32	461.39	267.62	115.91	0	0	0	0	254.12	489.34	709.67	
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	--

Total per year (kWh/year) = $\text{Sum}(98)_{1..12} =$ 3537.18 (98)

Space heating requirement in kWh/m²/year

39.61 (99)

2.4. Energy conservation measures including heating systems including air-to-water

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

93.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

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

Space heating requirement (calculated above)

693.81	545.32	461.39	267.62	115.91	0	0	0	0	254.12	489.34	709.67
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

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

742.04	583.23	493.47	286.22	123.97	0	0	0	0	271.79	523.36	759
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Total (kWh/year) = $\text{Sum}(211)_{1..12} =$ 3763.06 (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	
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Total (kWh/year) = $\text{Sum}(215)_{1..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

208.89	184.18	193.57	173.73	170.39	152.46	146.62	160.61	160.24	180.13	190.22	203.93
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Efficiency of water heater

79.8 (216)

(217)m=	87.78	87.54	87.05	85.96	83.81	79.8	79.8	79.8	79.8	85.73	87.23	87.87	(217)
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Fuel for water heating, kWh/month

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

(219)m=	237.98	210.4	222.37	202.09	203.3	191.05	183.73	201.27	200.81	210.11	218.08	232.09
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Total = $\text{Sum}(219a)_{1..12} =$ 2513.29 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

3763.08

Water heating fuel used

2513.29

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

385.53 (232)

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

6756.9 (233)

TER WorkSheet: New dwelling design stage

12a CO2 emissions – Individual heating systems Building with CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) ×	0.216	≡	817.15	(261)
Space heating (secondary)	(215) ×	0.519	≡	0	(263)
Water heating	(219) ×	0.216	≡	542.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1360.02	(265)
Electricity for pumps, fans and electric keep-hot	(231) ×	0.519	≡	38.93	(267)
Electricity for lighting	(232) ×	0.519	≡	200.09	(268)
Total CO2, kg/year		sum of (265)...(271) ≡		1599.03	(272)
TER =				26.28	(273)

DRAFT

DER WorkSheet: New dwelling design stage

Base Details

Assessor Name:

Software Name: Stroma FSAP 2012

Stroma Number:

Software Version:

Version: 1.0.5.51

Property Address: 3B5P

Address : 3B5P

1. Overall dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	49.43 (1a)	x	2.6 (2a)	=	128.52 (3a)
First floor	49.43 (1b)	x	2.8 (2b)	=	138.41 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	98.86 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	266.93 (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)
Number of intermittent fans				4 x 10 =	40 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	+ (5) =	0.15 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
If both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) + 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) + 20]x(8), otherwise (18) = (16)			0.4 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.34 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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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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DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

	0.43	0.42	0.42	0.37	0.37	0.32	0.32	0.31	0.34	0.37	0.38	0.4
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(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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(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
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(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
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(24c)

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

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

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

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

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

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			2.17	1	2.17		(26)
Windows Type 1			3.06	$\times 1/[1/(1.2) + 0.04]$	3.5		(27)
Windows Type 2			1.82	$\times 1/[1/(1.2) + 0.04]$	2.08		(27)
Windows Type 3			3.8	$\times 1/[1/(1.2) + 0.04]$	4.35		(27)
Windows Type 4			1.8	$\times 1/[1/(1.2) + 0.04]$	2.06		(27)
Windows Type 5			1.2	$\times 1/[1/(1.2) + 0.04]$	1.37		(27)
Windows Type 6			1.82	$\times 1/[1/(1.2) + 0.04]$	2.08		(27)
Windows Type 7			1.8	$\times 1/[1/(1.2) + 0.04]$	2.06		(27)
Floor			49.43125	0.13	6.426063	75	3707.344 (26)
Walls Type1	51.97	10.85	41.12	0.14	5.76	60	2467.13 (29)
Walls Type2	55.97	6.62	49.35	0.14	6.91	60	2960.78 (29)
Roof	49.43	0	49.43	0.11	5.44	9	444.88 (30)
Total area of elements, m²			206.8				(31)
Party wall			48.54	0	0	45	2184.084 (32)
Internal wall **			102.3			39	3989.68 (32c)
Internal wall **			126.43			9	1137.881 (32c)
Internal floor			49.43			18	889.7625 (32d)

DER WorkSheet: New dwelling design stage

Internal ceiling

49.43

9

444.8813 (32e)

* 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) =

44.22 (33)

Heat capacity Cm = S(A x k)

((28)...(30) + (32) + (32a)...(32e) =

18226.43 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

= (34) ÷ (4) =

184.36 (35)

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

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

16.22 (36)

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

Total fabric heat loss

(33) + (36) =

60.44 (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=	52.31	51.99	51.68	50.2	49.92	48.63	48.63	48.4	49.13	49.92	50.48	51.07

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=	112.75	112.43	112.11	110.64	110.36	109.07	109.07	108.83	109.57	110.36	110.92	111.5
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Average = Sum(39)...12 ÷ 12 =

110.63 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1.14	1.14	1.13	1.12	1.12	1.1	1.1	1.1	1.11	1.12	1.12	1.13
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Average = Sum(40)...12 ÷ 12 =

1.12 (40)

Number of days in month (Table 1a)

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

(41)

Assumed occupancy, N

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

2.73

(42)

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

99.01

(43)

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

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

(44)m=	108.91	104.95	100.99	97.03	93.07	89.11	89.11	93.07	97.03	100.99	104.95	108.91
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Total = Sum(44)...12 =

1188.09 (44)

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

(45)m=	161.51	141.26	145.76	127.08	121.94	105.22	97.5	111.89	113.22	131.95	144.03	156.41
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Total = Sum(45)...12 =

1557.78 (45)

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

(46)m=	24.23	21.19	21.86	19.06	18.29	15.78	14.63	16.78	16.98	19.79	21.61	23.46
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(46)

Water storage loss:

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

210

(47)

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

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

Water storage loss:

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

1.42

(48)

Temperature factor from Table 2b

0.54

(49)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(48) × (49) =	0.77	(50)										
b) If manufacturer's declared cylinder loss factor is not known:													
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)										
If community heating see section 4.3													
Volume factor from Table 2a		0	(52)										
Temperature factor from Table 2b		0	(53)										
Energy lost from water storage, kWh/year	(47) × (51) × (52) × (53) =	0	(54)										
Enter (50) or (54) in (55)		0.77	(55)										
Water storage loss calculated for each month	((56)m = (55) × (41)m												
(56)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m × [(50) – (H11)] + (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(57)
Primary circuit loss (annual) from Table 3	0												(58)
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m													
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)													
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m													
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m													
(62)m=	208.54	183.74	192.8	172.6	168.97	150.74	144.54	158.92	158.74	178.98	189.55	203.45	(62)
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)													
(add additional lines if FCHRS and/or WWHRS applies, see Appendix G)													
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
Output from water heater													
(64)m=	208.54	183.74	192.8	172.6	168.97	150.74	144.54	158.92	158.74	178.98	189.55	203.45	(64)
												Output from water heater (annual) 1...12	2111.55
Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]													
(65)m=	91.33	80.95	86.09	78.67	78.17	71.4	70.05	74.83	74.06	81.5	84.3	89.63	(65)
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating													
5. Internal heat gains (Table 5a)													
Metabolic gains (Table 5), Watts													
(66)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	23.83	21.16	17.21	13.03	9.74	8.22	8.89	11.55	15.5	19.68	22.97	24.49	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	254.48	257.12	250.46	236.3	218.41	201.61	190.38	187.74	194.39	208.56	226.44	243.25	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	(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=	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	(71)

DER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=	122.75	120.47	115.72	109.26	105.07	99.17	94.15	100.58	102.86	109.54	117.09	120.48
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(72)

Total internal gains =

$$\{66\}m + \{67\}m + \{68\}m + \{69\}m + \{70\}m + \{71\}m + \{72\}m$$

(73)m=	464.99	462.68	447.32	422.52	397.15	372.93	357.34	363.79	376.68	401.71	430.43	452.14
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(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)
North	0.9x 0.77	1.82	10.63	0.63	0.7	5.91 (74)
North	0.9x 0.77	3.8	10.63	0.63	0.7	12.35 (74)
North	0.9x 0.77	1.82	10.63	0.63	0.7	5.91 (74)
North	0.9x 0.77	1.8	10.63	0.63	0.7	5.85 (74)
North	0.9x 0.77	1.82	20.32	0.63	0.7	11.3 (74)
North	0.9x 0.77	3.8	20.32	0.63	0.7	23.6 (74)
North	0.9x 0.77	1.82	20.32	0.63	0.7	11.3 (74)
North	0.9x 0.77	1.8	20.32	0.63	0.7	11.18 (74)
North	0.9x 0.77	1.82	34.53	0.63	0.7	19.21 (74)
North	0.9x 0.77	3.8	34.53	0.63	0.7	40.1 (74)
North	0.9x 0.77	1.82	34.53	0.63	0.7	19.21 (74)
North	0.9x 0.77	1.8	34.53	0.63	0.7	19 (74)
North	0.9x 0.77	1.82	55.46	0.63	0.7	30.85 (74)
North	0.9x 0.77	3.8	55.46	0.63	0.7	64.41 (74)
North	0.9x 0.77	1.82	55.46	0.63	0.7	30.85 (74)
North	0.9x 0.77	1.8	55.46	0.63	0.7	30.51 (74)
North	0.9x 0.77	1.82	74.72	0.63	0.7	41.56 (74)
North	0.9x 0.77	3.8	74.72	0.63	0.7	86.77 (74)
North	0.9x 0.77	1.82	74.72	0.63	0.7	41.56 (74)
North	0.9x 0.77	1.8	74.72	0.63	0.7	41.1 (74)
North	0.9x 0.77	1.82	79.99	0.63	0.7	44.49 (74)
North	0.9x 0.77	3.8	79.99	0.63	0.7	92.89 (74)
North	0.9x 0.77	1.82	79.99	0.63	0.7	44.49 (74)
North	0.9x 0.77	1.8	79.99	0.63	0.7	44 (74)
North	0.9x 0.77	1.82	74.68	0.63	0.7	41.54 (74)
North	0.9x 0.77	3.8	74.68	0.63	0.7	86.72 (74)
North	0.9x 0.77	1.82	74.68	0.63	0.7	41.54 (74)
North	0.9x 0.77	1.8	74.68	0.63	0.7	41.08 (74)
North	0.9x 0.77	1.82	59.25	0.63	0.7	32.95 (74)
North	0.9x 0.77	3.8	59.25	0.63	0.7	68.8 (74)
North	0.9x 0.77	1.82	59.25	0.63	0.7	32.95 (74)
North	0.9x 0.77	1.8	59.25	0.63	0.7	32.59 (74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.63	x	0.7	=	48.21	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.63	x	0.7	=	22.84	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.63	x	0.7	=	28.09	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.63	x	0.7	=	13.31	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.63	x	0.7	=	7.22	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.63	x	0.7	=	10.29	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.63	x	0.7	=	4.88	(74)
South	0.9x	0.77	x	3.06	x	46.75	x	0.63	x	0.7	=	43.72	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	3.06	x	76.57	x	0.63	x	0.7	=	71.6	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	3.06	x	97.53	x	0.63	x	0.7	=	91.21	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)
South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	3.06	x	110.23	x	0.63	x	0.7	=	103.09	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	3.06	x	114.87	x	0.63	x	0.7	=	107.42	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	3.06	x	110.55	x	0.63	x	0.7	=	103.38	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	3.06	x	108.01	x	0.63	x	0.7	=	101.01	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	3.06	x	104.89	x	0.63	x	0.7	=	98.09	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	3.06	x	101.89	x	0.63	x	0.7	=	95.28	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	3.06	x	82.59	x	0.63	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	3.06	x	55.42	x	0.63	x	0.7	=	51.82	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.49	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	3.06	x	40.4	x	0.63	x	0.7	=	37.78	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)

Solar gains in watts, calculated for each month

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

(83)m=	116.61	199.19	278.14	360.78	423.73	430.6	410.92	361.57	305.93	221.26	139.68	99.85	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	581.6	661.86	725.46	783.3	820.88	803.53	768.26	725.36	682.62	622.97	570.11	551.99	(84)
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7. Mean internal temperature (for living area)

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

21

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.88	0.74	0.59	0.64	0.84	0.95	0.99	0.99	(86)

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

(87)m=	19.76	19.89	20.11	20.39	20.56	20.84	20.91	20.9	20.77	20.44	20.04	19.74	(87)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

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

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

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

(89)m=	0.99	0.99	0.97	0.93	0.84	0.66	0.47	0.52	0.78	0.95	0.99	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	18.3	18.5	18.81	19.23	19.59	19.83	19.89	19.88	19.75	19.3	18.74	18.28	(90)
--------	------	------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area + (4) =

0.15

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

(92)m=	18.51	18.7	19	19.4	19.75	19.98	20.04	20.03	19.9	19.46	18.93	18.49	(92)
--------	-------	------	----	------	-------	-------	-------	-------	------	-------	-------	-------	------

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

(93)m=	18.51	18.7	19	19.4	19.75	19.98	20.04	20.03	19.9	19.46	18.93	18.49	(93)
--------	-------	------	----	------	-------	-------	-------	-------	------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.92	0.83	0.66	0.47	0.52	0.77	0.94	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	575.09	649.14	699.55	723.44	683.56	531.83	364.51	379.68	527.77	582.61	558.85	546.92	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

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=	1602.51	1551.52	1401.44	1161.82	888.47	586.43	374.95	395.31	635.07	978.19	1311.79	1593.55	(97)
--------	---------	---------	---------	---------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(98)m=	764.4	606.4	522.2	315.63	152.46	0	0	0	0	294.31	542.12	778.69	
--------	-------	-------	-------	--------	--------	---	---	---	---	--------	--------	--------	--

Total per year (kWh/year) = $\text{Sum}(98)_{1..12} =$ 3976.22 (98)

Space heating requirement in kWh/m²/year

40.22 (99)

1a. Energy consumption – 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

277.21 (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)

764.4	606.4	522.2	315.63	152.46	0	0	0	0	294.31	542.12	778.69
-------	-------	-------	--------	--------	---	---	---	---	--------	--------	--------

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

275.75	218.75	188.38	113.86	55	0	0	0	0	106.17	195.57	280.91
--------	--------	--------	--------	----	---	---	---	---	--------	--------	--------

Total (kWh/year) = $\text{Sum}(211)_{1..12} =$ 1434.38 (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	
---------	---	---	---	---	---	---	---	---	---	---	---	--

Total (kWh/year) = $\text{Sum}(215)_{1..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

208.54	183.74	192.8	172.6	168.97	150.74	144.54	158.92	158.74	178.98	189.55	203.45
--------	--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

281.48 (216)

(217)m=	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	(217)
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Fuel for water heating, kWh/month

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

(219)m=	74.09	65.27	68.49	61.32	60.03	53.55	51.35	56.46	56.39	63.59	67.34	72.28
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Total = $\text{Sum}(219a)_{1..12} =$ 750.15 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

1434.38

Water heating fuel used

750.15

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

0 (231)

Electricity for lighting

420.8 (232)

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

2605.33 (338)

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

DER WorkSheet: New dwelling design stage

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	{211} ×	0.519	≡	744.44	{261}
Space heating (secondary)	{215} ×	0.519	≡	0	{263}
Water heating	{219} ×	0.519	≡	389.33	{264}
Space and water heating	{261} + {262} + {263} + {264} =			1133.77	{265}
Electricity for pumps, fans and electric keep-hot	{231} ×	0.519	≡	0	{267}
Electricity for lighting	{232} ×	0.519	≡	218.39	{268}
Total CO2, kg/year		sum of {265}...{271} ≡		1352.17	{272}
Dwelling CO2 Emission Rate		{272} ÷ {4} ≡		13.68	{273}
El rating (section 14)				87	{274}

DRAFT

TER WorkSheet: New dwelling design stage

Use Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.51

Property Address: 3B5P

Address : 3B5P

1. Overall dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	49.43 (1a) ×	2.6 (2a) =	128.52 (3a)
First floor	49.43 (1b) ×	2.8 (2b) =	138.41 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	98.86 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	266.93 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 × 40 =	0 (6a)
Number of open flues	0	0	0	0 × 20 =	0 (6b)
Number of intermittent fans				3 × 10 =	30 (7a)
Number of passive vents				0 × 10 =	0 (7b)
Number of flueless gas fires				0 × 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	+ (5) =	0.11 (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]×0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<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>			
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 × (14) + 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) + 20]÷(8), otherwise (18) = (16)			0.36 (18)
<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 × (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) × (20) =		0.31 (21)
Infiltration rate modified for monthly wind speed			

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

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.39	0.39	0.38	0.34	0.33	0.29	0.29	0.28	0.31	0.33	0.35	0.36
--	------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

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

(24a)

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

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

(24b)

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

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

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

(24c)

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

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

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

(24d)

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

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

(25)

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			2.17	1	2.17		(26)
Windows Type 1			3.06	$\times 1/[1/(1.4) + 0.04] =$	4.06		(27)
Windows Type 2			1.82	$\times 1/[1/(1.4) + 0.04] =$	2.41		(27)
Windows Type 3			3.8	$\times 1/[1/(1.4) + 0.04] =$	5.04		(27)
Windows Type 4			1.8	$\times 1/[1/(1.4) + 0.04] =$	2.39		(27)
Windows Type 5			1.2	$\times 1/[1/(1.4) + 0.04] =$	1.59		(27)
Windows Type 6			1.82	$\times 1/[1/(1.4) + 0.04] =$	2.41		(27)
Windows Type 7			1.8	$\times 1/[1/(1.4) + 0.04] =$	2.39		(27)
Floor			49.43125	$\times$ 0.13	6.426063		(28)
Walls Type1	51.97	10.85	41.12	$\times$ 0.18	7.4		(29)
Walls Type2	55.97	6.62	49.35	$\times$ 0.18	8.88		(29)
Roof	49.43	0	49.43	$\times$ 0.13	6.43		(30)
Total area of elements, m²			206.8				(31)
Party wall			48.54	$\times$ 0	0		(32)
Internal wall **			102.3				(32c)
Internal wall **			126.43				(32c)
Internal floor			49.43				(32d)

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Internal ceiling

49.43

(32e)

* 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) =

51.59

(33)

Heat capacity Cm = S(A x k)

((26)...(30) + (32) + (32a)...(32e) =

18226.43

(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

10.11

(36)

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

Total fabric heat loss

(33) + (36) =

61.7

(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=	50.84	50.57	50.31	49.1	48.87	47.81	47.81	47.62	48.22	48.87	49.33	49.81

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=	112.53	112.27	112.01	110.8	110.57	109.51	109.51	109.32	109.92	110.57	111.03	111.51
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

Average = Sum(39)...12 ÷

110.79

(39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

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

Average = Sum(40)...12 ÷

1.12

(40)

Number of days in month (Table 1a)

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

(41)

Assumed occupancy, N

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

2.73

(42)

