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SUSTAINABILITY AND ENERGY STATEMENT

for

**CONSTRUCTION
OF
41, STUDIO, 1, 2 AND 3-BEDROOM APARTMENTS**

at

**FORMER VICTORIA PUBLIC HOUSE
32 NORTH HYDE ROAD
HAYES
UB3 4NE
AND
SANDOW GARAGE SITE
SANDOW CRESCENT
HAYES
UB3 4QH**

13th December 2021

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Executive Summary

This Statement accompanies a detailed planning application for the construction of 41, Studio, 1, 2 and 3-bedroom apartments on land at the former Victoria Public House, 32 North Hyde Road, Hayes and the Sandow Garage Site, Sandow Crescent, Hayes.

This Statement considers the sustainability aspects relating to the proposed development and includes an energy demand assessment showing how selected energy efficiency, low-carbon and renewable energy measures have been incorporated into the development design.

SAP calculations have been prepared for a representative sample of the apartments. The calculations provide an assessment of the carbon dioxide emissions arising from the development and allow the testing of different technologies.

SAP calculations have been prepared for a baseline scenario using a gas heating system. This is not the proposed strategy but has been presented to demonstrate the reduction in emissions from energy efficiency alone.

The methodology used has been based upon the 'Energy Assessment Guidance' published by the Mayor of London and uses the carbon factors for gas and electricity proposed for SAP 10.

The Regulation TER and DER Worksheets for the 'Be Lean' case are attached as Appendix 1 and the corresponding SAP 10 Spreadsheet is attached as Appendix 2.

It is proposed to enhance the fabric insulation standards of the building above the minimum required by the Building Regulations including improving the air tightness standards and targeting a 65% improvement over the minimum standard required by the Building Regulations (Part L - 2013).

Further SAP calculations have been prepared based on the proposed strategy, which includes the installation of a communal space heating and hot water heating network using air source heat pumps. The system uses a common ambient temperature water loop throughout the buildings, which is connected to individual heat pumps in each apartment. The common heat pump chiller(s) will be located on the roof of each building. Each building will have its own individual system.

The TER and DER Worksheets for the 'Be Green' case based on air source heat pump heating system are attached as Appendix 3 and the corresponding SAP 10 Spreadsheet is attached as Appendix 4.

There is roof space on both buildings to install a total of 59 photovoltaic panels, which are an output of 400W per panel equates to a total array of 23.6 kW. The panels will be gently inclined on racks and orientated towards due south. A Roof Plan showing the indicative location of the panels is attached as Appendix 5. The Roof Plan also shows the indicative location of the chiller units to be installed on each building as part of the heating system. Both plant enclosures are adjacent the overruns for the lifts and will be screened in a similar treatment used the lift overrun.

The reductions in emissions from the various scenarios can be summarised as follows:

	Total	% Reduction
	kg CO ₂ /year	
Be Lean		
Baseline (Building Regulations TER)	39.505	
Be Lean - after energy efficiency (DER)	31.485	20.30%
Be Clean		
Be Clean – after energy efficiency	31.485	20.30%
Be Green		
Be Green – after energy efficiency and Air Source Heat Pumps (ASHPs)	16.443	58.38%
Be Green – after energy efficiency, ASHPs and Photovoltaic Panels	11.419	71.09%

The carbon offset payment should be **£32,544** based upon residual emissions of 11.419 tonnes of CO₂ and an offset payment of £2,850/tonne.

In addition, the apartments will achieve a water efficiency target of 105 litres per person per day (excluding five litres per person per day allowance for external water use).

1.0 Introduction

1.1 This report has been commissioned by North Hyde Investments Ltd and FJC Developments Ltd and provides a Sustainability and Energy Statement for the proposed construction of 41, Studio, 1, 2 and 3-bedroom apartments on the site of the former Victoria Public House, 32 North Hyde Road, Hayes and the Sandow Garages Site, Sandow Crescent, Hayes.

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

1.3 The buildings have been designed and will be constructed to reduce energy demand and carbon dioxide emissions. The objective is to reduce the energy demand to an economic minimum by making investment in the parts of the buildings that have the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric. Once cost-effective structures have been designed, low-carbon and renewable technologies have been considered to provide heat and/or electricity.

The following hierarchy has been followed:

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

1.4 The report has been prepared by Maven Sustainability who are Sustainability Consultants.

2.0 Planning Policy

National Policy

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

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

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

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

- National Planning Policy Framework - 2021

Paragraph 152 states;

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

Regional and Local Policies

- 2.4 The Development Plan comprises the London Plan (2021) and the London Borough of Hillingdon Local Plan Part 1 (2012) and Part 2 (2020).
- 2.5 **London Plan**, published March 2021 – the following policies are relevant to the application:

Policy SI 1 Improving air quality

- A *Development Plans, through relevant strategic, site-specific and area-based policies, should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.*
- B *To tackle poor air quality, protect health and meet legal obligations the following criteria should be addressed:*
- 1) *Development proposals should not:*
 - a) *lead to further deterioration of existing poor air quality*
 - b) *create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits*
 - c) *create unacceptable risk of high levels of exposure to poor air quality.*
 - 2) *In order to meet the requirements in Part 1, as a minimum:*
 - a) *development proposals must be at least Air Quality Neutral*
 - b) *development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures*
 - c) *major development proposals must be submitted with an Air Quality Assessment. Air quality assessments should show how the development will meet the requirements of B1*
 - d) *development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people should demonstrate that design measures have been used to minimise exposure.*
- C *Masterplans and development briefs for large-scale development proposals subject to an Environmental Impact Assessment should consider how local air quality can be improved across the area of the proposal as part of an air quality positive approach. To achieve this a statement should be submitted demonstrating:*
- 1) *how proposals have considered ways to maximise benefits to local air quality, and*
 - 2) *what measures or design features will be put in place to reduce exposure to pollution, and how they will achieve this.*
- D *In order to reduce the impact on air quality during the construction and demolition phase development proposals must demonstrate how they plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.*

- E Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development.*

Policy SI 2 Minimising greenhouse gas emissions

- A Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy: **
- 1) be lean: use less energy and manage demand during operation*
 - 2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly*
 - 3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site*
 - 4) be seen: monitor, verify and report on energy performance.*
- B Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.*
- C A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:*
- 1) through a cash in lieu contribution to the borough's carbon offset fund, or*
 - 2) off-site provided that an alternative proposal is identified and delivery is certain.*
- D Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.*
- E Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.*
- F Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.*

Policy SI 4 Managing heat risk

- A Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.*
- B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:*
- 1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure*
 - 2) minimise internal heat generation through energy efficient design*
 - 3) manage the heat within the building through exposed internal thermal mass and high ceilings*
 - 4) provide passive ventilation*

- 5) *provide mechanical ventilation*
- 6) *provide active cooling systems.*

Policy SI 5 Water infrastructure

- A *In order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.*
- B *Development Plans should promote improvements to water supply infrastructure to contribute to security of supply. This should be done in a timely, efficient and sustainable manner taking energy consumption into account.*
- C *Development proposals should:*
 - 1) *through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)*
 - 2) *achieve at least the BREEAM excellent standard for the 'Wat 01' water category or equivalent (commercial development)*
 - 3) *incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.*
- D *In terms of water quality, Development Plans should:*
 - 1) *promote the protection and improvement of the water environment in line with the Thames River Basin Management Plan, and should take account of Catchment Plans*
 - 2) *support wastewater treatment infrastructure investment to accommodate London's growth and climate change impacts. Such infrastructure should be constructed in a timely and sustainable manner taking account of new, smart technologies, intensification opportunities on existing sites, and energy implications. Boroughs should work with Thames Water in relation to local wastewater infrastructure requirements.*
- E *Development proposals should:*
 - 1) *seek to improve the water environment and ensure that adequate wastewater infrastructure capacity is provided*
 - 2) *take action to minimise the potential for misconnections between foul and surface water networks. F Development Plans and proposals for strategically or locally defined growth locations with particular flood risk constraints or where there is insufficient water infrastructure capacity should be informed by Integrated Water Management Strategies at an early stage.*

The energy strategy within the Statement has been prepared in accordance with **Energy Assessment Guidance** published by the Mayor of London.

2.6 Hillingdon Local Plan: Part 1 Strategic Policies, adopted November 2012

The following policies have been edited for relevance to this application;

Policy BE1: Built Environment

The Council will require all new development to improve and maintain the quality of the built environment in order to create successful and sustainable neighbourhoods, where people enjoy living and working and that serve the long-term needs of all residents. All new development should:

1. *Achieve a high quality of design in all new buildings, alterations, extensions and the public realm which enhances the local distinctiveness of the area, contributes to community cohesion and a sense of place;*
2. *Be designed to be appropriate to the identity and context of Hillingdon's buildings, townscapes, landscapes and views, and make a positive contribution to the local area in terms of layout, form, scale and materials and seek to protect the amenity of surrounding land and buildings, particularly residential properties;*
3. *Be designed to include "Lifetime Homes" principles so that they can be readily adapted to meet the needs of those with disabilities and the elderly, 10% of these should be wheelchair accessible or easily adaptable to wheelchair accessibility encouraging places of work and leisure, streets, neighbourhoods, parks and open spaces to be designed to meet the needs of the community at all stages of people's lives;*
4. *In the case of 10 dwellings or over, achieve a satisfactory assessment rating in terms of the latest Building for Life standards (as amended or replaced from time to time);*
5. *Improve areas of poorer environmental quality, including within the areas of relative disadvantage of Hayes, Yiewsley and West Drayton. All regeneration schemes should ensure that they are appropriate to their historic context, make use of heritage assets and reinforce their significance;*
6. *Incorporate a clear network of routes that are easy to understand, inclusive, safe, secure and connect positively with interchanges, public transport, community facilities and services;*
7. *Improve the quality of the public realm and provide for public and private spaces that are attractive, safe, functional, diverse, sustainable, accessible to all, respect the local character and landscape, integrate with the development, enhance and protect biodiversity through the inclusion of living walls, roofs and areas for wildlife, encourage physical activity and where appropriate introduce public art;*
8. *Create safe and secure environments that reduce crime and fear of crime, anti-social behaviour and risks from fire and arson having regard to Secure by Design standards and address resilience to terrorism in major development proposals;*
9. *Not result in the inappropriate development of gardens and green spaces that erode the character and biodiversity of suburban areas and increase the risk of flooding through the loss of permeable areas;*

10. *Maximise the opportunities for all new homes to contribute to tackling and adapting to climate change and reducing emissions of local air quality pollutants. The Council will require all new development to achieve reductions in carbon dioxide emission in line with the London Plan targets through energy efficient design and effective use of low and zero carbon technologies. Where the required reduction from on-site renewable energy is not feasible within major developments, contributions off-site will be sought. The Council will seek to merge a suite of sustainable design goals, such as the use of SUDS, water efficiency, lifetime homes, and energy efficiency into a requirement measured against the Code for Sustainable Homes* and BREEAM. These will be set out within the Hillingdon Local Plan: Part 2- Development Management Policies Local Development Document (LDD). All developments should be designed to make the most efficient use of natural resources whilst safeguarding historic assets, their settings and local amenity and include sustainable design and construction techniques to increase the re-use and recycling of construction, demolition and excavation waste and reduce the amount disposed to landfill;*
11. *In the case of tall buildings, not adversely affect their surroundings including the local character, cause harm to the significance of heritage assets or impact on important views. Appropriate locations for tall buildings will be defined on a Character Study and may include parts of Uxbridge and Hayes subject to considering the Obstacle Limitation Surfaces for Heathrow Airport. Outside of Uxbridge and Hayes town centres, tall buildings will not be supported. The height of all buildings should be based upon an understanding of the local character and be appropriate to the positive qualities of the surrounding townscape.*

Policy EM1: Climate Change Adaptation and Mitigation

The Council will ensure that climate change mitigation is addressed at every stage of the development process by:

1. *Prioritising higher density development in urban and town centres that are well served by sustainable forms of transport.*
2. *Promoting a modal shift away from private car use and requiring new development to include innovative initiatives to reduce car dependency.*
3. *Ensuring development meets the highest possible design standards whilst still retaining competitiveness within the market.*
4. *Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock.*
5. *Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.*
6. *Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.*
7. *Encouraging sustainable techniques to land remediation to reduce the need to transport waste to landfill. In particular developers should consider bioremediation as part of their proposals.*
8. *Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydro electricity and a greater use of waste as a resource.*

9. *Promoting new development to contribute to the upgrading of existing housing stock where appropriate.*

The Borough will ensure that climate change adaptation is addressed at every stage of the development process by:

10. *Locating and designing development to minimise the probability and impacts of flooding.*
11. *Requiring major development proposals to consider the whole water cycle impact, which includes flood risk management, foul and surface water drainage and water consumption.*
12. *Giving preference to development of previously developed land to avoid the loss of further green areas.*
13. *Promoting the use of living walls and roofs, alongside sustainable forms of drainage to manage surface water run-off and increase the amount of carbon sinks.*
14. *Promoting the inclusion of passive design measures to reduce the impacts of urban heat effects.*

Local Plan: Part 2 Development Management Policies, adopted January 2020

Policy DMEI 2: Reducing Carbon Emissions

- A) *All developments are required to make the fullest contribution to minimising carbon dioxide emissions in accordance with London Plan targets. * **
- B) *All major development proposals must be accompanied by an energy assessment showing how these reductions will be achieved.*
- C) *Proposals that fail to take reasonable steps to achieve the required savings will be resisted. However, where it is clearly demonstrated that the targets for carbon emissions cannot be met onsite, the Council may approve the application and seek an off-site contribution to make up for the shortfall.*

Policy DMEI 3: Decentralised Energy

- A) *All major developments are required to be designed to be able to connect to a Decentralised Energy Network (DEN).*
- B) *Major developments located within 500 metres of an existing DEN, and minor new-build developments located within 100 metres, will be required to connect to that network, including provision of the means to connect to that network and a reasonable financial contribution to the connection charge, unless a feasibility assessment demonstrates that connection is not reasonably possible.*
- C) *Major developments located within 500 metres of a planned future DEN, which is considered by the Council likely to be operational within 3 years of a grant of planning permission, will be required to provide a means to connect to that network and developers shall provide a reasonable financial contribution for the future cost of connection and a commitment to connect via a legal agreement or contract, unless a feasibility assessment demonstrates that connection is not reasonably possible.*
- D) *The Council will support the development of DENs and energy centres in principle, subject to meeting the wider policy requirements of this plan and in particular on design and air quality.*

Policy DMEI 10: Water Management, Efficiency, and Quality

- A) *Applications for all new build developments (not conversions, change of use, or refurbishment) are required to include a drainage assessment demonstrating that appropriate sustainable drainage systems (SuDS) have been incorporated in accordance with the London Plan Hierarchy (Policy 5.13: Sustainable drainage).*

- B) *All major new build developments, as well as minor developments in Critical Drainage Areas or an area identified at risk from surface water flooding must be designed to reduce surface water run-off rates to no higher than the pre-development greenfield run-off rate in a 1:100-year storm scenario, plus an appropriate allowance for climate change for the worst storm duration. The assessment is required regardless of the changes in impermeable areas and the fact that a site has an existing high run-off rate will not constitute justification.*
- C) *Rain Gardens and non-householder development should be designed to reduce surface water run-off rates to Greenfield run-off rates.*
- D) *Schemes for the use of SuDS must be accompanied by adequate arrangements for the management and maintenance of the measures used, with appropriate contributions made to the Council where necessary.*
- E) *Proposals that would fail to make adequate provision for the control and reduction of surface water run-off rates will be refused.*
- F) *Developments should be drained by a SuDS system and must include appropriate methods to avoid pollution of the water environment. Preference should be given to utilising the drainage options in the SuDS hierarchy which remove the key pollutants that hinder improving water quality in Hillingdon. Major development should adopt a 'treatment train' approach where water flows through different SuDS to ensure resilience in the system.*

Water Efficiency

- G) *All new development proposals (including refurbishments and conversions) will be required to include water efficiency measures, including the collection and reuse of rain water and grey water.*
- H) *All new development should demonstrate water usage rates of no more than 105 litres/person/day.*

Water and Wastewater Infrastructure

- J) *All new development proposals will be required to demonstrate that there is sufficient capacity in the water and wastewater infrastructure network to support the proposed development. Where there is a capacity constraint the Local Planning Authority will require the developer to provide a detailed water and/or drainage strategy to inform what infrastructure is required, where, when and how it will be delivered.*

* The Code for Sustainable Homes scheme has now been withdrawn by the Government.

** Part L of the Buildings Regulations will be revised in 2022 and the carbon factors will be revised compared to the current Part L (2013).

Consequently the Mayor of London has published Energy Assessment Guidance, which allows the use of the current SAP methodology (2013) to calculate energy demand but taken carbon emissions factors, which had been prepared for the new Part L in 2018, known colloquially as SAP 10.

3.0 Assessment Methodology

- 3.1 The baseline energy demand for the proposal has been established by preparing SAP calculations for a representative sample of the apartments. When the results are aggregated across similar unit types these provide an accurate assessment of the total emissions from the site.
- 3.2 These calculations have been based upon certain assumptions as to the building specification and these are clarified below. These are not design calculations but serve to establish the environmental, technical and economic viability of various renewable and low carbon technologies.

Emission Factors

- 3.3 The CO₂ emission factors, where applicable, used throughout this report have been taken from the emerging Building Regulation Approved Document L, known colloquially as SAP 10.

Fuel	Kg CO ₂ /kWh
Natural Gas	0.210
Grid supplied and displaced electricity	0.233

- 3.4 In assessing this proposal we have been informed by the following guidance:
- **BRE Green Guide to Specification**
The Building Research Establishment Green Guide to Specification lists building materials and components, and ranks their potential life cycle environmental impact.

4.0 Proposal

4.1 The proposal is for the construction of 41, Studio, 1, 2 and 3-bedroom apartments in two, 4-storey buildings.

The accommodation schedule in detail is as follows;

Unit Type	No.	Area	Totals
		m ²	m ²
Studio apartment	2	38.4	76.8
Studio apartment	1	39.6	39.6
Studio apartment	1	41.4	41.4
1-Bedroom apartment	3	50.2	150.6
1-Bedroom apartment	2	51.3	102.6
1-Bedroom apartment	1	51.7	51.7
1-Bedroom apartment	1	55.5	55.5
2-Bedroom apartment	1	61.8	61.8
2-Bedroom apartment	2	62.2	124.4
2-Bedroom apartment	1	62.8	62.8
2-Bedroom apartment	1	63.2	63.2
2-Bedroom apartment	1	66.0	66.0
2-Bedroom apartment	1	67.1	67.1
2-Bedroom apartment	2	67.5	135.0
2-Bedroom apartment	2	69.2	138.4
2-Bedroom apartment	1	69.5	69.5
2-Bedroom apartment	1	69.8	69.8
2-Bedroom apartment	1	70.0	70.0
2-Bedroom apartment	1	70.4	70.4
2-Bedroom apartment	1	73.5	73.5
2-Bedroom apartment	2	73.7	147.4
2-Bedroom apartment	1	74.4	74.4
2-Bedroom apartment	1	75.9	75.9
3-Bedroom apartment	3	81.2	243.6
3-Bedroom apartment	2	88.1	176.2
3-Bedroom apartment	2	90.2	180.4
3-Bedroom apartment	3	90.5	271.5
Total			2,759.5

5.0 Demand Reduction

Design

- 5.1 The energy performance of a building is affected by the building design, its construction and its use. Whilst occupant behaviour is beyond the remit of this statement, better design and construction methods can significantly reduce the life cycle emissions of a building and assist the occupant to reduce consumption.
- 5.2 Sustainable design is not just about incorporating renewable technologies, buildings should be designed at the outset to provide suitable environmental conditions for the occupants whilst also consuming as little energy as practical. It is possible to exceed Building Regulations requirements (Part L - 2013) through demand reduction measures alone, which typically include a combination of passive design measures (e.g. building design and efficient building fabric) and active design measures (e.g. variable speed motors)

Passive Design Measures

- 5.3 The passive design measures proposed include;

Passive Solar Gain

- 5.4 The architectural and structural features of a building will affect energy consumption and the use of natural daylight; orientation, thermal mass, shading and mitigation of wind exposure will reduce heating, cooling and lighting requirements.
- 5.5 There are no apartments with a solely northerly aspect and all apartments will benefit from access to direct sunlight at some point throughout the day. There are 24 units with a single aspect but these are orientated towards the northeast (5), southwest (7), southeast (6) and northwest (6).

Efficient Building Fabric

Building Envelope

- 5.6 U-values of the building envelope must meet Building Regulations Part L standards and further improvements will reduce the development heating requirements.
- 5.7 The selection of high thermal density materials can help to stabilise temperature fluctuations in a building, reducing maximum demands on building services.
- 5.8 The construction of the building is suited to the use of traditional construction methods with a load-bearing structure or the use of a structural frame with infill panels. Ground floors will be insulated with 150mm PIR insulation and flat and green roofs with at least 150mm PIR insulation.

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

Element	Proposed
	W/m ² K
Ground Floors	0.13
External Walls	0.18
Flat Roofs	0.15
Windows	1.40

Air Leakage

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

5.11 Approved Document Part L sets a minimum standard for air permeability of 10 m³ of air per hour per m² of envelope area, at 50Pa. The air tightness standard at the site will target a 65% improvement over the Regulations and will seek to achieve a permeability of 3.5 m³/hr/m².

Thermal Bridging

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

5.13 Accredited Construction Details (ACD's) have been developed to provide the performance standards required to achieve the higher energy efficiency requirements of the Building Regulations. The bridging losses have been calculated using SAP Appendix K Table 1.

Ventilation

5.14 As a result of increasing thermal efficiency and air tightness, Building Regulations Approved Document F was also revised in 2006 to address the possibility of overheating and poor air quality. Mechanical ventilation with heat recovery will be used for control of air quality to all apartments.

Overheating

5.15 The possibility of summertime overheating is addressed by providing opening windows to provide purge ventilation.

- 5.16 The apartments have been designed to be deliberately deep, which naturally provides shading to the internal spaces of the units. In addition, the 'g' value of the glazing (the transmittance of solar radiation through the glass with a value of 1.0 providing full transmittance and 0.0 providing no solar energy transmittance) used for the external doors and windows is specified to be 0.63.

Efficient Lighting and Controls

- 5.17 All light fittings will be of a dedicated energy efficient type.

Heating

- 5.18 The specification includes the use of a communal space heating and hot water heating system using air source heat pumps. This will consist of modular chiller units placed on the roof of each building, which will provide an ambient temperature water loop within the buildings to which will be connected the heat pump from each apartment.
- 5.19 However, for the Be Lean calculations a set of SAP calculations have been prepared using gas combination boilers in order to 'test' the efficiency of the building fabric.

6.0 Establishing Carbon Dioxide Emissions (Be Lean)

Baseline

- 6.1 The following analysis has been based upon SAP calculations prepared using Part L 2013 to calculate the reduction in emissions through energy efficiency measures only.
- 6.2 The baseline calculations have been based upon the use a gas boiler, which provides space heating and hot water to all apartments.
- 6.3 The TER and DER Worksheets are attached as Appendix 1 but the energy demand for the modelled apartments can be calculated as follows;

Studio apartment - Ground-floor (1 exposed side) – 39.6 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	1,421	943
Water heating	1,747	1,587
Electricity for fans & lighting	265	349
Total	3,433	2,879

Studio apartment - Mid-floor (1 exposed side) – 38.4 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	577	134
Water heating	1,759	1,583
Electricity for fans & lighting	267	349
Total	2,603	2,066

Studio apartment - Top-floor (1 exposed side) – 38.4 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	936	474
Water heating	1,742	1,578
Electricity for fans & lighting	267	349
Total	2,945	2,401

1-Bedroom apartment - Mid-floor (1 exposed side) – 50.2 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	1,354	720
Water heating	1,940	1,716
Electricity for fans & lighting	308	415
Total	3,602	2,851

1-Bedroom apartment - Top-floor (1 exposed side) – 50.2 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	1,936	1,474
Water heating	1,924	1,711
Electricity for fans & lighting	308	415
Total	4,168	3,600

2-Bedroom apartment - Ground-floor (2 exposed sides) – 69.8 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	2,101	1,360
Water heating	2,264	1,943
Electricity for fans & lighting	386	535
Total	4,751	3,838

2-Bedroom apartment - Mid-floor (2 exposed sides) – 69.2 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	1,405	658
Water heating	2,275	1,942
Electricity for fans & lighting	383	531
Total	4,063	3,131

2-Bedroom apartment - Top-floor (2 exposed sides) – 66.0 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	2,488	1,848
Water heating	2,194	1,899
Electricity for fans & lighting	373	514
Total	5,055	4,261

3-Bedroom apartment - Ground-floor (2 exposed sides) – 90.5 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	3,405	2,310
Water heating	2,473	2,103
Electricity for fans & lighting	462	655
Total	6,340	5,068

3-Bedroom apartment - Mid-floor (2 exposed sides) – 90.5 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	2,477	1,381
Water heating	2,491	2,108
Electricity for fans & lighting	462	655
Total	5,430	4,144

There is a single 1-bedroom ground-floor apartment and for the purposes of this assessment the emissions are assumed to be same as a top-floor unit of the same floor area.

In addition, there are no 3-bedroom top-floor units.

Be Lean Emissions

- 6.4 The energy demand figures calculated above have been inputted into the SAP 10 spreadsheet attached as Appendix 2 to provide TER and DER emissions figures using the carbon factor from SAP 10 and as required by the GLA Energy Assessment Guidance.
- 6.5 The Target Emissions (TER) are **39,505 kg CO₂ per year** with Actual DER emissions of **31,485 kg CO₂ per year**. This equates to a reduction in emissions using a gas system as a baseline and using the SAP 10 carbon factors of **8,019 kg CO₂ per year**, which is;
- **20.30%**
- 6.6 The reduction from energy efficiency for the Be Lean case therefore meets the requirements of the Guidance.

7.0 Low-Carbon and Renewable Technologies

7.1 The energy demand established above has been used to test the viability of various renewable and low carbon technologies as follows.

7.2 This section determines the appropriateness of each technology with the subject scheme.

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

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

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

Wind

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

7.6 The Government wind speed database predicts local wind speeds at North Hyde Road to be 4.9 m/s at 10m above ground level and 5.7 m/s at 25m above ground level. This is below the level generally required for commercial investment in large wind turbines and in addition the land take, potential for noise and signal interference make a large wind turbine unsuitable for this site.

7.7 Roof mounted turbines could be used at the development to generate small but valuable amounts of renewable electricity but the small output and contribution to total emissions means and investment would be small and purely tokenism.

Combined Heat and Power and Community Heating

7.8 Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for use in buildings. The plant is essentially a small-scale electrical power station. The production and transportation of electricity via the National Grid is very inefficient with over 65% of the energy produced at the power station being lost to the atmosphere and through transportation.

- 7.9 CHP units are generally gas fuelled and generate electricity with heat being a by-product. The heat is usually used to meet the hot water load, which is fairly consistent throughout the year.
- 7.10 Historically CO₂ savings have been achieved because gas has been used to generate electricity and gas has had a lower emissions factor than electricity. However, with the de-carbonisation of the electricity grid the benefit of CHP is negated.
- 7.11 CHP is longer an appropriate technology.
- 7.12 However, a communal heating and/or hot water network is proposed in order to meet the requirements of the planning policy, albeit fuelled by an electrical heat source.

Ground Source Heat Pumps

- 7.13 Sub soil temperatures are reasonable constant and predictable in the UK, providing a store of the sun's energy throughout the year. Ground source heat pumps (GSHP) extract this low-grade heat and convert it to usable heat for space heating.
- 7.14 GSHP operates on a similar principle to refrigerators, transferring heat from a cool place to a warmer place. They operate most efficiently when providing space heating at a low temperature, typically via under floor heating or with low temperature radiators.
- 7.15 There are generally two types of installation being a bore-hole (open loop) and a closed loop system.
- 7.16 Open loop bore holes extract energy from ground water located deep below the surface and discharge the water back to the ground reservoir whereas closed loop systems circulate a fluid around a series of boreholes or horizontal 'slinky' and extract heat from the ground.
- 7.17 Ground source heat pumps are not feasible for apartment buildings and are therefore not proposed.

Solar

(i) Solar Water Heating

- 7.18 Solar hot water panels use the sun's energy to directly heat water circulating through panels or pipes. The technology is simple and easily understood by purchasers.
- 7.19 Solar hot water heating panels are based generally around two types, which are available being 'flat plate collectors' and 'evacuated tubes'. Flat plate collectors can achieve an output of up to 1,124 kWh/year (Schuco) and evacuated tubes can achieve outputs up to 1,365 kWh/year (Riomay).
- 7.20 Panels are traditionally roof mounted and for highest efficiencies should be mounted plus or minus 30 degrees of due south.

7.21 The apartments do not suit the use solar hot water heating panels and therefore the technology is not proposed.

ii) Photovoltaics

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

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

7.24 Part of the roof over Block B2 includes an element of 'green' roof and an area set aside for amenity space and roof garden for the benefit of residents.

7.25 However, the roof over Block B1 and part of roof to Block B2 could accommodate a number of panels. A Roof Plan is attached as Appendix 5, which shows a total of 59 panels could be installed, installed on racks, inclined at circa 20 degrees and orientated towards due south. Assuming the installation of 400W panels the arrays would reduce emissions by a total of **5,024 kg CO₂ per year**.

Air Source Heat Pumps (ASHP)

7.26 Air sourced heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps; however, the initial heat energy is extracted from the external air rather than the ground.

7.27 The specification for the heating system within the apartments includes the installation of a communal space heating and hot water heating system using air source heat pumps. The heating system uses communal chiller units, which will be located on the roofs of both buildings.

7.28 The indicative location of the plant is shown on the Roof Plan attached as Appendix 5.

8.0 Establishing Carbon Dioxide Emissions (Be Clean and Be Green)

- 8.1 A further set of SAP calculations has been prepared for the modelled units but using a communal system with air source heat pumps to provide space heating and hot water.
- 8.2 The TER and DER Worksheets based on the proposed installation are attached as Appendix 3 but the energy demand for the modelled apartments can be calculated as follows;

Studio apartment - Ground-floor (1 exposed side) – 39.6 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	1,262	845
Water heating	1,937	416
Electricity for fans & lighting	265	274
Total	3,464	1,535

Studio apartment - Mid-floor (1 exposed side) – 38.4 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	463	205
Water heating	1,960	412
Electricity for fans & lighting	267	274
Total	2,690	891

Studio apartment - Top-floor (1 exposed side) – 38.4 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	800	512
Water heating	1,941	412
Electricity for fans & lighting	267	274
Total	3,008	1,198

1-Bedroom apartment - Mid-floor (1 exposed side) – 50.2 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	1,207	646
Water heating	2,079	452
Electricity for fans & lighting	308	340
Total	3,594	1,438

1-Bedroom apartment - Top-floor (1 exposed side) – 50.2 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	1,779	994
Water heating	2,060	452
Electricity for fans & lighting	308	340
Total	4,147	1,786

2-Bedroom apartment - Ground-floor (2 exposed sides) – 69.8 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	1,966	766
Water heating	2,306	517
Electricity for fans & lighting	386	460
Total	4,658	1,743

2-Bedroom apartment - Mid-floor (2 exposed sides) – 69.2 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	1,285	465
Water heating	2,322	515
Electricity for fans & lighting	383	456
Total	3,990	1,436

2-Bedroom apartment - Top-floor (2 exposed sides) – 66.0 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	2,330	1,061
Water heating	2,252	506
Electricity for fans & lighting	373	439
Total	4,955	2,006

3-Bedroom apartment - Ground-floor (2 exposed sides) – 90.5 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	3,247	1,118
Water heating	2,457	564
Electricity for fans & lighting	462	580
Total	6,166	2,262

3-Bedroom apartment - Mid-floor (2 exposed sides) – 90.5 m ²	Energy Demand TER	Energy Demand DER
	kWh /yr	kWh/yr
Space heating	2,327	814
Water heating	2,477	564
Electricity for fans & lighting	462	580
Total	5,266	1,958

Be Green Emissions – with a communal heat system using air source heat pumps

- 8.3 The energy demand figures calculated above have been inputted into the SAP 10 spreadsheet attached as Appendix 4 to provide the DER emissions for the Be Green case (without photovoltaic panels).
- 8.4 The total DER emissions for the Be Green case are **16,443 kg CO₂ per year**, which equates to a reduction in emissions of **23,062 kg CO₂ per year**, which is **58.38%**.

9.0 Summary of Calculations and Proposals for Renewable Technologies

Be Lean

- 9.1 Using the current (Part L) Regulations and SAP 10 carbon factors and based upon a gas heating system for the apartments the total site CO₂ emissions are calculated as **39,505 kg CO₂ per year** (TER) and **31,485 kg CO₂ per year** (DER).
- 9.2 This equates to a total reduction of **8,019 kg CO₂ per year** or **20.30%** of the total TER emissions. This is therefore compliant with the GLA energy planning guidance. The TER and DER Worksheets for the modelled apartments are attached as Appendix 1 and the SAP 10 spreadsheet is attached as Appendix 2.

Be Green – Air Source Heat Pumps

- 9.3 A further set of calculations has been prepared for the proposed energy strategy. This proposes the installation of a communal heating system using air source heat pumps. These calculations have been converted to SAP 10 emissions using the SAP spreadsheet (attached as Appendix 4). The TER and DER Worksheets for the proposed energy strategy are attached as Appendix 3.
- 9.4 The carbon dioxide emissions for the Be Green scenario (based on air source heat pumps only) are assessed as **16,443 kg CO₂ per year**, which equates to a reduction of **23,062 kg CO₂ per year** or **58.38%**.

Be Green – Photovoltaic Panels

- 9.5 It is proposed to install a photovoltaic array of 23.6 kW onto the roofs of the two buildings. The array will be comprised of 59 x 400W panels, which will be installed on racks, inclined at circa 20 degrees towards due south. The panels will reduce emissions by a further **5,024 kg CO₂ per year** (using the SAP 10 emissions factors).
- 9.6 A Roof Plan showing the indicative location of the panels is attached as Appendix 5.

Summary

- 9.7 **The total reduction in emissions from energy efficiency, low-carbon and renewable technologies are calculated as; 28.086 Tonnes CO₂ per year, which equates to a reduction of 71.09%.**

10.0 Climate change adaption and Water resources

Sustainable Drainage Systems (SUDS)

- 10.1 The Environment Agency flood maps show the site is located within Flood Zone 1.
- 10.2 It is understood that infiltration methods are unlikely to be feasible because of the underlying geology of the site and absence of a local watercourse for any surface water to discharge into. The surface water will discharge into an existing Thames Water combined sewer. However, attenuation will be provided and the strategy includes the use of permeable paving and the installation of a geo-cellular attenuation tank.

Surface Water Management

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

Green Roofs

- 10.4 The plans for the building propose the installation of 'green' roofs as part of the roof structure to Block B2.
- 10.5 Green roofs can provide additional surface water storage capacity and will also increase biodiversity.
- 10.6 Green roofs can provide additional surface water storage capacity, decrease the total amount of rainwater runoff and slow the rate of runoff from the roof. It has been found that they can retain up to 75% of rainwater, gradually releasing it back into the atmosphere via condensation and transpiration, while retaining pollutants in their soil. Green roofs have also been found to dramatically improve a roof's insulation value.
- 10.7 In addition green roofs can:
- Reduce heating (by adding mass and thermal resistance value) and cooling (by evaporative cooling) loads on a building
 - Reduce the urban heat island effect
 - Reduce surface water run off
 - Filter pollutants and CO₂ out of the air
 - Increase wildlife habitat in built-up areas and increase biodiversity

Water efficiency measures

- 10.8 In the South East of England, water demand exceeds the volume licensed for abstraction, with the shortfall being met from ground water. In excess of 20% of the UK's water is used domestically with over 50% of this used for flushing WCs and washing (source: Environment Agency). The majority of this comes from drinking quality standard or potable water.
- 10.9 The water efficiency measures included in this development will ensure that the water use target of 105 litres per person per day is achieved using the measures described below.
- 10.10 Water efficient devices will be fully evaluated, and installed, wherever possible. The specification of such devices will be considered at detailed design stage and each will be subject to an evaluation based on technical performance, cost and market appeal, together with compliance with the water use regulations.
- 10.11 The following devices will be incorporated within the apartments:
- Water efficient taps.
 - Water efficient toilets.
 - Low output showers.
 - Flow restrictors to manage water pressures to achieve optimum levels.
- 10.12 Water consumption calculations have been carried out using the Water Efficiency Calculator provided by the BRE. Although not perfect this calculator gives a good indication of the probable water use in a dwelling, although this is largely dependent on the way on which occupants use their homes.
- 10.13 Below is a typical specification, which would achieve the 105 Litres per person per day target (excluding five litres per person per day allowance for external water use).

Schedule of Appliance Water Consumption		
Appliance	Flow rate or capacity	Total Litres
WC	6/36 litres dual flush	17.64
Basin	2.0 litres/min.	4.74
Shower	9.0 litres/min	39.33
Bath	175 litres	19.25
Sink	5.0 litres/min	12.56
Washing Machine	6.75 litres/kg	14.18
Dishwasher	1.25 litres/places	4.50
		112.20
	Normalisation Factor	0.91
		102.10

11.0 Materials

- 11.1 The BRE Green Guide to Specification is a simple guide for design professionals. The guide provides environmental impact, cost and replacement interval information for a wide range of commonly used building specifications over a notional 60-year building life. The construction specification will prioritise materials within ratings A+, A or B.
- 11.2 Preference will be given to the use of local materials & suppliers where viable to reduce the transport distances and to support the local economy. A full evaluation of these suppliers will be undertaken at the next stage of design.
- 11.3 In addition, timber would be sourced, where practical, certified by PEFC or an equivalent approved certification body and all site timber used within the construction process would be recycled.
- 11.4 All insulation materials to will have a zero-ozone depleting potential

Construction waste

- 11.5 The setting of targets will promote resource efficiency in accordance with guidance from WRAP, Envirowise, BRE and DEFRA.
- 11.6 The overarching principle of waste management is that waste should be treated or disposed of within the region where it is produced.
- 11.7 Construction operations generate waste materials as a result of general handling losses and surpluses. These wastes can be reduced through appropriate selection of the construction method, good site management practices and spotting opportunities to avoid creating unnecessary waste.
- 11.8 The Construction Strategy will explore these issues, some of which are set out below:
- Proper handling and storage of all materials to avoid damage;
 - Efficient purchasing arrangements to minimise over ordering;
 - Segregation of construction waste to maximise potential for reuse/recycling;
 - Suppliers who collect and reuse/recycle packaging materials.

APPENDIX 1.0

TER and DER Worksheets for 'Be Lean' case based on gas installation

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes ST GND 40

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	39.6 (1a)	2.5 (2a)	99 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	39.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	99 (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				0	0 (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) =	0 (8)

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

Number of storeys in the dwelling (ns)	0 (9)
--	-------

Additional infiltration	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 (15)
---------------------	--------

Infiltration rate	0 (16)
-------------------	--------

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.5 (17)
---	----------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.18 (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	0.85 (20)
----------------	-----------

Infiltration rate incorporating shelter factor	0.15 (21)
--	-----------

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

78.2 (23c)

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

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

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

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

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

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

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

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

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

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

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

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.3	$\times 1/[1/(1.4) + 0.04] =$	8.35		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Floor			39.6	$\times$	0.13		5.148 (28)
Walls	14.3	9.45	4.85	$\times$	0.18		0.87 (29)
Total area of elements, m²			53.9				(31)
Party wall			48.47	$\times$	0		0 (32)
Party ceiling			39.6				(32b)

* 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) = 18.55 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5418.3 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.27 (36)

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

Total fabric heat loss (33) + (36) = 24.82 (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=	9.76	9.64	9.51	8.91	8.79	8.18	8.18	8.06	8.42	8.79	9.03	9.27

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

(39)m=	34.57	34.45	34.33	33.72	33.6	32.99	32.99	32.87	33.24	33.6	33.84	34.09
Average = Sum(39) _{1...12} /12=												33.69 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.87	0.87	0.87	0.85	0.85	0.83	0.83	0.83	0.84	0.85	0.85	0.86		
	Average = Sum(40) _{1...12} /12=												0.85	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.4

(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

67.35

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	74.08	71.39	68.7	66	63.31	60.61	60.61	63.31	66	68.7	71.39	74.08		
	Total = Sum(44) _{1...12} =												808.19	(44)

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

(45)m=	109.86	96.09	99.15	86.44	82.95	71.58	66.33	76.11	77.02	89.76	97.98	106.4		
	Total = Sum(45) _{1...12} =												1059.66	(45)

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

(46)m=	16.48	14.41	14.87	12.97	12.44	10.74	9.95	11.42	11.55	13.46	14.7	15.96		(46)
--------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

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

Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

DER WorkSheet: New dwelling design stage

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

(61)m=	29.8	26.91	29.78	28.81	29.77	28.8	29.75	29.76	28.81	29.78	28.83	29.79	(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=	139.66	122.99	128.94	115.26	112.71	100.37	96.08	105.87	105.82	119.53	126.8	136.19	(62)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	------

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

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

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

Output from water heater

(64)m=	139.66	122.99	128.94	115.26	112.71	100.37	96.08	105.87	105.82	119.53	126.8	136.19	
Output from water heater (annual) _{1...12}												1410.24	(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=	43.98	38.68	40.41	35.95	35.02	31	29.49	32.75	32.81	37.29	39.78	42.83	(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=	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	(66)

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

(67)m=	10.75	9.54	7.76	5.88	4.39	3.71	4.01	5.21	6.99	8.88	10.36	11.04	(67)
--------	-------	------	------	------	------	------	------	------	------	------	-------	-------	------

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

(68)m=	120.53	121.78	118.63	111.92	103.45	95.49	90.17	88.92	92.07	98.78	107.25	115.21	(68)
--------	--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	------

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

(69)m=	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	(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=	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	59.11	57.55	54.32	49.93	47.07	43.05	39.64	44.01	45.57	50.12	55.26	57.56	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	237.32	235.81	227.65	214.66	201.85	189.19	180.75	185.08	191.57	204.71	219.8	230.75	(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)	
Northwest 0.9x	0.77	x	6.3	x	11.28	x	0.63	x	0.7	=	21.72	(81)
Northwest 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	10.86	(81)
Northwest 0.9x	0.77	x	6.3	x	22.97	x	0.63	x	0.7	=	44.22	(81)
Northwest 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	22.11	(81)
Northwest 0.9x	0.77	x	6.3	x	41.38	x	0.63	x	0.7	=	79.67	(81)

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Northwest 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(81)
Northwest 0.9x	0.77	x	6.3	x	67.96	x	0.63	x	0.7	=	130.84	(81)
Northwest 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(81)
Northwest 0.9x	0.77	x	6.3	x	91.35	x	0.63	x	0.7	=	175.87	(81)
Northwest 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(81)
Northwest 0.9x	0.77	x	6.3	x	97.38	x	0.63	x	0.7	=	187.5	(81)
Northwest 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(81)
Northwest 0.9x	0.77	x	6.3	x	91.1	x	0.63	x	0.7	=	175.4	(81)
Northwest 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(81)
Northwest 0.9x	0.77	x	6.3	x	72.63	x	0.63	x	0.7	=	139.83	(81)
Northwest 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(81)
Northwest 0.9x	0.77	x	6.3	x	50.42	x	0.63	x	0.7	=	97.08	(81)
Northwest 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(81)
Northwest 0.9x	0.77	x	6.3	x	28.07	x	0.63	x	0.7	=	54.04	(81)
Northwest 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(81)
Northwest 0.9x	0.77	x	6.3	x	14.2	x	0.63	x	0.7	=	27.33	(81)
Northwest 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(81)
Northwest 0.9x	0.77	x	6.3	x	9.21	x	0.63	x	0.7	=	17.74	(81)
Northwest 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(81)

Solar gains in watts, calculated for each month

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

(83)m=	32.59	66.33	119.5	196.26	263.81	281.25	263.1	209.75	145.62	81.06	41	26.61	(83)
--------	-------	-------	-------	--------	--------	--------	-------	--------	--------	-------	----	-------	------

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

(84)m=	269.91	302.14	347.15	410.91	465.66	470.44	443.86	394.83	337.18	285.77	260.8	257.36	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.86	0.65	0.45	0.33	0.38	0.66	0.94	0.99	1	(86)

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

(87)m=	20.23	20.36	20.59	20.87	20.98	21	21	21	20.98	20.79	20.47	20.21	(87)
--------	-------	-------	-------	-------	-------	----	----	----	-------	-------	-------	-------	------

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

(88)m=	20.19	20.19	20.2	20.21	20.21	20.22	20.22	20.23	20.22	20.21	20.21	20.2	(88)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(89)m=	0.99	0.99	0.96	0.83	0.6	0.39	0.27	0.32	0.59	0.91	0.99	1	(89)
--------	------	------	------	------	-----	------	------	------	------	------	------	---	------

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

(90)m=	19.16	19.36	19.69	20.06	20.19	20.22	20.22	20.23	20.21	19.98	19.52	19.14	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.63

(91)

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

(92)m=	19.84	19.99	20.26	20.57	20.69	20.71	20.71	20.71	20.7	20.5	20.12	19.81	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	------	-------	-------	------

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

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(93)m=	19.84	19.99	20.26	20.57	20.69	20.71	20.71	20.71	20.7	20.5	20.12	19.81	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.99	0.99	0.96	0.85	0.63	0.43	0.31	0.36	0.64	0.92	0.99	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	268.14	297.97	332.58	347.68	295.31	201.24	135.7	141.73	214.46	263.45	257.05	256.07	(95)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	537.13	519.91	472.43	393.53	302.06	201.69	135.74	141.84	219.3	332.49	440.63	532.27	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

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

(98)m=	200.13	149.14	104.05	33.01	5.03	0	0	0	0	51.37	132.18	205.49	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												880.4	(98)

Space heating requirement in $kWh/m^2/year$

22.23	(99)
-------	------

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

Space heating:

Fraction of space heat from secondary/supplementary system

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

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

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

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

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

Efficiency of main space heating system 1

93.4	(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)

200.13	149.14	104.05	33.01	5.03	0	0	0	0	51.37	132.18	205.49
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

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

214.27	159.68	111.4	35.35	5.38	0	0	0	0	55	141.52	220.01
--------	--------	-------	-------	------	---	---	---	---	----	--------	--------

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

942.61	(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	
---------	---	---	---	---	---	---	---	---	---	---	---	--

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

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

Water heating

Output from water heater (calculated above)

139.66	122.99	128.94	115.26	112.71	100.37	96.08	105.87	105.82	119.53	126.8	136.19
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------

Efficiency of water heater

88.2	(216)
------	-------

(217)m=	89.48	89.39	89.17	88.68	88.29	88.2	88.2	88.2	88.2	88.85	89.31	89.51	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

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

(219)m=	156.07	137.59	144.6	129.97	127.66	113.8	108.93	120.04	119.98	134.53	141.98	152.15
---------	--------	--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	--------

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

1587.31	(219)
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Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

942.61

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Water heating fuel used		1587.31	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	84.55		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	159.55	(231)
Electricity for lighting		189.76	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	203.6 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	342.86 (264)
Space and water heating	(261) + (262) + (263) + (264) =			546.46 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	82.8 (267)
Electricity for lighting	(232) x	0.519	=	98.49 (268)
Total CO2, kg/year		sum of (265)...(271) =		727.76 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.38 (273)
El rating (section 14)				88 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes ST GND 40

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	39.6 (1a)	2.5 (2a)	99 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	39.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	99 (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				2	20 (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) =	20 ÷ (5) = 0.2 (8)

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

Number of storeys in the dwelling (ns)	0 (9)
--	-------

Additional infiltration	[(9)-1]x0.1 = 0 (10)
-------------------------	----------------------

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0 (11)
--	--------

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0 (12)
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If no draught lobby, enter 0.05, else enter 0	0 (13)
---	--------

Percentage of windows and doors draught stripped	0 (14)
--	--------

Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0 (15)
---------------------	------------------------------------

Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0 (16)
-------------------	---

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
---	--------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.45 (18)
--	-----------

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

Number of sides sheltered	2 (19)
---------------------------	--------

Shelter factor	0.85 (20)
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Infiltration rate incorporating shelter factor	0.38 (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
---------	------	------	------	-----	------	------	------	------	---	------	------	------

TER WorkSheet: New dwelling design stage

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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (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 0.57 0.59 0.59 0.6 (24d)

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.3	$\times 1/[1/(1.4) + 0.04] =$	8.35		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Floor			39.6	$\times$	0.13		(28)
Walls	14.3	9.45	4.85	$\times$	0.18		(29)
Total area of elements, m²			53.9				(31)
Party wall			48.47	$\times$	0		(32)
Party ceiling			39.6				(32b)

* 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) = 18.55 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5418.3 (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 3.64 (36)

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

Total fabric heat loss (33) + (36) = 22.19 (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=	20.26	20.1	19.95	19.25	19.12	18.51	18.51	18.4	18.75	19.12	19.39	19.66

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

(39)m=	42.44	42.29	42.14	41.44	41.31	40.7	40.7	40.58	40.93	41.31	41.57	41.85
Average = Sum(39) _{1...12} /12=												41.44 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.07	1.07	1.06	1.05	1.04	1.03	1.03	1.02	1.03	1.04	1.05	1.06		
	Average = Sum(40) _{1...12} /12=												1.05	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.4

(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

67.35

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	74.08	71.39	68.7	66	63.31	60.61	60.61	63.31	66	68.7	71.39	74.08		
	Total = Sum(44) _{1...12} =												808.19	(44)

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

(45)m=	109.86	96.09	99.15	86.44	82.95	71.58	66.33	76.11	77.02	89.76	97.98	106.4		
	Total = Sum(45) _{1...12} =												1059.66	(45)

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

(46)m=	16.48	14.41	14.87	12.97	12.44	10.74	9.95	11.42	11.55	13.46	14.7	15.96		(46)
--------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

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

Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

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

(61)m=	37.75	32.86	35.01	32.55	32.26	29.89	30.89	32.26	32.55	35.01	35.21	37.75	(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=	147.62	128.95	134.16	118.99	115.21	101.47	97.21	108.37	109.57	124.76	133.18	144.15	(62)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

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

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

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

Output from water heater

(64)m=	147.62	128.95	134.16	118.99	115.21	101.47	97.21	108.37	109.57	124.76	133.18	144.15	
Output from water heater (annual) _{1...12}												1463.64	(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=	45.97	40.16	41.72	36.88	35.64	31.27	29.78	33.37	33.75	38.6	41.38	44.82	(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=	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	(66)

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

(67)m=	10.75	9.54	7.76	5.88	4.39	3.71	4.01	5.21	6.99	8.88	10.36	11.04	(67)
--------	-------	------	------	------	------	------	------	------	------	------	-------	-------	------