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

99.01

(43)

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

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

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

(44)m=	108.91	104.95	100.99	97.03	93.07	89.11	89.11	93.07	97.03	100.99	104.95	108.91
--------	--------	--------	--------	-------	-------	-------	-------	-------	-------	--------	--------	--------

Total = Sum(44)...12 =

1188.09

(44)

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

(45)m=	161.51	141.26	145.76	127.08	121.94	105.22	97.5	111.89	113.22	131.95	144.03	156.41
--------	--------	--------	--------	--------	--------	--------	------	--------	--------	--------	--------	--------

Total = Sum(45)...12 =

1557.78

(45)

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

(46)m=	24.23	21.19	21.86	19.06	18.29	15.78	14.63	16.78	16.98	19.79	21.61	23.46
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(46)

Water storage loss:

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

150

(47)

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

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

Water storage loss:

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

1.7

(48)

Temperature factor from Table 2b

0.54

(49)

TER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(48) × (49) =	0.92	(50)										
b) If manufacturer's declared cylinder loss factor is not known:													
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)										
If community heating see section 4.3													
Volume factor from Table 2a		0	(52)										
Temperature factor from Table 2b		0	(53)										
Energy lost from water storage, kWh/year	(47) × (51) × (52) × (53) =	0	(54)										
Enter (50) or (54) in (55)		0.92	(55)										
Water storage loss calculated for each month	((56)m = (55) × (41)m												
(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m × [(50) – (H11)] + (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)
Primary circuit loss (annual) from Table 3	0												(58)
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m													
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)													
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m													
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m													
(62)m=	213.25	187.99	197.51	177.16	173.68	155.3	149.25	163.63	163.3	183.7	194.11	208.16	(62)
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)													
(add additional lines if FCHRS and/or WWHRS applies, see Appendix G)													
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
Output from water heater													
(64)m=	213.25	187.99	197.51	177.16	173.68	155.3	149.25	163.63	163.3	183.7	194.11	208.16	(64)
												Output from water heater (annual) =	2167.05
Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]													
(65)m=	95.1	84.36	89.86	82.32	81.94	75.05	73.82	78.6	77.71	85.27	87.95	93.4	(65)
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating													
5. Internal heat gains (Table 5a)													
Metabolic gains (Table 5), Watts													
(66)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	23.83	21.16	17.21	13.03	9.74	8.22	8.89	11.55	15.5	19.68	22.97	24.49	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	254.48	257.12	250.46	236.3	218.41	201.61	190.38	187.74	194.39	208.56	226.44	243.25	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	(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=	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	(71)

TER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=	127.82	125.53	120.78	114.33	110.14	104.23	99.22	105.64	107.93	114.61	122.16	125.54	(72)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

Total internal gains =

{(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	473.06	470.74	455.39	430.58	405.22	380.99	365.41	371.86	384.75	409.78	438.5	460.21	(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)	
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	3.8	x	10.63	x	0.63	x	0.7	=	12.35	(74)
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	1.8	x	10.63	x	0.63	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	3.8	x	20.32	x	0.63	x	0.7	=	23.6	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	1.8	x	20.32	x	0.63	x	0.7	=	11.18	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	3.8	x	34.53	x	0.63	x	0.7	=	40.1	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	1.8	x	34.53	x	0.63	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	3.8	x	55.46	x	0.63	x	0.7	=	64.41	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	1.8	x	55.46	x	0.63	x	0.7	=	30.51	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.8	x	74.72	x	0.63	x	0.7	=	86.77	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	1.8	x	74.72	x	0.63	x	0.7	=	41.1	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	3.8	x	79.99	x	0.63	x	0.7	=	92.89	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	1.8	x	79.99	x	0.63	x	0.7	=	44	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	3.8	x	74.68	x	0.63	x	0.7	=	86.72	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	1.8	x	74.68	x	0.63	x	0.7	=	41.08	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	3.8	x	59.25	x	0.63	x	0.7	=	68.8	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	1.8	x	59.25	x	0.63	x	0.7	=	32.59	(74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.63	x	0.7	=	48.21	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.63	x	0.7	=	22.84	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.63	x	0.7	=	28.09	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.63	x	0.7	=	13.31	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.63	x	0.7	=	7.22	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.63	x	0.7	=	10.29	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.63	x	0.7	=	4.88	(74)
South	0.9x	0.77	x	3.06	x	46.75	x	0.63	x	0.7	=	43.72	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	3.06	x	76.57	x	0.63	x	0.7	=	71.6	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	3.06	x	97.53	x	0.63	x	0.7	=	91.21	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)
South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	3.06	x	110.23	x	0.63	x	0.7	=	103.09	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	3.06	x	114.87	x	0.63	x	0.7	=	107.42	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	3.06	x	110.55	x	0.63	x	0.7	=	103.38	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	3.06	x	108.01	x	0.63	x	0.7	=	101.01	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	3.06	x	104.89	x	0.63	x	0.7	=	98.09	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	3.06	x	101.89	x	0.63	x	0.7	=	95.28	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	3.06	x	82.59	x	0.63	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	3.06	x	55.42	x	0.63	x	0.7	=	51.82	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.49	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	3.06	x	40.4	x	0.63	x	0.7	=	37.78	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)

Solar gains in watts, calculated for each month

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

(83)m=	116.61	199.19	278.14	360.78	423.73	430.6	410.92	361.57	305.93	221.26	139.68	99.85	(83)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	589.67	669.93	733.53	791.36	828.95	811.6	776.33	733.43	690.68	631.04	578.18	560.06	(84)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (in living area)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.77	0.6	0.65	0.87	0.93	1	1	(86)

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

(87)m=	19.77	19.91	20.14	20.45	20.74	20.93	20.98	20.98	20.85	20.49	20.08	19.75	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.97	19.97	19.97	19.98	19.99	19.99	19.99	20	19.99	19.99	19.98	19.98	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.88	0.68	0.47	0.53	0.81	0.97	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	18.33	18.54	18.88	19.33	19.72	19.94	19.99	19.99	19.87	19.39	18.79	18.3	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

fLA = Living area ÷ (4) =

0.15

(91)

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

(92)m=	18.54	18.74	19.06	19.49	19.87	20.09	20.13	20.13	20.01	19.55	18.98	18.51	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.54	18.74	19.06	19.49	19.87	20.09	20.13	20.13	20.01	19.55	18.98	18.51	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

(94)m=	1	0.99	0.98	0.95	0.87	0.69	0.49	0.54	0.81	0.96	0.99	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	587.31	664.58	720.51	753.91	721.88	562.02	381.72	399.01	560.27	606.88	573.39	558.33	(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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TER WorkSheet: New dwelling design stage

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

(97)m=	1602.72	1554.05	1407.25	1173.75	903.3	601.03	387.07	407.87	649.82	989.62	1318.49	1596.04	(97)
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Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	755.46	597.72	510.94	302.28	134.97	0	0	0	0	284.76	536.47	772.06	(98)
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = $\text{Sum}(98)_{1..12} =$ 3894.67 (98)

Space heating requirement in kWh/m²/year

39.39 (99)

2.4 Energy conservation measures including heating systems including air-to-water (A-W)

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

93.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

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

Space heating requirement (calculated above)

755.46	597.72	510.94	302.28	134.97	0	0	0	0	284.76	536.47	772.06
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

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

807.98	639.27	546.46	323.3	144.35	0	0	0	0	304.56	573.77	825.73
--------	--------	--------	-------	--------	---	---	---	---	--------	--------	--------

Total (kWh/year) = $\text{Sum}(211)_{1..12} =$ 4165.42 (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	(215)
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Total (kWh/year) = $\text{Sum}(215)_{1..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

213.25	187.99	197.51	177.16	173.68	155.3	149.25	163.63	163.3	183.7	194.11	208.16
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Efficiency of water heater

79.8 (216)

(217)m=	87.91	87.69	87.24	86.23	84.15	79.8	79.8	79.8	79.8	85.98	87.39	87.99	(217)
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Fuel for water heating, kWh/month

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

(219)m=	242.6	214.39	226.4	205.45	206.4	194.61	187.03	205.05	204.64	213.65	222.13	236.56
---------	-------	--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------

Total = $\text{Sum}(219a)_{1..12} =$ 2558.91 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

4165.42

Water heating fuel used

2558.91

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

420.8 (232)

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

7220.13 (338)

TER WorkSheet: New dwelling design stage

12a CO2 emissions – Individual heating systems Building with CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) ×	0.216	≡	899.73	(261)
Space heating (secondary)	(215) ×	0.519	≡	0	(263)
Water heating	(219) ×	0.216	≡	552.72	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1452.46	(265)
Electricity for pumps, fans and electric keep-hot	(231) ×	0.519	≡	38.93	(267)
Electricity for lighting	(232) ×	0.519	≡	218.39	(268)
Total CO2, kg/year		sum of (265)...(271) ≡		1709.78	(272)
TER =				25.37	(273)

DRAFT

DER WorkSheet: New dwelling design stage

Use Details

Assessor Name:

Software Name: Stroma FSAP 10 Beta

Stroma Number:

Software Version:

Version: 1.0.0.37

Property Address: 2B3P

Address : 2B3P

1. Overall dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	35.54 (1a)	x	2.6 (2a)	=	92.4 (3a)
First floor	35.54 (1b)	x	2.8 (2b)	=	99.51 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.08 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	191.92 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	0	+	0	=	0 x 20 = 0 (6b)
-chimneys/flues attached to closed fire	0	+	0	=	0 x 10 = 0 (6c)
-flues attached to solid fuel boiler	0	+	0	=	0 x 20 = 0 (6d)
-flues attached to other heater	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) =	0.21 (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		0 (11)
<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>		
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)		0.46 (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) =	0.39 (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
---------	------	------	------	-----	------	------	------	------	---	------	------	------

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

	0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46
--	-----	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.58	0.59	0.6	0.6	(25)
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3. Heat losses and model parameters

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			2.17	×	1	=	2.17 (26)
Windows Type 1			2.3	×	1/[1/(1.2)+0.04]	=	2.63 (27)
Windows Type 2			1.21	×	1/[1/(1.2)+0.04]	=	1.39 (27)
Windows Type 3			3.18	×	1/[1/(1.2)+0.04]	=	3.64 (27)
Windows Type 4			0.63	×	1/[1/(1.2)+0.04]	=	0.72 (27)
Windows Type 5			1.2	×	1/[1/(1.2)+0.04]	=	1.37 (27)
Windows Type 6			1.8	×	1/[1/(1.2)+0.04]	=	2.06 (27)
Windows Type 7			1.8	×	1/[1/(1.2)+0.04]	=	2.06 (27)
Windows Type 8			1.2	×	1/[1/(1.2)+0.04]	=	1.37 (27)
Windows Type 9			0.63	×	1/[1/(1.2)+0.04]	=	0.72 (27)
Floor			35.54031	×	0.13	=	4.620241 75 2665.523 (28)
Walls Type1	44.95	9.49	35.46	×	0.14	=	4.96 60 2127.53 (29)
Walls Type2	48.41	6.63	41.78	×	0.14	=	5.85 60 2506.58 (29)

DER WorkSheet: New dwelling design stage

Roof	35.54	0	35.54	×	0.11	=	3.91	9	319.86	(30)
Total area of elements, m ²			164.44							(31)
Party wall			36.39	×	0	=	0	45	1637.334	(32)
Internal wall **			102.3					39	3989.68	(32c)
Internal wall **			126.43					9	1137.881	(32c)
Internal floor			35.54					18	639.7256	(32d)
Internal ceiling			35.54					9	319.8628	(32e)

* 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)	(25) ... (30) + (32) =	37.49	(33)
Heat capacity Cm = S(A x k)	((25) ... (30) + (32) + (32a) ... (32e) =	15343.98	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K	= (34) ÷ (4) =	215.87	(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	9.23	(36)
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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	46.72	(37)
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Ventilation heat loss calculated monthly	(38)m = 0.33 x (25)m x (5)	
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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m =	39.48	39.18	38.88	37.48	37.22	36.01	36.01	35.78	36.47	37.22	37.75	38.3	(38)

Heat transfer coefficient, W/K											(39)m = (37) + (38)m		
(39)m=	36.2	85.9	85.6	84.2	83.94	82.73	82.73	82.5	83.19	83.94	84.47	85.02	
Average = Sum(39) _{1..12} / 12=											84.2	(39)	

Heat loss parameter (HLP), W/m²K												(40)m = (39)m ÷ (4)	
(40)m =	1.21	1.21	1.2	1.18	1.18	1.16	1.18	1.16	1.17	1.18	1.19	1.2	
Average = Sum(40) _{1...12} / 12 =												1.18	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement

WATER USE

Assumed occupancy, N	2.27	(42)
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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 =	39.89	38.44	36.99	35.54	34.09	32.64	32.64	34.09	35.54	36.99	38.44	39.89	
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Annual average hot water usage in litres per day Vd,average (from Appendix J)	109.5	(43)
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DER WorkSheet: New dwelling design stage

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

(44)m=	40.67	39.21	37.76	36.28	34.82	33.35	33.34	34.8	36.26	37.73	39.22	40.7	
Total = Sum(44) _{1...12} =												444.15	(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=	171.96	153.39	161.49	141.52	137.95	120.51	111.12	124.73	123.86	142.99	157.35	170.81	
Total = Sum(45) _{1...12} =												1717.66	(45)

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

(46)m=	25.79	23.01	24.22	21.23	20.69	18.08	16.67	18.71	18.58	21.45	23.6	25.62	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	210	(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):	1.42	(48)
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Temperature factor from Table 2b	0.54	(49)
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Energy lost from water storage, kWh/year	$(48) \times (49) =$	0.77	(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	$(47) \times (51) \times (52) \times (53) =$	0	(54)
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Enter (50) or (54) in (55)	0.77	(55)
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Water storage loss calculated for each month $(56)_m = (55) \times (41)_m$

(56)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS storage, $(57)_m = (56)_m \times [(47) - V_s] + (47)$, else $(57)_m = (56)_m$

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

(57)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(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)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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=	219	195.87	208.52	187.03	184.98	166.02	158.15	171.76	169.38	190.02	202.87	217.84	(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)
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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)
---------	--	--	--	--	--	--	--	--	--	--	--	--	-------

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=	219	195.87	208.52	187.03	184.98	166.02	158.15	171.76	169.38	190.02	202.87	217.84	
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Output from water heater (annual) _{1...12}	2271.44	(64)
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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
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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=	94.8	84.99	91.32	83.47	83.49	76.48	74.57	79.1	77.6	85.17	88.73	94.42
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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=	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6

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

(67)m=	6.7	5.95	4.84	3.66	2.74	2.31	2.5	3.25	4.36	5.54	6.46	6.89
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	199.81	201.88	196.65	185.53	171.49	158.29	149.48	147.41	152.63	163.75	177.79	190.99
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36
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Pumps and fans gains (Table 5a)

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

(71)m=	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88
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Water heating gains (Table 5)

(72)m=	127.43	126.47	122.74	115.93	112.22	106.22	100.23	105.32	107.77	114.48	123.24	126.91
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	391.01	391.36	381.32	362.2	343.53	323.91	309.29	314.05	321.84	340.65	364.58	381.87
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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 _l Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.21	x	10.63	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	3.18	x	10.63	x	0.63	x	0.7	=	10.33	(74)
North	0.9x	0.77	x	1.8	x	10.63	x	0.63	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	1.2	x	10.63	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	1.21	x	20.32	x	0.63	x	0.7	=	7.51	(74)
North	0.9x	0.77	x	3.18	x	20.32	x	0.63	x	0.7	=	19.75	(74)
North	0.9x	0.77	x	1.8	x	20.32	x	0.63	x	0.7	=	11.18	(74)
North	0.9x	0.77	x	1.2	x	20.32	x	0.63	x	0.7	=	7.45	(74)
North	0.9x	0.77	x	1.21	x	34.53	x	0.63	x	0.7	=	12.77	(74)
North	0.9x	0.77	x	3.18	x	34.53	x	0.63	x	0.7	=	33.56	(74)
North	0.9x	0.77	x	1.8	x	34.53	x	0.63	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.2	x	34.53	x	0.63	x	0.7	=	12.66	(74)
North	0.9x	0.77	x	1.21	x	55.46	x	0.63	x	0.7	=	20.51	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	3.18	x	55.46	x	0.63	x	0.7	=	53.9	(74)
North	0.9x	0.77	x	1.8	x	55.46	x	0.63	x	0.7	=	30.51	(74)
North	0.9x	0.77	x	1.2	x	55.46	x	0.63	x	0.7	=	20.34	(74)
North	0.9x	0.77	x	1.21	x	74.72	x	0.63	x	0.7	=	27.63	(74)
North	0.9x	0.77	x	3.18	x	74.72	x	0.63	x	0.7	=	72.61	(74)
North	0.9x	0.77	x	1.8	x	74.72	x	0.63	x	0.7	=	41.1	(74)
North	0.9x	0.77	x	1.2	x	74.72	x	0.63	x	0.7	=	27.4	(74)
North	0.9x	0.77	x	1.21	x	79.99	x	0.63	x	0.7	=	29.58	(74)
North	0.9x	0.77	x	3.18	x	79.99	x	0.63	x	0.7	=	77.73	(74)
North	0.9x	0.77	x	1.8	x	79.99	x	0.63	x	0.7	=	44	(74)
North	0.9x	0.77	x	1.2	x	79.99	x	0.63	x	0.7	=	29.33	(74)
North	0.9x	0.77	x	1.21	x	74.68	x	0.63	x	0.7	=	27.61	(74)
North	0.9x	0.77	x	3.18	x	74.68	x	0.63	x	0.7	=	72.57	(74)
North	0.9x	0.77	x	1.8	x	74.68	x	0.63	x	0.7	=	41.08	(74)
North	0.9x	0.77	x	1.2	x	74.68	x	0.63	x	0.7	=	27.39	(74)
North	0.9x	0.77	x	1.21	x	59.25	x	0.63	x	0.7	=	21.91	(74)
North	0.9x	0.77	x	3.18	x	59.25	x	0.63	x	0.7	=	57.58	(74)
North	0.9x	0.77	x	1.8	x	59.25	x	0.63	x	0.7	=	32.59	(74)
North	0.9x	0.77	x	1.2	x	59.25	x	0.63	x	0.7	=	21.73	(74)
North	0.9x	0.77	x	1.21	x	41.52	x	0.63	x	0.7	=	18.35	(74)
North	0.9x	0.77	x	3.18	x	41.52	x	0.63	x	0.7	=	48.35	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.63	x	0.7	=	22.84	(74)
North	0.9x	0.77	x	1.2	x	41.52	x	0.63	x	0.7	=	18.23	(74)
North	0.9x	0.77	x	1.21	x	24.19	x	0.63	x	0.7	=	8.95	(74)
North	0.9x	0.77	x	3.18	x	24.19	x	0.63	x	0.7	=	23.51	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.63	x	0.7	=	13.31	(74)
North	0.9x	0.77	x	1.2	x	24.19	x	0.63	x	0.7	=	8.87	(74)
North	0.9x	0.77	x	1.21	x	13.12	x	0.63	x	0.7	=	4.85	(74)
North	0.9x	0.77	x	3.18	x	13.12	x	0.63	x	0.7	=	12.75	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.63	x	0.7	=	7.22	(74)
North	0.9x	0.77	x	1.2	x	13.12	x	0.63	x	0.7	=	4.81	(74)
North	0.9x	0.77	x	1.21	x	8.86	x	0.63	x	0.7	=	3.28	(74)
North	0.9x	0.77	x	3.18	x	8.86	x	0.63	x	0.7	=	8.61	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.63	x	0.7	=	4.88	(74)
North	0.9x	0.77	x	1.2	x	8.86	x	0.63	x	0.7	=	3.25	(74)
South	0.9x	0.77	x	2.3	x	46.75	x	0.63	x	0.7	=	32.86	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	2.3	x	76.57	x	0.63	x	0.7	=	53.82	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	2.3	x	97.53	x	0.63	x	0.7	=	68.56	(78)
South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)
South	0.9x	0.77	x	2.3	x	110.23	x	0.63	x	0.7	=	77.48	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	2.3	x	114.87	x	0.63	x	0.7	=	80.74	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	2.3	x	110.55	x	0.63	x	0.7	=	77.71	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	2.3	x	108.01	x	0.63	x	0.7	=	75.92	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	2.3	x	104.89	x	0.63	x	0.7	=	73.73	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	2.3	x	101.89	x	0.63	x	0.7	=	71.62	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	58.05	(78)
South	0.9x	0.77	x	2.3	x	82.59	x	0.63	x	0.7	=	58.05	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	2.3	x	55.42	x	0.63	x	0.7	=	38.95	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.49	(78)
South	0.9x	0.77	x	2.3	x	40.4	x	0.63	x	0.7	=	28.4	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)
West	0.9x	0.77	x	0.63	x	19.64	x	0.63	x	0.7	=	3.78	(80)
West	0.9x	0.77	x	0.63	x	19.64	x	0.63	x	0.7	=	3.78	(80)
West	0.9x	0.77	x	0.63	x	38.42	x	0.63	x	0.7	=	7.4	(80)
West	0.9x	0.77	x	0.63	x	38.42	x	0.63	x	0.7	=	7.4	(80)
West	0.9x	0.77	x	0.63	x	63.27	x	0.63	x	0.7	=	12.18	(80)
West	0.9x	0.77	x	0.63	x	63.27	x	0.63	x	0.7	=	12.18	(80)
West	0.9x	0.77	x	0.63	x	92.28	x	0.63	x	0.7	=	17.77	(80)
West	0.9x	0.77	x	0.63	x	92.28	x	0.63	x	0.7	=	17.77	(80)
West	0.9x	0.77	x	0.63	x	113.09	x	0.63	x	0.7	=	21.77	(80)
West	0.9x	0.77	x	0.63	x	113.09	x	0.63	x	0.7	=	21.77	(80)
West	0.9x	0.77	x	0.63	x	115.77	x	0.63	x	0.7	=	22.29	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	0.63	x	115.77	x	0.63	x	0.7	=	22.29	(80)
West	0.9x	0.77	x	0.63	x	110.22	x	0.63	x	0.7	=	21.22	(80)
West	0.9x	0.77	x	0.63	x	110.22	x	0.63	x	0.7	=	21.22	(80)
West	0.9x	0.77	x	0.63	x	94.68	x	0.63	x	0.7	=	18.23	(80)
West	0.9x	0.77	x	0.63	x	94.68	x	0.63	x	0.7	=	18.23	(80)
West	0.9x	0.77	x	0.63	x	73.59	x	0.63	x	0.7	=	14.17	(80)
West	0.9x	0.77	x	0.63	x	73.59	x	0.63	x	0.7	=	14.17	(80)
West	0.9x	0.77	x	0.63	x	45.59	x	0.63	x	0.7	=	8.78	(80)
West	0.9x	0.77	x	0.63	x	45.59	x	0.63	x	0.7	=	8.78	(80)
West	0.9x	0.77	x	0.63	x	24.49	x	0.63	x	0.7	=	4.72	(80)
West	0.9x	0.77	x	0.63	x	24.49	x	0.63	x	0.7	=	4.72	(80)
West	0.9x	0.77	x	0.63	x	16.15	x	0.63	x	0.7	=	3.11	(80)
West	0.9x	0.77	x	0.63	x	16.15	x	0.63	x	0.7	=	3.11	(80)

Solar gains in watts, calculated for each month

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

(83)m=	107.3	184.71	260.33	339.35	398.36	404.29	386.05	340.17	287.13	205.95	128.82	91.67	(83)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	498.32	576.09	641.65	701.56	741.89	728.2	695.34	654.22	608.97	546.8	493.39	473.54	(84)
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Temperature during heating periods in the living area from Table 9, Th1 (°C)

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.93	0.83	0.67	0.51	0.58	0.79	0.95	0.99	0.99	(86)

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

(87)m=	19.75	19.91	20.15	20.47	20.73	20.88	20.92	20.91	20.81	20.48	20.06	19.73	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.91	19.91	19.92	19.93	19.94	19.95	19.95	19.95	19.94	19.94	19.93	19.92	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.96	0.91	0.78	0.58	0.39	0.44	0.71	0.93	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.45	18.66	18.97	19.37	19.67	19.83	19.85	19.85	19.77	19.4	18.87	18.43	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.15

(91)

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

(92)m=	18.64	18.84	19.15	19.53	19.82	19.98	20.01	20.01	19.92	19.56	19.05	18.63	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.64	18.84	19.15	19.53	19.82	19.98	20.01	20.01	19.92	19.56	19.05	18.63	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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	0.98	0.95	0.9	0.78	0.58	0.4	0.45	0.71	0.92	0.98	0.99	(94)
--------	------	------	------	-----	------	------	-----	------	------	------	------	------	------

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

(95)m=	492.27	563.05	612.55	630.02	577.55	424.23	279.15	292.91	433.73	501.81	482.05	468.85	(95)
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DER WorkSheet: New dwelling design stage

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, $L_m, W = [(39)m \times ((93)m - (96)m)]$

(97)m=	1236.21	1197.64	1082.46	895.27	681.98	445.19	282.25	297.9	484.57	751.94	1009.22	1226.53	(97)
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Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(97a)m=	553.49	426.45	349.61	190.98	77.7	0	0	0	0	186.1	379.57	563.71	
Total per year (kWh/year) = $\text{Sum}(97a)_{1..12}$												2727.61	(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	(97b)
Total per year (kWh/year) = $\text{Sum}(97b)_{1..12}$												0	(97b)

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

(98)m=	553.49	426.45	349.61	190.98	77.7	0	0	0	0	186.1	379.57	563.71	
Total per year (kWh/year) = $\text{Sum}(98)_{1..12}$												2727.61	(98)

Space heating requirement in kWh/m²/year

38.37	(99)
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Energy requirement for individual heating systems including internal HP

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

288.04	(206)
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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)

553.49	426.45	349.61	190.98	77.7	0	0	0	0	186.1	379.57	563.71
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(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

266.05	204.98	168.05	91.8	37.35	0	0	0	0	89.45	182.45	270.96
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$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..12}$$

1311.09	(211)
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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
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$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..12}$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

219	195.87	208.52	187.03	184.98	166.02	158.15	171.76	169.38	190.02	202.87	217.84
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Efficiency of water heater

281.48	(216)
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(217)m=	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	(217)
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Fuel for water heating, kWh/month

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

(219)m=	77.8	69.58	74.08	66.44	65.72	58.98	56.18	61.02	60.17	67.51	72.07	77.39
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$$\text{Total} = \text{Sum}(219a)_{1..12}$$

806.95	(219)
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Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1311.09

DER WorkSheet: New dwelling design stage

Water heating fuel used		806.95	
Electricity for pumps, fans and electric keep-hot			
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	0	(231)
Electricity for lighting		118.36	(232)

(24) 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	=	178.31 (261)
Space heating (secondary)	(215) x	0.136	=	0 (263)
Water heating	(219) x	0.136	=	109.74 (264)
Space and water heating	(261) + (262) + (263) + (264) =			288.05 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	0 (267)
Electricity for lighting	(232) x	0.136	=	16.1 (268)
Total CO2, kg/year		sum of (265) ... (271) =		304.15 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		4.28 (273)
El rating (section 14)				95 (274)

DRAFT

TER WorkSheet: New dwelling design stage

Use Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 10 Beta

Software Version:

Version: 1.0.0.37

Property Address: 2B3P

Address : 2B3P

1. Overall dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	35.54 (1a) ×	2.6 (2a) =	92.4 (3a)
First floor	35.54 (1b) ×	2.8 (2b) =	99.51 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.08 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	191.92 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 × 40 =	0 (6a)
Number of open flues	0	0	0	0 × 20 =	0 (6b)
-chimneys/flues attached to closed fire	0	0	0	0 × 10 =	0 (6c)
-flues attached to solid fuel boiler	0	0	0	0 × 20 =	0 (6d)
-flues attached to other heater	0	0	0	0 × 35 =	0 (6e)
Number of blocked chimneys				0 × 20 =	0 (6f)
Number of intermittent fans				3 × 10 =	30 (7a)
Number of passive vents				0 × 10 =	0 (7b)
Number of flueless gas fires				0 × 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) =	0.16 (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]×0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0 (11)
<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>		
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 × (14) ÷ 100] =	0 (15)
Infiltration rate	(6) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]÷(8), otherwise (18) = (16)		0.41 (18)
<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 × (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) × (20) =	0.35 (21)

TER 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

	0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
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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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(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
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(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
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(24c)

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

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

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

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

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

3. Heat losses and modelled 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			2.17	×	1	=	2.17 (26)
Windows Type 1			2.3	×	1/[1/(1.2)+0.04]	=	2.63 (27)
Windows Type 2			1.21	×	1/[1/(1.2)+0.04]	=	1.39 (27)
Windows Type 3			3.18	×	1/[1/(1.2)+0.04]	=	3.64 (27)
Windows Type 4			0.63	×	1/[1/(1.2)+0.04]	=	0.72 (27)
Windows Type 5			1.2	×	1/[1/(1.2)+0.04]	=	1.37 (27)
Windows Type 6			1.8	×	1/[1/(1.2)+0.04]	=	2.06 (27)
Windows Type 7			1.8	×	1/[1/(1.2)+0.04]	=	2.06 (27)
Windows Type 8			1.2	×	1/[1/(1.2)+0.04]	=	1.37 (27)
Windows Type 9			0.63	×	1/[1/(1.2)+0.04]	=	0.72 (27)
Floor			35.54031	×	0.13	=	4.620241 75 2665.523 (28)
Walls Type1	44.95	9.49	35.46	×	0.18	=	6.38 60 2127.53 (29)
Walls Type2	48.41	6.63	41.78	×	0.18	=	7.52 60 2506.58 (29)

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Roof	35.54	0	35.54	×	0.11	=	3.78	9	319.86	(30)
Total area of elements, m ²			164.44							(31)
Party wall			36.39	×	0	=	0	45	1637.334	(32)
Internal wall **			102.3					39	3989.68	(32c)
Internal wall **			126.43					9	1137.881	(32c)
Internal floor			35.54					18	639.7256	(32d)
Internal ceiling			35.54					9	319.8628	(32e)

* 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)	(25) ... (30) + (32) =	40.45	(33)
Heat capacity Cm = S(A x k)	((25) ... (30) + (32) + (32a) ... (32e) =	15343.98	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K	= (34) ÷ (4) =	215.87	(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	9.23	(36)
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if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	49.68	(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 =	37.81	37.57	37.33	36.24	36.03	35.08	35.08	34.9	35.44	35.03	36.45	36.88	(38)

Heat transfer coefficient, W/K												(39)m = (37) + (38)m		
(39)m=	87.49	87.25	87.02	85.92	85.72	84.76	84.76	84.58	85.13	85.72	86.13	86.57		
Average = Sum(39) ... / 12=												85.92	(39)	

Heat loss parameter (HLP), W/m ² K												(40)m = (39)m ÷ (4)	
(40)m =	1.23	1.23	1.22	1.21	1.21	1.19	1.19	1.19	1.2	1.21	1.21	1.22	
Average = Sum(40) _{1...12} / 12 =												1.21	(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

Assumed occupancy, N	2.27	(42)
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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 =	39.89	38.44	36.99	35.54	34.09	32.64	32.64	34.09	35.54	36.99	38.44	39.89	
----------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--

Annual average hot water usage in litres per day Vd,average (from Appendix J)	109.5	(43)
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TER WorkSheet: New dwelling design stage

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

(44)m=	40.67	39.21	37.76	36.28	34.82	33.35	33.34	34.8	36.26	37.73	39.22	40.7		
Total = Sum(44) _{1...12} =													444.15	(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=	171.96	153.39	161.49	141.52	137.95	120.51	111.12	124.73	123.86	142.99	157.35	170.81		
Total = Sum(45) _{1...12} =													1717.66	(45)

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

(46)m=	25.79	23.01	24.22	21.23	20.69	18.08	16.67	18.71	18.58	21.45	23.6	25.62		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	150	(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):	1.7	(48)
---	-----	------

Temperature factor from Table 2b	0.54	(49)
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Energy lost from water storage, kWh/year	$(48) \times (49) =$	0.92	(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	$(48) \times (51) \times (52) \times (53) =$	0	(54)
--	--	---	------

Enter (50) or (54) in (55)	0.92	(55)
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Water storage loss calculated for each month $(56)_m = (55) \times (41)_m$

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48		(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS storage, $(57)_m = (56)_m \times [(47) - V_s] + (47)$, else $(57)_m = (56)_m$

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

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48		(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)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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=	223.71	200.12	213.23	191.59	189.69	170.59	162.86	176.48	173.94	194.73	207.43	222.56		(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=	-26.42	-23.25	-23.73	-19.54	-18.15	-14.97	-12.68	-15.35	-15.79	-19.52	-22.59	-25.54		(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=	197.29	176.88	189.5	172.06	171.55	155.61	150.18	161.12	158.14	175.22	184.84	197.02		
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Output from water heater (annual) _{1...12}	2089.41	(64)
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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=	98.57	88.39	95.09	87.12	87.26	80.13	78.34	82.87	81.25	88.94	92.38	98.19
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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=	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6	113.6

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

(67)m=	9.66	8.58	6.98	5.28	3.95	3.33	3.6	4.68	6.28	7.98	9.31	9.93
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	199.81	201.88	196.65	185.53	171.49	158.29	149.48	147.41	152.63	163.75	177.79	190.99
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36	34.36
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Pumps and fans gains (Table 5a)

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

(71)m=	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88	-90.88
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Water heating gains (Table 5)

(72)m=	132.49	131.54	127.81	120.99	117.29	111.29	105.3	111.38	112.84	119.54	128.31	131.98
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	402.04	402.07	391.52	371.89	352.81	333	318.46	323.55	331.83	351.35	375.49	392.97
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6 Solar gains

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.21	x	10.63	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	3.18	x	10.63	x	0.63	x	0.7	=	10.33	(74)
North	0.9x	0.77	x	1.8	x	10.63	x	0.63	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	1.2	x	10.63	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	1.21	x	20.32	x	0.63	x	0.7	=	7.51	(74)
North	0.9x	0.77	x	3.18	x	20.32	x	0.63	x	0.7	=	19.75	(74)
North	0.9x	0.77	x	1.8	x	20.32	x	0.63	x	0.7	=	11.18	(74)
North	0.9x	0.77	x	1.2	x	20.32	x	0.63	x	0.7	=	7.45	(74)
North	0.9x	0.77	x	1.21	x	34.53	x	0.63	x	0.7	=	12.77	(74)
North	0.9x	0.77	x	3.18	x	34.53	x	0.63	x	0.7	=	33.56	(74)
North	0.9x	0.77	x	1.8	x	34.53	x	0.63	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.2	x	34.53	x	0.63	x	0.7	=	12.66	(74)
North	0.9x	0.77	x	1.21	x	55.46	x	0.63	x	0.7	=	20.51	(74)

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North	0.9x	0.77	x	3.18	x	55.46	x	0.63	x	0.7	=	53.9	(74)
North	0.9x	0.77	x	1.8	x	55.46	x	0.63	x	0.7	=	30.51	(74)
North	0.9x	0.77	x	1.2	x	55.46	x	0.63	x	0.7	=	20.34	(74)
North	0.9x	0.77	x	1.21	x	74.72	x	0.63	x	0.7	=	27.63	(74)
North	0.9x	0.77	x	3.18	x	74.72	x	0.63	x	0.7	=	72.61	(74)
North	0.9x	0.77	x	1.8	x	74.72	x	0.63	x	0.7	=	41.1	(74)
North	0.9x	0.77	x	1.2	x	74.72	x	0.63	x	0.7	=	27.4	(74)
North	0.9x	0.77	x	1.21	x	79.99	x	0.63	x	0.7	=	29.58	(74)
North	0.9x	0.77	x	3.18	x	79.99	x	0.63	x	0.7	=	77.73	(74)
North	0.9x	0.77	x	1.8	x	79.99	x	0.63	x	0.7	=	44	(74)
North	0.9x	0.77	x	1.2	x	79.99	x	0.63	x	0.7	=	29.33	(74)
North	0.9x	0.77	x	1.21	x	74.68	x	0.63	x	0.7	=	27.61	(74)
North	0.9x	0.77	x	3.18	x	74.68	x	0.63	x	0.7	=	72.57	(74)
North	0.9x	0.77	x	1.8	x	74.68	x	0.63	x	0.7	=	41.08	(74)
North	0.9x	0.77	x	1.2	x	74.68	x	0.63	x	0.7	=	27.39	(74)
North	0.9x	0.77	x	1.21	x	59.25	x	0.63	x	0.7	=	21.91	(74)
North	0.9x	0.77	x	3.18	x	59.25	x	0.63	x	0.7	=	57.58	(74)
North	0.9x	0.77	x	1.8	x	59.25	x	0.63	x	0.7	=	32.59	(74)
North	0.9x	0.77	x	1.2	x	59.25	x	0.63	x	0.7	=	21.73	(74)
North	0.9x	0.77	x	1.21	x	41.52	x	0.63	x	0.7	=	18.35	(74)
North	0.9x	0.77	x	3.18	x	41.52	x	0.63	x	0.7	=	48.35	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.63	x	0.7	=	22.84	(74)
North	0.9x	0.77	x	1.2	x	41.52	x	0.63	x	0.7	=	18.23	(74)
North	0.9x	0.77	x	1.21	x	24.19	x	0.63	x	0.7	=	8.95	(74)
North	0.9x	0.77	x	3.18	x	24.19	x	0.63	x	0.7	=	23.51	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.63	x	0.7	=	13.31	(74)
North	0.9x	0.77	x	1.2	x	24.19	x	0.63	x	0.7	=	8.87	(74)
North	0.9x	0.77	x	1.21	x	13.12	x	0.63	x	0.7	=	4.85	(74)
North	0.9x	0.77	x	3.18	x	13.12	x	0.63	x	0.7	=	12.75	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.63	x	0.7	=	7.22	(74)
North	0.9x	0.77	x	1.2	x	13.12	x	0.63	x	0.7	=	4.81	(74)
North	0.9x	0.77	x	1.21	x	8.86	x	0.63	x	0.7	=	3.28	(74)
North	0.9x	0.77	x	3.18	x	8.86	x	0.63	x	0.7	=	8.61	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.63	x	0.7	=	4.88	(74)
North	0.9x	0.77	x	1.2	x	8.86	x	0.63	x	0.7	=	3.25	(74)
South	0.9x	0.77	x	2.3	x	46.75	x	0.63	x	0.7	=	32.86	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	2.3	x	76.57	x	0.63	x	0.7	=	53.82	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)