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

(68)m=	120.53	121.78	118.63	111.92	103.45	95.49	90.17	88.92	92.07	98.78	107.25	115.21	(68)
--------	--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	------

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

(69)m=	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	(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=	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	61.78	59.77	56.08	51.22	47.91	43.43	40.02	44.85	46.87	51.88	57.47	60.24	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	239.99	238.03	229.4	215.95	202.69	189.57	181.13	185.92	192.87	206.47	222.02	233.43	(73)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northwest 0.9x	0.77	x	6.3	x	11.28	x	0.63	x	0.7	=	21.72	(81)
Northwest 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	10.86	(81)
Northwest 0.9x	0.77	x	6.3	x	22.97	x	0.63	x	0.7	=	44.22	(81)
Northwest 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	22.11	(81)
Northwest 0.9x	0.77	x	6.3	x	41.38	x	0.63	x	0.7	=	79.67	(81)

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Northwest 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(81)
Northwest 0.9x	0.77	x	6.3	x	67.96	x	0.63	x	0.7	=	130.84	(81)
Northwest 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(81)
Northwest 0.9x	0.77	x	6.3	x	91.35	x	0.63	x	0.7	=	175.87	(81)
Northwest 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(81)
Northwest 0.9x	0.77	x	6.3	x	97.38	x	0.63	x	0.7	=	187.5	(81)
Northwest 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(81)
Northwest 0.9x	0.77	x	6.3	x	91.1	x	0.63	x	0.7	=	175.4	(81)
Northwest 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(81)
Northwest 0.9x	0.77	x	6.3	x	72.63	x	0.63	x	0.7	=	139.83	(81)
Northwest 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(81)
Northwest 0.9x	0.77	x	6.3	x	50.42	x	0.63	x	0.7	=	97.08	(81)
Northwest 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(81)
Northwest 0.9x	0.77	x	6.3	x	28.07	x	0.63	x	0.7	=	54.04	(81)
Northwest 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(81)
Northwest 0.9x	0.77	x	6.3	x	14.2	x	0.63	x	0.7	=	27.33	(81)
Northwest 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(81)
Northwest 0.9x	0.77	x	6.3	x	9.21	x	0.63	x	0.7	=	17.74	(81)
Northwest 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(81)

Solar gains in watts, calculated for each month

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

(83)m=	32.59	66.33	119.5	196.26	263.81	281.25	263.1	209.75	145.62	81.06	41	26.61	(83)
--------	-------	-------	-------	--------	--------	--------	-------	--------	--------	-------	----	-------	------

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

(84)m=	272.58	304.36	348.9	412.21	466.5	470.82	444.24	395.67	338.48	287.53	263.02	260.04	(84)
--------	--------	--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.91	0.75	0.54	0.4	0.47	0.76	0.96	0.99	1	(86)

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

(87)m=	19.95	20.09	20.35	20.7	20.92	20.99	21	21	20.94	20.63	20.23	19.93	(87)
--------	-------	-------	-------	------	-------	-------	----	----	-------	-------	-------	-------	------

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

(88)m=	20.02	20.03	20.03	20.04	20.05	20.06	20.06	20.06	20.06	20.05	20.04	20.04	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.99	0.97	0.89	0.7	0.47	0.32	0.37	0.68	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=	18.63	18.83	19.21	19.71	19.98	20.05	20.06	20.06	20.01	19.62	19.06	18.61	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.63

(91)

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

(92)m=	19.46	19.63	19.93	20.33	20.57	20.64	20.65	20.65	20.6	20.26	19.8	19.44	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------	-------	------

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

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(93)m=	19.46	19.63	19.93	20.33	20.57	20.64	20.65	20.65	20.6	20.26	19.8	19.44	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.99	0.99	0.97	0.9	0.73	0.52	0.37	0.43	0.73	0.95	0.99	1	(94)
--------	------	------	------	-----	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	270.94	300.91	338.36	369.61	339.65	242.63	164.47	171.54	246.69	272.13	259.94	258.8	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	643.46	622.72	565.97	473.75	366.47	245.97	164.91	172.54	265.92	398.95	528.02	637.9	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(98)m=	277.15	216.26	169.34	74.98	19.96	0	0	0	0	94.36	193.01	282.05	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												1327.11	(98)

Space heating requirement in $kWh/m^2/year$

33.51	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

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

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

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

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

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

Efficiency of main space heating system 1

93.4	(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)

277.15	216.26	169.34	74.98	19.96	0	0	0	0	94.36	193.01	282.05	
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------	--

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

296.73	231.54	181.31	80.28	21.37	0	0	0	0	101.02	206.65	301.98	
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------	--

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

1420.89	(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	
---------	---	---	---	---	---	---	---	---	---	---	---	--

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

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

Water heating

Output from water heater (calculated above)

147.62	128.95	134.16	118.99	115.21	101.47	97.21	108.37	109.57	124.76	133.18	144.15	
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--

Efficiency of water heater

80.3	(216)
------	-------

(217)m=	86.61	86.34	85.64	83.92	81.65	80.3	80.3	80.3	80.3	84.36	85.98	86.71	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

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

(219)m=	170.43	149.34	156.66	141.79	141.1	126.36	121.06	134.96	136.45	147.9	154.89	166.24	
---------	--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	--

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

1747.19	(219)
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Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

1420.89

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Water heating fuel used		1747.19	
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		189.76	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	306.91 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	377.39 (264)
Space and water heating	(261) + (262) + (263) + (264) =		684.3 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	98.49 (268)
Total CO2, kg/year	sum of (265)...(271) =		821.72 (272)
TER =			20.75 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes ST MID 38

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	38.4 (1a)	2.5 (2a)	96 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	38.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	96 (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				0	0 (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) =	0 (8)

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

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.18 (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) = 0.15 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

78.2 (23c)

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

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

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

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

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

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

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

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

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

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

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

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	13.5	6.3	7.2	$\times 0.18 =$	1.3		(29)
Total area of elements, m²			13.5				(31)
Party wall			52.65	$\times 0 =$	0		(32)
Party floor			38.4				(32a)
Party ceiling			38.4				(32b)

* 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) = 9.65 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4173 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 2.12 (36)

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

Total fabric heat loss (33) + (36) = 11.77 (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=	9.46	9.34	9.23	8.64	8.52	7.93	7.93	7.81	8.17	8.52	8.75	8.99

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

(39)m=	21.23	21.11	20.99	20.4	20.29	19.7	19.7	19.58	19.93	20.29	20.52	20.76
Average = Sum(39) _{1...12} /12=												20.37 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.55	0.55	0.55	0.53	0.53	0.51	0.51	0.51	0.52	0.53	0.53	0.54		
	Average = Sum(40) _{1...12} /12=												0.53	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.36

(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

66.61

(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=	73.27	70.6	67.94	65.27	62.61	59.95	59.95	62.61	65.27	67.94	70.6	73.27		
	Total = Sum(44) _{1...12} =												799.28	(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=	108.65	95.03	98.06	85.49	82.03	70.79	65.59	75.27	76.17	88.77	96.9	105.22		
	Total = Sum(45) _{1...12} =												1047.98	(45)

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

(46)m=	16.3	14.25	14.71	12.82	12.3	10.62	9.84	11.29	11.43	13.32	14.53	15.78		(46)
--------	------	-------	-------	-------	------	-------	------	-------	-------	-------	-------	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

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

Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

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

(61)m=	29.79	26.91	29.78	28.81	29.77	28.8	29.75	29.76	28.81	29.77	28.82	29.79	(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=	138.45	121.93	127.84	114.3	111.8	99.58	95.35	105.03	104.97	118.54	125.72	135.02	(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=	138.45	121.93	127.84	114.3	111.8	99.58	95.35	105.03	104.97	118.54	125.72	135.02	
Output from water heater (annual) _{1...12}												1398.54	(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=	43.58	38.32	40.05	35.63	34.72	30.74	29.25	32.47	32.53	36.96	39.42	42.44	(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=	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	(66)

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

(67)m=	10.88	9.66	7.86	5.95	4.45	3.75	4.06	5.27	7.08	8.99	10.49	11.18	(67)
--------	-------	------	------	------	------	------	------	------	------	------	-------	-------	------

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

(68)m=	117.53	118.75	115.68	109.13	100.88	93.11	87.93	86.71	89.78	96.32	104.58	112.35	(68)
--------	--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	------

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

(69)m=	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	(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=	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	58.57	57.03	53.83	49.48	46.66	42.69	39.31	43.64	45.18	49.68	54.76	57.04	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	233.45	231.91	223.83	211.04	198.45	186.02	177.76	182.09	188.5	201.45	216.29	227.03	(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)	
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)

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Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)

Solar gains in watts, calculated for each month

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

(83)m=	70.84	120.67	165.1	204.57	229.14	227.48	219.32	200.99	178.77	133.37	84.85	60.63	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	304.29	352.58	388.94	415.61	427.59	413.51	397.08	383.08	367.28	334.82	301.15	287.66	(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=	0.96	0.89	0.76	0.59	0.44	0.3	0.22	0.24	0.37	0.63	0.88	0.97	(86)

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

(87)m=	20.83	20.93	20.98	21	21	21	21	21	21	21	20.94	20.81	(87)
--------	-------	-------	-------	----	----	----	----	----	----	----	-------	-------	------

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

(88)m=	20.47	20.48	20.48	20.49	20.49	20.51	20.51	20.51	20.5	20.49	20.49	20.48	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

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

(89)m=	0.95	0.87	0.74	0.57	0.42	0.28	0.19	0.21	0.35	0.6	0.86	0.96	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	20.25	20.39	20.46	20.49	20.49	20.51	20.51	20.51	20.5	20.49	20.43	20.24	(90)
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fLA = Living area ÷ (4) = 0.65 (91)

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

(92)m=	20.63	20.74	20.8	20.82	20.82	20.83	20.83	20.83	20.83	20.82	20.76	20.61	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	20.63	20.74	20.8	20.82	20.82	20.83	20.83	20.83	20.83	20.82	20.76	20.61	(93)
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8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.95	0.88	0.76	0.58	0.43	0.3	0.21	0.23	0.37	0.62	0.87	0.96	(94)
--------	------	------	------	------	------	-----	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	289.49	309.66	293.84	242.67	185.05	122.68	83.29	86.73	134.07	206.61	262.2	276.97	(95)
--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	-------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	346.57	334.32	300.14	243.23	185.08	122.68	83.29	86.73	134.08	207.34	280.38	340.56	(97)
--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	------

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

(98)m=	42.47	16.57	4.69	0.4	0.02	0	0	0	0	0.55	13.09	47.31	
--------	-------	-------	------	-----	------	---	---	---	---	------	-------	-------	--

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 125.1 (98)

Space heating requirement in $kWh/m^2/year$

3.26 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

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

1 (204)

Efficiency of main space heating system 1

93.4 (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)

42.47	16.57	4.69	0.4	0.02	0	0	0	0	0.55	13.09	47.31
-------	-------	------	-----	------	---	---	---	---	------	-------	-------

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

45.47	17.74	5.02	0.43	0.02	0	0	0	0	0.59	14.01	50.65
-------	-------	------	------	------	---	---	---	---	------	-------	-------

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 133.94 (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 ($kWh/year$) = $Sum(215)_{1..5,10..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

138.45	121.93	127.84	114.3	111.8	99.58	95.35	105.03	104.97	118.54	125.72	135.02
--------	--------	--------	-------	-------	-------	-------	--------	--------	--------	--------	--------

Efficiency of water heater

88.2 (216)

(217)m=	88.71	88.46	88.28	88.21	88.2	88.2	88.2	88.2	88.2	88.21	88.4	88.76	(217)
---------	-------	-------	-------	-------	------	------	------	------	------	-------	------	-------	-------

Fuel for water heating, $kWh/month$

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

(219)m=	156.07	137.84	144.82	129.58	126.75	112.91	108.1	119.08	119.02	134.39	142.21	152.11
---------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

Total = $Sum(219a)_{1..12} =$ 1582.9 (219)

Annual totals

Space heating fuel used, main system 1

$kWh/year$

$kWh/year$

133.94

DER WorkSheet: New dwelling design stage

Water heating fuel used		1582.9	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	81.98		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	156.98	(231)
Electricity for lighting		192.12	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	28.93 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	341.91 (264)
Space and water heating	(261) + (262) + (263) + (264) =			370.84 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	81.47 (267)
Electricity for lighting	(232) x	0.519	=	99.71 (268)
Total CO2, kg/year		sum of (265)...(271) =		552.02 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.38 (273)
El rating (section 14)				91 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes ST MID 38

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	38.4 (1a)	2.5 (2a)	96 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	38.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	96 (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				2	20 (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) =	20 ÷ (5) = 0.21 (8)

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

Number of storeys in the dwelling (ns)	0 (9)
--	-------

Additional infiltration	[(9)-1]x0.1 = 0 (10)
-------------------------	----------------------

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0 (11)
--	--------

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0 (12)
---	--------

If no draught lobby, enter 0.05, else enter 0	0 (13)
---	--------

Percentage of windows and doors draught stripped	0 (14)
--	--------

Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0 (15)
---------------------	------------------------------------

Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0 (16)
-------------------	---

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
---	--------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.46 (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) = 0.39 (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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

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

TER WorkSheet: New dwelling design stage

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

0.5	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) x 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) x [1 - (23c) ÷ 100]

(24a)m=

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

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

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

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

(24c)m=

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		
Walls	13.5	6.3	7.2	$\times 0.18 =$	1.3		
Total area of elements, m²			13.5				
Party wall			52.65	$\times 0 =$	0		
Party floor			38.4				
Party ceiling			38.4				

* 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) = 9.65 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4173 (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 1.4 (36)

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

Total fabric heat loss (33) + (36) = 11.05 (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=	19.75	19.6	19.45	18.75	18.62	18.01	18.01	17.9	18.24	18.62	18.88	19.16

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

(39)m=	30.79	30.64	30.49	29.8	29.66	29.06	29.06	28.94	29.29	29.66	29.93	30.21
Average = Sum(39) _{1...12} /12=												29.79

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.8	0.8	0.79	0.78	0.77	0.76	0.76	0.75	0.76	0.77	0.78	0.79		
	Average = Sum(40) _{1...12} /12=												0.78	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.36

(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

66.61

(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=	73.27	70.6	67.94	65.27	62.61	59.95	59.95	62.61	65.27	67.94	70.6	73.27		
	Total = Sum(44) _{1...12} =												799.28	(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=	108.65	95.03	98.06	85.49	82.03	70.79	65.59	75.27	76.17	88.77	96.9	105.22		
	Total = Sum(45) _{1...12} =												1047.98	(45)

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

(46)m=	16.3	14.25	14.71	12.82	12.3	10.62	9.84	11.29	11.43	13.32	14.53	15.78		(46)
--------	------	-------	-------	-------	------	-------	------	-------	-------	-------	-------	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

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

Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

TER WorkSheet: New dwelling design stage

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

(61)m=	37.34	32.5	34.62	32.19	31.91	29.56	30.55	31.91	32.19	34.62	34.82	37.34	(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=	145.99	127.53	132.68	117.68	113.94	100.35	96.14	107.18	108.36	123.39	131.72	142.56	(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=	145.99	127.53	132.68	117.68	113.94	100.35	96.14	107.18	108.36	123.39	131.72	142.56	
Output from water heater (annual) _{1...12}												1447.51	(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=	45.46	39.72	41.26	36.47	35.25	30.93	29.45	33	33.37	38.17	40.92	44.32	(65)
--------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	------

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	(66)

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

(67)m=	10.88	9.66	7.86	5.95	4.45	3.75	4.06	5.27	7.08	8.99	10.49	11.18	(67)
--------	-------	------	------	------	------	------	------	------	------	------	-------	-------	------

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

(68)m=	117.53	118.75	115.68	109.13	100.88	93.11	87.93	86.71	89.78	96.32	104.58	112.35	(68)
--------	--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	------

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

(69)m=	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	(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=	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	61.1	59.11	55.46	50.66	47.38	42.95	39.58	44.36	46.35	51.3	56.84	59.57	(72)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(73)m=	235.98	233.99	225.46	212.21	199.17	186.29	178.03	182.81	189.68	203.08	218.38	229.57	(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)	
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)

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Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)

Solar gains in watts, calculated for each month

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

(83)m=	70.84	120.67	165.1	204.57	229.14	227.48	219.32	200.99	178.77	133.37	84.85	60.63	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	306.82	354.66	390.57	416.78	428.31	413.77	397.35	383.8	368.45	336.45	303.23	290.19	(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)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	0.99	0.97	0.92	0.8	0.63	0.45	0.32	0.35	0.54	0.83	0.97	0.99	

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

(87)m=	20.45	20.61	20.78	20.93	20.99	21	21	21	21	20.93	20.68	20.42	(87)
--------	-------	-------	-------	-------	-------	----	----	----	----	-------	-------	-------	------

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

(88)m=	20.25	20.26	20.26	20.27	20.28	20.29	20.29	20.29	20.29	20.28	20.27	20.26	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.98	0.96	0.9	0.77	0.59	0.4	0.27	0.29	0.49	0.8	0.96	0.99	(89)
--------	------	------	-----	------	------	-----	------	------	------	-----	------	------	------

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

(90)m=	19.53	19.76	20	20.2	20.27	20.29	20.29	20.29	20.28	20.2	19.87	19.5	(90)
--------	-------	-------	----	------	-------	-------	-------	-------	-------	------	-------	------	------

fLA = Living area ÷ (4) =

0.65 (91)

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

(92)m=	20.13	20.31	20.51	20.68	20.74	20.75	20.75	20.75	20.75	20.67	20.4	20.1	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------	------

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

TER WorkSheet: New dwelling design stage

(93)m=	20.13	20.31	20.51	20.68	20.74	20.75	20.75	20.75	20.75	20.67	20.4	20.1	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.98	0.96	0.91	0.79	0.62	0.43	0.3	0.33	0.53	0.82	0.96	0.99	(94)
--------	------	------	------	------	------	------	-----	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	301.74	340.55	354.57	328.49	264.18	178.49	120.64	125.97	193.7	275.03	290.86	286.55	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	487.39	472.23	427.21	350.92	268.05	178.75	120.66	126	194.71	298.84	397.96	480.35	(97)
--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------	------

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

(98)m=	138.12	88.49	54.04	16.15	2.88	0	0	0	0	17.72	77.11	144.19	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												538.7	(98)

Space heating requirement in $kWh/m^2/year$

14.03	(99)
-------	------

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

Space heating:

Fraction of space heat from secondary/supplementary system

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

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

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

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

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

Efficiency of main space heating system 1

93.4	(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)

138.12	88.49	54.04	16.15	2.88	0	0	0	0	17.72	77.11	144.19
--------	-------	-------	-------	------	---	---	---	---	-------	-------	--------

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

147.88	94.74	57.86	17.29	3.09	0	0	0	0	18.97	82.56	154.38
--------	-------	-------	-------	------	---	---	---	---	-------	-------	--------

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

576.77	(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
---------	---	---	---	---	---	---	---	---	---	---	---

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

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

Water heating

Output from water heater (calculated above)

145.99	127.53	132.68	117.68	113.94	100.35	96.14	107.18	108.36	123.39	131.72	142.56
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3	(216)
------	-------

(217)m=	84.91	84.15	82.98	81.4	80.52	80.3	80.3	80.3	80.3	81.44	83.76	85.08	(217)
---------	-------	-------	-------	------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

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

(219)m=	171.93	151.54	159.89	144.58	141.5	124.97	119.73	133.47	134.94	151.5	157.26	167.56
---------	--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------

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

1758.88	(219)
---------	-------

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

576.77

TER WorkSheet: New dwelling design stage

Water heating fuel used		1758.88	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		192.12	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	124.58 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	379.92 (264)
Space and water heating	(261) + (262) + (263) + (264) =		504.5 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	99.71 (268)
Total CO2, kg/year	sum of (265)...(271) =		643.13 (272)
TER =			16.75 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes ST TOP 38

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	38.4 (1a)	2.5 (2a)	96 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	38.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	96 (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				0	0 (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) =	0 (8)

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

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.18 (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) = 0.15 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

78.2 (23c)

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

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

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

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

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

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

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

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

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

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

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

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	13.5	6.3	7.2	$\times$ 0.18	1.3		(29)
Roof	38.4	0	38.4	$\times$ 0.15	5.76		(30)
Total area of elements, m²			51.9				(31)
Party wall			52.65	$\times$ 0	0		(32)
Party floor			38.4				(32a)

* 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) = 15.41 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 3366.6 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 3.85 (36)

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

Total fabric heat loss (33) + (36) = 19.25 (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=	9.46	9.34	9.23	8.64	8.52	7.93	7.93	7.81	8.17	8.52	8.75	8.99

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

(39)m=	28.72	28.6	28.48	27.89	27.77	27.18	27.18	27.07	27.42	27.77	28.01	28.24
Average = Sum(39) _{1...12} /12=												27.86 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.75	0.74	0.74	0.73	0.72	0.71	0.71	0.7	0.71	0.72	0.73	0.74		
	Average = Sum(40) _{1...12} /12=												0.73	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.36

(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

66.61

(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=	73.27	70.6	67.94	65.27	62.61	59.95	59.95	62.61	65.27	67.94	70.6	73.27		
	Total = Sum(44) _{1...12} =												799.28	(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=	108.65	95.03	98.06	85.49	82.03	70.79	65.59	75.27	76.17	88.77	96.9	105.22		
	Total = Sum(45) _{1...12} =												1047.98	(45)

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

(46)m=	16.3	14.25	14.71	12.82	12.3	10.62	9.84	11.29	11.43	13.32	14.53	15.78		(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

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

Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

DER WorkSheet: New dwelling design stage

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

(61)m=	29.79	26.91	29.78	28.81	29.77	28.8	29.75	29.76	28.81	29.77	28.82	29.79	(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=	138.45	121.93	127.84	114.3	111.8	99.58	95.35	105.03	104.97	118.54	125.72	135.02	(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=	138.45	121.93	127.84	114.3	111.8	99.58	95.35	105.03	104.97	118.54	125.72	135.02	
Output from water heater (annual) _{1...12}												1398.54	(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=	43.58	38.32	40.05	35.63	34.72	30.74	29.25	32.47	32.53	36.96	39.42	42.44	(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=	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	(66)

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

(67)m=	10.88	9.66	7.86	5.95	4.45	3.75	4.06	5.27	7.08	8.99	10.49	11.18	(67)
--------	-------	------	------	------	------	------	------	------	------	------	-------	-------	------

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

(68)m=	117.53	118.75	115.68	109.13	100.88	93.11	87.93	86.71	89.78	96.32	104.58	112.35	(68)
--------	--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	------

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

(69)m=	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	(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=	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	58.57	57.03	53.83	49.48	46.66	42.69	39.31	43.64	45.18	49.68	54.76	57.04	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	233.45	231.91	223.83	211.04	198.45	186.02	177.76	182.09	188.5	201.45	216.29	227.03	(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)	
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)

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Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)

Solar gains in watts, calculated for each month

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

(83)m=	70.84	120.67	165.1	204.57	229.14	227.48	219.32	200.99	178.77	133.37	84.85	60.63	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	304.29	352.58	388.94	415.61	427.59	413.51	397.08	383.08	367.28	334.82	301.15	287.66	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.96	0.9	0.77	0.6	0.42	0.3	0.32	0.51	0.81	0.96	0.99	(86)

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

(87)m=	20.53	20.68	20.84	20.96	20.99	21	21	21	21	20.95	20.74	20.5	(87)
--------	-------	-------	-------	-------	-------	----	----	----	----	-------	-------	------	------

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

(88)m=	20.3	20.3	20.3	20.32	20.32	20.33	20.33	20.34	20.33	20.32	20.31	20.31	(88)
--------	------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.98	0.95	0.88	0.74	0.56	0.38	0.26	0.28	0.46	0.77	0.95	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	19.68	19.9	20.11	20.27	20.31	20.33	20.33	20.34	20.33	20.27	19.99	19.65	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.65 (91)

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

(92)m=	20.23	20.41	20.58	20.72	20.76	20.77	20.77	20.77	20.76	20.71	20.47	20.2	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

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(93)m=	20.23	20.41	20.58	20.72	20.76	20.77	20.77	20.77	20.76	20.71	20.47	20.2	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.98	0.95	0.89	0.76	0.58	0.41	0.29	0.31	0.5	0.79	0.95	0.99	(94)
--------	------	------	------	------	------	------	------	------	-----	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	298.66	336.29	346.85	315.19	249.47	167.54	113.28	118.23	182.23	264.89	286.98	283.69	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	457.44	443.45	401.12	329.6	251.53	167.65	113.29	118.24	182.73	280.88	374.62	451.93	(97)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	118.14	72.01	40.38	10.37	1.54	0	0	0	0	11.89	63.1	125.17	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												442.6	(98)

Space heating requirement in $kWh/m^2/year$

11.53	(99)
-------	------

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

Space heating:

Fraction of space heat from secondary/supplementary system

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

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

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

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

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

Efficiency of main space heating system 1

93.4	(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)

118.14	72.01	40.38	10.37	1.54	0	0	0	0	11.89	63.1	125.17
--------	-------	-------	-------	------	---	---	---	---	-------	------	--------

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

126.49	77.09	43.23	11.11	1.64	0	0	0	0	12.73	67.56	134.02
--------	-------	-------	-------	------	---	---	---	---	-------	-------	--------

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

473.87	(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	
---------	---	---	---	---	---	---	---	---	---	---	---	--

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

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

Water heating

Output from water heater (calculated above)

138.45	121.93	127.84	114.3	111.8	99.58	95.35	105.03	104.97	118.54	125.72	135.02
--------	--------	--------	-------	-------	-------	-------	--------	--------	--------	--------	--------

Efficiency of water heater

88.2	(216)
------	-------

(217)m=	89.2	89	88.72	88.38	88.23	88.2	88.2	88.2	88.2	88.4	88.92	89.24	(217)
---------	------	----	-------	-------	-------	------	------	------	------	------	-------	-------	-------

Fuel for water heating, $kWh/month$

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

(219)m=	155.21	137	144.1	129.33	126.71	112.91	108.1	119.08	119.02	134.1	141.38	151.29
---------	--------	-----	-------	--------	--------	--------	-------	--------	--------	-------	--------	--------

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

1578.24	(219)
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Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year	
473.87	

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Water heating fuel used		1578.24	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	81.98		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	156.98	(231)
Electricity for lighting		192.12	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	102.36 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	340.9 (264)
Space and water heating	(261) + (262) + (263) + (264) =			443.26 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	81.47 (267)
Electricity for lighting	(232) x	0.519	=	99.71 (268)
Total CO2, kg/year		sum of (265)...(271) =		624.44 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.26 (273)
El rating (section 14)				90 (274)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes ST TOP 38

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	38.4 (1a)	2.5 (2a)	96 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	38.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	96 (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				2	20 (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) =	20 ÷ (5) = 0.21 (8)

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

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.46 (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) = 0.39 (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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

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

TER WorkSheet: New dwelling design stage

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

0.5	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) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

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

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (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)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	13.5	6.3	7.2	$\times$ 0.18	1.3		(29)
Roof	38.4	0	38.4	$\times$ 0.13	4.99		(30)
Total area of elements, m²			51.9				(31)
Party wall			52.65	$\times$ 0	0		(32)
Party floor			38.4				(32a)

* 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) = 14.64 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 3366.6 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 2.48 (36)

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

Total fabric heat loss (33) + (36) = 17.12 (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=	19.75	19.6	19.45	18.75	18.62	18.01	18.01	17.9	18.24	18.62	18.88	19.16

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

(39)m=	36.87	36.71	36.57	35.87	35.74	35.13	35.13	35.02	35.36	35.74	36	36.28
Average = Sum(39) _{1...12} /12=												35.87 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.96	0.96	0.95	0.93	0.93	0.91	0.91	0.91	0.92	0.93	0.94	0.94		
	Average = Sum(40) _{1...12} /12=												0.93	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.36

(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

66.61

(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=	73.27	70.6	67.94	65.27	62.61	59.95	59.95	62.61	65.27	67.94	70.6	73.27		
	Total = Sum(44) _{1...12} =												799.28	(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=	108.65	95.03	98.06	85.49	82.03	70.79	65.59	75.27	76.17	88.77	96.9	105.22		
	Total = Sum(45) _{1...12} =												1047.98	(45)

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

(46)m=	16.3	14.25	14.71	12.82	12.3	10.62	9.84	11.29	11.43	13.32	14.53	15.78		(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

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

Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

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

(61)m=	37.34	32.5	34.62	32.19	31.91	29.56	30.55	31.91	32.19	34.62	34.82	37.34	(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=	145.99	127.53	132.68	117.68	113.94	100.35	96.14	107.18	108.36	123.39	131.72	142.56	(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=	145.99	127.53	132.68	117.68	113.94	100.35	96.14	107.18	108.36	123.39	131.72	142.56	
Output from water heater (annual) _{1...12}												1447.51	(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=	45.46	39.72	41.26	36.47	35.25	30.93	29.45	33	33.37	38.17	40.92	44.32	(65)
--------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	------

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	(66)

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

(67)m=	10.88	9.66	7.86	5.95	4.45	3.75	4.06	5.27	7.08	8.99	10.49	11.18	(67)
--------	-------	------	------	------	------	------	------	------	------	------	-------	-------	------

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

(68)m=	117.53	118.75	115.68	109.13	100.88	93.11	87.93	86.71	89.78	96.32	104.58	112.35	(68)
--------	--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	------

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

(69)m=	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	(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=	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	61.1	59.11	55.46	50.66	47.38	42.95	39.58	44.36	46.35	51.3	56.84	59.57	(72)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(73)m=	235.98	233.99	225.46	212.21	199.17	186.29	178.03	182.81	189.68	203.08	218.38	229.57	(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)	
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)

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Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)

Solar gains in watts, calculated for each month

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

(83)m=	70.84	120.67	165.1	204.57	229.14	227.48	219.32	200.99	178.77	133.37	84.85	60.63	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	306.82	354.66	390.57	416.78	428.31	413.77	397.35	383.8	368.45	336.45	303.23	290.19	(84)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.87	0.73	0.54	0.39	0.42	0.64	0.9	0.98	0.99	(86)

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

(87)m=	20.21	20.38	20.6	20.82	20.95	20.99	21	21	20.98	20.82	20.48	20.18	(87)
--------	-------	-------	------	-------	-------	-------	----	----	-------	-------	-------	-------	------

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

(88)m=	20.12	20.12	20.12	20.14	20.14	20.15	20.15	20.16	20.15	20.14	20.14	20.13	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.97	0.94	0.84	0.68	0.47	0.31	0.34	0.57	0.86	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	19.08	19.33	19.63	19.94	20.1	20.15	20.15	20.16	20.14	19.95	19.49	19.05	(90)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.65

(91)

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

(92)m=	19.82	20.01	20.26	20.52	20.65	20.7	20.7	20.71	20.69	20.52	20.13	19.79	(92)
--------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	------

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

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(93)m=	19.82	20.01	20.26	20.52	20.65	20.7	20.7	20.71	20.69	20.52	20.13	19.79	(93)
--------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.99	0.97	0.94	0.86	0.71	0.51	0.36	0.39	0.62	0.88	0.97	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	302.98	344.84	366.54	356.79	303.62	212.33	143.99	150.43	227.3	295.37	294.8	287.41	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	-------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	572.01	554.89	503.12	416.6	319.92	214.26	144.18	150.74	232.92	354.42	469.25	565.5	(97)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(98)m=	200.15	141.16	101.62	43.06	12.12	0	0	0	0	43.93	125.61	206.9	(98)
--------	--------	--------	--------	-------	-------	---	---	---	---	-------	--------	-------	------

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 874.55

Space heating requirement in $kWh/m^2/year$

22.77 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

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

1 (204)

Efficiency of main space heating system 1

93.4 (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)

200.15	141.16	101.62	43.06	12.12	0	0	0	0	43.93	125.61	206.9
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	-------

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

214.3	151.13	108.8	46.1	12.98	0	0	0	0	47.03	134.49	221.52
-------	--------	-------	------	-------	---	---	---	---	-------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 936.35 (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 ($kWh/year$) = $Sum(215)_{1..5,10..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

145.99	127.53	132.68	117.68	113.94	100.35	96.14	107.18	108.36	123.39	131.72	142.56
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3 (216)

(217)m=	85.85	85.31	84.39	82.78	81.17	80.3	80.3	80.3	80.3	82.73	84.93	85.99	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

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

(219)m=	170.06	149.49	157.23	142.17	140.37	124.97	119.73	133.47	134.94	149.15	155.08	165.79
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = $Sum(219a)_{1..12} =$ 1742.45 (219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

936.35

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Water heating fuel used		1742.45	
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		192.12	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	202.25 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	376.37 (264)
Space and water heating	(261) + (262) + (263) + (264) =			578.62 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93 (267)
Electricity for lighting	(232) x	0.519	=	99.71 (268)
Total CO2, kg/year	sum of (265)...(271) =			717.25 (272)
TER =				18.68 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 1BF MID 50

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50.2 (1a) x	2.5 (2a) =	125.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	125.5 (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				0 x 10 =	0 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) = 0 (8)

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

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.18 (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) = 0.15 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

78.2 (23c)

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

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

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

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

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

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

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

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

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

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

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

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			9.45	$\times 1/[1/(1.4) + 0.04] =$	12.53		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	24.73	12.6	12.13	$\times 0.18 =$	2.18		(29)
Total area of elements, m²			24.73				(31)
Party wall			45.62	$\times 0 =$	0		(32)
Party floor			50.2				(32a)
Party ceiling			50.2				(32b)

* 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) = 18.89 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5153.95 (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 3.68 (36)

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

Total fabric heat loss (33) + (36) = 22.56 (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=	12.37	12.21	12.06	11.29	11.14	10.37	10.37	10.21	10.67	11.14	11.44	11.75

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

(39)m= 34.93 34.78 34.63 33.86 33.7 32.93 32.93 32.78 33.24 33.7 34.01 34.32
Average = Sum(39)_{1...12} /12= 33.82 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.7	0.69	0.69	0.67	0.67	0.66	0.66	0.65	0.66	0.67	0.68	0.68		
Average = Sum(40) _{1...12} /12=													0.67	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.7

(42)

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

if TFA ≤ 13.9, N = 1

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

74.48

(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=	81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93		
Total = Sum(44) _{1...12} =													893.76	(44)

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

(45)m=	121.5	106.26	109.65	95.6	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66		
Total = Sum(45) _{1...12} =													1171.86	(45)

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

(46)m=	18.22	15.94	16.45	14.34	13.76	11.87	11	12.63	12.78	14.89	16.25	17.65		(46)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

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

Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

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

(61)m=	29.81	26.92	29.8	28.83	29.78	28.81	29.76	29.77	28.82	29.79	28.84	29.81	(61)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(62)m=	151.31	133.18	139.45	124.42	121.51	107.96	103.11	113.94	113.99	129.05	137.19	147.47	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

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

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

Output from water heater

(64)m=	151.31	133.18	139.45	124.42	121.51	107.96	103.11	113.94	113.99	129.05	137.19	147.47	
Output from water heater (annual) _{1...12}												1522.59	(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=	47.85	42.06	43.91	38.99	37.94	33.52	31.83	35.43	35.52	40.45	43.24	46.58	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	(66)

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

(67)m=	13.17	11.7	9.51	7.2	5.38	4.55	4.91	6.38	8.57	10.88	12.7	13.54	(67)
--------	-------	------	------	-----	------	------	------	------	------	-------	------	-------	------

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

(68)m=	147.75	149.29	145.42	137.2	126.81	117.06	110.54	109	112.87	121.09	131.48	141.23	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-----	--------	--------	--------	--------	------

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

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

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

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

(71)m=	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	64.32	62.59	59.02	54.16	51	46.56	42.78	47.62	49.34	54.37	60.05	62.6	(72)
--------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	-------	------	------

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

(73)m=	276.68	275.02	265.39	250	234.64	219.6	209.67	214.45	222.22	237.78	255.67	268.81	(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)	
Northwest 0.9x	0.77	x	9.45	x	11.28	x	0.63	x	0.7	=	32.59	(81)
Northwest 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	10.86	(81)
Northwest 0.9x	0.77	x	9.45	x	22.97	x	0.63	x	0.7	=	66.33	(81)
Northwest 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	22.11	(81)
Northwest 0.9x	0.77	x	9.45	x	41.38	x	0.63	x	0.7	=	119.5	(81)

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Northwest 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(81)
Northwest 0.9x	0.77	x	9.45	x	67.96	x	0.63	x	0.7	=	196.26	(81)
Northwest 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(81)
Northwest 0.9x	0.77	x	9.45	x	91.35	x	0.63	x	0.7	=	263.81	(81)
Northwest 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(81)
Northwest 0.9x	0.77	x	9.45	x	97.38	x	0.63	x	0.7	=	281.25	(81)
Northwest 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(81)
Northwest 0.9x	0.77	x	9.45	x	91.1	x	0.63	x	0.7	=	263.1	(81)
Northwest 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(81)
Northwest 0.9x	0.77	x	9.45	x	72.63	x	0.63	x	0.7	=	209.75	(81)
Northwest 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(81)
Northwest 0.9x	0.77	x	9.45	x	50.42	x	0.63	x	0.7	=	145.62	(81)
Northwest 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(81)
Northwest 0.9x	0.77	x	9.45	x	28.07	x	0.63	x	0.7	=	81.06	(81)
Northwest 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(81)
Northwest 0.9x	0.77	x	9.45	x	14.2	x	0.63	x	0.7	=	41	(81)
Northwest 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(81)
Northwest 0.9x	0.77	x	9.45	x	9.21	x	0.63	x	0.7	=	26.61	(81)
Northwest 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(81)

Solar gains in watts, calculated for each month

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

(83)m=	43.45	88.44	159.34	261.68	351.75	375	350.81	279.67	194.16	108.08	54.67	35.48	(83)
--------	-------	-------	--------	--------	--------	-----	--------	--------	--------	--------	-------	-------	------

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

(84)m=	320.13	363.46	424.73	511.68	586.39	594.6	560.48	494.11	416.37	345.86	310.33	304.3	(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	0.94	0.77	0.53	0.35	0.26	0.31	0.55	0.89	0.99	1	(86)

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

(87)m=	20.46	20.59	20.79	20.97	21	21	21	21	21	20.91	20.66	20.44	(87)
--------	-------	-------	-------	-------	----	----	----	----	----	-------	-------	-------	------

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

(88)m=	20.34	20.35	20.35	20.36	20.37	20.38	20.38	20.38	20.37	20.37	20.36	20.36	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.93	0.74	0.5	0.32	0.22	0.26	0.5	0.86	0.98	1	(89)
--------	------	------	------	------	-----	------	------	------	-----	------	------	---	------

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

(90)m=	19.62	19.81	20.1	20.33	20.36	20.38	20.38	20.38	20.37	20.28	19.92	19.6	(90)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	20.04	20.2	20.45	20.65	20.68	20.69	20.69	20.69	20.68	20.59	20.29	20.02	(92)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

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(93)m=	20.04	20.2	20.45	20.65	20.68	20.69	20.69	20.69	20.68	20.59	20.29	20.02	(93)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.99	0.98	0.93	0.75	0.51	0.34	0.24	0.28	0.52	0.88	0.98	1	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	317.98	357.06	396.47	384	301.84	200.48	134.64	140.61	218.25	302.79	304.78	302.8	(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, L_m , $W = [(39)m \times [(93)m - (96)m]$

(97)m=	549.81	532.05	482.85	397.66	302.63	200.51	134.64	140.62	218.86	336.81	448.57	542.91	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	172.48	117.59	64.26	9.84	0.59	0	0	0	0	25.31	103.52	178.64	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												672.24	(98)

Space heating requirement in $kWh/m^2/year$

13.39	(99)
-------	------

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

Space heating:

Fraction of space heat from secondary/supplementary system

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

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

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

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

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

Efficiency of main space heating system 1

93.4	(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)

172.48	117.59	64.26	9.84	0.59	0	0	0	0	25.31	103.52	178.64
--------	--------	-------	------	------	---	---	---	---	-------	--------	--------

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

184.67	125.9	68.81	10.53	0.63	0	0	0	0	27.1	110.84	191.26
--------	-------	-------	-------	------	---	---	---	---	------	--------	--------

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

719.74	(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...5,10...12} =												0	(215)

Water heating

Output from water heater (calculated above)

151.31	133.18	139.45	124.42	121.51	107.96	103.11	113.94	113.99	129.05	137.19	147.47
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

88.2	(216)
------	-------

(217)m=	89.36	89.22	88.88	88.36	88.21	88.2	88.2	88.2	88.2	88.55	89.13	89.39	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

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

(219)m=	169.33	149.28	156.89	140.82	137.75	122.41	116.91	129.18	129.24	145.73	153.92	164.97	
Total = Sum(219a) _{1...12} =												1716.43	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

719.74

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Water heating fuel used		1716.43	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	107.18		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		182.18 (231)
Electricity for lighting		232.63	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	155.46 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	370.75 (264)
Space and water heating	(261) + (262) + (263) + (264) =			526.21 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	94.55 (267)
Electricity for lighting	(232) x	0.519	=	120.73 (268)
Total CO2, kg/year	sum of (265)...(271) =			741.5 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			14.77 (273)
El rating (section 14)				90 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 1BF MID 50

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50.2 (1a)	2.5 (2a)	125.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	125.5 (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				2	20 (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) =	20 ÷ (5) = 0.16 (8)

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

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.41 (18)

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

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			9.41	$\times 1/[1/(1.4) + 0.04] =$	12.48		(27)
Windows Type 2			3.14	$\times 1/[1/(1.4) + 0.04] =$	4.16		(27)
Walls	24.73	12.55	12.18	$\times 0.18 =$	2.19		(29)
Total area of elements, m²			24.73				(31)
Party wall			45.62	$\times 0 =$	0		(32)
Party floor			50.2				(32a)
Party ceiling			50.2				(32b)

* 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) = 18.83 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5156.95 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 2.24 (36)

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

Total fabric heat loss (33) + (36) = 21.07 (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=	24.78	24.62	24.47	23.74	23.6	22.97	22.97	22.85	23.21	23.6	23.88	24.17

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

(39)m= 45.85 45.69 45.54 44.81 44.67 44.04 44.04 43.92 44.28 44.67 44.95 45.24
Average = Sum(39)_{1...12} /12= 44.81 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.91	0.91	0.91	0.89	0.89	0.88	0.88	0.87	0.88	0.89	0.9	0.9		
Average = Sum(40) _{1...12} /12=													0.89	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.7

(42)

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

if TFA ≤ 13.9, N = 1

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

74.48

(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=	81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93		
Total = Sum(44) _{1...12} =													893.76	(44)

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

(45)m=	121.5	106.26	109.65	95.6	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66		
Total = Sum(45) _{1...12} =													1171.86	(45)

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

(46)m=	18.22	15.94	16.45	14.34	13.76	11.87	11	12.63	12.78	14.89	16.25	17.65		(46)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

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

Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

TER WorkSheet: New dwelling design stage

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

(61)m=	41.75	36.34	38.71	36	35.68	33.06	34.16	35.68	36	38.71	38.93	41.75	(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=	163.25	142.6	148.37	131.59	127.41	112.21	107.51	119.85	121.17	137.97	147.29	159.41	(62)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

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

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

Output from water heater

(64)m=	163.25	142.6	148.37	131.59	127.41	112.21	107.51	119.85	121.17	137.97	147.29	159.41	
Output from water heater (annual) _{1...12}												1618.61	(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=	50.83	44.42	46.14	40.79	39.42	34.58	32.93	36.91	37.32	42.68	45.76	49.56	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	(66)

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

(67)m=	13.17	11.7	9.51	7.2	5.38	4.55	4.91	6.38	8.57	10.88	12.7	13.54	(67)
--------	-------	------	------	-----	------	------	------	------	------	-------	------	-------	------

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

(68)m=	147.75	149.29	145.42	137.2	126.81	117.06	110.54	109	112.87	121.09	131.48	141.23	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-----	--------	--------	--------	--------	------

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

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

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

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

(71)m=	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	68.33	66.1	62.01	56.65	52.98	48.03	44.26	49.6	51.83	57.37	63.56	66.61	(72)
--------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(73)m=	280.69	278.52	268.39	252.49	236.62	221.07	211.15	216.43	224.71	240.78	259.17	272.83	(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)	
Northwest 0.9x	0.77	x	9.41	x	11.28	x	0.63	x	0.7	=	32.45	(81)
Northwest 0.9x	0.77	x	3.14	x	11.28	x	0.63	x	0.7	=	10.83	(81)
Northwest 0.9x	0.77	x	9.41	x	22.97	x	0.63	x	0.7	=	66.05	(81)
Northwest 0.9x	0.77	x	3.14	x	22.97	x	0.63	x	0.7	=	22.04	(81)
Northwest 0.9x	0.77	x	9.41	x	41.38	x	0.63	x	0.7	=	119	(81)

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Northwest 0.9x	0.77	x	3.14	x	41.38	x	0.63	x	0.7	=	39.71	(81)
Northwest 0.9x	0.77	x	9.41	x	67.96	x	0.63	x	0.7	=	195.43	(81)
Northwest 0.9x	0.77	x	3.14	x	67.96	x	0.63	x	0.7	=	65.21	(81)
Northwest 0.9x	0.77	x	9.41	x	91.35	x	0.63	x	0.7	=	262.69	(81)
Northwest 0.9x	0.77	x	3.14	x	91.35	x	0.63	x	0.7	=	87.66	(81)
Northwest 0.9x	0.77	x	9.41	x	97.38	x	0.63	x	0.7	=	280.06	(81)
Northwest 0.9x	0.77	x	3.14	x	97.38	x	0.63	x	0.7	=	93.45	(81)
Northwest 0.9x	0.77	x	9.41	x	91.1	x	0.63	x	0.7	=	261.99	(81)
Northwest 0.9x	0.77	x	3.14	x	91.1	x	0.63	x	0.7	=	87.42	(81)
Northwest 0.9x	0.77	x	9.41	x	72.63	x	0.63	x	0.7	=	208.86	(81)
Northwest 0.9x	0.77	x	3.14	x	72.63	x	0.63	x	0.7	=	69.69	(81)
Northwest 0.9x	0.77	x	9.41	x	50.42	x	0.63	x	0.7	=	145	(81)
Northwest 0.9x	0.77	x	3.14	x	50.42	x	0.63	x	0.7	=	48.38	(81)
Northwest 0.9x	0.77	x	9.41	x	28.07	x	0.63	x	0.7	=	80.72	(81)
Northwest 0.9x	0.77	x	3.14	x	28.07	x	0.63	x	0.7	=	26.93	(81)
Northwest 0.9x	0.77	x	9.41	x	14.2	x	0.63	x	0.7	=	40.83	(81)
Northwest 0.9x	0.77	x	3.14	x	14.2	x	0.63	x	0.7	=	13.62	(81)
Northwest 0.9x	0.77	x	9.41	x	9.21	x	0.63	x	0.7	=	26.5	(81)
Northwest 0.9x	0.77	x	3.14	x	9.21	x	0.63	x	0.7	=	8.84	(81)

Solar gains in watts, calculated for each month

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

(83)m=	43.28	88.09	158.71	260.64	350.35	373.51	349.41	278.56	193.39	107.65	54.45	35.34	(83)
--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	323.97	366.61	427.1	513.13	586.97	594.59	560.56	494.99	418.09	348.43	313.62	308.17	(84)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

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

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	1	0.99	0.97	0.88	0.68	0.47	0.35	0.41	0.7	0.95	0.99	1	

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

(87)m=	20.13	20.27	20.52	20.83	20.97	21	21	21	20.97	20.74	20.39	20.11	(87)
--------	-------	-------	-------	-------	-------	----	----	----	-------	-------	-------	-------	------

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

(88)m=	20.16	20.16	20.16	20.17	20.18	20.19	20.19	20.19	20.18	20.18	20.17	20.17	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	0.99	0.97	0.85	0.63	0.41	0.28	0.34	0.63	0.93	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19	19.2	19.56	19.98	20.15	20.19	20.19	20.19	20.16	19.88	19.38	18.98	(90)
--------	----	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	19.56	19.74	20.04	20.4	20.56	20.59	20.59	20.59	20.57	20.31	19.88	19.54	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.56	19.74	20.04	20.4	20.56	20.59	20.59	20.59	20.57	20.31	19.88	19.54	(93)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set $T_{i,m}$ to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.99	0.99	0.96	0.86	0.65	0.44	0.31	0.37	0.66	0.94	0.99	1	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	322.34	362.56	412.03	442.69	383.83	262.87	175.7	183.89	277.34	326.22	310.17	306.99	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	699.86	677.84	616.55	515.37	395.7	263.77	175.78	184.12	286.41	433.67	574.36	694.01	(97)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	280.88	211.87	152.16	52.33	8.83	0	0	0	0	79.95	190.21	287.94	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1264.18	(98)

Space heating requirement in $kWh/m^2/year$

25.18	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
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Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

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

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

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

Efficiency of main space heating system 1

93.4	(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)

280.88	211.87	152.16	52.33	8.83	0	0	0	0	79.95	190.21	287.94
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

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

300.73	226.84	162.91	56.03	9.45	0	0	0	0	85.6	203.65	308.29
--------	--------	--------	-------	------	---	---	---	---	------	--------	--------

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

1353.51	(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
---------	---	---	---	---	---	---	---	---	---	---	---

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

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

Water heating

Output from water heater (calculated above)

163.25	142.6	148.37	131.59	127.41	112.21	107.51	119.85	121.17	137.97	147.29	159.41
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3	(216)
------	-------

(217)m=	86.41	86.05	85.11	82.94	80.89	80.3	80.3	80.3	80.3	83.73	85.7	86.52	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	------	-------	-------

Fuel for water heating, $kWh/month$

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

(219)m=	188.93	165.72	174.31	158.67	157.51	139.74	133.88	149.25	150.89	164.78	171.87	184.24
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1939.81	(219)
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Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1353.51

TER WorkSheet: New dwelling design stage

Water heating fuel used		1939.81	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		232.63	(232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	292.36	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	419	(264)
Space and water heating	(261) + (262) + (263) + (264) =				711.36	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	120.73	(268)
Total CO2, kg/year	sum of (265)...(271) =				871.01	(272)
TER =					17.35	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 1BF TOP 50

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50.2 (1a) x	2.5 (2a) =	125.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	125.5 (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				0 x 10 =	0 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) = 0 (8)

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

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.18 (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) = 0.15 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

78.2 (23c)

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

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

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

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

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

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

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

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

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

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

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

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			9.45	$\times 1/[1/(1.4) + 0.04] =$	12.53		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	24.73	12.6	12.13	$\times$ 0.18	2.18		(29)
Roof	50.2	0	50.2	$\times$ 0.15	7.53		(30)
Total area of elements, m²			74.93				(31)
Party wall			45.62	$\times$ 0	0		(32)
Party floor			50.2				(32a)

* 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) = 26.42 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4099.75 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.85 (36)