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South	0.9x	0.77	x	2.3	x	97.53	x	0.63	x	0.7	=	68.56	(78)
South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)
South	0.9x	0.77	x	2.3	x	110.23	x	0.63	x	0.7	=	77.48	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	2.3	x	114.87	x	0.63	x	0.7	=	80.74	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	2.3	x	110.55	x	0.63	x	0.7	=	77.71	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	2.3	x	108.01	x	0.63	x	0.7	=	75.92	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	2.3	x	104.89	x	0.63	x	0.7	=	73.73	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	2.3	x	101.89	x	0.63	x	0.7	=	71.62	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	58.05	(78)
South	0.9x	0.77	x	2.3	x	82.59	x	0.63	x	0.7	=	58.05	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	2.3	x	55.42	x	0.63	x	0.7	=	38.95	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.49	(78)
South	0.9x	0.77	x	2.3	x	40.4	x	0.63	x	0.7	=	28.4	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)
West	0.9x	0.77	x	0.63	x	19.64	x	0.63	x	0.7	=	3.78	(80)
West	0.9x	0.77	x	0.63	x	19.64	x	0.63	x	0.7	=	3.78	(80)
West	0.9x	0.77	x	0.63	x	38.42	x	0.63	x	0.7	=	7.4	(80)
West	0.9x	0.77	x	0.63	x	38.42	x	0.63	x	0.7	=	7.4	(80)
West	0.9x	0.77	x	0.63	x	63.27	x	0.63	x	0.7	=	12.18	(80)
West	0.9x	0.77	x	0.63	x	63.27	x	0.63	x	0.7	=	12.18	(80)
West	0.9x	0.77	x	0.63	x	92.28	x	0.63	x	0.7	=	17.77	(80)
West	0.9x	0.77	x	0.63	x	92.28	x	0.63	x	0.7	=	17.77	(80)
West	0.9x	0.77	x	0.63	x	113.09	x	0.63	x	0.7	=	21.77	(80)
West	0.9x	0.77	x	0.63	x	113.09	x	0.63	x	0.7	=	21.77	(80)
West	0.9x	0.77	x	0.63	x	115.77	x	0.63	x	0.7	=	22.29	(80)

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West	0.9x	0.77	x	0.63	x	115.77	x	0.63	x	0.7	=	22.29	(80)
West	0.9x	0.77	x	0.63	x	110.22	x	0.63	x	0.7	=	21.22	(80)
West	0.9x	0.77	x	0.63	x	110.22	x	0.63	x	0.7	=	21.22	(80)
West	0.9x	0.77	x	0.63	x	94.68	x	0.63	x	0.7	=	18.23	(80)
West	0.9x	0.77	x	0.63	x	94.68	x	0.63	x	0.7	=	18.23	(80)
West	0.9x	0.77	x	0.63	x	73.59	x	0.63	x	0.7	=	14.17	(80)
West	0.9x	0.77	x	0.63	x	73.59	x	0.63	x	0.7	=	14.17	(80)
West	0.9x	0.77	x	0.63	x	45.59	x	0.63	x	0.7	=	8.78	(80)
West	0.9x	0.77	x	0.63	x	45.59	x	0.63	x	0.7	=	8.78	(80)
West	0.9x	0.77	x	0.63	x	24.49	x	0.63	x	0.7	=	4.72	(80)
West	0.9x	0.77	x	0.63	x	24.49	x	0.63	x	0.7	=	4.72	(80)
West	0.9x	0.77	x	0.63	x	16.15	x	0.63	x	0.7	=	3.11	(80)
West	0.9x	0.77	x	0.63	x	16.15	x	0.63	x	0.7	=	3.11	(80)

Solar gains in watts, calculated for each month

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

(83)m=	107.3	184.71	260.33	339.35	398.36	404.29	386.05	340.17	287.13	205.95	128.82	91.67	(83)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	509.34	586.78	651.85	711.24	751.16	737.29	704.51	663.72	618.96	557.31	504.31	484.65	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(85)m=	21	(85)
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Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.93	0.84	0.67	0.51	0.58	0.79	0.95	0.99	0.99	(86)

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

(87)m=	19.41	19.62	19.95	20.37	20.72	20.92	20.98	20.97	20.84	20.39	19.83	19.38	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.9	19.9	19.9	19.91	19.92	19.93	19.93	19.93	19.92	19.92	19.91	19.91	(88)
--------	------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.96	0.91	0.78	0.58	0.4	0.44	0.71	0.92	0.98	0.99	(89)
--------	------	------	------	------	------	------	-----	------	------	------	------	------	------

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

(90)m=	18.06	18.33	18.75	19.27	19.67	19.88	19.92	19.92	19.81	19.31	18.61	18.03	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

(91)	0.15	(91)
------	------	------

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

(92)m=	18.26	18.52	18.93	19.43	19.82	20.03	20.08	20.07	19.96	19.47	18.79	18.23	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.26	18.52	18.93	19.43	19.82	20.03	20.08	20.07	19.96	19.47	18.79	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	
(94)m=	0.99	0.97	0.95	0.89	0.78	0.59	0.41	0.46	0.72	0.91	0.97	0.99	(94)

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

(95)m=	502.04	571.7	619.72	636.42	585.81	436.21	290.74	304.52	443.21	509.08	491.08	478.9	(95)
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TER WorkSheet: New dwelling design stage

Monthly average external temperature from Table 8

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

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

(97)m=	1221.35	1188.75	1081.27	904.73	696.35	460.44	294.63	310.67	498.65	760.15	1006.66	1214.12	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(97a)m=	535.17	414.66	343.4	193.19	82.24	0	0	0	0	186.8	371.22	547.01	
Total per year (kWh/year) = $\text{Sum}(97a)_{1..12}$												2673.67	(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	(97b)
Total per year (kWh/year) = $\text{Sum}(97b)_{1..12}$												0	(97b)

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

(98)m=	535.17	414.66	343.4	193.19	82.24	0	0	0	0	186.8	371.22	547.01	
Total per year (kWh/year) = $\text{Sum}(98)_{1..12}$												2673.67	(98)

Space heating requirement in kWh/m²/year

37.61	(99)
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Energy requirement for individual heating systems including internal (IP)

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

90.5	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

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

Space heating requirement (calculated above)

535.17	414.66	343.4	193.19	82.24	0	0	0	0	186.8	371.22	547.01
--------	--------	-------	--------	-------	---	---	---	---	-------	--------	--------

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

591.34	458.19	379.44	213.47	90.87	0	0	0	0	206.41	410.19	604.43
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

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

2954.34	(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		
Total (kWh/year) =Sum(215) _{1..12}												0	(215)

Water heating

Output from water heater (calculated above)

197.29	176.88	189.5	172.06	171.55	155.61	150.18	161.12	158.14	175.22	184.84	197.02
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Efficiency of water heater

79.8	(216)
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(217)m=	87.35	87.01	86.38	85.12	82.98	79.8	79.8	79.8	79.8	84.98	86.64	87.4	(217)
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Fuel for water heating, kWh/month

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

(219)m=	225.87	203.28	219.38	202.13	206.74	195	188.2	201.91	198.17	206.17	213.34	225.43	
Total = $\text{Sum}(219a)_{1..12}$												2485.63	(219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2954.34

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Water heating fuel used		2485.63	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		170.54	(232)
Electricity generated by PVs		-1803.14	(233)

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	=	620.41 (261)
Space heating (secondary)	(215) x	0.136	=	0 (263)
Water heating	(219) x	0.21	=	521.98 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1142.39 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	10.2 (267)
Electricity for lighting	(232) x	0.136	=	23.19 (268)
Energy saving/generation technologies				
Item 1		0.136	=	-245.23 (269)
Total CO2, kg/year	sum of (265) – (271) =			930.55 (272)
TER =				13.89 (273)

DER WorkSheet: New dwelling design stage

Use Details

Assessor Name:

Software Name: Stroma FSAP 10 Beta

Stroma Number:

Software Version:

Version: 1.0.0.37

Property Address: 2B4P

Address : 2B4P

1. Overall dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	40.59 (1a)	x	2.6 (2a)	=	105.53 (3a)
First floor	40.59 (1b)	x	2.8 (2b)	=	113.65 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	81.18 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	219.19 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	0	+	0	=	0 x 20 = 0 (6b)
-chimneys/flues attached to closed fire	0	+	0	=	0 x 10 = 0 (6c)
-flues attached to solid fuel boiler	0	+	0	=	0 x 20 = 0 (6d)
-flues attached to other heater	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) =	0.18 (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		0 (11)
<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>		
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)		0.43 (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) =	0.37 (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

	0.47	0.46	0.45	0.4	0.4	0.35	0.35	0.34	0.37	0.4	0.41	0.43
--	------	------	------	-----	-----	------	------	------	------	-----	------	------

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)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

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

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

(24d)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

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

3. Heat losses and model input 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			2.17	×	1	=	2.17 (26)
Windows Type 1			2.36	×	1/[1/(1.2)+0.04]	=	2.7 (27)
Windows Type 2			0.63	×	1/[1/(1.2)+0.04]	=	0.72 (27)
Windows Type 3			0.96	×	1/[1/(1.2)+0.04]	=	1.1 (27)
Windows Type 4			3.18	×	1/[1/(1.2)+0.04]	=	3.64 (27)
Windows Type 5			1.2	×	1/[1/(1.2)+0.04]	=	1.37 (27)
Windows Type 6			1.8	×	1/[1/(1.2)+0.04]	=	2.06 (27)
Windows Type 7			1.8	×	1/[1/(1.2)+0.04]	=	2.06 (27)
Windows Type 8			1.2	×	1/[1/(1.2)+0.04]	=	1.37 (27)
Floor			40.59015	×	0.13	=	5.276719 (28)
Walls Type1	47.29	9.3	37.99	×	0.14	=	5.32 (29)
Walls Type2	50.93	6	44.93	×	0.14	=	6.29 (29)
Roof	40.59	0	40.59	×	0.11	=	4.46 (30)

DER WorkSheet: New dwelling design stage

Total area of elements, m²	179.4							(31)
Party wall	42.46	×	0	=	0	45	1910.709	(32)
Internal wall **	102.3					39	3989.68	(32c)
Internal wall **	126.43					9	1137.881	(32c)
Internal floor	40.59					18	730.6227	(32d)
Internal ceiling	40.59					9	365.3113	(32e)

* 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) = 38.55 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 16519.01 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 203.49 (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 9.47 (36)

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

Total fabric heat loss (33) + (36) = 48.02 (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=	44.11	43.8	43.5	42.08	41.81	40.58	40.58	40.35	41.05	41.31	42.35	42.91	(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=	92.14	91.83	91.52	90.1	89.84	88.6	88.6	88.37	89.08	89.84	90.38	90.94	
Average = Sum(39) / 12 = 90.1													(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=	1.13	1.13	1.13	1.11	1.11	1.09	1.09	1.09	1.1	1.11	1.11	1.12	
Average = Sum(40) / 12 = 1.11													(40)

Number of days in month (Table 1a)

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

4. Whole building energy requirement (kWh/year)

Assumed occupancy, N 2.48 (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	
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Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	42.19	40.65	39.12	37.58	36.05	34.52	34.52	36.05	37.58	39.12	40.65	42.19	
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Annual average hot water usage in litres per day Vd,average (from Appendix J) 115.8 (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=	42.96	41.42	39.88	38.33	36.78	35.23	35.22	36.76	38.31	39.86	41.43	42.99	
Total = Sum(44) / 12 = 469.18													(44)

DER WorkSheet: New dwelling design stage

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=	181.85	162.21	170.77	149.65	145.88	127.44	117.51	131.9	130.98	151.21	166.4	180.63	
Total = Sum(45) _{1..12} =													1816.43 (45)

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

(46)m=	27.28	24.33	25.62	22.45	21.88	19.12	17.63	19.79	19.65	22.68	24.96	27.09	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	210	(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):	1.42	(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) =	0.77	(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)	0.77	(55)
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Water storage loss calculated for each month (56)m = (55) x (41)m = (55) x (41)m

(56)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS storage (57)m = (56)m x [(47) - V_s] + (47), else (57)m = (56)m

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

(57)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(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) ÷ 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)
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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)
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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=	228.88	204.69	217.8	195.17	192.91	172.95	164.54	178.93	176.5	198.24	211.92	227.67	(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=	228.88	204.69	217.8	195.17	192.91	172.95	164.54	178.93	176.5	198.24	211.92	227.67	
Output from water heater (annual) _{1..12}													2370.21 (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
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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=	98.09	87.92	94.41	86.17	86.13	78.79	76.7	81.48	79.96	87.9	91.74	97.69
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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=	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24

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

(67)m=	7.62	6.77	5.5	4.17	3.12	2.63	2.84	3.69	4.96	6.3	7.35	7.83
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	221.89	224.19	218.39	206.04	190.44	175.79	166	163.7	169.5	181.85	197.44	212.1
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42
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Pumps and fans gains (Table 5a)

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

(71)m=	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39
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Water heating gains (Table 5)

(72)m=	131.84	130.83	126.89	119.68	115.77	109.43	103.09	109.52	111.06	118.15	127.42	131.3
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	421.83	422.07	411.06	390.16	369.6	348.12	332.2	337.19	345.79	368.57	392.48	411.51
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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 m ²		Flux Table 6a		g _l Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	0.96	x	10.63	x	0.63	x	0.7	=	3.12
North	0.9x	0.77	x	3.18	x	10.63	x	0.63	x	0.7	=	10.33
North	0.9x	0.77	x	1.8	x	10.63	x	0.63	x	0.7	=	5.85
North	0.9x	0.77	x	1.2	x	10.63	x	0.63	x	0.7	=	3.9
North	0.9x	0.77	x	0.96	x	20.32	x	0.63	x	0.7	=	5.96
North	0.9x	0.77	x	3.18	x	20.32	x	0.63	x	0.7	=	19.75
North	0.9x	0.77	x	1.8	x	20.32	x	0.63	x	0.7	=	11.18
North	0.9x	0.77	x	1.2	x	20.32	x	0.63	x	0.7	=	7.45
North	0.9x	0.77	x	0.96	x	34.53	x	0.63	x	0.7	=	10.13
North	0.9x	0.77	x	3.18	x	34.53	x	0.63	x	0.7	=	33.56
North	0.9x	0.77	x	1.8	x	34.53	x	0.63	x	0.7	=	19
North	0.9x	0.77	x	1.2	x	34.53	x	0.63	x	0.7	=	12.66
North	0.9x	0.77	x	0.96	x	55.46	x	0.63	x	0.7	=	16.27

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	3.18	x	55.46	x	0.63	x	0.7	=	53.9	(74)
North	0.9x	0.77	x	1.8	x	55.46	x	0.63	x	0.7	=	30.51	(74)
North	0.9x	0.77	x	1.2	x	55.46	x	0.63	x	0.7	=	20.34	(74)
North	0.9x	0.77	x	0.96	x	74.72	x	0.63	x	0.7	=	21.92	(74)
North	0.9x	0.77	x	3.18	x	74.72	x	0.63	x	0.7	=	72.61	(74)
North	0.9x	0.77	x	1.8	x	74.72	x	0.63	x	0.7	=	41.1	(74)
North	0.9x	0.77	x	1.2	x	74.72	x	0.63	x	0.7	=	27.4	(74)
North	0.9x	0.77	x	0.96	x	79.99	x	0.63	x	0.7	=	23.47	(74)
North	0.9x	0.77	x	3.18	x	79.99	x	0.63	x	0.7	=	77.73	(74)
North	0.9x	0.77	x	1.8	x	79.99	x	0.63	x	0.7	=	44	(74)
North	0.9x	0.77	x	1.2	x	79.99	x	0.63	x	0.7	=	29.33	(74)
North	0.9x	0.77	x	0.96	x	74.68	x	0.63	x	0.7	=	21.91	(74)
North	0.9x	0.77	x	3.18	x	74.68	x	0.63	x	0.7	=	72.57	(74)
North	0.9x	0.77	x	1.8	x	74.68	x	0.63	x	0.7	=	41.08	(74)
North	0.9x	0.77	x	1.2	x	74.68	x	0.63	x	0.7	=	27.39	(74)
North	0.9x	0.77	x	0.96	x	59.25	x	0.63	x	0.7	=	17.38	(74)
North	0.9x	0.77	x	3.18	x	59.25	x	0.63	x	0.7	=	57.58	(74)
North	0.9x	0.77	x	1.8	x	59.25	x	0.63	x	0.7	=	32.59	(74)
North	0.9x	0.77	x	1.2	x	59.25	x	0.63	x	0.7	=	21.73	(74)
North	0.9x	0.77	x	0.96	x	41.52	x	0.63	x	0.7	=	12.16	(74)
North	0.9x	0.77	x	3.18	x	41.52	x	0.63	x	0.7	=	40.35	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.63	x	0.7	=	22.84	(74)
North	0.9x	0.77	x	1.2	x	41.52	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	0.96	x	24.19	x	0.63	x	0.7	=	7.1	(74)
North	0.9x	0.77	x	3.18	x	24.19	x	0.63	x	0.7	=	23.51	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.63	x	0.7	=	13.31	(74)
North	0.9x	0.77	x	1.2	x	24.19	x	0.63	x	0.7	=	8.87	(74)
North	0.9x	0.77	x	0.96	x	13.12	x	0.63	x	0.7	=	3.85	(74)
North	0.9x	0.77	x	3.18	x	13.12	x	0.63	x	0.7	=	12.75	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.63	x	0.7	=	7.22	(74)
North	0.9x	0.77	x	1.2	x	13.12	x	0.63	x	0.7	=	4.81	(74)
North	0.9x	0.77	x	0.96	x	8.86	x	0.63	x	0.7	=	2.6	(74)
North	0.9x	0.77	x	3.18	x	8.86	x	0.63	x	0.7	=	8.61	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.63	x	0.7	=	4.88	(74)
North	0.9x	0.77	x	1.2	x	8.86	x	0.63	x	0.7	=	3.25	(74)
South	0.9x	0.77	x	2.36	x	46.75	x	0.63	x	0.7	=	33.72	(78)
South	0.9x	0.77	x	0.63	x	46.75	x	0.63	x	0.7	=	9	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	2.36	x	76.57	x	0.63	x	0.7	=	55.22	(78)
South	0.9x	0.77	x	0.63	x	76.57	x	0.63	x	0.7	=	14.74	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	2.36	x	97.53	x	0.63	x	0.7	=	70.35	(78)
South	0.9x	0.77	x	0.63	x	97.53	x	0.63	x	0.7	=	18.78	(78)
South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)
South	0.9x	0.77	x	2.36	x	110.23	x	0.63	x	0.7	=	79.51	(78)
South	0.9x	0.77	x	0.63	x	110.23	x	0.63	x	0.7	=	21.22	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	2.36	x	114.87	x	0.63	x	0.7	=	82.85	(78)
South	0.9x	0.77	x	0.63	x	114.87	x	0.63	x	0.7	=	22.12	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	2.36	x	110.55	x	0.63	x	0.7	=	79.73	(78)
South	0.9x	0.77	x	0.63	x	110.55	x	0.63	x	0.7	=	21.28	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	2.36	x	108.01	x	0.63	x	0.7	=	77.9	(78)
South	0.9x	0.77	x	0.63	x	108.01	x	0.63	x	0.7	=	20.8	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	2.36	x	104.89	x	0.63	x	0.7	=	75.65	(78)
South	0.9x	0.77	x	0.63	x	104.89	x	0.63	x	0.7	=	20.2	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	2.36	x	101.89	x	0.63	x	0.7	=	73.48	(78)
South	0.9x	0.77	x	0.63	x	101.89	x	0.63	x	0.7	=	19.62	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	2.36	x	82.59	x	0.63	x	0.7	=	59.56	(78)
South	0.9x	0.77	x	0.63	x	82.59	x	0.63	x	0.7	=	15.9	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	2.36	x	55.42	x	0.63	x	0.7	=	39.97	(78)
South	0.9x	0.77	x	0.63	x	55.42	x	0.63	x	0.7	=	10.67	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.49	(78)
South	0.9x	0.77	x	2.36	x	40.4	x	0.63	x	0.7	=	29.14	(78)
South	0.9x	0.77	x	0.63	x	40.4	x	0.63	x	0.7	=	7.78	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)