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

Total fabric heat loss (33) + (36) = 35.27 (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=	12.37	12.21	12.06	11.29	11.14	10.37	10.37	10.21	10.67	11.14	11.44	11.75

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

(39)m=	47.63	47.48	47.33	46.56	46.4	45.63	45.63	45.48	45.94	46.4	46.71	47.02
Average = Sum(39) _{1...12} /12=												46.52 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.95	0.95	0.94	0.93	0.92	0.91	0.91	0.91	0.92	0.92	0.93	0.94		
	Average = Sum(40) _{1...12} /12=												0.93	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.7

(42)

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

if TFA ≤ 13.9, N = 1

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

74.48

(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=	81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93		
	Total = Sum(44) _{1...12} =												893.76	(44)

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

(45)m=	121.5	106.26	109.65	95.6	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66		
	Total = Sum(45) _{1...12} =												1171.86	(45)

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

(46)m=	18.22	15.94	16.45	14.34	13.76	11.87	11	12.63	12.78	14.89	16.25	17.65		(46)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

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

Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

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

(61)m=	29.81	26.92	29.8	28.83	29.78	28.81	29.76	29.77	28.82	29.79	28.84	29.81	(61)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(62)m=	151.31	133.18	139.45	124.42	121.51	107.96	103.11	113.94	113.99	129.05	137.19	147.47	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

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

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

Output from water heater

(64)m=	151.31	133.18	139.45	124.42	121.51	107.96	103.11	113.94	113.99	129.05	137.19	147.47	
Output from water heater (annual) _{1...12}												1522.59	(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=	47.85	42.06	43.91	38.99	37.94	33.52	31.83	35.43	35.52	40.45	43.24	46.58	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	(66)

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

(67)m=	13.17	11.7	9.51	7.2	5.38	4.55	4.91	6.38	8.57	10.88	12.7	13.54	(67)
--------	-------	------	------	-----	------	------	------	------	------	-------	------	-------	------

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

(68)m=	147.75	149.29	145.42	137.2	126.81	117.06	110.54	109	112.87	121.09	131.48	141.23	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-----	--------	--------	--------	--------	------

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

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

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

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

(71)m=	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	64.32	62.59	59.02	54.16	51	46.56	42.78	47.62	49.34	54.37	60.05	62.6	(72)
--------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	-------	------	------

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

(73)m=	276.68	275.02	265.39	250	234.64	219.6	209.67	214.45	222.22	237.78	255.67	268.81	(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)	
Northwest 0.9x	0.77	x	9.45	x	11.28	x	0.63	x	0.7	=	32.59	(81)
Northwest 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	10.86	(81)
Northwest 0.9x	0.77	x	9.45	x	22.97	x	0.63	x	0.7	=	66.33	(81)
Northwest 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	22.11	(81)
Northwest 0.9x	0.77	x	9.45	x	41.38	x	0.63	x	0.7	=	119.5	(81)

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Northwest 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(81)
Northwest 0.9x	0.77	x	9.45	x	67.96	x	0.63	x	0.7	=	196.26	(81)
Northwest 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(81)
Northwest 0.9x	0.77	x	9.45	x	91.35	x	0.63	x	0.7	=	263.81	(81)
Northwest 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(81)
Northwest 0.9x	0.77	x	9.45	x	97.38	x	0.63	x	0.7	=	281.25	(81)
Northwest 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(81)
Northwest 0.9x	0.77	x	9.45	x	91.1	x	0.63	x	0.7	=	263.1	(81)
Northwest 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(81)
Northwest 0.9x	0.77	x	9.45	x	72.63	x	0.63	x	0.7	=	209.75	(81)
Northwest 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(81)
Northwest 0.9x	0.77	x	9.45	x	50.42	x	0.63	x	0.7	=	145.62	(81)
Northwest 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(81)
Northwest 0.9x	0.77	x	9.45	x	28.07	x	0.63	x	0.7	=	81.06	(81)
Northwest 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(81)
Northwest 0.9x	0.77	x	9.45	x	14.2	x	0.63	x	0.7	=	41	(81)
Northwest 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(81)
Northwest 0.9x	0.77	x	9.45	x	9.21	x	0.63	x	0.7	=	26.61	(81)
Northwest 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(81)

Solar gains in watts, calculated for each month

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

(83)m=	43.45	88.44	159.34	261.68	351.75	375	350.81	279.67	194.16	108.08	54.67	35.48	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	320.13	363.46	424.73	511.68	586.39	594.6	560.48	494.11	416.37	345.86	310.33	304.3	(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	0.89	0.7	0.49	0.36	0.42	0.72	0.96	0.99	1	(86)

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

(87)m=	20.08	20.22	20.47	20.79	20.96	21	21	21	20.97	20.7	20.34	20.05	(87)
--------	-------	-------	-------	-------	-------	----	----	----	-------	------	-------	-------	------

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

(88)m=	20.13	20.13	20.13	20.14	20.15	20.16	20.16	20.16	20.15	20.15	20.14	20.14	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.87	0.65	0.43	0.29	0.35	0.65	0.94	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.89	19.1	19.47	19.92	20.11	20.16	20.16	20.16	20.13	19.81	19.28	18.87	(90)
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fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	19.48	19.65	19.97	20.35	20.53	20.58	20.58	20.58	20.55	20.26	19.81	19.46	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.48	19.65	19.97	20.35	20.53	20.58	20.58	20.58	20.55	20.26	19.81	19.46	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	1	0.99	0.97	0.87	0.67	0.46	0.32	0.38	0.68	0.94	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	318.64	359.76	411.04	447.22	394.3	271.38	181.39	189.7	284.24	325.97	307.23	303.22	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	723.07	700.52	637.37	533.21	409.93	272.66	181.52	190.04	296.17	448.03	593.51	717.36	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	300.9	228.99	168.39	61.92	11.62	0	0	0	0	90.82	206.12	308.12	
--------	-------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 1376.88 (98)

Space heating requirement in $kWh/m^2/year$

27.43 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

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

1 (204)

Efficiency of main space heating system 1

93.4 (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)

300.9	228.99	168.39	61.92	11.62	0	0	0	0	90.82	206.12	308.12
-------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------

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

322.16	245.17	180.29	66.29	12.45	0	0	0	0	97.24	220.69	329.89
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 1474.17 (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 ($kWh/year$) = $Sum(215)_{1..5,10..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

151.31	133.18	139.45	124.42	121.51	107.96	103.11	113.94	113.99	129.05	137.19	147.47
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

88.2 (216)

(217)m=	89.65	89.58	89.39	88.92	88.39	88.2	88.2	88.2	88.2	89.1	89.51	89.68	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	------	-------	-------	-------

Fuel for water heating, $kWh/month$

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

(219)m=	168.78	148.68	156	139.93	137.47	122.41	116.91	129.18	129.24	144.85	153.27	164.45	
---------	--------	--------	-----	--------	--------	--------	--------	--------	--------	--------	--------	--------	--

Total = $Sum(219a)_{1..12} =$ 1711.16 (219)

Annual totals

Space heating fuel used, main system 1

$kWh/year$

$kWh/year$

1474.17

DER WorkSheet: New dwelling design stage

Water heating fuel used		1711.16	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	107.18		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		182.18 (231)
Electricity for lighting		232.63	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	318.42 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	369.61 (264)
Space and water heating	(261) + (262) + (263) + (264) =			688.03 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	94.55 (267)
Electricity for lighting	(232) x	0.519	=	120.73 (268)
Total CO2, kg/year	sum of (265)...(271) =			903.32 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			17.99 (273)
El rating (section 14)				87 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 1BF TOP 50

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50.2 (1a)	2.5 (2a)	125.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	125.5 (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				2	20 (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) =	20 ÷ (5) = 0.16 (8)

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

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.41 (18)

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

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 (21)

Infiltration rate modified for monthly wind speed

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			9.41	x1/[1/(1.4)+0.04] =	12.48		(27)
Windows Type 2			3.14	x1/[1/(1.4)+0.04] =	4.16		(27)
Walls	24.73	12.55	12.18	x 0.18 =	2.19		(29)
Roof	50.2	0	50.2	x 0.13 =	6.53		(30)
Total area of elements, m²			74.93				(31)
Party wall			45.62	x 0 =	0		(32)
Party floor			50.2				(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 25.36 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4102.75 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 5.22 (36)

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

Total fabric heat loss (33) + (36) = 30.57 (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=	24.78	24.62	24.47	23.74	23.6	22.97	22.97	22.85	23.21	23.6	23.88	24.17

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

(39)m=	55.36	55.2	55.04	54.32	54.18	53.54	53.54	53.43	53.79	54.18	54.45	54.74
Average = Sum(39) _{1...12} /12=												54.31 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.1	1.1	1.1	1.08	1.08	1.07	1.07	1.06	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)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.7

(42)

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

if TFA ≤ 13.9, N = 1

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

74.48

(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=	81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93		
	Total = Sum(44) _{1...12} =												893.76	(44)

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

(45)m=	121.5	106.26	109.65	95.6	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66		
	Total = Sum(45) _{1...12} =												1171.86	(45)

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

(46)m=	18.22	15.94	16.45	14.34	13.76	11.87	11	12.63	12.78	14.89	16.25	17.65		(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

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

Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

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

(61)m=	41.75	36.34	38.71	36	35.68	33.06	34.16	35.68	36	38.71	38.93	41.75	(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=	163.25	142.6	148.37	131.59	127.41	112.21	107.51	119.85	121.17	137.97	147.29	159.41	(62)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

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

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

Output from water heater

(64)m=	163.25	142.6	148.37	131.59	127.41	112.21	107.51	119.85	121.17	137.97	147.29	159.41	
Output from water heater (annual) _{1...12}												1618.61	(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=	50.83	44.42	46.14	40.79	39.42	34.58	32.93	36.91	37.32	42.68	45.76	49.56	(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 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	(66)

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

(67)m=	13.17	11.7	9.51	7.2	5.38	4.55	4.91	6.38	8.57	10.88	12.7	13.54	(67)
--------	-------	------	------	-----	------	------	------	------	------	-------	------	-------	------

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

(68)m=	147.75	149.29	145.42	137.2	126.81	117.06	110.54	109	112.87	121.09	131.48	141.23	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-----	--------	--------	--------	--------	------

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

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

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

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

(71)m=	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	68.33	66.1	62.01	56.65	52.98	48.03	44.26	49.6	51.83	57.37	63.56	66.61	(72)
--------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(73)m=	280.69	278.52	268.39	252.49	236.62	221.07	211.15	216.43	224.71	240.78	259.17	272.83	(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)	
Northwest 0.9x	0.77	x	9.41	x	11.28	x	0.63	x	0.7	=	32.45	(81)
Northwest 0.9x	0.77	x	3.14	x	11.28	x	0.63	x	0.7	=	10.83	(81)
Northwest 0.9x	0.77	x	9.41	x	22.97	x	0.63	x	0.7	=	66.05	(81)
Northwest 0.9x	0.77	x	3.14	x	22.97	x	0.63	x	0.7	=	22.04	(81)
Northwest 0.9x	0.77	x	9.41	x	41.38	x	0.63	x	0.7	=	119	(81)

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Northwest 0.9x	0.77	x	3.14	x	41.38	x	0.63	x	0.7	=	39.71	(81)
Northwest 0.9x	0.77	x	9.41	x	67.96	x	0.63	x	0.7	=	195.43	(81)
Northwest 0.9x	0.77	x	3.14	x	67.96	x	0.63	x	0.7	=	65.21	(81)
Northwest 0.9x	0.77	x	9.41	x	91.35	x	0.63	x	0.7	=	262.69	(81)
Northwest 0.9x	0.77	x	3.14	x	91.35	x	0.63	x	0.7	=	87.66	(81)
Northwest 0.9x	0.77	x	9.41	x	97.38	x	0.63	x	0.7	=	280.06	(81)
Northwest 0.9x	0.77	x	3.14	x	97.38	x	0.63	x	0.7	=	93.45	(81)
Northwest 0.9x	0.77	x	9.41	x	91.1	x	0.63	x	0.7	=	261.99	(81)
Northwest 0.9x	0.77	x	3.14	x	91.1	x	0.63	x	0.7	=	87.42	(81)
Northwest 0.9x	0.77	x	9.41	x	72.63	x	0.63	x	0.7	=	208.86	(81)
Northwest 0.9x	0.77	x	3.14	x	72.63	x	0.63	x	0.7	=	69.69	(81)
Northwest 0.9x	0.77	x	9.41	x	50.42	x	0.63	x	0.7	=	145	(81)
Northwest 0.9x	0.77	x	3.14	x	50.42	x	0.63	x	0.7	=	48.38	(81)
Northwest 0.9x	0.77	x	9.41	x	28.07	x	0.63	x	0.7	=	80.72	(81)
Northwest 0.9x	0.77	x	3.14	x	28.07	x	0.63	x	0.7	=	26.93	(81)
Northwest 0.9x	0.77	x	9.41	x	14.2	x	0.63	x	0.7	=	40.83	(81)
Northwest 0.9x	0.77	x	3.14	x	14.2	x	0.63	x	0.7	=	13.62	(81)
Northwest 0.9x	0.77	x	9.41	x	9.21	x	0.63	x	0.7	=	26.5	(81)
Northwest 0.9x	0.77	x	3.14	x	9.21	x	0.63	x	0.7	=	8.84	(81)

Solar gains in watts, calculated for each month

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

(83)m=	43.28	88.09	158.71	260.64	350.35	373.51	349.41	278.56	193.39	107.65	54.45	35.34	(83)
--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	323.97	366.61	427.1	513.13	586.97	594.59	560.56	494.99	418.09	348.43	313.62	308.17	(84)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.92	0.77	0.56	0.42	0.49	0.79	0.97	0.99	1	(86)

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

(87)m=	19.87	20.01	20.28	20.65	20.9	20.99	21	20.99	20.92	20.57	20.16	19.84	(87)
--------	-------	-------	-------	-------	------	-------	----	-------	-------	-------	-------	-------	------

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

(88)m=	20	20	20	20.02	20.02	20.03	20.03	20.03	20.02	20.02	20.01	20.01	(88)
--------	----	----	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	0.99	0.98	0.9	0.71	0.48	0.33	0.39	0.71	0.95	0.99	1	(89)
--------	---	------	------	-----	------	------	------	------	------	------	------	---	------

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

(90)m=	18.49	18.7	19.1	19.62	19.93	20.02	20.03	20.03	19.96	19.52	18.93	18.46	(90)
--------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.5

(91)

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

(92)m=	19.17	19.35	19.69	20.14	20.41	20.5	20.51	20.51	20.44	20.05	19.54	19.15	(92)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

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

TER WorkSheet: New dwelling design stage

(93)m=	19.17	19.35	19.69	20.14	20.41	20.5	20.51	20.51	20.44	20.05	19.54	19.15	(93)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	1	0.99	0.97	0.9	0.74	0.52	0.37	0.44	0.75	0.95	0.99	1	(94)
--------	---	------	------	-----	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	322.42	363.13	415.66	463.83	432.96	310.77	208.7	217.96	311.67	332.45	310.68	307.02	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	823.4	797.81	726.02	610.3	472.11	315.92	209.38	219.54	341.03	511.75	677.38	818.39	(97)
--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	372.72	292.1	230.9	105.46	29.13	0	0	0	0	133.4	264.02	380.46	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												1808.19	(98)

Space heating requirement in $kWh/m^2/year$

36.02	(99)
-------	------

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

Space heating:

Fraction of space heat from secondary/supplementary system

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

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

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

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

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

Efficiency of main space heating system 1

93.4	(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)

372.72	292.1	230.9	105.46	29.13	0	0	0	0	133.4	264.02	380.46
--------	-------	-------	--------	-------	---	---	---	---	-------	--------	--------

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

399.06	312.75	247.22	112.91	31.18	0	0	0	0	142.83	282.68	407.34
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

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

1935.97	(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
---------	---	---	---	---	---	---	---	---	---	---	---

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

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

Water heating

Output from water heater (calculated above)

163.25	142.6	148.37	131.59	127.41	112.21	107.51	119.85	121.17	137.97	147.29	159.41
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3	(216)
------	-------

(217)m=	87.06	86.82	86.16	84.5	82	80.3	80.3	80.3	80.3	84.97	86.5	87.16	(217)
---------	-------	-------	-------	------	----	------	------	------	------	-------	------	-------	-------

Fuel for water heating, $kWh/month$

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

(219)m=	187.5	164.25	172.2	155.73	155.36	139.74	133.88	149.25	150.89	162.39	170.26	182.89
---------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1924.35	(219)
---------	-------

Annual totals

Space heating fuel used, main system 1

$kWh/year$

$kWh/year$

1935.97

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Water heating fuel used		1924.35	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		232.63	(232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	418.17	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	415.66	(264)
Space and water heating	(261) + (262) + (263) + (264) =				833.83	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	120.73	(268)
Total CO2, kg/year	sum of (265)...(271) =				993.49	(272)

TER =

19.79 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 2BF GND 70

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	69.8 (1a)	2.5 (2a)	174.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	69.8 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	174.5 (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				0	0 (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) =	0 (8)

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

Number of storeys in the dwelling (ns)	0 (9)
--	-------

Additional infiltration	0 (10)
-------------------------	--------

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0 (11)
--	--------

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0 (12)
---	--------

If no draught lobby, enter 0.05, else enter 0	0 (13)
---	--------

Percentage of windows and doors draught stripped	0 (14)
--	--------

Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0 (15)
---------------------	------------------------------------

Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0 (16)
-------------------	---

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.5 (17)
---	----------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.18 (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	0.85 (20)
----------------	-----------

Infiltration rate incorporating shelter factor	0.15 (21)
--	-----------

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

DER WorkSheet: New dwelling design stage

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

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

78.2 (23c)

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

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

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

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

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

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

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

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

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

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

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

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.46	$\times 1/[1/(1.4) + 0.04] =$	7.24		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			2.84	$\times 1/[1/(1.4) + 0.04] =$	3.77		(27)
Floor			69.8	$\times$ 0.13	= 9.074		(28)
Walls	39.88	14.6	25.27	$\times$ 0.18	= 4.55		(29)
Total area of elements, m²			109.68				(31)
Party wall			43.59	$\times$ 0	= 0		(32)
Party ceiling			69.8				(32b)

* 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) = 32.98 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9717.25 (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 9.07 (36)

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

Total fabric heat loss (33) + (36) = 42.05 (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=	17.2	16.98	16.77	15.7	15.48	14.41	14.41	14.2	14.84	15.48	15.91	16.34

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

(39)m= 59.25 59.03 58.82 57.75 57.53 56.46 56.46 56.25 56.89 57.53 57.96 58.39
Average = Sum(39)_{1...12} /12= 57.69 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.85	0.85	0.84	0.83	0.82	0.81	0.81	0.81	0.82	0.82	0.83	0.84		
	Average = Sum(40) _{1...12} /12=												0.83	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.24

(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

87.43

(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=	96.17	92.68	89.18	85.68	82.18	78.69	78.69	82.18	85.68	89.18	92.68	96.17		
	Total = Sum(44) _{1...12} =												1049.16	(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=	142.62	124.74	128.72	112.22	107.68	92.92	86.1	98.8	99.98	116.52	127.19	138.12		
	Total = Sum(45) _{1...12} =												1375.61	(45)

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

(46)m=	21.39	18.71	19.31	16.83	16.15	13.94	12.92	14.82	15	17.48	19.08	20.72		(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

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

Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

DER WorkSheet: New dwelling design stage

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

(61)m=	29.85	26.95	29.83	28.85	29.8	28.83	29.78	29.8	28.84	29.82	28.87	29.85	(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=	172.47	151.69	158.55	141.07	137.48	121.75	115.88	128.6	128.82	146.34	156.06	167.97	(62)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

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

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

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

Output from water heater

(64)m=	172.47	151.69	158.55	141.07	137.48	121.75	115.88	128.6	128.82	146.34	156.06	167.97	
Output from water heater (annual) _{1...12}												1726.68	(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=	54.88	48.21	50.26	44.53	43.25	38.1	36.07	40.3	40.45	46.2	49.51	53.39	(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=	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	(66)

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

(67)m=	17.6	15.63	12.71	9.62	7.19	6.07	6.56	8.53	11.45	14.54	16.97	18.09	(67)
--------	------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	196.83	198.87	193.73	182.77	168.94	155.94	147.25	145.21	150.36	161.31	175.15	188.15	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	(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=	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	73.77	71.75	67.55	61.84	58.14	52.92	48.49	54.17	56.19	62.09	68.76	71.76	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	347.82	345.87	333.61	313.85	293.89	274.55	261.92	267.53	277.61	297.57	320.5	337.61	(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)	
Southwest _{0.9x}	0.77	x	5.46	x	36.79		0.63	x	0.7	=	61.4	(79)
Southwest _{0.9x}	0.77	x	3.15	x	36.79		0.63	x	0.7	=	70.84	(79)
Southwest _{0.9x}	0.77	x	5.46	x	62.67		0.63	x	0.7	=	104.58	(79)
Southwest _{0.9x}	0.77	x	3.15	x	62.67		0.63	x	0.7	=	120.67	(79)
Southwest _{0.9x}	0.77	x	5.46	x	85.75		0.63	x	0.7	=	143.09	(79)

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Southwest	0.9x	0.77	x	3.15	x	85.75	0.63	x	0.7	=	165.1	(79)
Southwest	0.9x	0.77	x	5.46	x	106.25	0.63	x	0.7	=	177.3	(79)
Southwest	0.9x	0.77	x	3.15	x	106.25	0.63	x	0.7	=	204.57	(79)
Southwest	0.9x	0.77	x	5.46	x	119.01	0.63	x	0.7	=	198.59	(79)
Southwest	0.9x	0.77	x	3.15	x	119.01	0.63	x	0.7	=	229.14	(79)
Southwest	0.9x	0.77	x	5.46	x	118.15	0.63	x	0.7	=	197.15	(79)
Southwest	0.9x	0.77	x	3.15	x	118.15	0.63	x	0.7	=	227.48	(79)
Southwest	0.9x	0.77	x	5.46	x	113.91	0.63	x	0.7	=	190.07	(79)
Southwest	0.9x	0.77	x	3.15	x	113.91	0.63	x	0.7	=	219.32	(79)
Southwest	0.9x	0.77	x	5.46	x	104.39	0.63	x	0.7	=	174.19	(79)
Southwest	0.9x	0.77	x	3.15	x	104.39	0.63	x	0.7	=	200.99	(79)
Southwest	0.9x	0.77	x	5.46	x	92.85	0.63	x	0.7	=	154.94	(79)
Southwest	0.9x	0.77	x	3.15	x	92.85	0.63	x	0.7	=	178.77	(79)
Southwest	0.9x	0.77	x	5.46	x	69.27	0.63	x	0.7	=	115.58	(79)
Southwest	0.9x	0.77	x	3.15	x	69.27	0.63	x	0.7	=	133.37	(79)
Southwest	0.9x	0.77	x	5.46	x	44.07	0.63	x	0.7	=	73.54	(79)
Southwest	0.9x	0.77	x	3.15	x	44.07	0.63	x	0.7	=	84.85	(79)
Southwest	0.9x	0.77	x	5.46	x	31.49	0.63	x	0.7	=	52.54	(79)
Southwest	0.9x	0.77	x	3.15	x	31.49	0.63	x	0.7	=	60.63	(79)
Northwest	0.9x	0.77	x	2.84	x	11.28	0.63	x	0.7	=	9.79	(81)
Northwest	0.9x	0.77	x	2.84	x	22.97	0.63	x	0.7	=	19.93	(81)
Northwest	0.9x	0.77	x	2.84	x	41.38	0.63	x	0.7	=	35.91	(81)
Northwest	0.9x	0.77	x	2.84	x	67.96	0.63	x	0.7	=	58.98	(81)
Northwest	0.9x	0.77	x	2.84	x	91.35	0.63	x	0.7	=	79.28	(81)
Northwest	0.9x	0.77	x	2.84	x	97.38	0.63	x	0.7	=	84.52	(81)
Northwest	0.9x	0.77	x	2.84	x	91.1	0.63	x	0.7	=	79.07	(81)
Northwest	0.9x	0.77	x	2.84	x	72.63	0.63	x	0.7	=	63.04	(81)
Northwest	0.9x	0.77	x	2.84	x	50.42	0.63	x	0.7	=	43.76	(81)
Northwest	0.9x	0.77	x	2.84	x	28.07	0.63	x	0.7	=	24.36	(81)
Northwest	0.9x	0.77	x	2.84	x	14.2	0.63	x	0.7	=	12.32	(81)
Northwest	0.9x	0.77	x	2.84	x	9.21	0.63	x	0.7	=	8	(81)

Solar gains in watts, calculated for each month

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

(83)m= 142.03 245.18 344.11 440.85 507.01 509.16 488.46 438.22 377.47 273.31 170.71 121.17 (83)

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

(84)m= 489.85 591.05 677.72 754.7 800.89 783.71 750.38 705.74 655.09 570.87 491.21 458.78 (84)

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	0.99	0.98	0.94	0.83	0.65	0.46	0.33	0.37	0.59	0.89	0.98	1

(86)

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

(87)m= 20.29 20.47 20.7 20.9 20.98 21 21 21 20.99 20.87 20.54 20.25 (87)

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

(88)m=	20.21	20.21	20.22	20.23	20.23	20.25	20.25	20.25	20.24	20.23	20.23	20.22	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.93	0.8	0.6	0.41	0.27	0.31	0.53	0.86	0.98	1	(89)
--------	------	------	------	-----	-----	------	------	------	------	------	------	---	------

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

(90)m=	19.26	19.53	19.85	20.12	20.22	20.24	20.25	20.25	20.24	20.09	19.64	19.22	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.36 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.63	19.87	20.15	20.4	20.49	20.51	20.52	20.52	20.51	20.37	19.96	19.59	(92)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.63	19.87	20.15	20.4	20.49	20.51	20.52	20.52	20.51	20.37	19.96	19.59	(93)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.93	0.81	0.62	0.43	0.29	0.33	0.55	0.86	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	485.61	575.82	628.86	608.94	496.57	333.34	221.05	231.51	361.22	492.08	479.95	455.98	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	908.08	883.69	802.94	664.14	505.75	333.96	221.09	231.6	364.47	562.22	745.59	898.65	(97)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

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

(98)m=	314.32	206.89	129.52	39.75	6.83	0	0	0	0	52.18	191.26	329.34	(98)
--------	--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1270.09 \quad (98)$$

Space heating requirement in kWh/m²/year

$$18.2 \quad (99)$$

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

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.4 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

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

kWh/year

Space heating requirement (calculated above)

314.32	206.89	129.52	39.75	6.83	0	0	0	0	52.18	191.26	329.34
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

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

336.53	221.51	138.67	42.56	7.31	0	0	0	0	55.87	204.77	352.61
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 1359.84 \quad (211)$$

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)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

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

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

172.47	151.69	158.55	141.07	137.48	121.75	115.88	128.6	128.82	146.34	156.06	167.97
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

Efficiency of water heater

88.2 (216)

(217)m= 89.61 89.46 89.18 88.67 88.3 88.2 88.2 88.2 88.2 88.77 89.4 89.64 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

192.47	169.57	177.79	159.09	155.69	138.03	131.39	145.8	146.06	164.85	174.57	187.37
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} = 1942.7 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1359.84

Water heating fuel used

1942.7

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

149.02 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 224.02 (231)

Electricity for lighting

310.83 (232)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	293.72 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	419.62 (264)
Space and water heating	(261) + (262) + (263) + (264) =		713.35 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	116.27 (267)
Electricity for lighting	(232) x	0.519 =	161.32 (268)
Total CO2, kg/year		sum of (265)...(271) =	990.94 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	14.2 (273)
EI rating (section 14)			88 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 2BF GND 70

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	69.8 (1a)	2.5 (2a)	174.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	69.8 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	174.5 (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				2	20 (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) =	0.11 (8)

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

Number of storeys in the dwelling (ns)	0 (9)
--	-------

Additional infiltration	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)
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If no draught lobby, enter 0.05, else enter 0	0 (13)
---	--------

Percentage of windows and doors draught stripped	0 (14)
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Window infiltration	0 (15)
---------------------	--------

Infiltration rate	0 (16)
-------------------	--------

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
---	--------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.36 (18)
--	-----------

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

Number of sides sheltered	2 (19)
---------------------------	--------

Shelter factor	0.85 (20)
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Infiltration rate incorporating shelter factor	0.31 (21)
--	-----------

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

TER WorkSheet: New dwelling design stage

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

0.4	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36
-----	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

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

0 (23b)

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

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.46	$\times 1/[1/(1.4) + 0.04] =$	7.24		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			2.84	$\times 1/[1/(1.4) + 0.04] =$	3.77		(27)
Floor			69.8	x 0.13 =	9.074		(28)
Walls	39.88	14.6	25.27	x 0.18 =	4.55		(29)
Total area of elements, m²			109.68				(31)
Party wall			43.59	x 0 =	0		(32)
Party ceiling			69.8				(32b)

* 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) = 32.98 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9717.25 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.01 (36)

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

Total fabric heat loss (33) + (36) = 38.99 (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=	33.29	33.11	32.94	32.14	31.99	31.29	31.29	31.16	31.56	31.99	32.29	32.61

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

(39)m= 72.27 72.1 71.93 71.13 70.97 70.27 70.27 70.15 70.54 70.97 71.28 71.6
Average = Sum(39)_{1...12} /12= 71.12 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.04	1.03	1.03	1.02	1.02	1.01	1.01	1	1.01	1.02	1.02	1.03		
Average = Sum(40) _{1...12} /12=													1.02	(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)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.24

(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

87.43

(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=	96.17	92.68	89.18	85.68	82.18	78.69	78.69	82.18	85.68	89.18	92.68	96.17		
Total = Sum(44) _{1...12} =													1049.16	(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=	142.62	124.74	128.72	112.22	107.68	92.92	86.1	98.8	99.98	116.52	127.19	138.12		
Total = Sum(45) _{1...12} =													1375.61	(45)

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

(46)m=	21.39	18.71	19.31	16.83	16.15	13.94	12.92	14.82	15	17.48	19.08	20.72	
--------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	--

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

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

Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

TER WorkSheet: New dwelling design stage

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

(61)m=	49.01	42.66	45.44	42.25	41.88	38.8	40.1	41.88	42.25	45.44	45.7	49.01	(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=	191.63	167.39	174.16	154.47	149.56	131.72	126.2	140.68	142.24	161.96	172.89	187.13	(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=	191.63	167.39	174.16	154.47	149.56	131.72	126.2	140.68	142.24	161.96	172.89	187.13	
Output from water heater (annual) _{1...12}												1900.05	(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=	59.67	52.14	54.16	47.88	46.27	40.6	38.65	43.32	43.81	50.1	53.72	58.18	(65)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	------	-------	-------	------

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	(66)

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

(67)m=	17.6	15.63	12.71	9.62	7.19	6.07	6.56	8.53	11.45	14.54	16.97	18.09	(67)
--------	------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	196.83	198.87	193.73	182.77	168.94	155.94	147.25	145.21	150.36	161.31	175.15	188.15	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	(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=	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	80.21	77.59	72.8	66.5	62.19	56.38	51.95	58.23	60.84	67.34	74.61	78.2	(72)
--------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(73)m=	354.26	351.71	338.85	318.51	297.94	278.01	265.39	271.59	282.27	302.82	326.34	344.05	(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)	
Southwest _{0.9x}	0.77	x	5.46	x	36.79		0.63	x	0.7	=	61.4	(79)
Southwest _{0.9x}	0.77	x	3.15	x	36.79		0.63	x	0.7	=	70.84	(79)
Southwest _{0.9x}	0.77	x	5.46	x	62.67		0.63	x	0.7	=	104.58	(79)
Southwest _{0.9x}	0.77	x	3.15	x	62.67		0.63	x	0.7	=	120.67	(79)
Southwest _{0.9x}	0.77	x	5.46	x	85.75		0.63	x	0.7	=	143.09	(79)

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Southwest	0.9x	0.77	x	3.15	x	85.75	0.63	x	0.7	=	165.1	(79)
Southwest	0.9x	0.77	x	5.46	x	106.25	0.63	x	0.7	=	177.3	(79)
Southwest	0.9x	0.77	x	3.15	x	106.25	0.63	x	0.7	=	204.57	(79)
Southwest	0.9x	0.77	x	5.46	x	119.01	0.63	x	0.7	=	198.59	(79)
Southwest	0.9x	0.77	x	3.15	x	119.01	0.63	x	0.7	=	229.14	(79)
Southwest	0.9x	0.77	x	5.46	x	118.15	0.63	x	0.7	=	197.15	(79)
Southwest	0.9x	0.77	x	3.15	x	118.15	0.63	x	0.7	=	227.48	(79)
Southwest	0.9x	0.77	x	5.46	x	113.91	0.63	x	0.7	=	190.07	(79)
Southwest	0.9x	0.77	x	3.15	x	113.91	0.63	x	0.7	=	219.32	(79)
Southwest	0.9x	0.77	x	5.46	x	104.39	0.63	x	0.7	=	174.19	(79)
Southwest	0.9x	0.77	x	3.15	x	104.39	0.63	x	0.7	=	200.99	(79)
Southwest	0.9x	0.77	x	5.46	x	92.85	0.63	x	0.7	=	154.94	(79)
Southwest	0.9x	0.77	x	3.15	x	92.85	0.63	x	0.7	=	178.77	(79)
Southwest	0.9x	0.77	x	5.46	x	69.27	0.63	x	0.7	=	115.58	(79)
Southwest	0.9x	0.77	x	3.15	x	69.27	0.63	x	0.7	=	133.37	(79)
Southwest	0.9x	0.77	x	5.46	x	44.07	0.63	x	0.7	=	73.54	(79)
Southwest	0.9x	0.77	x	3.15	x	44.07	0.63	x	0.7	=	84.85	(79)
Southwest	0.9x	0.77	x	5.46	x	31.49	0.63	x	0.7	=	52.54	(79)
Southwest	0.9x	0.77	x	3.15	x	31.49	0.63	x	0.7	=	60.63	(79)
Northwest	0.9x	0.77	x	2.84	x	11.28	0.63	x	0.7	=	9.79	(81)
Northwest	0.9x	0.77	x	2.84	x	22.97	0.63	x	0.7	=	19.93	(81)
Northwest	0.9x	0.77	x	2.84	x	41.38	0.63	x	0.7	=	35.91	(81)
Northwest	0.9x	0.77	x	2.84	x	67.96	0.63	x	0.7	=	58.98	(81)
Northwest	0.9x	0.77	x	2.84	x	91.35	0.63	x	0.7	=	79.28	(81)
Northwest	0.9x	0.77	x	2.84	x	97.38	0.63	x	0.7	=	84.52	(81)
Northwest	0.9x	0.77	x	2.84	x	91.1	0.63	x	0.7	=	79.07	(81)
Northwest	0.9x	0.77	x	2.84	x	72.63	0.63	x	0.7	=	63.04	(81)
Northwest	0.9x	0.77	x	2.84	x	50.42	0.63	x	0.7	=	43.76	(81)
Northwest	0.9x	0.77	x	2.84	x	28.07	0.63	x	0.7	=	24.36	(81)
Northwest	0.9x	0.77	x	2.84	x	14.2	0.63	x	0.7	=	12.32	(81)
Northwest	0.9x	0.77	x	2.84	x	9.21	0.63	x	0.7	=	8	(81)

Solar gains in watts, calculated for each month

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

(83)m= 142.03 245.18 344.11 440.85 507.01 509.16 488.46 438.22 377.47 273.31 170.71 121.17 (83)

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

(84)m= 496.29 596.9 682.96 759.36 804.95 787.17 753.85 709.8 659.74 576.12 497.05 465.21 (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	0.96	0.89	0.75	0.56	0.41	0.45	0.7	0.93	0.99	1

(86)

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

(87)m= 20.02 20.21 20.47 20.75 20.93 20.99 21 21 20.96 20.72 20.31 19.98 (87)

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

(88)m=	20.05	20.06	20.06	20.07	20.07	20.08	20.08	20.08	20.07	20.07	20.07	20.06	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.95	0.87	0.7	0.48	0.32	0.36	0.62	0.9	0.98	1	(89)
--------	------	------	------	------	-----	------	------	------	------	-----	------	---	------

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

(90)m=	18.76	19.04	19.4	19.79	20	20.07	20.08	20.08	20.05	19.76	19.19	18.71	(90)
--------	-------	-------	------	-------	----	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.36 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.21	19.46	19.79	20.13	20.33	20.4	20.41	20.41	20.38	20.11	19.59	19.16	(92)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.21	19.46	19.79	20.13	20.33	20.4	20.41	20.41	20.38	20.11	19.59	19.16	(93)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.95	0.87	0.71	0.51	0.35	0.39	0.65	0.91	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	492.41	584.93	648.26	659.05	574.09	402.53	267.01	280.14	425.76	521.84	488.13	462.55	(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=	1077.49	1049.69	955.68	799.06	612.7	407.53	267.54	281.09	442.7	674.78	890.34	1071.32	(97)
--------	---------	---------	--------	--------	-------	--------	--------	--------	-------	--------	--------	---------	------

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

(98)m=	435.3	312.32	228.72	100.81	28.72	0	0	0	0	113.79	289.59	452.92	(98)
--------	-------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1962.18 \quad (98)$$

Space heating requirement in kWh/m²/year

$$28.11 \quad (99)$$

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

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.4 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

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

kWh/year

Space heating requirement (calculated above)

435.3	312.32	228.72	100.81	28.72	0	0	0	0	113.79	289.59	452.92
-------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

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

466.06	334.39	244.89	107.93	30.75	0	0	0	0	121.83	310.06	484.93
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 2100.83 \quad (211)$$

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)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

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

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

191.63	167.39	174.16	154.47	149.56	131.72	126.2	140.68	142.24	161.96	172.89	187.13
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3 (216)

(217)m= 87.05 86.6 85.74 84.01 81.77 80.3 80.3 80.3 80.3 84.18 86.34 87.19 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

220.13	193.3	203.13	183.88	182.9	164.04	157.16	175.2	177.13	192.4	200.25	214.61
--------	-------	--------	--------	-------	--------	--------	-------	--------	-------	--------	--------

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

2264.13 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2100.83

Water heating fuel used

2264.13

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

310.83

(232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	453.78	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	489.05	(264)
Space and water heating	(261) + (262) + (263) + (264) =				942.83	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	161.32	(268)
Total CO2, kg/year				sum of (265)...(271) =	1143.08	(272)

TER =

16.38 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 2BF MID 69

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	69.2 (1a)	2.5 (2a)	173 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	69.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	173 (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				0	0 (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) =	0 (8)

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

Number of storeys in the dwelling (ns)	0 (9)
--	-------

Additional infiltration	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)
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Window infiltration	0 (15)
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Infiltration rate	0 (16)
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Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.5 (17)
---	----------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.18 (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	0.85 (20)
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Infiltration rate incorporating shelter factor	0.15 (21)
--	-----------

Infiltration rate modified for monthly wind speed

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

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

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

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

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

78.2 (23c)

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

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

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

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

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

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

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

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

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

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

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

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.46	$\times 1/[1/(1.4) + 0.04] =$	7.24		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			2.84	$\times 1/[1/(1.4) + 0.04] =$	3.77		(27)
Walls	39.88	14.6	25.27	$\times 0.18 =$	4.55		(29)
Total area of elements, m²			39.88				(31)
Party wall			43.59	$\times 0 =$	0		(32)
Party floor			69.2				(32a)
Party ceiling			69.2				(32b)

* 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) = 23.91 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7232.25 (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 4.84 (36)

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

Total fabric heat loss (33) + (36) = 28.75 (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=	17.05	16.84	16.63	15.56	15.35	14.29	14.29	14.08	14.71	15.35	15.78	16.2

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

(39)m= 45.8 45.59 45.38 44.31 44.1 43.04 43.04 42.83 43.47 44.1 44.53 44.95
Average = Sum(39)_{1...12} /12= 44.26 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.66	0.66	0.66	0.64	0.64	0.62	0.62	0.62	0.63	0.64	0.64	0.65		
	Average = Sum(40) _{1...12} /12=												0.64	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.23

(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

87.08

(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=	95.79	92.31	88.82	85.34	81.86	78.37	78.37	81.86	85.34	88.82	92.31	95.79		
	Total = Sum(44) _{1...12} =												1044.97	(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=	142.05	124.24	128.2	111.77	107.25	92.55	85.76	98.41	99.58	116.05	126.68	137.57		
	Total = Sum(45) _{1...12} =												1370.12	(45)

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

(46)m=	21.31	18.64	19.23	16.77	16.09	13.88	12.86	14.76	14.94	17.41	19	20.64		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	--	------

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

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

Primary circuit loss (annual) from Table 3

0

(58)

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

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

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

DER WorkSheet: New dwelling design stage

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

(61)m=	29.85	26.95	29.83	28.85	29.8	28.83	29.78	29.79	28.84	29.82	28.87	29.85	(61)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

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

(62)m=	171.9	151.19	158.03	140.62	137.05	121.37	115.54	128.2	128.42	145.87	155.56	167.41	(62)
--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

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

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

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

Output from water heater

(64)m=	171.9	151.19	158.03	140.62	137.05	121.37	115.54	128.2	128.42	145.87	155.56	167.41	
Output from water heater (annual) _{1...12}												1721.18	(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=	54.69	48.05	50.08	44.38	43.11	37.98	35.96	40.17	40.32	46.04	49.34	53.2	(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=	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	(66)

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

(67)m=	17.46	15.51	12.61	9.55	7.14	6.03	6.51	8.47	11.36	14.43	16.84	17.95	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

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

(68)m=	195.42	197.45	192.34	181.46	167.73	154.82	146.2	144.17	149.28	160.16	173.89	186.8	(68)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	------

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

(69)m=	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	(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=	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	73.51	71.5	67.32	61.63	57.94	52.75	48.33	53.99	56	61.89	68.53	71.51	(72)
--------	-------	------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	------

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

(73)m=	345.8	343.86	331.67	312.04	292.21	273	260.44	266.03	276.04	295.87	318.66	335.66	(73)
--------	-------	--------	--------	--------	--------	-----	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest _{0.9x}	0.77	x	5.46	x	36.79		0.63	x	0.7	=	61.4	(79)
Southwest _{0.9x}	0.77	x	3.15	x	36.79		0.63	x	0.7	=	70.84	(79)
Southwest _{0.9x}	0.77	x	5.46	x	62.67		0.63	x	0.7	=	104.58	(79)
Southwest _{0.9x}	0.77	x	3.15	x	62.67		0.63	x	0.7	=	120.67	(79)
Southwest _{0.9x}	0.77	x	5.46	x	85.75		0.63	x	0.7	=	143.09	(79)

DER WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	3.15	x	85.75	0.63	x	0.7	=	165.1	(79)
Southwest	0.9x	0.77	x	5.46	x	106.25	0.63	x	0.7	=	177.3	(79)
Southwest	0.9x	0.77	x	3.15	x	106.25	0.63	x	0.7	=	204.57	(79)
Southwest	0.9x	0.77	x	5.46	x	119.01	0.63	x	0.7	=	198.59	(79)
Southwest	0.9x	0.77	x	3.15	x	119.01	0.63	x	0.7	=	229.14	(79)
Southwest	0.9x	0.77	x	5.46	x	118.15	0.63	x	0.7	=	197.15	(79)
Southwest	0.9x	0.77	x	3.15	x	118.15	0.63	x	0.7	=	227.48	(79)
Southwest	0.9x	0.77	x	5.46	x	113.91	0.63	x	0.7	=	190.07	(79)
Southwest	0.9x	0.77	x	3.15	x	113.91	0.63	x	0.7	=	219.32	(79)
Southwest	0.9x	0.77	x	5.46	x	104.39	0.63	x	0.7	=	174.19	(79)
Southwest	0.9x	0.77	x	3.15	x	104.39	0.63	x	0.7	=	200.99	(79)
Southwest	0.9x	0.77	x	5.46	x	92.85	0.63	x	0.7	=	154.94	(79)
Southwest	0.9x	0.77	x	3.15	x	92.85	0.63	x	0.7	=	178.77	(79)
Southwest	0.9x	0.77	x	5.46	x	69.27	0.63	x	0.7	=	115.58	(79)
Southwest	0.9x	0.77	x	3.15	x	69.27	0.63	x	0.7	=	133.37	(79)
Southwest	0.9x	0.77	x	5.46	x	44.07	0.63	x	0.7	=	73.54	(79)
Southwest	0.9x	0.77	x	3.15	x	44.07	0.63	x	0.7	=	84.85	(79)
Southwest	0.9x	0.77	x	5.46	x	31.49	0.63	x	0.7	=	52.54	(79)
Southwest	0.9x	0.77	x	3.15	x	31.49	0.63	x	0.7	=	60.63	(79)
Northwest	0.9x	0.77	x	2.84	x	11.28	0.63	x	0.7	=	9.79	(81)
Northwest	0.9x	0.77	x	2.84	x	22.97	0.63	x	0.7	=	19.93	(81)
Northwest	0.9x	0.77	x	2.84	x	41.38	0.63	x	0.7	=	35.91	(81)
Northwest	0.9x	0.77	x	2.84	x	67.96	0.63	x	0.7	=	58.98	(81)
Northwest	0.9x	0.77	x	2.84	x	91.35	0.63	x	0.7	=	79.28	(81)
Northwest	0.9x	0.77	x	2.84	x	97.38	0.63	x	0.7	=	84.52	(81)
Northwest	0.9x	0.77	x	2.84	x	91.1	0.63	x	0.7	=	79.07	(81)
Northwest	0.9x	0.77	x	2.84	x	72.63	0.63	x	0.7	=	63.04	(81)
Northwest	0.9x	0.77	x	2.84	x	50.42	0.63	x	0.7	=	43.76	(81)
Northwest	0.9x	0.77	x	2.84	x	28.07	0.63	x	0.7	=	24.36	(81)
Northwest	0.9x	0.77	x	2.84	x	14.2	0.63	x	0.7	=	12.32	(81)
Northwest	0.9x	0.77	x	2.84	x	9.21	0.63	x	0.7	=	8	(81)

Solar gains in watts, calculated for each month

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

(83)m= 142.03 245.18 344.11 440.85 507.01 509.16 488.46 438.22 377.47 273.31 170.71 121.17 (83)

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

(84)m= 487.83 589.04 675.78 752.9 799.22 782.15 748.9 704.24 653.52 569.18 489.37 456.82 (84)

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	0.99	0.96	0.88	0.7	0.51	0.35	0.25	0.28	0.46	0.78	0.97	0.99

(86)

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

(87)m= 20.58 20.75 20.9 20.99 21 21 21 21 21 20.97 20.78 20.55 (87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.37	20.38	20.38	20.39	20.4	20.41	20.41	20.41	20.4	20.4	20.39	20.39	(88)
--------	-------	-------	-------	-------	------	-------	-------	-------	------	------	-------	-------	------

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

(89)m=	0.99	0.95	0.86	0.67	0.48	0.32	0.22	0.24	0.42	0.74	0.96	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	19.82	20.06	20.27	20.38	20.4	20.41	20.41	20.41	20.4	20.37	20.12	19.78	(90)
--------	-------	-------	-------	-------	------	-------	-------	-------	------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.36 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	20.09	20.31	20.5	20.6	20.61	20.62	20.62	20.63	20.62	20.59	20.36	20.06	(92)
--------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	20.09	20.31	20.5	20.6	20.61	20.62	20.62	20.63	20.62	20.59	20.36	20.06	(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	0.95	0.86	0.68	0.49	0.33	0.23	0.26	0.43	0.75	0.96	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	480.82	559.99	581.24	510.65	392.53	259.23	173.16	180.95	283.22	427.32	467.48	452.34	(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=	723.37	702.5	635.13	518.39	393.1	259.24	173.17	180.95	283.37	440.53	590.35	712.98	(97)
--------	--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	180.46	95.77	40.09	5.57	0.42	0	0	0	0	9.83	88.47	193.92	(98)
--------	--------	-------	-------	------	------	---	---	---	---	------	-------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 614.53 \quad (98)$$

Space heating requirement in kWh/m²/year

$$8.88 \quad (99)$$

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

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.4 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

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

kWh/year

Space heating requirement (calculated above)

180.46	95.77	40.09	5.57	0.42	0	0	0	0	9.83	88.47	193.92
--------	-------	-------	------	------	---	---	---	---	------	-------	--------

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

193.21	102.54	42.93	5.96	0.45	0	0	0	0	10.53	94.72	207.62
--------	--------	-------	------	------	---	---	---	---	-------	-------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 657.95 \quad (211)$$

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)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

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

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

171.9	151.19	158.03	140.62	137.05	121.37	115.54	128.2	128.42	145.87	155.56	167.41
-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

Efficiency of water heater

88.2 (216)

(217)m= 89.31 89.04 88.64 88.28 88.21 88.2 88.2 88.2 88.2 88.34 88.99 89.37 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

192.47	169.8	178.29	159.29	155.37	137.61	131	145.35	145.61	165.13	174.81	187.33
--------	-------	--------	--------	--------	--------	-----	--------	--------	--------	--------	--------

Total = Sum(219a)_{1..12} =

1942.07 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

657.95

Water heating fuel used

1942.07

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

147.74 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

222.74 (231)

Electricity for lighting

308.42 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	142.12 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	419.49 (264)
Space and water heating	(261) + (262) + (263) + (264) =		561.6 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	115.6 (267)
Electricity for lighting	(232) x	0.519 =	160.07 (268)
Total CO2, kg/year		sum of (265)...(271) =	837.28 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	12.1 (273)
EI rating (section 14)			90 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 2BF MID 69

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	69.2 (1a)	2.5 (2a)	173 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	69.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	173 (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				2	20 (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) =	0.12 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.37 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.31 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.4	0.39	0.38	0.34	0.33	0.3	0.3	0.29	0.31	0.33	0.35	0.37
-----	------	------	------	------	-----	-----	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.46	$\times 1/[1/(1.4) + 0.04] =$	7.24		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			2.84	$\times 1/[1/(1.4) + 0.04] =$	3.77		(27)
Walls	39.88	14.6	25.27	x 0.18	= 4.55		(29)
Total area of elements, m²			39.88				(31)
Party wall			43.59	x 0	= 0		(32)
Party floor			69.2				(32a)
Party ceiling			69.2				(32b)

* 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) = 23.91 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7232.25 (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 3.18 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 27.08 (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=	33.03	32.85	32.68	31.88	31.73	31.03	31.03	30.9	31.3	31.73	32.03	32.35

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 60.11 59.93 59.76 58.96 58.81 58.12 58.12 57.99 58.38 58.81 59.12 59.43
Average = Sum(39)_{1...12} /12= 58.96 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.87	0.87	0.86	0.85	0.85	0.84	0.84	0.84	0.84	0.85	0.85	0.86		
	Average = Sum(40) _{1...12} /12=												0.85	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.23