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South $0.9 \times 0.77 \times 1.8 \times 40.4 \times 0.63 \times 0.7 = 22.22$ (78)

Solar gains in watts, calculated for each month

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

(83)m=	108.79	184.51	253.9	322.83	373.32	376.91	360.68	321.3	277.11	203.97	130.07	93.3	(83)
--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	--------	------	------

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

(84)m=	530.42	606.57	664.96	712.99	742.92	725.02	692.88	658.49	622.9	570.54	522.56	504.8	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	------

7. Mean internal temperature (heating periods)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.94	0.86	0.7	0.54	0.59	0.81	0.95	0.99	0.99	(86)

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

(87)m=	19.75	19.9	20.14	20.44	20.7	20.86	20.91	20.91	20.8	20.47	20.06	19.73	(87)
--------	-------	------	-------	-------	------	-------	-------	-------	------	-------	-------	-------	------

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

(88)m=	19.97	19.98	19.98	19.99	20	20.01	20.01	20.01	20	20	19.99	19.98	(88)
--------	-------	-------	-------	-------	----	-------	-------	-------	----	----	-------	-------	------

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

(89)m=	0.99	0.98	0.97	0.92	0.82	0.62	0.43	0.47	0.74	0.93	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	18.51	18.71	19	19.39	19.7	19.88	19.91	19.91	19.82	19.44	18.92	18.49	(90)
--------	-------	-------	----	-------	------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	18.68	18.88	19.16	19.54	19.84	20.02	20.05	20.05	19.96	19.58	19.08	18.67	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.88	18.88	19.16	19.54	19.84	20.02	20.05	20.05	19.96	19.58	19.08	18.67	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.91	0.81	0.62	0.44	0.48	0.74	0.92	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	524.28	593.89	638.19	650.6	600.6	450.96	301.5	315.79	459.23	527.68	511.26	500.02	(95)
--------	--------	--------	--------	-------	-------	--------	-------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	1325.29	1283.33	1159.04	958.48	731.15	479.82	306.05	322.77	521.66	807.12	1083.01	1315.71	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(97a)m=	595.95	463.3	387.51	221.67	97.13	0	0	0	0	207.9	411.66	606.87	(97a)
---------	--------	-------	--------	--------	-------	---	---	---	---	-------	--------	--------	-------

Total per year (kWh/year) = Sum(97a)1...12 = 2992.01 (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	(97b)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

Total per year (kWh/year) = Sum(97b)1...12 = 0 (97b)

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

(98)m=	595.95	463.3	387.51	221.67	97.13	0	0	0	0	207.9	411.66	606.87	(98)
--------	--------	-------	--------	--------	-------	---	---	---	---	-------	--------	--------	------

DER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)_{1, 5, 9, 12} = 2992.01 (98)

Space heating requirement in kWh/m²/year

36.86 (99)

1a Energy requirement - 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

223.31 (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)

595.95	463.3	387.51	221.67	97.13	0	0	0	0	207.9	411.66	606.87	
--------	-------	--------	--------	-------	---	---	---	---	-------	--------	--------	--

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

(211)

266.87	207.47	173.53	99.27	43.5	0	0	0	0	93.1	184.34	271.76	
--------	--------	--------	-------	------	---	---	---	---	------	--------	--------	--

Total (kWh/year) = Sum(211)_{1, 5, 10, 12} = 1339.84 (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	
----------	---	---	---	---	---	---	---	---	---	---	---	--

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

Water heating

Output from water heater (calculated above)

228.88	204.69	217.8	195.17	192.91	172.95	164.54	178.93	176.5	198.24	211.92	227.67	
--------	--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--

Efficiency of water heater

281.48 (216)

(217)m =	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	
----------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--

(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m =	81.31	72.72	77.38	69.34	68.53	61.44	58.45	63.57	62.7	70.43	75.29	80.88
----------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------

Total = Sum(219a)_{1, 12} = 842.04 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1339.84

Water heating fuel used

842.04

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

0 (231)

Electricity for lighting

134.59 (232)

1b CO₂ emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating (main system 1)	(211) ×	0.136	182.22 (261)
Space heating (secondary)	(215) ×	0.136	0 (263)
Water heating	(219) ×	0.136	114.52 (264)
Space and water heating	(261) + (262) + (263) + (264) =		296.73 (265)

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Electricity for pumps, fans and electric keep-hot	{231} ×	0.136	≡	0	{267}
Electricity for lighting	{232} ×	0.136	≡	18.3	{268}
Total CO2, kg/year		sum of {265}... {271} =		315.04	{272}
Dwelling CO2 Emission Rate		{272} ÷ {4} =		3.88	{273}
EI rating (section 14)				97	{274}

DRAFT

TER WorkSheet: New dwelling design stage

Use Details

Assessor Name:

Software Name: Stroma FSAP 10 Beta

Stroma Number:

Software Version:

Version: 1.0.0.37

Property Address: 2B4P

Address : 2B4P

1. Overall dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	40.59 (1a)	x	2.6 (2a)	=	105.53 (3a)
First floor	40.59 (1b)	x	2.8 (2b)	=	113.65 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	81.18 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	219.19 (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) =	0.14 (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		0 (11)
<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>		
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0 (12)
If no draught lobby, enter 0.05, else enter 0		0 (13)
Percentage of windows and doors draught stripped		0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.39 (18)
<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) =	0.33 (21)

TER 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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

(24a)

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

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

(24b)

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

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

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

(24c)

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

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

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

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

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

(25)

3. Heat losses and modelled 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			2.17	×	1	=	2.17 (26)
Windows Type 1			2.36	×	1/[1/(1.2)+0.04]	=	2.7 (27)
Windows Type 2			0.63	×	1/[1/(1.2)+0.04]	=	0.72 (27)
Windows Type 3			0.96	×	1/[1/(1.2)+0.04]	=	1.1 (27)
Windows Type 4			3.18	×	1/[1/(1.2)+0.04]	=	3.64 (27)
Windows Type 5			1.2	×	1/[1/(1.2)+0.04]	=	1.37 (27)
Windows Type 6			1.8	×	1/[1/(1.2)+0.04]	=	2.06 (27)
Windows Type 7			1.8	×	1/[1/(1.2)+0.04]	=	2.06 (27)
Windows Type 8			1.2	×	1/[1/(1.2)+0.04]	=	1.37 (27)
Floor			40.59015	×	0.13	=	5.276719 (28)
Walls Type1	47.29	9.3	37.99	×	0.18	=	6.84 (29)
Walls Type2	50.93	6	44.93	×	0.18	=	8.09 (29)
Roof	40.59	0	40.59	×	0.11	=	4.32 (30)
							75
							3044.261
							60
							2279.48
							60
							2695.75
							9
							365.31

TER WorkSheet: New dwelling design stage

Total area of elements, m²	179.4							(31)
Party wall	42.46	×	0	=	0	45	1910.709	(32)
Internal wall **	102.3					39	3989.68	(32c)
Internal wall **	126.43					9	1137.881	(32c)
Internal floor	40.59					18	730.6227	(32d)
Internal ceiling	40.59					9	365.3113	(32e)

* 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) = 41.73 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 16519.01 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 203.49 (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 9.47 (36)

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

Total fabric heat loss (33) + (36) = 51.2 (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=	42.52	42.28	42.03	40.9	40.69	39.7	39.7	38.51	40.08	40.68	41.12	41.57	(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=	93.72	93.47	93.23	92.1	91.88	90.89	90.89	90.71	91.27	91.88	92.31	92.76	
Average = Sum(39) / 12 = 92.1													(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=	1.15	1.15	1.15	1.13	1.13	1.12	1.12	1.12	1.12	1.13	1.14	1.14	
Average = Sum(40) / 12 = 1.13													(40)

Number of days in month (Table 1a)

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

4. Whole building energy performance 1 ton/year

Assumed occupancy, N 2.48 (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	
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Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	42.19	40.65	39.12	37.58	36.05	34.52	34.52	36.05	37.58	39.12	40.65	42.19	
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Annual average hot water usage in litres per day Vd,average (from Appendix J) 115.8 (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=	42.96	41.42	39.88	38.33	36.78	35.23	35.22	36.76	38.31	39.86	41.43	42.99	
Total = Sum(44) / 12 = 469.18													(44)

TER WorkSheet: New dwelling design stage

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=	181.85	162.21	170.77	149.65	145.88	127.44	117.51	131.9	130.98	151.21	166.4	180.63	
Total = Sum(45) _{1..12} =													1816.43 (45)

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

(46)m=	27.28	24.33	25.62	22.45	21.88	19.12	17.63	19.79	19.65	22.68	24.96	27.09	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	150	(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):	1.7	(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) =	0.92	(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)	0.92	(55)
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Water storage loss calculated for each month (56)m = (55) x (41)m = (55) x (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS storage (57)m = (56)m x [(47) - V_s] + (47), else (57)m = (56)m

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

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(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) ÷ 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)
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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)
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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=	233.6	208.95	222.52	199.73	197.62	177.52	169.25	183.65	181.06	202.96	216.48	232.38	(62)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(63a)m=	-28.5	-25.08	-25.6	-21.07	-19.56	-16.14	-13.66	-16.54	-17.02	-21.04	-24.37	-27.55	(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=	205.09	183.87	196.92	178.66	178.06	161.38	155.59	167.1	164.04	181.91	192.11	204.83	
Output from water heater (annual) _{1..12}													2169.57 (64)

TER 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
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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=	101.86	91.32	98.18	89.82	89.9	82.44	80.47	85.25	83.61	91.67	95.39	101.46
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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=	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	124.24	(66)

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

(67)m=	11.06	9.83	7.99	6.05	4.52	3.82	4.13	5.36	7.2	9.14	10.67	11.37	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	221.89	224.19	218.39	206.04	190.44	175.79	166	163.7	169.5	181.85	197.44	212.1	(68)
--------	--------	--------	--------	--------	--------	--------	-----	-------	-------	--------	--------	-------	------

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

(69)m=	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	35.42	(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=	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	-99.39	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	136.91	135.9	131.96	124.75	120.84	114.49	108.16	114.59	116.13	123.22	132.49	136.37	(72)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(73)m=	433.14	433.19	421.62	400.11	379.08	357.37	341.55	346.92	356.1	377.43	403.87	423.11	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

6 Solar gains

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	0.96	x	10.63	x	0.63	x	0.7	=	3.12	(74)
North	0.9x	0.77	x	3.18	x	10.63	x	0.63	x	0.7	=	10.33	(74)
North	0.9x	0.77	x	1.8	x	10.63	x	0.63	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	1.2	x	10.63	x	0.63	x	0.7	=	3.9	(74)
North	0.9x	0.77	x	0.96	x	20.32	x	0.63	x	0.7	=	5.96	(74)
North	0.9x	0.77	x	3.18	x	20.32	x	0.63	x	0.7	=	19.75	(74)
North	0.9x	0.77	x	1.8	x	20.32	x	0.63	x	0.7	=	11.18	(74)
North	0.9x	0.77	x	1.2	x	20.32	x	0.63	x	0.7	=	7.45	(74)
North	0.9x	0.77	x	0.96	x	34.53	x	0.63	x	0.7	=	10.13	(74)
North	0.9x	0.77	x	3.18	x	34.53	x	0.63	x	0.7	=	33.56	(74)
North	0.9x	0.77	x	1.8	x	34.53	x	0.63	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.2	x	34.53	x	0.63	x	0.7	=	12.66	(74)
North	0.9x	0.77	x	0.96	x	55.46	x	0.63	x	0.7	=	16.27	(74)

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North	0.9x	0.77	x	3.18	x	55.46	x	0.63	x	0.7	=	53.9	(74)
North	0.9x	0.77	x	1.8	x	55.46	x	0.63	x	0.7	=	30.51	(74)
North	0.9x	0.77	x	1.2	x	55.46	x	0.63	x	0.7	=	20.34	(74)
North	0.9x	0.77	x	0.96	x	74.72	x	0.63	x	0.7	=	21.92	(74)
North	0.9x	0.77	x	3.18	x	74.72	x	0.63	x	0.7	=	72.61	(74)
North	0.9x	0.77	x	1.8	x	74.72	x	0.63	x	0.7	=	41.1	(74)
North	0.9x	0.77	x	1.2	x	74.72	x	0.63	x	0.7	=	27.4	(74)
North	0.9x	0.77	x	0.96	x	79.99	x	0.63	x	0.7	=	23.47	(74)
North	0.9x	0.77	x	3.18	x	79.99	x	0.63	x	0.7	=	77.73	(74)
North	0.9x	0.77	x	1.8	x	79.99	x	0.63	x	0.7	=	44	(74)
North	0.9x	0.77	x	1.2	x	79.99	x	0.63	x	0.7	=	29.33	(74)
North	0.9x	0.77	x	0.96	x	74.68	x	0.63	x	0.7	=	21.91	(74)
North	0.9x	0.77	x	3.18	x	74.68	x	0.63	x	0.7	=	72.57	(74)
North	0.9x	0.77	x	1.8	x	74.68	x	0.63	x	0.7	=	41.08	(74)
North	0.9x	0.77	x	1.2	x	74.68	x	0.63	x	0.7	=	27.39	(74)
North	0.9x	0.77	x	0.96	x	59.25	x	0.63	x	0.7	=	17.38	(74)
North	0.9x	0.77	x	3.18	x	59.25	x	0.63	x	0.7	=	57.58	(74)
North	0.9x	0.77	x	1.8	x	59.25	x	0.63	x	0.7	=	32.59	(74)
North	0.9x	0.77	x	1.2	x	59.25	x	0.63	x	0.7	=	21.73	(74)
North	0.9x	0.77	x	0.96	x	41.52	x	0.63	x	0.7	=	12.16	(74)
North	0.9x	0.77	x	3.18	x	41.52	x	0.63	x	0.7	=	49.35	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.63	x	0.7	=	22.84	(74)
North	0.9x	0.77	x	1.2	x	41.52	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	0.96	x	24.19	x	0.63	x	0.7	=	7.1	(74)
North	0.9x	0.77	x	3.18	x	24.19	x	0.63	x	0.7	=	23.51	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.63	x	0.7	=	13.31	(74)
North	0.9x	0.77	x	1.2	x	24.19	x	0.63	x	0.7	=	8.87	(74)
North	0.9x	0.77	x	0.96	x	13.12	x	0.63	x	0.7	=	3.85	(74)
North	0.9x	0.77	x	3.18	x	13.12	x	0.63	x	0.7	=	12.75	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.63	x	0.7	=	7.22	(74)
North	0.9x	0.77	x	1.2	x	13.12	x	0.63	x	0.7	=	4.81	(74)
North	0.9x	0.77	x	0.96	x	8.86	x	0.63	x	0.7	=	2.6	(74)
North	0.9x	0.77	x	3.18	x	8.86	x	0.63	x	0.7	=	8.61	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.63	x	0.7	=	4.88	(74)
North	0.9x	0.77	x	1.2	x	8.86	x	0.63	x	0.7	=	3.25	(74)
South	0.9x	0.77	x	2.36	x	46.75	x	0.63	x	0.7	=	33.72	(78)
South	0.9x	0.77	x	0.63	x	46.75	x	0.63	x	0.7	=	9	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	2.36	x	76.57	x	0.63	x	0.7	=	55.22	(78)
South	0.9x	0.77	x	0.63	x	76.57	x	0.63	x	0.7	=	14.74	(78)

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South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	2.36	x	97.53	x	0.63	x	0.7	=	70.35	(78)
South	0.9x	0.77	x	0.63	x	97.53	x	0.63	x	0.7	=	18.78	(78)
South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)
South	0.9x	0.77	x	2.36	x	110.23	x	0.63	x	0.7	=	79.51	(78)
South	0.9x	0.77	x	0.63	x	110.23	x	0.63	x	0.7	=	21.22	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	2.36	x	114.87	x	0.63	x	0.7	=	82.85	(78)
South	0.9x	0.77	x	0.63	x	114.87	x	0.63	x	0.7	=	22.12	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	2.36	x	110.55	x	0.63	x	0.7	=	79.73	(78)
South	0.9x	0.77	x	0.63	x	110.55	x	0.63	x	0.7	=	21.28	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	2.36	x	108.01	x	0.63	x	0.7	=	77.9	(78)
South	0.9x	0.77	x	0.63	x	108.01	x	0.63	x	0.7	=	20.8	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	2.36	x	104.89	x	0.63	x	0.7	=	75.65	(78)
South	0.9x	0.77	x	0.63	x	104.89	x	0.63	x	0.7	=	20.2	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	2.36	x	101.89	x	0.63	x	0.7	=	73.48	(78)
South	0.9x	0.77	x	0.63	x	101.89	x	0.63	x	0.7	=	19.62	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	2.36	x	82.59	x	0.63	x	0.7	=	59.56	(78)
South	0.9x	0.77	x	0.63	x	82.59	x	0.63	x	0.7	=	15.9	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	2.36	x	55.42	x	0.63	x	0.7	=	39.97	(78)
South	0.9x	0.77	x	0.63	x	55.42	x	0.63	x	0.7	=	10.67	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.49	(78)
South	0.9x	0.77	x	2.36	x	40.4	x	0.63	x	0.7	=	29.14	(78)
South	0.9x	0.77	x	0.63	x	40.4	x	0.63	x	0.7	=	7.78	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)

TER WorkSheet: New dwelling design stage

South $0.9 \times 0.77 \times 1.8 \times 40.4 \times 0.63 \times 0.7 = 22.22$ (78)

Solar gains in watts, calculated for each month

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

(83)m=	108.79	184.51	253.9	322.83	373.32	376.91	360.68	321.3	277.11	203.97	130.07	93.3	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m, watts

(84)m=	541.93	617.7	675.51	722.94	752.4	734.28	702.23	668.22	633.21	581.45	533.94	516.41	(84)
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7. Mean internal temperature (heating periods)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.94	0.86	0.71	0.55	0.59	0.81	0.95	0.99	0.99	(86)

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

(87)m=	19.41	19.61	19.92	20.32	20.68	20.9	20.98	20.97	20.82	20.37	19.83	19.38	(87)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

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

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

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

(89)m=	0.99	0.98	0.97	0.92	0.82	0.62	0.43	0.48	0.74	0.93	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.11	18.37	18.76	19.27	19.68	19.92	19.98	19.97	19.85	19.34	18.65	18.08	(90)
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fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	18.29	18.55	18.93	19.42	19.82	20.06	20.12	20.11	19.98	19.46	18.82	18.26	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.29	18.55	18.93	19.42	19.82	20.06	20.12	20.11	19.98	19.46	18.82	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
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.91	0.81	0.63	0.45	0.49	0.74	0.92	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	534.52	603	645.84	657.32	608.81	463.23	313.98	328.22	469.03	535.4	520.76	510.55	(95)
--------	--------	-----	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	1311.58	1275.54	1158.76	968.65	746.52	496.4	319.67	336.79	537	816.38	1081.48	1304.31	(97)
--------	---------	---------	---------	--------	--------	-------	--------	--------	-----	--------	---------	---------	------

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

(97a)m=	578.13	451.95	381.62	224.16	102.46	0	0	0	0	209.05	403.72	590.56	(97a)
---------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	-------

Total per year (kWh/year) = Sum(97a)_{1...12} = 2941.65 (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	(97b)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

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

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

(98)m=	578.13	451.95	381.62	224.16	102.46	0	0	0	0	209.05	403.72	590.56	(98)
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	------

TER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)_{1...12} = 2941.65 (98)

Space heating requirement in kWh/m²/year

36.24 (99)

9a Energy requirement - Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = 1 - (201) =

1 (202)

Fraction of total heating from main system 1

(204) = (202) × [1 - (203)] =

1 (204)

Efficiency of main space heating system 1

90.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

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

Space heating requirement (calculated above)

578.13	451.95	381.62	224.16	102.46	0	0	0	0	209.05	403.72	590.56	
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	--

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

(211)

638.82	499.39	421.68	247.69	113.21	0	0	0	0	231	446.1	652.56	
--------	--------	--------	--------	--------	---	---	---	---	-----	-------	--------	--

Total (kWh/year) = Sum(211)_{1...12} = 3250.44 (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	
----------	---	---	---	---	---	---	---	---	---	---	---	--

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

Water heating

Output from water heater (calculated above)

205.09	183.87	196.92	178.86	178.06	161.38	155.59	167.1	184.04	181.91	192.11	204.83	
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--

Efficiency of water heater

79.8 (216)

(217)m =	87.43	87.12	86.55	85.42	83.4	79.8	79.8	79.8	79.8	85.19	86.75	87.48
----------	-------	-------	-------	-------	------	------	------	------	------	-------	-------	-------

(217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m =	234.58	211.05	227.52	209.16	213.5	202.22	194.97	209.4	205.56	213.55	221.46	234.15
----------	--------	--------	--------	--------	-------	--------	--------	-------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} = 2577.12 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

3250.44

Water heating fuel used

2577.12

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

195.38 (232)

Electricity generated by PVs

-2058.37 (233)

9b CO₂ emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating (main system 1)	(211) ×	0.21	682.59 (261)

TER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) ×	0.136	≡	0	(263)
Water heating	(219) ×	0.21	≡	541.2	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1223.79	(265)
Electricity for pumps, fans and electric keep-hot	(231) ×	0.136	≡	10.2	(267)
Electricity for lighting	(232) ×	0.136	≡	26.57	(268)
Energy saving/generation technologies					
Item 1		0.136	≡	-279.94	(269)
Total CO2, kg/year		sum of (265)...(271) =		980.62	(272)
TER =				12.08	(273)

DRAFT

DER WorkSheet: New dwelling design stage

Use Details

Assessor Name:

Software Name: Stroma FSAP 10 Beta

Stroma Number:

Software Version:

Version: 1.0.0.37

Property Address: 3B4P

Address : 3B4P

1. Overall dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	44.66 (1a)	x	2.6 (2a)	=	116.1 (3a)
First floor	44.66 (1b)	x	2.8 (2b)	=	125.04 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	89.31 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	241.14 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 x 40 = 0 (6a)
Number of open flues	0	+	0	=	0 x 20 = 0 (6b)
-chimneys/flues attached to closed fire	0	+	0	=	0 x 10 = 0 (6c)
-flues attached to solid fuel boiler	0	+	0	=	0 x 20 = 0 (6d)
-flues attached to other heater	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) =	0.17 (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		0 (11)
<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>		
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	(6) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.42 (18)
<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) =	0.35 (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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

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

	0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	0.4	0.42
--	------	------	------	------	------	------	------	------	------	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

(24a)

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

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

(24b)

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

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

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

(24c)

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

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

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

(24d)

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

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

(25)

3. Heat losses and modellos 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			2.17	×	1	=	2.17 (26)
Windows Type 1			3.06	×	1/[1/(1.2)+0.04]	=	3.5 (27)
Windows Type 2			1.82	×	1/[1/(1.2)+0.04]	=	2.08 (27)
Windows Type 3			3.8	×	1/[1/(1.2)+0.04]	=	4.35 (27)
Windows Type 4			1.8	×	1/[1/(1.2)+0.04]	=	2.06 (27)
Windows Type 5			1.2	×	1/[1/(1.2)+0.04]	=	1.37 (27)
Windows Type 6			1.82	×	1/[1/(1.2)+0.04]	=	2.08 (27)
Windows Type 7			1.82	×	1/[1/(1.2)+0.04]	=	2.08 (27)
Floor			44.65562	×	0.13	=	5.805231 (28)
Walls Type1	49.34	10.85	38.49	×	0.14	=	5.39 (29)
Walls Type2	53.13	6.64	46.49	×	0.14	=	6.51 (29)
Roof	44.66	0	44.66	×	0.11	=	4.91 (30)
Total area of elements, m²			191.78				(31)

DER WorkSheet: New dwelling design stage

Party wall	46.71	×	0	=	0	45	2101.95	(32)
Internal wall **	102.3					39	3989.68	(32c)
Internal wall **	126.43					9	1137.881	(32c)
Internal floor	44.66					18	803.8013	(32d)
Internal ceiling	44.66					9	401.9006	(32e)

* 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) (28) ... (30) + (32) = 42.33 (33)

Heat capacity Cm = S(A x k) ((28) ... (30) + (32) + (32a) ... (32e) = 17285.11 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 193.54 (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 9.77 (36)

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

Total fabric heat loss (33) + (36) = 52.1 (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=	47.87	47.56	47.25	45.8	45.53	44.28	44.28	44.04	44.76	45.53	46.08	46.65	(38)

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

(39)m=	99.97	99.65	99.35	97.9	97.63	96.37	96.37	96.14	96.86	97.63	98.18	98.75	
Average = Sum(39) _{1...12} / 12=												97.9	(39)

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

(40)m=	1.12	1.12	1.11	1.1	1.09	1.08	1.08	1.08	1.08	1.09	1.1	1.11		
Average = Sum(40) _{1...12} / 12 =													1.1	(40)

Number of days in month (Table 1a)

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

F. Water heating energy requirement kWh/year

Assumed occupancy, N 2.62 (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	
(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

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	
(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 baths, Vd,bath (from Appendix J)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(42c)m=	43.6	42.02	40.43	38.85	37.26	35.67	35.67	37.26	38.85	40.43	42.02	43.6	

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

Annual average hot water usage in litres per day Vd,average (from Appendix J) 119.68 (43)

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

(44)m=	44.38	42.79	41.2	39.59	37.99	36.38	36.38	37.97	39.57	41.17	42.8	44.41		
Total = Sum(44) _{1..12} =													484.62	(44)

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

(45)m=	187.95	167.65	176.5	154.67	150.77	131.71	121.45	136.33	135.38	156.28	171.98	186.69		
Total = Sum(45) _{1...12} =													1877.38	(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=	28.19	25.15	26.48	23.2	22.62	19.76	18.22	20.45	20.31	23.44	25.8	28	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	210	(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):	1.42	(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) =	0.77	(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)
----------------------------------	---	------

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

Enter (50) or (54) in (55)	0.77	(55)
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Water storage loss calculated for each month (56)m = (55) x (41)m

(56)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) - V_s] + (47), else (57)m = (56)m

where V_s is V_{ww} from Appendix G3 or (112) from Appendix H (as applicable)

(57)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(57)
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Primary circuit loss (annual) from Table 3	0	(58)
--	---	------

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 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)
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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=	234.99	210.13	223.53	200.19	197.81	177.23	168.48	183.36	180.89	203.32	217.5	233.73	(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=	234.99	210.13	223.53	200.19	197.81	177.23	168.48	183.36	180.89	203.32	217.5	233.73	
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--

Output from water heater (annual) 1...12

2431.15	(64)
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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
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Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$ (64a)

(65)m=	100.12	89.73	96.31	87.84	87.76	80.21	78.01	82.96	81.43	89.59	93.6	99.7	(65)
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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 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	(66)

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

(67)m=	8.04	7.14	5.81	4.4	3.29	2.77	3	3.9	5.23	6.64	7.75	8.26	(67)
--------	------	------	------	-----	------	------	---	-----	------	------	------	------	------

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

(68)m=	237.8	240.27	234.05	220.82	204.1	188.4	177.91	175.44	181.66	194.9	211.61	227.31	(68)
--------	-------	--------	--------	--------	-------	-------	--------	--------	--------	-------	--------	--------	------

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

(69)m=	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	(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=	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	(71)
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

(72)m=	134.57	133.52	129.45	122	117.95	111.4	104.65	111.5	113.09	120.42	130	134.01	(72)
--------	--------	--------	--------	-----	--------	-------	--------	-------	--------	--------	-----	--------	------

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

(73)m=	442.66	443.18	431.56	409.46	387.59	364.82	348	353.08	362.22	384.2	411.6	431.83	(73)
--------	--------	--------	--------	--------	--------	--------	-----	--------	--------	-------	-------	--------	------

6. External gains (see Table 6a)

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	3.8	x	10.63	x	0.63	x	0.7	=	12.35	(74)
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	3.8	x	20.32	x	0.63	x	0.7	=	23.6	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	3.8	x	34.53	x	0.63	x	0.7	=	40.1	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	3.8	x	55.46	x	0.63	x	0.7	=	64.41	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.8	x	74.72	x	0.63	x	0.7	=	86.77	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	3.8	x	79.99	x	0.63	x	0.7	=	92.89	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	3.8	x	74.68	x	0.63	x	0.7	=	86.72	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	3.8	x	59.25	x	0.63	x	0.7	=	68.8	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.63	x	0.7	=	48.21	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.63	x	0.7	=	28.09	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.63	x	0.7	=	10.29	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
South	0.9x	0.77	x	3.06	x	46.75	x	0.63	x	0.7	=	43.72	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	3.06	x	76.57	x	0.63	x	0.7	=	71.6	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	3.06	x	97.53	x	0.63	x	0.7	=	91.21	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	3.06	x	110.23	x	0.63	x	0.7	=	103.09	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	3.06	x	114.87	x	0.63	x	0.7	=	107.42	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	3.06	x	110.55	x	0.63	x	0.7	=	103.38	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	3.06	x	108.01	x	0.63	x	0.7	=	101.01	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	3.06	x	104.89	x	0.63	x	0.7	=	98.09	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	3.06	x	101.89	x	0.63	x	0.7	=	95.28	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	3.06	x	82.59	x	0.63	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	3.06	x	55.42	x	0.63	x	0.7	=	51.82	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.45	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	3.06	x	40.4	x	0.63	x	0.7	=	37.78	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)

Solar gains in watts, calculated for each month

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

(83)m=	116.68	199.31	278.35	361.12	424.19	431.09	411.37	361.93	306.18	221.41	139.76	99.9	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------	------

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

(84)m=	559.34	642.49	709.91	770.58	811.78	795.91	759.37	715.01	668.41	605.6	551.35	531.73	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.94	0.85	0.7	0.54	0.59	0.81	0.95	0.99	0.99	(86)

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

(87)m=	19.7	19.86	20.1	20.42	20.69	20.86	20.91	20.9	20.79	20.44	20.02	19.68	(87)
--------	------	-------	------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

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

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

DER WorkSheet: New dwelling design stage

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

(89)m=	0.99	0.98	0.97	0.92	0.81	0.62	0.43	0.48	0.74	0.94	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	18.46	18.66	18.97	19.37	19.7	19.88	19.92	19.92	19.81	19.41	18.88	18.44	(90)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.15 (91)

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

(92)m=	18.64	18.83	19.13	19.52	19.84	20.02	20.06	20.06	19.96	19.56	19.04	18.62	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.64	18.83	19.13	19.52	19.84	20.02	20.06	20.06	19.96	19.56	19.04	18.62	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

9. Space heating calculation

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.91	0.8	0.62	0.43	0.48	0.74	0.93	0.98	0.99	(94)
--------	------	------	------	------	-----	------	------	------	------	------	------	------	------

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

(95)m=	552.74	628.81	680.61	700.72	650.92	489.96	328.34	343.42	494.33	560.53	539.4	526.59	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	1433.21	1388.5	1255.13	1040.18	794.72	522.57	333.77	351.92	567.16	875.01	1172.85	1423.75	(97)
--------	---------	--------	---------	---------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(97a)m=	655.06	510.51	427.44	244.4	106.98	0	0	0	0	233.98	455.94	667.49	(97a)
---------	--------	--------	--------	-------	--------	---	---	---	---	--------	--------	--------	-------

Total per year (kWh/year) = Sum(97a)1..12 = 3301.81 (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	(97b)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

Total per year (kWh/year) = Sum(97b)1..12 = 0 (97b)

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

(98)m=	655.06	510.51	427.44	244.4	106.98	0	0	0	0	233.98	455.94	667.49	(98)
--------	--------	--------	--------	-------	--------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98)1..12 = 3301.81 (98)

Space heating requirement in kWh/m²/year

36.97 (99)

10. Energy requirements by individual room/systems including main 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

243.64 (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)

655.06	510.51	427.44	244.4	106.98	0	0	0	0	233.98	455.94	667.49
--------	--------	--------	-------	--------	---	---	---	---	--------	--------	--------

DER WorkSheet: New dwelling design stage

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

(211)

268.86	209.53	175.44	100.31	43.91	0	0	0	0	96.03	187.13	273.96
--------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------

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

1355.18

(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
---------	---	---	---	---	---	---	---	---	---	---	---

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

0

(215)

Water heating

Output from water heater (calculated above)

234.99	210.13	223.53	200.19	197.81	177.23	168.48	183.36	180.89	203.32	217.5	233.73
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

Efficiency of water heater

281.48

(216)

(217)m=	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(217)

Fuel for water heating, kWh/month

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

(219)m=	83.48	74.65	79.41	71.12	70.27	62.96	59.85	65.14	64.26	72.23	77.27	83.03
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

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

863.69

(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

1355.18

Water heating fuel used

863.69

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year

$$\text{sum of } (230a) \dots (230g) =$$

0

(231)

Electricity for lighting

141.98

(232)

Energy
kWh/year

Emission factor
kg CO2/kWh

Emissions
kg CO2/year

Space heating (main system 1)

(211) ×

0.136

=

184.3

(261)

Space heating (secondary)

(215) ×

0.136

=

0

(263)

Water heating

(219) ×

0.136

=

117.46

(264)

Space and water heating

$$(261) + (262) + (263) + (264) =$$

301.77

(265)

Electricity for pumps, fans and electric keep-hot

(231) ×

0.136

=

0

(267)

Electricity for lighting

(232) ×

0.136

=

19.31

(268)

Total CO2, kg/year

$$\text{sum of } (265) \dots (271) =$$

321.08

(272)

Dwelling CO2 Emission Rate

$$(272) \div (4) =$$

3.6

(273)

EI rating (section 14)

97

(274)

TER WorkSheet: New dwelling design stage

Use Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 10 Beta

Software Version:

Version: 1.0.0.37

Property Address: 3B4P

Address : 3B4P

1. Overall dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	44.66 (1a)	x	2.6 (2a)	=	116.1 (3a)
First floor	44.66 (1b)	x	2.8 (2b)	=	125.04 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	89.31 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	241.14 (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) =	0.12 (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 (6) + (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) =	0.32 (21)

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Infiltration rate modified for monthly wind speed

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

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.41	0.4	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.36	0.37
--	------	-----	------	------	------	-----	-----	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

(24a)

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

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

(24b)

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

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

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

(24c)

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

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

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

(24d)

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

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

(25)

3. Heat losses and modellos parameter

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m2K	A X U (W/K)	k-value kJ/m ² ·K	A X k kJ/K
Doors			2.17	x 1	= 2.17		(26)
Windows Type 1			3.06	x1/[1/(1.2)+ 0.04]	≈ 3.5		(27)
Windows Type 2			1.82	x1/[1/(1.2)+ 0.04]	≈ 2.08		(27)
Windows Type 3			3.8	x1/[1/(1.2)+ 0.04]	≈ 4.35		(27)
Windows Type 4			1.8	x1/[1/(1.2)+ 0.04]	≈ 2.06		(27)
Windows Type 5			1.2	x1/[1/(1.2)+ 0.04]	≈ 1.37		(27)
Windows Type 6			1.82	x1/[1/(1.2)+ 0.04]	≈ 2.08		(27)
Windows Type 7			1.82	x1/[1/(1.2)+ 0.04]	≈ 2.08		(27)
Floor			44.65562	x 0.13	= 5.805231	75	3349.172 (28)
Walls Type1	49.34	10.85	38.49	x 0.18	≈ 6.93	60	2309.26 (29)
Walls Type2	53.13	6.64	46.49	x 0.18	≈ 8.37	60	2789.57 (29)
Roof	44.66	0	44.66	x 0.11	≈ 4.76	9	401.9 (30)
Total area of elements, m ²			191.78				(31)