(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

87.08

(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=	95.79	92.31	88.82	85.34	81.86	78.37	78.37	81.86	85.34	88.82	92.31	95.79		
	Total = Sum(44) _{1...12} =												1044.97	(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=	142.05	124.24	128.2	111.77	107.25	92.55	85.76	98.41	99.58	116.05	126.68	137.57		
	Total = Sum(45) _{1...12} =												1370.12	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.31	18.64	19.23	16.77	16.09	13.88	12.86	14.76	14.94	17.41	19	20.64		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	48.81	42.49	45.26	42.08	41.71	38.65	39.94	41.71	42.08	45.26	45.52	48.81	(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=	190.86	166.72	173.47	153.86	148.96	131.2	125.7	140.12	141.67	161.32	172.2	186.38	(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=	190.86	166.72	173.47	153.86	148.96	131.2	125.7	140.12	141.67	161.32	172.2	186.38	
Output from water heater (annual) _{1...12}												1892.45	(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=	59.44	51.93	53.94	47.69	46.09	40.43	38.5	43.15	43.63	49.9	53.5	57.95	(65)
--------	-------	-------	-------	-------	-------	-------	------	-------	-------	------	------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.46	15.51	12.61	9.55	7.14	6.03	6.51	8.47	11.36	14.43	16.84	17.95	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	195.42	197.45	192.34	181.46	167.73	154.82	146.2	144.17	149.28	160.16	173.89	186.8	(68)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	(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=	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	79.89	77.28	72.5	66.23	61.95	56.16	51.75	58	60.6	67.08	74.31	77.88	(72)
--------	-------	-------	------	-------	-------	-------	-------	----	------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	352.17	349.64	336.86	316.64	296.21	276.41	263.86	270.03	280.64	301.06	324.44	342.03	(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)	
Southwest _{0.9x}	0.77	x	5.46	x	36.79		0.63	x	0.7	=	61.4	(79)
Southwest _{0.9x}	0.77	x	3.15	x	36.79		0.63	x	0.7	=	70.84	(79)
Southwest _{0.9x}	0.77	x	5.46	x	62.67		0.63	x	0.7	=	104.58	(79)
Southwest _{0.9x}	0.77	x	3.15	x	62.67		0.63	x	0.7	=	120.67	(79)
Southwest _{0.9x}	0.77	x	5.46	x	85.75		0.63	x	0.7	=	143.09	(79)

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Southwest	0.9x	0.77	x	3.15	x	85.75	0.63	x	0.7	=	165.1	(79)
Southwest	0.9x	0.77	x	5.46	x	106.25	0.63	x	0.7	=	177.3	(79)
Southwest	0.9x	0.77	x	3.15	x	106.25	0.63	x	0.7	=	204.57	(79)
Southwest	0.9x	0.77	x	5.46	x	119.01	0.63	x	0.7	=	198.59	(79)
Southwest	0.9x	0.77	x	3.15	x	119.01	0.63	x	0.7	=	229.14	(79)
Southwest	0.9x	0.77	x	5.46	x	118.15	0.63	x	0.7	=	197.15	(79)
Southwest	0.9x	0.77	x	3.15	x	118.15	0.63	x	0.7	=	227.48	(79)
Southwest	0.9x	0.77	x	5.46	x	113.91	0.63	x	0.7	=	190.07	(79)
Southwest	0.9x	0.77	x	3.15	x	113.91	0.63	x	0.7	=	219.32	(79)
Southwest	0.9x	0.77	x	5.46	x	104.39	0.63	x	0.7	=	174.19	(79)
Southwest	0.9x	0.77	x	3.15	x	104.39	0.63	x	0.7	=	200.99	(79)
Southwest	0.9x	0.77	x	5.46	x	92.85	0.63	x	0.7	=	154.94	(79)
Southwest	0.9x	0.77	x	3.15	x	92.85	0.63	x	0.7	=	178.77	(79)
Southwest	0.9x	0.77	x	5.46	x	69.27	0.63	x	0.7	=	115.58	(79)
Southwest	0.9x	0.77	x	3.15	x	69.27	0.63	x	0.7	=	133.37	(79)
Southwest	0.9x	0.77	x	5.46	x	44.07	0.63	x	0.7	=	73.54	(79)
Southwest	0.9x	0.77	x	3.15	x	44.07	0.63	x	0.7	=	84.85	(79)
Southwest	0.9x	0.77	x	5.46	x	31.49	0.63	x	0.7	=	52.54	(79)
Southwest	0.9x	0.77	x	3.15	x	31.49	0.63	x	0.7	=	60.63	(79)
Northwest	0.9x	0.77	x	2.84	x	11.28	0.63	x	0.7	=	9.79	(81)
Northwest	0.9x	0.77	x	2.84	x	22.97	0.63	x	0.7	=	19.93	(81)
Northwest	0.9x	0.77	x	2.84	x	41.38	0.63	x	0.7	=	35.91	(81)
Northwest	0.9x	0.77	x	2.84	x	67.96	0.63	x	0.7	=	58.98	(81)
Northwest	0.9x	0.77	x	2.84	x	91.35	0.63	x	0.7	=	79.28	(81)
Northwest	0.9x	0.77	x	2.84	x	97.38	0.63	x	0.7	=	84.52	(81)
Northwest	0.9x	0.77	x	2.84	x	91.1	0.63	x	0.7	=	79.07	(81)
Northwest	0.9x	0.77	x	2.84	x	72.63	0.63	x	0.7	=	63.04	(81)
Northwest	0.9x	0.77	x	2.84	x	50.42	0.63	x	0.7	=	43.76	(81)
Northwest	0.9x	0.77	x	2.84	x	28.07	0.63	x	0.7	=	24.36	(81)
Northwest	0.9x	0.77	x	2.84	x	14.2	0.63	x	0.7	=	12.32	(81)
Northwest	0.9x	0.77	x	2.84	x	9.21	0.63	x	0.7	=	8	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 142.03 245.18 344.11 440.85 507.01 509.16 488.46 438.22 377.47 273.31 170.71 121.17 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 494.2 594.82 680.97 757.49 803.22 785.56 752.32 708.25 658.12 574.37 495.15 463.2 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	0.99	0.98	0.94	0.84	0.66	0.47	0.34	0.38	0.6	0.89	0.98	1

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 20.27 20.45 20.68 20.89 20.98 21 21 21 20.99 20.86 20.52 20.23 (87)

TER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.2	20.2	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.21	20.2	(88)
--------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.93	0.8	0.61	0.41	0.28	0.31	0.54	0.86	0.98	0.99	(89)
--------	------	------	------	-----	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.22	19.49	19.81	20.09	20.19	20.22	20.22	20.22	20.21	20.06	19.6	19.17	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

fLA = Living area ÷ (4) =	0.36	(91)
---------------------------	------	------

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.6	19.84	20.12	20.38	20.48	20.5	20.5	20.5	20.49	20.35	19.93	19.56	(92)
--------	------	-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.6	19.84	20.12	20.38	20.48	20.5	20.5	20.5	20.49	20.35	19.93	19.56	(93)
--------	------	-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.93	0.81	0.63	0.44	0.3	0.34	0.56	0.86	0.98	0.99	(94)
--------	------	------	------	------	------	------	-----	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	489.67	579.15	632.09	615.15	505.03	341.97	226.64	237.72	369.02	496.76	483.53	460.18	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m – (96)m]

(97)m=	919.56	895.42	814.22	676.7	516.09	342.85	226.71	237.85	373.15	573.26	758.49	912.61	(97)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	319.84	212.53	135.5	44.32	8.23	0	0	0	0	56.91	197.97	336.6	(98)
--------	--------	--------	-------	-------	------	---	---	---	---	-------	--------	-------	------

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	1311.91	(98)
---	---------	------

Space heating requirement in kWh/m²/year

18.96	(99)
-------	------

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

93.4	(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)

319.84	212.53	135.5	44.32	8.23	0	0	0	0	56.91	197.97	336.6
--------	--------	-------	-------	------	---	---	---	---	-------	--------	-------

(211)m = {[(98)m x (204)] } x 100 ÷ (206)	(211)
---	-------

342.45	227.55	145.08	47.45	8.81	0	0	0	0	60.93	211.96	360.39
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

Total (kWh/year) = Sum(211) _{1...5,10...12} =	1404.62	(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)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

Total (kWh/year) = Sum(215) _{1...5,10...12} =	0	(215)
--	---	-------

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

190.86	166.72	173.47	153.86	148.96	131.2	125.7	140.12	141.67	161.32	172.2	186.38
--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	-------	--------

Efficiency of water heater

80.3 (216)

(217)m= 86.34 85.66 84.44 82.36 80.77 80.3 80.3 80.3 80.3 82.71 85.4 86.52 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

221.06	194.63	205.44	186.81	184.42	163.38	156.53	174.5	176.42	195.04	201.64	215.42
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} =

2275.29 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1404.62

Water heating fuel used

2275.29

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

308.42 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x		0.216	=	303.4 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)
Water heating	(219) x		0.216	=	491.46 (264)
Space and water heating	(261) + (262) + (263) + (264) =				794.86 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93 (267)
Electricity for lighting	(232) x		0.519	=	160.07 (268)
Total CO2, kg/year	sum of (265)...(271) =				993.86 (272)

TER =

14.36 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 2BF TOP 66

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	66 (1a)	2.5 (2a)	165 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	165 (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				0	0 (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) =	0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0 (9)
--	-------

Additional infiltration	0 (10)
-------------------------	--------

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0 (11)
--	--------

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0 (12)
---	--------

If no draught lobby, enter 0.05, else enter 0	0 (13)
---	--------

Percentage of windows and doors draught stripped	0 (14)
--	--------

Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0 (15)
---------------------	------------------------------------

Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0 (16)
-------------------	---

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.5 (17)
---	----------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.18 (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	0.85 (20)
----------------	-----------

Infiltration rate incorporating shelter factor	0.15 (21)
--	-----------

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.62	$\times 1/[1/(1.4) + 0.04] =$	8.78		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	41.17	12.92	28.25	$\times$ 0.18	5.09		(29)
Roof	66	0	66	$\times$ 0.15	9.9		(30)
Total area of elements, m²			107.17				(31)
Party wall			41.03	$\times$ 0	0		(32)
Party floor			66				(32a)

* 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) = 32.11 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5749.8 (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 9.43 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 41.54 (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=	16.26	16.06	15.86	14.84	14.64	13.63	13.63	13.43	14.03	14.64	15.05	15.45

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	57.81	57.6	57.4	56.39	56.19	55.17	55.17	54.97	55.58	56.19	56.59	57
Average = Sum(39) _{1...12} /12=												56.34 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.88	0.87	0.87	0.85	0.85	0.84	0.84	0.83	0.84	0.85	0.86	0.86		
	Average = Sum(40) _{1...12} /12=												0.85	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.15

(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

85.15

(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=	93.66	90.26	86.85	83.45	80.04	76.63	76.63	80.04	83.45	86.85	90.26	93.66		
	Total = Sum(44) _{1...12} =												1021.79	(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=	138.9	121.48	125.36	109.29	104.87	90.49	83.86	96.23	97.38	113.48	123.87	134.52		
	Total = Sum(45) _{1...12} =												1339.73	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.84	18.22	18.8	16.39	15.73	13.57	12.58	14.43	14.61	17.02	18.58	20.18		(46)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	29.84	26.95	29.82	28.85	29.8	28.82	29.78	29.79	28.84	29.81	28.87	29.84	(61)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	168.75	148.43	155.18	138.14	134.67	119.32	113.63	126.02	126.21	143.29	152.74	164.36	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	168.75	148.43	155.18	138.14	134.67	119.32	113.63	126.02	126.21	143.29	152.74	164.36	
Output from water heater (annual) _{1...12}												1690.74	(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=	53.65	47.13	49.14	43.55	42.32	37.3	35.33	39.44	39.59	45.19	48.4	52.19	(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=	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	16.9	15.01	12.21	9.24	6.91	5.83	6.3	8.19	10.99	13.96	16.29	17.37	(67)
--------	------	-------	-------	------	------	------	-----	------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	187.79	189.74	184.83	174.37	161.18	148.77	140.49	138.54	143.45	153.9	167.1	179.5	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	-------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	(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=	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	72.1	70.13	66.05	60.49	56.88	51.8	47.48	53.01	54.98	60.73	67.23	70.14	(72)
--------	------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	334.97	333.06	321.26	302.28	283.14	264.58	252.45	257.92	267.6	286.77	308.8	325.19	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	-------	--------	------

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	6.62	x	11.28	x	0.63	x	0.7	=	22.83	(75)
Northeast 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast 0.9x	0.77	x	6.62	x	22.97	x	0.63	x	0.7	=	46.47	(75)
Northeast 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast 0.9x	0.77	x	6.62	x	41.38	x	0.63	x	0.7	=	83.72	(75)

DER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast 0.9x	0.77	x	6.62	x	67.96	x	0.63	x	0.7	=	137.49	(75)
Northeast 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast 0.9x	0.77	x	6.62	x	91.35	x	0.63	x	0.7	=	184.81	(75)
Northeast 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast 0.9x	0.77	x	6.62	x	97.38	x	0.63	x	0.7	=	197.02	(75)
Northeast 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast 0.9x	0.77	x	6.62	x	91.1	x	0.63	x	0.7	=	184.31	(75)
Northeast 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast 0.9x	0.77	x	6.62	x	72.63	x	0.63	x	0.7	=	146.94	(75)
Northeast 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast 0.9x	0.77	x	6.62	x	50.42	x	0.63	x	0.7	=	102.01	(75)
Northeast 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast 0.9x	0.77	x	6.62	x	28.07	x	0.63	x	0.7	=	56.78	(75)
Northeast 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast 0.9x	0.77	x	6.62	x	14.2	x	0.63	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast 0.9x	0.77	x	6.62	x	9.21	x	0.63	x	0.7	=	18.64	(75)
Northeast 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	44.55	90.68	163.38	268.32	360.68	384.52	359.71	286.77	199.09	110.82	56.06	36.38	(83)
--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	379.52	423.74	484.64	570.6	643.82	649.11	612.16	544.69	466.69	397.6	364.86	361.58	(84)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.93	0.76	0.54	0.4	0.46	0.77	0.97	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.12	20.24	20.47	20.77	20.95	21	21	21	20.96	20.7	20.36	20.1	(87)
--------	-------	-------	-------	-------	-------	----	----	----	-------	------	-------	------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.19	20.19	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.2	20.2	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.91	0.71	0.48	0.33	0.39	0.7	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=	19	19.18	19.51	19.94	20.16	20.22	20.22	20.22	20.19	19.86	19.37	18.99	(90)
--------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.38 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.43	19.58	19.87	20.26	20.46	20.51	20.52	20.52	20.48	20.18	19.75	19.41	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

DER WorkSheet: New dwelling design stage

(93)m=	19.43	19.58	19.87	20.26	20.46	20.51	20.52	20.52	20.48	20.18	19.75	19.41	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	1	0.99	0.98	0.91	0.73	0.5	0.35	0.41	0.72	0.96	0.99	1	(94)
--------	---	------	------	------	------	-----	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	378.39	421.02	474.55	519.06	468.49	324.45	215.94	225.94	338.28	381.07	362.44	360.77	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	874.46	845.87	767.69	640.41	492.32	326.26	216.09	226.35	354.68	538.19	715.69	866.94	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	369.07	285.5	218.1	87.38	17.73	0	0	0	0	116.9	254.34	376.6	
--------	--------	-------	-------	-------	-------	---	---	---	---	-------	--------	-------	--

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 1725.61 (98)

Space heating requirement in $kWh/m^2/year$

26.15 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

93.4 (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)

369.07	285.5	218.1	87.38	17.73	0	0	0	0	116.9	254.34	376.6
--------	-------	-------	-------	-------	---	---	---	---	-------	--------	-------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

395.15	305.67	233.51	93.55	18.98	0	0	0	0	125.16	272.31	403.21
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 1847.55 (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 ($kWh/year$) = $Sum(215)_{1..5,10..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

168.75	148.43	155.18	138.14	134.67	119.32	113.63	126.02	126.21	143.29	152.74	164.36
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Efficiency of water heater

88.2 (216)

(217)m=	89.7	89.64	89.47	89.04	88.45	88.2	88.2	88.2	88.2	89.18	89.56	89.72	(217)
---------	------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	188.13	165.6	173.44	155.14	152.25	135.28	128.84	142.88	143.1	160.69	170.54	183.19	
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Total = $Sum(219a)_{1..12} =$ 1899.07 (219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

1847.55

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Water heating fuel used		1899.07	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	140.91		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	215.91	(231)
Electricity for lighting		298.45	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216	=	399.07 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	410.2 (264)
Space and water heating	(261) + (262) + (263) + (264) =			809.27 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	112.06 (267)
Electricity for lighting	(232) x	0.519	=	154.9 (268)
Total CO2, kg/year		sum of (265)...(271) =		1076.22 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.31 (273)
El rating (section 14)				87 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 2BF TOP 66

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	66 (1a)	2.5 (2a)	165 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	165 (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				2	20 (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) =	0.12 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0 (9)
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Additional infiltration	0 (10)
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Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0 (11)
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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)
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If no draught lobby, enter 0.05, else enter 0	0 (13)
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Percentage of windows and doors draught stripped	0 (14)
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Window infiltration	0 (15)
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Infiltration rate	0 (16)
-------------------	--------

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
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If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.37 (18)
--	-----------

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered	2 (19)
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Shelter factor	0.85 (20)
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Infiltration rate incorporating shelter factor	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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

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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TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.4	0.39	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.35	0.37
-----	------	------	------	------	-----	-----	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.62	$\times 1/[1/(1.4) + 0.04] =$	8.78		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	41.17	12.92	28.25	$\times$ 0.18	5.09		(29)
Roof	66	0	66	$\times$ 0.13	8.58		(30)
Total area of elements, m²			107.17				(31)
Party wall			41.03	$\times$ 0	0		(32)
Party floor			66				(32a)

* 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) = 30.79 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5749.8 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.98 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 36.78 (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=	31.63	31.46	31.29	30.5	30.36	29.67	29.67	29.54	29.94	30.36	30.66	30.97

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	68.41	68.24	68.07	67.28	67.14	66.45	66.45	66.32	66.71	67.14	67.43	67.75
Average = Sum(39) _{1...12} /12=												67.28 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.04	1.03	1.03	1.02	1.02	1.01	1.01	1	1.01	1.02	1.02	1.03		
Average = Sum(40) _{1...12} /12=													1.02	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.15

(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

85.15

(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=	93.66	90.26	86.85	83.45	80.04	76.63	76.63	80.04	83.45	86.85	90.26	93.66		
Total = Sum(44) _{1...12} =													1021.79	(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=	138.9	121.48	125.36	109.29	104.87	90.49	83.86	96.23	97.38	113.48	123.87	134.52		
Total = Sum(45) _{1...12} =													1339.73	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.84	18.22	18.8	16.39	15.73	13.57	12.58	14.43	14.61	17.02	18.58	20.18		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	47.73	41.54	44.26	41.15	40.79	37.79	39.05	40.79	41.15	44.26	44.51	47.73	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	186.63	163.03	169.62	150.44	145.66	128.29	122.91	137.01	138.53	157.74	168.38	182.25	(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=	186.63	163.03	169.62	150.44	145.66	128.29	122.91	137.01	138.53	157.74	168.38	182.25	
Output from water heater (annual) _{1...12}												1850.49	(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=	58.12	50.78	52.75	46.63	45.07	39.54	37.65	42.19	42.67	48.8	52.32	56.66	(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=	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	16.9	15.01	12.21	9.24	6.91	5.83	6.3	8.19	10.99	13.96	16.29	17.37	(67)
--------	------	-------	-------	------	------	------	-----	------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	187.79	189.74	184.83	174.37	161.18	148.77	140.49	138.54	143.45	153.9	167.1	179.5	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	-------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	(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=	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	78.11	75.56	70.9	64.76	60.57	54.91	50.6	56.71	59.26	65.59	72.66	76.16	(72)
--------	-------	-------	------	-------	-------	-------	------	-------	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	340.98	338.49	326.11	306.55	286.83	267.7	255.57	261.62	271.88	291.63	314.23	331.21	(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)	
Northeast 0.9x	0.77	x	6.62	x	11.28	x	0.63	x	0.7	=	22.83	(75)
Northeast 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast 0.9x	0.77	x	6.62	x	22.97	x	0.63	x	0.7	=	46.47	(75)
Northeast 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast 0.9x	0.77	x	6.62	x	41.38	x	0.63	x	0.7	=	83.72	(75)

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Northeast 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast 0.9x	0.77	x	6.62	x	67.96	x	0.63	x	0.7	=	137.49	(75)
Northeast 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast 0.9x	0.77	x	6.62	x	91.35	x	0.63	x	0.7	=	184.81	(75)
Northeast 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast 0.9x	0.77	x	6.62	x	97.38	x	0.63	x	0.7	=	197.02	(75)
Northeast 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast 0.9x	0.77	x	6.62	x	91.1	x	0.63	x	0.7	=	184.31	(75)
Northeast 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast 0.9x	0.77	x	6.62	x	72.63	x	0.63	x	0.7	=	146.94	(75)
Northeast 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast 0.9x	0.77	x	6.62	x	50.42	x	0.63	x	0.7	=	102.01	(75)
Northeast 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast 0.9x	0.77	x	6.62	x	28.07	x	0.63	x	0.7	=	56.78	(75)
Northeast 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast 0.9x	0.77	x	6.62	x	14.2	x	0.63	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast 0.9x	0.77	x	6.62	x	9.21	x	0.63	x	0.7	=	18.64	(75)
Northeast 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	44.55	90.68	163.38	268.32	360.68	384.52	359.71	286.77	199.09	110.82	56.06	36.38	(83)
--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	385.53	429.17	489.49	574.88	647.52	652.22	615.28	548.39	470.97	402.45	370.29	367.59	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.95	0.83	0.63	0.47	0.55	0.84	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.9	20.02	20.27	20.61	20.87	20.98	21	20.99	20.9	20.56	20.17	19.88	(87)
--------	------	-------	-------	-------	-------	-------	----	-------	------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.05	20.06	20.06	20.07	20.07	20.08	20.08	20.08	20.07	20.07	20.07	20.06	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.94	0.78	0.55	0.37	0.44	0.77	0.97	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.58	18.76	19.12	19.61	19.95	20.06	20.08	20.08	20	19.54	18.99	18.55	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.38 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.08	19.24	19.55	19.99	20.3	20.41	20.42	20.42	20.34	19.93	19.44	19.05	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.08	19.24	19.55	19.99	20.3	20.41	20.42	20.42	20.34	19.93	19.44	19.05	(93)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	1	0.99	0.98	0.93	0.79	0.58	0.41	0.48	0.79	0.97	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	384.3	426.52	480.98	536.87	514.72	377.48	253.11	264.4	372.66	389.38	367.94	366.68	(95)
--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	1011.01	978.6	888.63	746.18	577.38	386.13	254.17	266.83	416.34	626.25	831.81	1006.34	(97)
--------	---------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	---------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	466.27	370.99	303.29	150.71	46.62	0	0	0	0	176.23	333.99	475.91	
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 2324.01 (98)

Space heating requirement in $kWh/m^2/year$

35.21 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

93.4 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

466.27	370.99	303.29	150.71	46.62	0	0	0	0	176.23	333.99	475.91
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

499.22	397.21	324.72	161.36	49.92	0	0	0	0	188.68	357.59	509.54
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 2488.23 (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 ($kWh/year$) = $Sum(215)_{1..5,10..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

186.63	163.03	169.62	150.44	145.66	128.29	122.91	137.01	138.53	157.74	168.38	182.25
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3 (216)

(217)m=	87.26	87.06	86.5	85.06	82.54	80.3	80.3	80.3	80.3	85.33	86.74	87.36	(217)
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Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	213.87	187.27	196.1	176.88	176.48	159.76	153.06	170.63	172.51	184.86	194.12	208.62
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Total = $Sum(219a)_{1..12} =$ 2194.15 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2488.23

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Water heating fuel used		2194.15	
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		298.45	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	537.46	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	473.94	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1011.4	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	154.9	(268)
Total CO2, kg/year			sum of (265)...(271) =		1205.22	(272)
TER =					18.26	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 3BF GND 91

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	90.5 (1a)	2.5 (2a)	226.25 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.5 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	226.25 (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				0	0 (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) =	0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.18 (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) = 0.15 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.62	$\times 1/[1/(1.4) + 0.04] =$	8.78		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			1.58	$\times 1/[1/(1.4) + 0.04] =$	2.09		(27)
Floor			90.5	$\times$ 0.13	= 11.765		(28)
Walls	49.66	16.08	33.58	$\times$ 0.18	= 6.04		(29)
Total area of elements, m²			140.16				(31)
Party wall			47.23	$\times$ 0	= 0		(32)
Party ceiling			90.5				(32b)

* 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) = 39.13 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 12462.08 (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 10.38 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.5 (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=	22.3	22.02	21.74	20.35	20.08	18.69	18.69	18.41	19.24	20.08	20.63	21.19

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	71.8	71.53	71.25	69.86	69.58	68.19	68.19	67.92	68.75	69.58	70.14	70.69
Average = Sum(39) _{1...12} /12=												69.79 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.79	0.79	0.79	0.77	0.77	0.75	0.75	0.75	0.76	0.77	0.77	0.78		
	Average = Sum(40) _{1...12} /12=												0.77	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.63