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Party wall	46.71	×	0	=	0	45	2101.95	(32)
Internal wall **	102.3					39	3989.68	(32c)
Internal wall **	126.43					9	1137.881	(32c)
Internal floor	44.66					18	803.8013	(32d)
Internal ceiling	44.66					9	401.9006	(32e)

* 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) (28) ... (30) + (32) = 45.57 (33)

Heat capacity Cm = S(A x k) ((28) ... (30) + (32) + (32a) ... (32e) = 17285.11 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 193.54 (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 9.77 (36)

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

Total fabric heat loss (33) + (36) = 55.34 (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=	46.34	46.08	45.84	44.66	44.45	43.43	43.43	43.24	43.82	44.45	44.89	45.35	(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=	101.68	101.42	101.18	100	99.78	98.76	98.76	98.58	99.16	99.78	100.23	100.69	(39)
Average = Sum(39) _{1...12} / 12 = 100													(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=	1.14	1.14	1.13	1.12	1.12	1.11	1.11	1.1	1.11	1.12	1.12	1.13	(40)
Average = Sum(40) _{1...12} / 12 = 1.12													(40)

Number of days in month (Table 1a)

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

F Water Heating Energy Requirement kWh/year

Assumed occupancy, N 2.62 (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	
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Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	43.6	42.02	40.43	38.85	37.26	35.67	35.67	37.26	38.85	40.43	42.02	43.6	
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Annual average hot water usage in litres per day Vd,average (from Appendix J) 119.68 (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=	44.38	42.79	41.2	39.59	37.99	36.38	36.38	37.97	39.57	41.17	42.8	44.41	(44)
Total = Sum(44) _{1...12} = 484.62													(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=	187.95	167.65	176.5	154.67	150.77	131.71	121.45	136.33	135.38	156.28	171.98	186.69	(45)
Total = Sum(45) _{1...12} = 1877.38													(45)

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

(46)m=	28.19	25.15	26.48	23.2	22.62	19.76	18.22	20.45	20.31	23.44	25.8	28	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	150	(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):	1.7	(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) =	0.92	(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)	0.92	(55)
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Water storage loss calculated for each month (56)m = (55) x (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) - V_s] + (47), else (57)m = (56)m

where V_s is V_{ww} from Appendix G3 or (112) from Appendix H (as applicable)

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(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) ÷ 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)
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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)
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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=	239.7	214.39	228.25	204.75	202.52	181.79	173.2	188.07	185.45	208.03	222.06	238.44	(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=	-29.79	-26.21	-26.75	-22.01	-20.44	-16.86	-14.27	-17.28	-17.78	-21.98	-25.46	-28.79	(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=	209.91	188.18	201.5	182.74	182.08	164.93	158.92	170.79	167.67	186.05	196.6	209.65	
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Output from water heater (annual) 1...12 2219.03 (64)

if (64)m < 0 then set to 0

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Energy	0	0	0	0	0	0	0	0	0	0	0	0
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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=	103.89	93.13	100.08	91.49	91.53	83.86	81.78	86.73	85.07	93.36	97.25	103.47
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(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 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81	130.81

(66)

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

(67)m=	11.73	10.42	8.47	6.41	4.79	4.05	4.37	5.68	7.63	9.69	11.31	12.05
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(67)

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

(68)m=	237.8	240.27	234.05	220.82	204.1	188.4	177.91	175.44	181.66	194.9	211.61	227.31
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(68)

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

(69)m=	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08	36.08
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(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65	-104.65
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(71)

Water heating gains (Table 5)

(72)m=	139.64	138.59	134.52	127.07	123.02	118.47	109.92	116.57	118.16	125.49	135.06	139.08
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(72)

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

(73)m=	454.41	454.52	442.29	419.54	397.18	374.16	357.44	362.93	372.69	395.31	423.22	443.68
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(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)	
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	3.8	x	10.63	x	0.63	x	0.7	=	12.35	(74)
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	3.8	x	20.32	x	0.63	x	0.7	=	23.6	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	3.8	x	34.53	x	0.63	x	0.7	=	40.1	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	3.8	x	55.46	x	0.63	x	0.7	=	64.41	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)

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North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.8	x	74.72	x	0.63	x	0.7	=	86.77	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	3.8	x	79.99	x	0.63	x	0.7	=	92.89	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	3.8	x	74.68	x	0.63	x	0.7	=	86.72	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	3.8	x	59.25	x	0.63	x	0.7	=	68.8	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.63	x	0.7	=	48.21	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.63	x	0.7	=	28.09	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.63	x	0.7	=	10.29	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
South	0.9x	0.77	x	3.06	x	46.75	x	0.63	x	0.7	=	43.72	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	3.06	x	76.57	x	0.63	x	0.7	=	71.6	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	3.06	x	97.53	x	0.63	x	0.7	=	91.21	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)

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South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	3.06	x	110.23	x	0.63	x	0.7	=	103.09	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	3.06	x	114.87	x	0.63	x	0.7	=	107.42	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	3.06	x	110.55	x	0.63	x	0.7	=	103.38	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	3.06	x	108.01	x	0.63	x	0.7	=	101.01	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	3.06	x	104.89	x	0.63	x	0.7	=	98.09	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	3.06	x	101.89	x	0.63	x	0.7	=	95.28	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	3.06	x	82.59	x	0.63	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	3.06	x	55.42	x	0.63	x	0.7	=	51.82	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.45	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	3.06	x	40.4	x	0.63	x	0.7	=	37.78	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)

Solar gains in watts, calculated for each month

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

(83)m=	116.68	199.31	278.35	361.12	424.19	431.09	411.37	361.93	306.18	221.41	139.76	99.9	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------	------

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

(84)m=	571.09	653.84	720.64	780.66	821.35	805.25	768.81	724.86	678.87	616.72	562.98	543.59	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.94	0.85	0.7	0.54	0.59	0.81	0.95	0.99	0.99	(86)

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

(87)m=	19.34	19.55	19.88	20.3	20.67	20.9	20.97	20.96	20.8	20.34	19.77	19.31	(87)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	-------	-------	------

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

(88)m=	19.97	19.97	19.97	19.98	19.99	20	20	20	19.99	19.99	19.98	19.98	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.92	0.81	0.62	0.43	0.48	0.74	0.93	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	18.04	18.31	18.72	19.25	19.68	19.93	19.99	19.98	19.84	19.31	18.59	18	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	------

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

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

(92)m=	18.23	18.49	18.89	19.4	19.83	20.07	20.13	20.12	19.98	19.46	18.76	18.19	(92)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.23	18.49	18.89	19.4	19.83	20.07	20.13	20.12	19.98	19.46	18.76	18.19	(93)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

9. Space heating calculation

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.95	0.91	0.8	0.62	0.44	0.49	0.74	0.92	0.98	0.99	(94)
--------	------	------	------	------	-----	------	------	------	------	------	------	------	------

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

(95)m=	563.14	638	688.2	707.31	659.33	502.95	341.8	356.71	504.34	568.25	549.03	537.3	(95)
--------	--------	-----	-------	--------	--------	--------	-------	--------	--------	--------	--------	-------	------

Monthly average external temperature from Table 8

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

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

(97)m=	1416.21	1378.05	1253.22	1050	810.83	540.29	348.58	367.08	583.27	883.83	1188.83	1408.85	(97)
--------	---------	---------	---------	------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(97a)m=	634.68	497.31	420.38	246.74	112.72	0	0	0	0	234.64	446.26	648.43	(97a)
---------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	-------

Total per year (kWh/year) = Sum(97a) _{1..12} =	3241.16	(97a)
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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	(97b)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

Total per year (kWh/year) = Sum(97b) _{1..12} =	0	(97b)
---	---	-------

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

(98)m=	634.68	497.31	420.38	246.74	112.72	0	0	0	0	234.64	446.26	648.43	(98)
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98) _{1..12} =	3241.16	(98)
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Space heating requirement in kWh/m²/year

36.29	(99)
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9a. Energy requirements by individual heating systems including solar (HP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

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

1	(202)
---	-------

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

1	(204)
---	-------

Efficiency of main space heating system 1

90.5	(206)
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Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

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

Space heating requirement (calculated above)

634.68	497.31	420.38	246.74	112.72	0	0	0	0	234.64	446.26	648.43
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

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

(211)

701.31	549.52	464.51	272.64	124.55	0	0	0	0	259.27	493.1	716.5
--------	--------	--------	--------	--------	---	---	---	---	--------	-------	-------

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

3581.39 (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
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$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..12} =$$

0 (215)

Water heating

Output from water heater (calculated above)

209.91	188.18	201.5	182.74	182.08	164.93	158.92	170.79	167.67	186.05	196.6	209.65
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Efficiency of water heater

79.8 (216)

(217)m=	87.58	87.29	86.73	85.62	83.58	79.8	79.8	79.8	79.8	85.43	86.94	87.63
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(217)

Fuel for water heating, kWh/month

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

(219)m=	239.68	215.59	232.32	213.44	217.86	206.68	199.15	214.03	210.11	217.77	226.15	239.25
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

2632.02 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

3581.39

Water heating fuel used

2632.02

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

$$\text{sum of (230a)...(230g)} =$$

75 (231)

Electricity for lighting

207.11 (232)

Electricity generated by PVs

-2264.21 (233)

2.6 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) ×	0.21	752.09 (261)
Space heating (secondary)	(215) ×	0.136	0 (263)
Water heating	(219) ×	0.21	552.72 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1304.82 (265)
Electricity for pumps, fans and electric keep-hot	(231) ×	0.136	10.2 (267)
Electricity for lighting	(232) ×	0.136	28.17 (268)
Energy saving/generation technologies Item 1		0.136	-307.93 (269)
Total CO2, kg/year		sum of (265)...(271) =	1035.25 (272)
TER =			11.59 (273)

DRAFT

DER WorkSheet: New dwelling design stage

Use Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 10 Beta

Software Version:

Version: 1.0.0.37

Property Address: 3B5P

Address : 3B5P

1. Overall dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	49.43 (1a) ×	2.6 (2a) =	128.52 (3a)
First floor	49.43 (1b) ×	2.8 (2b) =	138.41 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	98.86 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	266.93 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 × 40 =	0 (6a)
Number of open flues	0	0	0	0 × 20 =	0 (6b)
-chimneys/flues attached to closed fire	0	0	0	0 × 10 =	0 (6c)
-flues attached to solid fuel boiler	0	0	0	0 × 20 =	0 (6d)
-flues attached to other heater	0	0	0	0 × 35 =	0 (6e)
Number of blocked chimneys				0 × 20 =	0 (6f)
Number of intermittent fans				4 × 10 =	40 (7a)
Number of passive vents				0 × 10 =	0 (7b)
Number of flueless gas fires				0 × 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) =	0.15 (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]×0.1 =	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 × (14) ÷ 100] =	0 (15)
Infiltration rate (6) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]÷(8), otherwise (18) = (16)	0.4 (18)
<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 × (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor (21) = (18) × (20) =	0.34 (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
---------	------	------	------	-----	------	------	------	------	---	------	------	------

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

	0.43	0.42	0.42	0.37	0.37	0.32	0.32	0.31	0.34	0.37	0.38	0.4
--	------	------	------	------	------	------	------	------	------	------	------	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)
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3. Heat losses and model 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			2.17	×	1	=	2.17 (26)
Windows Type 1			3.06	×	1/[1/(1.2)+0.04]	=	3.5 (27)
Windows Type 2			1.82	×	1/[1/(1.2)+0.04]	=	2.08 (27)
Windows Type 3			3.8	×	1/[1/(1.2)+0.04]	=	4.35 (27)
Windows Type 4			1.8	×	1/[1/(1.2)+0.04]	=	2.06 (27)
Windows Type 5			1.2	×	1/[1/(1.2)+0.04]	=	1.37 (27)
Windows Type 6			1.82	×	1/[1/(1.2)+0.04]	=	2.08 (27)
Windows Type 7			1.8	×	1/[1/(1.2)+0.04]	=	2.06 (27)
Floor			49.43125	×	0.13	=	6.426063 (28)
Walls Type1	51.97	10.85	41.12	×	0.14	=	5.76 (29)
Walls Type2	55.97	6.62	49.35	×	0.14	=	6.91 (29)
Roof	49.43	0	49.43	×	0.11	=	5.44 (30)
Total area of elements, m²			206.8				(31)

DER WorkSheet: New dwelling design stage

Party wall	48.54	×	0	=	0	45	2184.084	(32)
Internal wall **	102.3					39	3989.68	(32c)
Internal wall **	126.43					9	1137.881	(32c)
Internal floor	49.43					18	889.7625	(32d)
Internal ceiling	49.43					9	444.8813	(32e)

* 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) (28) ... (30) + (32) = 44.22 (33)

Heat capacity Cm = S(A x k) ((28) ... (30) + (32) + (32a) ... (32e) = 18226.43 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 184.36 (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 10.11 (36)

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

Total fabric heat loss (33) + (36) = 54.32 (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=	52.31	51.99	51.68	50.2	49.92	48.63	48.63	48.4	49.13	49.92	50.48	51.07	(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=	106.64	106.32	106	104.52	104.25	102.96	102.96	102.72	103.45	104.25	104.81	105.39	(39)
Average = Sum(39) _{1...12} / 12 = 104.52													(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=	1.08	1.08	1.07	1.06	1.05	1.04	1.04	1.04	1.05	1.05	1.06	1.07	(40)
Average = Sum(40) _{1...12} / 12 = 1.06													(40)

Number of days in month (Table 1a)

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

F Water Heating Energy Requirement kWh/year

Assumed occupancy, N 2.73 (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	
(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(42a)

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	
(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	(42b)

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	
(42c)m=	44.82	43.19	41.56	39.93	38.3	36.67	36.67	38.3	39.93	41.56	43.19	44.82	(42c)

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	
(42d)m=	44.82	43.19	41.56	39.93	38.3	36.67	36.67	38.3	39.93	41.56	43.19	44.82	(42d)

Annual average hot water usage in litres per day Vd,average (from Appendix J) 123.01 (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=	45.59	43.96	42.32	40.67	39.02	37.38	37.37	39.01	40.65	42.3	43.96	45.62	(44)
Total = Sum(44) _{1...12} = 497.86													(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=	193.18	172.31	181.41	158.98	154.97	135.38	124.83	140.12	139.14	160.63	176.77	191.89	(45)
Total = Sum(45) _{1...12} = 1929.62													(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=	28.98	25.85	27.21	23.85	23.25	20.31	18.72	21.02	20.87	24.09	26.52	28.78	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	210	(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):	1.42	(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) =	0.77	(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)	0.77	(55)
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Water storage loss calculated for each month (56)m = (55) x (41)m

(56)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) - V_s] + (47), else (57)m = (56)m

where V_s is V_{ww} from Appendix G3 or (112) from Appendix H (as applicable)

(57)m=	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77	(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) ÷ 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)
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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)
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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=	240.22	214.8	228.45	204.5	202	180.9	171.86	187.15	184.66	207.66	222.29	238.92	(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=	240.22	214.8	228.45	204.5	202	180.9	171.86	187.15	184.66	207.66	222.29	238.92	
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Output from water heater (annual) 1...12 2483.4 (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
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Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$ (64a)

(65)m=	101.86	91.28	97.95	89.27	89.15	81.43	79.13	84.22	82.68	91.04	95.19	101.43	(65)
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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 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	(66)

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

(67)m=	8.77	7.79	6.34	4.8	3.59	3.03	3.27	4.25	5.71	7.25	8.46	9.02	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	254.48	257.12	250.46	236.3	218.41	201.61	190.38	187.74	194.39	208.56	226.44	243.25	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	(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=	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	(71)
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Water heating gains (Table 5)

(72)m=	136.91	135.83	131.65	123.99	119.83	113.09	106.38	113.19	114.83	122.36	132.21	136.33	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	464.09	464.67	452.38	429.01	405.76	381.66	363.94	369.11	378.86	402.1	431.04	452.52	(73)
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6. External gains (see Table 6a)

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	3.8	x	10.63	x	0.63	x	0.7	=	12.35	(74)
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	1.8	x	10.63	x	0.63	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	3.8	x	20.32	x	0.63	x	0.7	=	23.6	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	1.8	x	20.32	x	0.63	x	0.7	=	11.18	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	3.8	x	34.53	x	0.63	x	0.7	=	40.1	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	1.8	x	34.53	x	0.63	x	0.7	=	19	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	3.8	x	55.46	x	0.63	x	0.7	=	64.41	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.8	x	55.46	x	0.63	x	0.7	=	30.51	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.8	x	74.72	x	0.63	x	0.7	=	86.77	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	1.8	x	74.72	x	0.63	x	0.7	=	41.1	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	3.8	x	79.99	x	0.63	x	0.7	=	92.89	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	1.8	x	79.99	x	0.63	x	0.7	=	44	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	3.8	x	74.68	x	0.63	x	0.7	=	86.72	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	1.8	x	74.68	x	0.63	x	0.7	=	41.08	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	3.8	x	59.25	x	0.63	x	0.7	=	68.8	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	1.8	x	59.25	x	0.63	x	0.7	=	32.59	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.63	x	0.7	=	48.21	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.63	x	0.7	=	22.84	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.63	x	0.7	=	28.09	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.63	x	0.7	=	13.31	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.63	x	0.7	=	7.22	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.63	x	0.7	=	10.29	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.63	x	0.7	=	4.88	(74)
South	0.9x	0.77	x	3.06	x	46.75	x	0.63	x	0.7	=	43.72	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	3.06	x	76.57	x	0.63	x	0.7	=	71.6	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	3.06	x	97.53	x	0.63	x	0.7	=	91.21	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	3.06	x	110.23	x	0.63	x	0.7	=	103.09	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	3.06	x	114.87	x	0.63	x	0.7	=	107.42	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	3.06	x	110.55	x	0.63	x	0.7	=	103.38	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	3.06	x	108.01	x	0.63	x	0.7	=	101.01	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	3.06	x	104.89	x	0.63	x	0.7	=	98.09	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	3.06	x	101.89	x	0.63	x	0.7	=	95.28	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	3.06	x	82.59	x	0.63	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	3.06	x	55.42	x	0.63	x	0.7	=	51.82	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.45	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	3.06	x	40.4	x	0.63	x	0.7	=	37.78	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)

Solar gains in watts, calculated for each month

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

(83)m=	116.61	199.19	278.14	360.78	423.73	430.6	410.92	361.57	305.93	221.26	139.68	99.85	(83)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	580.7	663.86	730.52	789.79	829.49	812.26	774.86	730.68	684.79	623.35	570.71	552.37	(84)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.94	0.87	0.72	0.56	0.61	0.83	0.96	0.99	0.99	(86)

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

(87)m=	19.67	19.82	20.07	20.38	20.66	20.85	20.91	20.9	20.77	20.42	19.99	19.65	(87)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(88)m=	20.02	20.02	20.02	20.04	20.04	20.05	20.05	20.05	20.04	20.04	20.03	20.03	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.99	0.97	0.93	0.83	0.64	0.45	0.5	0.76	0.94	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	-----	------	------	------	------	------

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

(90)m=	18.45	18.65	18.96	19.36	19.7	19.9	19.95	19.94	19.83	19.41	18.87	18.43	(90)
--------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.15 (91)

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

(92)m=	18.63	18.82	19.12	19.51	19.84	20.04	20.09	20.08	19.97	19.56	19.04	18.61	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.63	18.82	19.12	19.51	19.84	20.04	20.09	20.08	19.97	19.56	19.04	18.61	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

9. Space heating calculation

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.92	0.82	0.64	0.45	0.5	0.76	0.93	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	-----	------	------	------	------	------

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

(95)m=	574.26	650.77	702.94	724.69	678.66	518.79	351.78	367.18	519.18	580.85	559.21	547.34	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	1528.03	1480.01	1337.67	1109.2	848.58	560.01	359.08	378.39	806.91	933.81	1251.04	1518.67	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(97a)m=	709.61	557.25	472.24	276.85	126.42	0	0	0	0	262.6	498.12	722.67	(97a)
---------	--------	--------	--------	--------	--------	---	---	---	---	-------	--------	--------	-------

Total per year (kWh/year) = Sum(97a)1..12 = 3625.75 (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	(97b)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

Total per year (kWh/year) = Sum(97b)1..12 = 0 (97b)

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

(98)m=	709.61	557.25	472.24	276.85	126.42	0	0	0	0	262.6	498.12	722.67	(98)
--------	--------	--------	--------	--------	--------	---	---	---	---	-------	--------	--------	------

Total per year (kWh/year) = Sum(98)1..12 = 3625.75 (98)

Space heating requirement in kWh/m²/year

36.67 (99)

10. Energy requirements by individual room/systems including non-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

261.04 (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)

709.61	557.25	472.24	276.85	126.42	0	0	0	0	262.6	498.12	722.67
--------	--------	--------	--------	--------	---	---	---	---	-------	--------	--------

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

(211)

271.84	213.47	180.91	106.06	48.43	0	0	0	0	100.6	190.82	276.84
--------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------

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

1388.97

(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
---------	---	---	---	---	---	---	---	---	---	---	---

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

0

(215)

Water heating

Output from water heater (calculated above)

240.22	214.8	228.45	204.5	202	180.9	171.86	187.15	184.66	207.66	222.29	238.92
--------	-------	--------	-------	-----	-------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

281.48

(216)

(217)m=	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48	281.48
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(217)

Fuel for water heating, kWh/month

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

(219)m=	85.34	76.31	81.16	72.65	71.76	64.26	61.06	66.49	65.6	73.77	78.97	84.88
---------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------

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

882.25

(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

1388.97

Water heating fuel used

882.25

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year

$$\text{sum of } (230a) \dots (230g) =$$

0

(231)

Electricity for lighting

154.9

(232)

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) ×	0.136	188.9
Space heating (secondary)	(215) ×	0.136	0
Water heating	(219) ×	0.136	119.99
Space and water heating	(261) + (262) + (263) + (264) =		308.89
Electricity for pumps, fans and electric keep-hot	(231) ×	0.136	0
Electricity for lighting	(232) ×	0.136	21.07
Total CO2, kg/year		sum of (265) ... (271) =	329.95
Dwelling CO2 Emission Rate		(272) ÷ (4) =	3.34
EI rating (section 14)			97

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Use Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 10 Beta

Software Version:

Version: 1.0.0.37

Property Address: 3B5P

Address : 3B5P

1. Overall dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	49.43 (1a)	x	2.6 (2a)	=	128.52 (3a)
First floor	49.43 (1b)	x	2.8 (2b)	=	138.41 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	98.86 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	266.93 (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) =	0.11 (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		0 (11)
<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>		
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0 (12)
If no draught lobby, enter 0.05, else enter 0		0 (13)
Percentage of windows and doors draught stripped		0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.36 (18)
<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)

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Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.39	0.39	0.38	0.34	0.33	0.29	0.29	0.28	0.31	0.33	0.35	0.36
--	------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

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

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

(24a)

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

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

(24b)

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

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

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

(24c)

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

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

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

(24d)

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

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

(25)

3. Heat losses and modelled 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			2.17	×	1	=	2.17 (26)
Windows Type 1			3.06	×	1/[1/(1.2)+0.04]	=	3.5 (27)
Windows Type 2			1.82	×	1/[1/(1.2)+0.04]	=	2.08 (27)
Windows Type 3			3.8	×	1/[1/(1.2)+0.04]	=	4.35 (27)
Windows Type 4			1.8	×	1/[1/(1.2)+0.04]	=	2.06 (27)
Windows Type 5			1.2	×	1/[1/(1.2)+0.04]	=	1.37 (27)
Windows Type 6			1.82	×	1/[1/(1.2)+0.04]	=	2.08 (27)
Windows Type 7			1.8	×	1/[1/(1.2)+0.04]	=	2.06 (27)
Floor			49.43125	×	0.13	=	6.426063 (28)
Walls Type1	51.97	10.85	41.12	×	0.18	=	7.4 (29)
Walls Type2	55.97	6.62	49.35	×	0.18	=	8.88 (29)
Roof	49.43	0	49.43	×	0.11	=	5.26 (30)
Total area of elements, m²			206.8				(31)

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Party wall	48.54	×	0	=	0	45	2184.084	(32)
Internal wall **	102.3					39	3989.68	(32c)
Internal wall **	126.43					9	1137.881	(32c)
Internal floor	49.43					18	889.7625	(32d)
Internal ceiling	49.43					9	444.8813	(32e)

* 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) (28) ... (30) + (32) = 47.66 (33)

Heat capacity Cm = S(A x k) ((28) ... (30) + (32) + (32a) ... (32e) = 18226.43 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 184.36 (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 10.11 (36)

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

Total fabric heat loss (33) + (36) = 57.77 (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=	50.84	50.57	50.31	49.1	48.87	47.81	47.81	47.62	48.22	48.87	49.33	49.81	(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=	108.61	108.34	108.08	106.87	106.64	105.58	105.58	105.39	105.99	106.64	107.1	107.58	
Average = Sum(39) _{1...12} / 12 =													106.87 (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=	1.1	1.1	1.09	1.08	1.08	1.07	1.07	1.07	1.07	1.08	1.08	1.09	
Average = Sum(40) _{1...12} / 12 =													1.08 (40)

Number of days in month (Table 1a)

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

F Water Heating Energy Requirement kWh/year

Assumed occupancy, N 2.73 (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=	44.82	43.19	41.56	39.93	38.3	36.67	36.67	38.3	39.93	41.56	43.19	44.82	
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Annual average hot water usage in litres per day Vd,average (from Appendix J) 123.01 (43)

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

(44)m=	45.59	43.96	42.32	40.67	39.02	37.38	37.37	39.01	40.65	42.3	43.96	45.62	
Total = Sum(44) _{1...12} =													497.86 (44)

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

(45)m=	193.18	172.31	181.41	158.98	154.97	135.38	124.83	140.12	139.14	160.63	176.77	191.89	
Total = Sum(45) _{1...12} =													1929.62 (45)

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

(46)m=	28.98	25.85	27.21	23.85	23.25	20.31	18.72	21.02	20.87	24.09	26.52	28.78	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	150	(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):	1.7	(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) =	0.92	(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)	0.92	(55)
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Water storage loss calculated for each month (56)m = (55) x (41)m

(56)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(56)
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If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) - V_s] + (47), else (57)m = (56)m

where V_s is V_{ww} from Appendix G3 or (112) from Appendix H (as applicable)

(57)m=	28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48	(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Primary circuit loss (annual) from Table 3	0	(58)
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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)
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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=	244.93	219.05	233.16	209.06	206.72	185.46	176.58	191.87	189.22	212.38	226.85	243.64	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(63a)m=	-30.89	-27.18	-27.74	-22.82	-21.19	-17.48	-14.79	-17.91	-18.43	-22.79	-26.4	-29.85	(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=	214.04	191.88	205.42	186.24	185.53	167.98	161.78	173.96	170.79	189.59	200.45	213.78	
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Output from water heater (annual) 1...12 2261.43 (64)

if (64)m < 0 then set to 0

TER 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 $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$ (64a)

(65)m=	105.63	94.69	101.72	92.92	92.92	85.08	82.9	87.99	86.33	94.81	98.84	105.2
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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 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44	136.44

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

(67)m=	12.8	11.37	9.25	7	5.23	4.42	4.77	6.2	8.33	10.57	12.34	13.16
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	254.48	257.12	250.46	236.3	218.41	201.61	190.38	187.74	194.39	208.56	226.44	243.25
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Pumps and fans gains (Table 5a)

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

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

(71)m=	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15	-109.15
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

Water heating gains (Table 5)

(72)m=	141.98	140.9	136.72	129.06	124.9	118.16	111.43	118.28	119.9	127.43	137.28	141.4
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	476.18	476.32	463.36	439.29	415.47	391.12	373.51	379.74	389.55	413.49	442.99	464.73
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6. Solar gains (see Table 6a)

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 1.82	x 10.63	x 0.63	x 0.7	= 5.91 (74)
North	0.9x 0.77	x 3.8	x 10.63	x 0.63	x 0.7	= 12.35 (74)
North	0.9x 0.77	x 1.82	x 10.63	x 0.63	x 0.7	= 5.91 (74)
North	0.9x 0.77	x 1.8	x 10.63	x 0.63	x 0.7	= 5.85 (74)
North	0.9x 0.77	x 1.82	x 20.32	x 0.63	x 0.7	= 11.3 (74)
North	0.9x 0.77	x 3.8	x 20.32	x 0.63	x 0.7	= 23.6 (74)
North	0.9x 0.77	x 1.82	x 20.32	x 0.63	x 0.7	= 11.3 (74)
North	0.9x 0.77	x 1.8	x 20.32	x 0.63	x 0.7	= 11.18 (74)
North	0.9x 0.77	x 1.82	x 34.53	x 0.63	x 0.7	= 19.21 (74)
North	0.9x 0.77	x 3.8	x 34.53	x 0.63	x 0.7	= 40.1 (74)
North	0.9x 0.77	x 1.82	x 34.53	x 0.63	x 0.7	= 19.21 (74)
North	0.9x 0.77	x 1.8	x 34.53	x 0.63	x 0.7	= 19 (74)
North	0.9x 0.77	x 1.82	x 55.46	x 0.63	x 0.7	= 30.85 (74)
North	0.9x 0.77	x 3.8	x 55.46	x 0.63	x 0.7	= 64.41 (74)
North	0.9x 0.77	x 1.82	x 55.46	x 0.63	x 0.7	= 30.85 (74)

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North	0.9x	0.77	x	1.8	x	55.46	x	0.63	x	0.7	=	30.51	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.8	x	74.72	x	0.63	x	0.7	=	86.77	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	1.8	x	74.72	x	0.63	x	0.7	=	41.1	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	3.8	x	79.99	x	0.63	x	0.7	=	92.89	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	1.8	x	79.99	x	0.63	x	0.7	=	44	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	3.8	x	74.68	x	0.63	x	0.7	=	86.72	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	1.8	x	74.68	x	0.63	x	0.7	=	41.08	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	3.8	x	59.25	x	0.63	x	0.7	=	68.8	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	1.8	x	59.25	x	0.63	x	0.7	=	32.59	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.8	x	41.52	x	0.63	x	0.7	=	48.21	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.63	x	0.7	=	22.84	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.8	x	24.19	x	0.63	x	0.7	=	28.09	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.63	x	0.7	=	13.31	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.8	x	13.12	x	0.63	x	0.7	=	15.23	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.63	x	0.7	=	7.22	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	3.8	x	8.86	x	0.63	x	0.7	=	10.29	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.63	x	0.7	=	4.88	(74)
South	0.9x	0.77	x	3.06	x	46.75	x	0.63	x	0.7	=	43.72	(78)
South	0.9x	0.77	x	1.8	x	46.75	x	0.63	x	0.7	=	25.72	(78)
South	0.9x	0.77	x	1.2	x	46.75	x	0.63	x	0.7	=	17.15	(78)
South	0.9x	0.77	x	3.06	x	76.57	x	0.63	x	0.7	=	71.6	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.63	x	0.7	=	42.12	(78)
South	0.9x	0.77	x	1.2	x	76.57	x	0.63	x	0.7	=	28.08	(78)
South	0.9x	0.77	x	3.06	x	97.53	x	0.63	x	0.7	=	91.21	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.63	x	0.7	=	53.65	(78)

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South	0.9x	0.77	x	1.2	x	97.53	x	0.63	x	0.7	=	35.77	(78)
South	0.9x	0.77	x	3.06	x	110.23	x	0.63	x	0.7	=	103.09	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.63	x	0.7	=	60.64	(78)
South	0.9x	0.77	x	1.2	x	110.23	x	0.63	x	0.7	=	40.43	(78)
South	0.9x	0.77	x	3.06	x	114.87	x	0.63	x	0.7	=	107.42	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.63	x	0.7	=	63.19	(78)
South	0.9x	0.77	x	1.2	x	114.87	x	0.63	x	0.7	=	42.13	(78)
South	0.9x	0.77	x	3.06	x	110.55	x	0.63	x	0.7	=	103.38	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.63	x	0.7	=	60.81	(78)
South	0.9x	0.77	x	1.2	x	110.55	x	0.63	x	0.7	=	40.54	(78)
South	0.9x	0.77	x	3.06	x	108.01	x	0.63	x	0.7	=	101.01	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.63	x	0.7	=	59.42	(78)
South	0.9x	0.77	x	1.2	x	108.01	x	0.63	x	0.7	=	39.61	(78)
South	0.9x	0.77	x	3.06	x	104.89	x	0.63	x	0.7	=	98.09	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.63	x	0.7	=	57.7	(78)
South	0.9x	0.77	x	1.2	x	104.89	x	0.63	x	0.7	=	38.47	(78)
South	0.9x	0.77	x	3.06	x	101.89	x	0.63	x	0.7	=	95.28	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.63	x	0.7	=	56.05	(78)
South	0.9x	0.77	x	1.2	x	101.89	x	0.63	x	0.7	=	37.37	(78)
South	0.9x	0.77	x	3.06	x	82.59	x	0.63	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.63	x	0.7	=	45.43	(78)
South	0.9x	0.77	x	1.2	x	82.59	x	0.63	x	0.7	=	30.29	(78)
South	0.9x	0.77	x	3.06	x	55.42	x	0.63	x	0.7	=	51.82	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.63	x	0.7	=	30.45	(78)
South	0.9x	0.77	x	1.2	x	55.42	x	0.63	x	0.7	=	20.32	(78)
South	0.9x	0.77	x	3.06	x	40.4	x	0.63	x	0.7	=	37.78	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.63	x	0.7	=	22.22	(78)
South	0.9x	0.77	x	1.2	x	40.4	x	0.63	x	0.7	=	14.82	(78)

Solar gains in watts, calculated for each month

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

(83)m=	116.61	199.19	278.14	360.78	423.73	430.6	410.92	361.57	305.93	221.26	139.68	99.85	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	592.8	675.51	741.5	800.07	839.2	821.72	784.43	740.71	695.48	634.75	582.66	564.58	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.94	0.87	0.72	0.56	0.61	0.83	0.96	0.99	0.99	(86)

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

(87)m=	19.3	19.51	19.83	20.25	20.63	20.88	20.97	20.96	20.78	20.3	19.73	19.27	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20.01	20.02	20.02	20.03	20.03	20.03	20.02	20.02	20.01	20.01	(88)
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TER WorkSheet: New dwelling design stage

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

(89)m=	0.99	0.98	0.97	0.93	0.83	0.64	0.45	0.5	0.76	0.94	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.02	18.28	18.69	19.22	19.68	19.95	20.01	20.01	19.85	19.29	18.57	17.98	(90)
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fLA = Living area ÷ (4) = 0.15 (91)

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

(92)m=	18.21	18.46	18.86	19.37	19.82	20.08	20.15	20.15	19.99	19.44	18.74	18.17	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.21	18.46	18.86	19.37	19.82	20.08	20.15	20.15	19.99	19.44	18.74	18.17	(93)
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9. Space heating calculation

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.91	0.82	0.65	0.47	0.51	0.76	0.93	0.98	0.99	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	585	660.3	710.83	731.41	686.98	532.04	366.12	381.22	529.29	588.86	569.2	558.41	(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=	1510.17	1468.85	1335.37	1119.12	865.47	579.01	375.18	394.84	624.02	942.57	1246.71	1502.8	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(97a)m=	688.33	543.35	464.66	279.15	132.8	0	0	0	0	263.16	487.81	702.63	(97a)
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Total per year (kWh/year) = Sum(97a)1..12 = 3561.87 (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	(97b)
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Total per year (kWh/year) = Sum(97b)1..12 = 0 (97b)

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

(98)m=	688.33	543.35	464.66	279.15	132.8	0	0	0	0	263.16	487.81	702.63	(98)
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Total per year (kWh/year) = Sum(98)1..12 = 3561.87 (98)

Space heating requirement in kWh/m²/year

36.03 (99)

9a. Energy requirements by individual room/systems including main CHP

Space heating:

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

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

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

Efficiency of main space heating system 1 90.5 (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)

688.33	543.35	464.66	279.15	132.8	0	0	0	0	263.16	487.81	702.63
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TER WorkSheet: New dwelling design stage

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

(211)

760.58	600.38	513.43	308.46	146.74	0	0	0	0	290.79	539.01	776.38
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$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..12} =$$

3935.77

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

0

(215)

Water heating

Output from water heater (calculated above)

214.04	191.88	205.42	186.24	185.53	167.98	161.78	173.96	170.79	189.59	200.45	213.78
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Efficiency of water heater

79.8

(216)

(217)m=	87.71	87.44	86.93	85.89	83.94	79.8	79.8	79.8	79.8	85.69	87.1	87.76
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(217)

Fuel for water heating, kWh/month

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

(219)m=	244.03	219.44	236.32	216.83	221.02	210.5	202.74	217.99	214.02	221.25	230.14	243.61
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$$\text{Total} = \text{Sum}(219)_{1..12} =$$

2677.89

(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

3935.77

Water heating fuel used

2677.89

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

$$\text{sum of (230a)...(230g)} =$$

75

(231)

Electricity for lighting

226.06

(232)

Electricity generated by PVs

-2502.98

(233)

26 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) ×	0.21	826.51 (261)
Space heating (secondary)	(215) ×	0.136	0 (263)
Water heating	(219) ×	0.21	562.36 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1388.87 (265)
Electricity for pumps, fans and electric keep-hot	(231) ×	0.136	10.2 (267)
Electricity for lighting	(232) ×	0.136	30.74 (268)
Energy saving/generation technologies Item 1		0.136	-340.41 (269)
Total CO2, kg/year		sum of (265)...(271) =	1089.41 (272)
TER =			11.02 (273)

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