(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

96.72

(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=	106.39	102.53	98.66	94.79	90.92	87.05	87.05	90.92	94.79	98.66	102.53	106.39		
	Total = Sum(44) _{1...12} =												1160.66	(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=	157.78	137.99	142.4	124.15	119.12	102.79	95.25	109.3	110.61	128.9	140.71	152.8		
	Total = Sum(45) _{1...12} =												1521.81	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.67	20.7	21.36	18.62	17.87	15.42	14.29	16.4	16.59	19.34	21.11	22.92		(46)
--------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	29.87	26.98	29.85	28.87	29.82	28.84	29.8	29.81	28.86	29.84	28.9	29.87	(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=	187.65	164.97	172.25	153.02	148.94	131.64	125.05	139.12	139.47	158.75	169.61	182.67	(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=	187.65	164.97	172.25	153.02	148.94	131.64	125.05	139.12	139.47	158.75	169.61	182.67	
Output from water heater (annual) _{1...12}												1873.13	(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=	59.93	52.63	54.81	48.5	47.06	41.39	39.12	43.8	43.99	50.32	54.01	58.27	(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=	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.9	19.45	15.82	11.98	8.95	7.56	8.17	10.61	14.25	18.09	21.11	22.51	(67)
--------	------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	239.99	242.48	236.21	222.85	205.98	190.13	179.54	177.05	183.33	196.69	213.55	229.41	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	(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=	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	80.55	78.31	73.67	67.36	63.26	57.49	52.58	58.87	61.1	67.64	75.01	78.32	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	407.93	405.74	391.19	367.67	343.68	320.66	305.78	312.02	324.16	347.9	375.17	395.72	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	6.62	x	11.28	x	0.63	x	0.7	=	22.83	(75)
Northeast 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast 0.9x	0.77	x	6.62	x	22.97	x	0.63	x	0.7	=	46.47	(75)
Northeast 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast 0.9x	0.77	x	6.62	x	41.38	x	0.63	x	0.7	=	83.72	(75)

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Northeast 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast 0.9x	0.77	x	6.62	x	67.96	x	0.63	x	0.7	=	137.49	(75)
Northeast 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast 0.9x	0.77	x	6.62	x	91.35	x	0.63	x	0.7	=	184.81	(75)
Northeast 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast 0.9x	0.77	x	6.62	x	97.38	x	0.63	x	0.7	=	197.02	(75)
Northeast 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast 0.9x	0.77	x	6.62	x	91.1	x	0.63	x	0.7	=	184.31	(75)
Northeast 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast 0.9x	0.77	x	6.62	x	72.63	x	0.63	x	0.7	=	146.94	(75)
Northeast 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast 0.9x	0.77	x	6.62	x	50.42	x	0.63	x	0.7	=	102.01	(75)
Northeast 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast 0.9x	0.77	x	6.62	x	28.07	x	0.63	x	0.7	=	56.78	(75)
Northeast 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast 0.9x	0.77	x	6.62	x	14.2	x	0.63	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast 0.9x	0.77	x	6.62	x	9.21	x	0.63	x	0.7	=	18.64	(75)
Northeast 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)
Northwest 0.9x	0.77	x	1.58	x	11.28	x	0.63	x	0.7	=	10.9	(81)
Northwest 0.9x	0.77	x	1.58	x	22.97	x	0.63	x	0.7	=	22.18	(81)
Northwest 0.9x	0.77	x	1.58	x	41.38	x	0.63	x	0.7	=	39.96	(81)
Northwest 0.9x	0.77	x	1.58	x	67.96	x	0.63	x	0.7	=	65.63	(81)
Northwest 0.9x	0.77	x	1.58	x	91.35	x	0.63	x	0.7	=	88.22	(81)
Northwest 0.9x	0.77	x	1.58	x	97.38	x	0.63	x	0.7	=	94.05	(81)
Northwest 0.9x	0.77	x	1.58	x	91.1	x	0.63	x	0.7	=	87.98	(81)
Northwest 0.9x	0.77	x	1.58	x	72.63	x	0.63	x	0.7	=	70.14	(81)
Northwest 0.9x	0.77	x	1.58	x	50.42	x	0.63	x	0.7	=	48.69	(81)
Northwest 0.9x	0.77	x	1.58	x	28.07	x	0.63	x	0.7	=	27.11	(81)
Northwest 0.9x	0.77	x	1.58	x	14.2	x	0.63	x	0.7	=	13.71	(81)
Northwest 0.9x	0.77	x	1.58	x	9.21	x	0.63	x	0.7	=	8.9	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 55.45 112.86 203.35 333.95 448.9 478.57 447.69 356.91 247.78 137.93 69.77 45.28 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 463.38 518.6 594.53 701.62 792.58 799.24 753.47 668.93 571.94 485.83 444.94 441.01 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	1	0.99	0.94	0.77	0.54	0.4	0.47	0.78	0.98	1	1

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 20.18 20.3 20.51 20.79 20.96 21 21 21 20.97 20.72 20.41 20.17 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.26	20.26	20.26	20.28	20.28	20.29	20.29	20.3	20.29	20.28	20.28	20.27	(88)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.92	0.72	0.48	0.33	0.4	0.72	0.97	1	1	(89)
--------	---	---	------	------	------	------	------	-----	------	------	---	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.15	19.32	19.62	20.04	20.24	20.29	20.29	20.3	20.26	19.95	19.49	19.14	(90)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =	0.28	(91)
---------------------------	------	------

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.43	19.59	19.87	20.25	20.44	20.49	20.49	20.49	20.46	20.16	19.74	19.42	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.43	19.59	19.87	20.25	20.44	20.49	20.49	20.49	20.46	20.16	19.74	19.42	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	1	0.98	0.92	0.74	0.5	0.35	0.41	0.73	0.97	1	1	(94)
--------	---	---	------	------	------	-----	------	------	------	------	---	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	462.59	516.52	585.58	646.53	583.21	399.97	265.09	277.5	419.91	470.17	443.12	440.47	(95)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m – (96)m]

(97)m=	1086.7	1050.45	952.4	792.61	608.26	401.44	265.19	277.8	437.18	665.44	886.86	1076.07	(97)
--------	--------	---------	-------	--------	--------	--------	--------	-------	--------	--------	--------	---------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	464.33	358.8	272.91	105.17	18.64	0	0	0	0	145.28	319.49	472.89	(98)
--------	--------	-------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

2157.52	(98)
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Space heating requirement in kWh/m²/year

23.84	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

(202) = 1 – (201) =

1	(202)
---	-------

Fraction of total heating from main system 1

(204) = (202) × [1 – (203)] =

1	(204)
---	-------

Efficiency of main space heating system 1

93.4	(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)

464.33	358.8	272.91	105.17	18.64	0	0	0	0	145.28	319.49	472.89
--------	-------	--------	--------	-------	---	---	---	---	--------	--------	--------

(211)m = {[(98)m x (204)] } x 100 ÷ (206)

497.15	384.15	292.2	112.61	19.96	0	0	0	0	155.55	342.06	506.31
--------	--------	-------	--------	-------	---	---	---	---	--------	--------	--------

Total (kWh/year) = Sum(211)_{1...5,10...12} =

2309.98	(211)
---------	-------

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

Total (kWh/year) = Sum(215)_{1...5,10...12} =

0	(215)
---	-------

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

187.65	164.97	172.25	153.02	148.94	131.64	125.05	139.12	139.47	158.75	169.61	182.67
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

88.2 (216)

(217)m= 89.76 89.7 89.54 89.08 88.44 88.2 88.2 88.2 88.2 89.24 89.62 89.78 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

209.07	183.92	192.38	171.77	168.41	149.25	141.78	157.73	158.13	177.89	189.24	203.47
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} = 2103.05 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2309.98

Water heating fuel used

2103.05

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

193.22 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 268.22 (231)

Electricity for lighting

386.74 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	498.96 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	454.26 (264)
Space and water heating	(261) + (262) + (263) + (264) =		953.21 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	139.2 (267)
Electricity for lighting	(232) x	0.519 =	200.72 (268)
Total CO2, kg/year		sum of (265)...(271) =	1293.14 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	14.29 (273)
EI rating (section 14)			87 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 3BF GND 91

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	90.5 (1a) x	2.5 (2a) =	226.25 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.5 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	226.25 (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) = 0.13 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.38 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.33 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.41	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.38
------	------	-----	------	------	------	------	-----	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.59 0.58 0.58 0.56 0.56 0.55 0.55 0.55 0.55 0.56 0.57 0.57 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.59 0.58 0.58 0.56 0.56 0.55 0.55 0.55 0.55 0.56 0.57 0.57 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.62	x1/[1/(1.4)+0.04] =	8.78		(27)
Windows Type 2			3.15	x1/[1/(1.4)+0.04] =	4.18		(27)
Windows Type 3			1.58	x1/[1/(1.4)+0.04] =	2.09		(27)
Floor			90.5	x 0.13 =	11.765		(28)
Walls	49.66	16.08	33.58	x 0.18 =	6.04		(29)
Total area of elements, m²			140.16				(31)
Party wall			47.23	x 0 =	0		(32)
Party ceiling			90.5				(32b)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 39.13 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 12462.08 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 7.03 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.16 (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=	43.75	43.5	43.26	42.11	41.89	40.89	40.89	40.71	41.28	41.89	42.33	42.78

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 89.91 89.66 89.41 88.27 88.05 87.05 87.05 86.87 87.44 88.05 88.49 88.94
Average = Sum(39)_{1...12} /12= 88.27 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.99	0.99	0.99	0.98	0.97	0.96	0.96	0.96	0.97	0.97	0.98	0.98		
Average = Sum(40) _{1...12} /12=													0.98	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.63

(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

96.72

(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=	106.39	102.53	98.66	94.79	90.92	87.05	87.05	90.92	94.79	98.66	102.53	106.39		
Total = Sum(44) _{1...12} =													1160.66	(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=	157.78	137.99	142.4	124.15	119.12	102.79	95.25	109.3	110.61	128.9	140.71	152.8		
Total = Sum(45) _{1...12} =													1521.81	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.67	20.7	21.36	18.62	17.87	15.42	14.29	16.4	16.59	19.34	21.11	22.92		(46)
--------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	50.96	46.03	50.27	46.74	46.33	42.93	44.36	46.33	46.74	50.27	49.32	50.96	(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=	208.74	184.02	192.67	170.89	165.45	145.72	139.61	155.63	157.35	179.18	190.02	203.76	(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=	208.74	184.02	192.67	170.89	165.45	145.72	139.61	155.63	157.35	179.18	190.02	203.76	
Output from water heater (annual) _{1...12}												2093.06	(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=	65.2	57.39	59.92	52.96	51.19	44.91	42.76	47.93	48.46	55.43	59.11	63.55	(65)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.9	19.45	15.82	11.98	8.95	7.56	8.17	10.61	14.25	18.09	21.11	22.51	(67)
--------	------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	239.99	242.48	236.21	222.85	205.98	190.13	179.54	177.05	183.33	196.69	213.55	229.41	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	(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=	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	87.64	85.4	80.53	73.56	68.8	62.38	57.47	64.42	67.31	74.5	82.1	85.41	(72)
--------	-------	------	-------	-------	------	-------	-------	-------	-------	------	------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	415.02	412.82	398.05	373.87	349.23	325.55	310.67	317.57	330.37	354.77	382.26	402.81	(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)	
Northeast 0.9x	0.77	x	6.62	x	11.28	x	0.63	x	0.7	=	22.83	(75)
Northeast 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast 0.9x	0.77	x	6.62	x	22.97	x	0.63	x	0.7	=	46.47	(75)
Northeast 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast 0.9x	0.77	x	6.62	x	41.38	x	0.63	x	0.7	=	83.72	(75)

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Northeast 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast 0.9x	0.77	x	6.62	x	67.96	x	0.63	x	0.7	=	137.49	(75)
Northeast 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast 0.9x	0.77	x	6.62	x	91.35	x	0.63	x	0.7	=	184.81	(75)
Northeast 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast 0.9x	0.77	x	6.62	x	97.38	x	0.63	x	0.7	=	197.02	(75)
Northeast 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast 0.9x	0.77	x	6.62	x	91.1	x	0.63	x	0.7	=	184.31	(75)
Northeast 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast 0.9x	0.77	x	6.62	x	72.63	x	0.63	x	0.7	=	146.94	(75)
Northeast 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast 0.9x	0.77	x	6.62	x	50.42	x	0.63	x	0.7	=	102.01	(75)
Northeast 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast 0.9x	0.77	x	6.62	x	28.07	x	0.63	x	0.7	=	56.78	(75)
Northeast 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast 0.9x	0.77	x	6.62	x	14.2	x	0.63	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast 0.9x	0.77	x	6.62	x	9.21	x	0.63	x	0.7	=	18.64	(75)
Northeast 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)
Northwest 0.9x	0.77	x	1.58	x	11.28	x	0.63	x	0.7	=	10.9	(81)
Northwest 0.9x	0.77	x	1.58	x	22.97	x	0.63	x	0.7	=	22.18	(81)
Northwest 0.9x	0.77	x	1.58	x	41.38	x	0.63	x	0.7	=	39.96	(81)
Northwest 0.9x	0.77	x	1.58	x	67.96	x	0.63	x	0.7	=	65.63	(81)
Northwest 0.9x	0.77	x	1.58	x	91.35	x	0.63	x	0.7	=	88.22	(81)
Northwest 0.9x	0.77	x	1.58	x	97.38	x	0.63	x	0.7	=	94.05	(81)
Northwest 0.9x	0.77	x	1.58	x	91.1	x	0.63	x	0.7	=	87.98	(81)
Northwest 0.9x	0.77	x	1.58	x	72.63	x	0.63	x	0.7	=	70.14	(81)
Northwest 0.9x	0.77	x	1.58	x	50.42	x	0.63	x	0.7	=	48.69	(81)
Northwest 0.9x	0.77	x	1.58	x	28.07	x	0.63	x	0.7	=	27.11	(81)
Northwest 0.9x	0.77	x	1.58	x	14.2	x	0.63	x	0.7	=	13.71	(81)
Northwest 0.9x	0.77	x	1.58	x	9.21	x	0.63	x	0.7	=	8.9	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 55.45 112.86 203.35 333.95 448.9 478.57 447.69 356.91 247.78 137.93 69.77 45.28 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 470.46 525.69 601.39 707.83 798.13 804.13 758.37 674.48 578.15 492.7 452.03 448.09 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	1	0.99	0.97	0.86	0.67	0.5	0.58	0.87	0.99	1	1

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.9 20.02 20.25 20.59 20.86 20.98 21 20.99 20.89 20.54 20.17 19.88 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.09	20.09	20.09	20.1	20.11	20.12	20.12	20.12	20.11	20.11	20.1	20.1	(88)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------	------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.95	0.82	0.58	0.4	0.48	0.81	0.98	1	1	(89)
--------	---	---	------	------	------	------	-----	------	------	------	---	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.6	18.78	19.12	19.61	19.97	20.1	20.11	20.11	20.02	19.55	19	18.58	(90)
--------	------	-------	-------	-------	-------	------	-------	-------	-------	-------	----	-------	------

$$fLA = \text{Living area} \div (4) = 0.28 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	18.96	19.12	19.43	19.88	20.22	20.34	20.36	20.36	20.26	19.82	19.32	18.94	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.96	19.12	19.43	19.88	20.22	20.34	20.36	20.36	20.26	19.82	19.32	18.94	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.95	0.82	0.61	0.43	0.5	0.82	0.98	1	1	(94)
--------	---	---	------	------	------	------	------	-----	------	------	---	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	469.58	523.66	594.3	672.19	657.77	487.42	325.69	340.28	474.7	481.41	450.26	447.45	(95)
--------	--------	--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	1318.11	1275.09	1156.56	969.25	749.77	499.83	327.1	343.63	538.75	812.11	1081.72	1311.08	(97)
--------	---------	---------	---------	--------	--------	--------	-------	--------	--------	--------	---------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	631.31	504.96	418.32	213.88	68.45	0	0	0	0	246.04	454.66	642.54	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 3180.16 \quad (98)$$

Space heating requirement in kWh/m²/year

$$35.14 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.4 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

631.31	504.96	418.32	213.88	68.45	0	0	0	0	246.04	454.66	642.54
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

675.92	540.65	447.88	228.99	73.29	0	0	0	0	263.42	486.78	687.95
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 3404.88 \quad (211)$$

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)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

208.74	184.02	192.67	170.89	165.45	145.72	139.61	155.63	157.35	179.18	190.02	203.76
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

80.3 (216)

(217)m= 87.66 87.46 86.95 85.62 83.01 80.3 80.3 80.3 80.3 85.85 87.17 87.74 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

238.12	210.4	221.59	199.6	199.31	181.47	173.86	193.82	195.96	208.71	218	232.22
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	-----	--------

Total = Sum(219a)_{1...12} =

2473.06 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

3404.88

Water heating fuel used

2473.06

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

386.74 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	735.45	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	534.18	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1269.63	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	200.72	(268)
Total CO2, kg/year				sum of (265)...(271) =	1509.28	(272)

TER =

16.68 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 3BF MID 91

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	90.5 (1a) x	2.5 (2a) =	226.25 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.5 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	226.25 (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				0 x 10 =	0 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) = 0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.18 (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) = 0.15 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.62	$\times 1/[1/(1.4) + 0.04] =$	8.78		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			1.58	$\times 1/[1/(1.4) + 0.04] =$	2.09		(27)
Walls	49.66	16.08	33.58	$\times 0.18 =$	6.04		(29)
Total area of elements, m²			49.66				(31)
Party wall			47.23	$\times 0 =$	0		(32)
Party floor			90.5				(32a)
Party ceiling			90.5				(32b)

* 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) = 27.36 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9294.58 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.96 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.32 (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=	22.3	22.02	21.74	20.35	20.08	18.69	18.69	18.41	19.24	20.08	20.63	21.19

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 56.62 56.34 56.06 54.68 54.4 53.01 53.01 52.73 53.56 54.4 54.95 55.51
Average = Sum(39)_{1...12} /12= 54.61 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.63	0.62	0.62	0.6	0.6	0.59	0.59	0.58	0.59	0.6	0.61	0.61		
Average = Sum(40) _{1...12} /12=													0.6	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.63

(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

96.72

(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=	106.39	102.53	98.66	94.79	90.92	87.05	87.05	90.92	94.79	98.66	102.53	106.39		
Total = Sum(44) _{1...12} =													1160.66	(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=	157.78	137.99	142.4	124.15	119.12	102.79	95.25	109.3	110.61	128.9	140.71	152.8		
Total = Sum(45) _{1...12} =													1521.81	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.67	20.7	21.36	18.62	17.87	15.42	14.29	16.4	16.59	19.34	21.11	22.92		(46)
--------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	29.87	26.98	29.85	28.87	29.82	28.84	29.8	29.81	28.86	29.84	28.9	29.87	(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=	187.65	164.97	172.25	153.02	148.94	131.64	125.05	139.12	139.47	158.75	169.61	182.67	(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=	187.65	164.97	172.25	153.02	148.94	131.64	125.05	139.12	139.47	158.75	169.61	182.67	
Output from water heater (annual) _{1...12}												1873.13	(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=	59.93	52.63	54.81	48.5	47.06	41.39	39.12	43.8	43.99	50.32	54.01	58.27	(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=	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.9	19.45	15.82	11.98	8.95	7.56	8.17	10.61	14.25	18.09	21.11	22.51	(67)
--------	------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	239.99	242.48	236.21	222.85	205.98	190.13	179.54	177.05	183.33	196.69	213.55	229.41	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	(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=	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	80.55	78.31	73.67	67.36	63.26	57.49	52.58	58.87	61.1	67.64	75.01	78.32	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	407.93	405.74	391.19	367.67	343.68	320.66	305.78	312.02	324.16	347.9	375.17	395.72	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	6.62	x	11.28	x	0.63	x	0.7	=	22.83	(75)
Northeast 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast 0.9x	0.77	x	6.62	x	22.97	x	0.63	x	0.7	=	46.47	(75)
Northeast 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast 0.9x	0.77	x	6.62	x	41.38	x	0.63	x	0.7	=	83.72	(75)

DER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast 0.9x	0.77	x	6.62	x	67.96	x	0.63	x	0.7	=	137.49	(75)
Northeast 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast 0.9x	0.77	x	6.62	x	91.35	x	0.63	x	0.7	=	184.81	(75)
Northeast 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast 0.9x	0.77	x	6.62	x	97.38	x	0.63	x	0.7	=	197.02	(75)
Northeast 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast 0.9x	0.77	x	6.62	x	91.1	x	0.63	x	0.7	=	184.31	(75)
Northeast 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast 0.9x	0.77	x	6.62	x	72.63	x	0.63	x	0.7	=	146.94	(75)
Northeast 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast 0.9x	0.77	x	6.62	x	50.42	x	0.63	x	0.7	=	102.01	(75)
Northeast 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast 0.9x	0.77	x	6.62	x	28.07	x	0.63	x	0.7	=	56.78	(75)
Northeast 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast 0.9x	0.77	x	6.62	x	14.2	x	0.63	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast 0.9x	0.77	x	6.62	x	9.21	x	0.63	x	0.7	=	18.64	(75)
Northeast 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)
Northwest 0.9x	0.77	x	1.58	x	11.28	x	0.63	x	0.7	=	10.9	(81)
Northwest 0.9x	0.77	x	1.58	x	22.97	x	0.63	x	0.7	=	22.18	(81)
Northwest 0.9x	0.77	x	1.58	x	41.38	x	0.63	x	0.7	=	39.96	(81)
Northwest 0.9x	0.77	x	1.58	x	67.96	x	0.63	x	0.7	=	65.63	(81)
Northwest 0.9x	0.77	x	1.58	x	91.35	x	0.63	x	0.7	=	88.22	(81)
Northwest 0.9x	0.77	x	1.58	x	97.38	x	0.63	x	0.7	=	94.05	(81)
Northwest 0.9x	0.77	x	1.58	x	91.1	x	0.63	x	0.7	=	87.98	(81)
Northwest 0.9x	0.77	x	1.58	x	72.63	x	0.63	x	0.7	=	70.14	(81)
Northwest 0.9x	0.77	x	1.58	x	50.42	x	0.63	x	0.7	=	48.69	(81)
Northwest 0.9x	0.77	x	1.58	x	28.07	x	0.63	x	0.7	=	27.11	(81)
Northwest 0.9x	0.77	x	1.58	x	14.2	x	0.63	x	0.7	=	13.71	(81)
Northwest 0.9x	0.77	x	1.58	x	9.21	x	0.63	x	0.7	=	8.9	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 55.45 112.86 203.35 333.95 448.9 478.57 447.69 356.91 247.78 137.93 69.77 45.28 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 463.38 518.6 594.53 701.62 792.58 799.24 753.47 668.93 571.94 485.83 444.94 441.01 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	1	0.98	0.87	0.63	0.42	0.31	0.36	0.64	0.95	1	1

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 20.45 20.55 20.74 20.94 21 21 21 21 21 20.88 20.63 20.43 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.41	20.41	20.41	20.43	20.43	20.44	20.44	20.45	20.44	20.43	20.42	20.42	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.84	0.6	0.39	0.27	0.32	0.59	0.93	0.99	1	(89)
--------	---	------	------	------	-----	------	------	------	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.65	19.81	20.07	20.36	20.43	20.44	20.44	20.45	20.43	20.29	19.94	19.64	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.28 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.87	20.01	20.26	20.52	20.58	20.6	20.6	20.6	20.59	20.46	20.13	19.86	(92)
--------	-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.87	20.01	20.26	20.52	20.58	20.6	20.6	20.6	20.59	20.46	20.13	19.86	(93)
--------	-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.97	0.85	0.61	0.4	0.28	0.33	0.6	0.94	0.99	1	(94)
--------	---	------	------	------	------	-----	------	------	-----	------	------	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	462.39	515.48	578.12	594.14	480.64	317.83	211.86	221.4	345.94	454.4	442.12	440.35	(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=	881.63	851.51	771.28	635.34	483.2	317.88	211.86	221.41	347.64	536.09	715.88	869.36	(97)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	311.91	225.81	143.71	29.66	1.91	0	0	0	0	60.78	197.11	319.19	(98)
--------	--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1290.08 \quad (98)$$

Space heating requirement in kWh/m²/year

$$14.25 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.4 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

311.91	225.81	143.71	29.66	1.91	0	0	0	0	60.78	197.11	319.19
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

333.96	241.77	153.86	31.76	2.04	0	0	0	0	65.08	211.03	341.74
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 1381.24 \quad (211)$$

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)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

187.65	164.97	172.25	153.02	148.94	131.64	125.05	139.12	139.47	158.75	169.61	182.67
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

88.2 (216)

(217)m= 89.56 89.46 89.19 88.55 88.23 88.2 88.2 88.2 88.2 88.8 89.37 89.59 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

209.52	184.41	193.14	172.81	168.82	149.25	141.78	157.73	158.13	178.77	189.78	203.9
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Total = Sum(219a)_{1...12} = 2108.03 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1381.24

Water heating fuel used

2108.03

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

193.22 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 268.22 (231)

Electricity for lighting

386.74 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	298.35 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	455.33 (264)
Space and water heating	(261) + (262) + (263) + (264) =		753.68 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	139.2 (267)
Electricity for lighting	(232) x	0.519 =	200.72 (268)
Total CO2, kg/year		sum of (265)...(271) =	1093.6 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	12.08 (273)
EI rating (section 14)			89 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 3BF MID 91

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	90.5 (1a)	2.5 (2a)	226.25 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.5 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	226.25 (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				3	30 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.13 (8)
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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)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.38 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.33 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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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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TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.41	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.38
------	------	-----	------	------	------	------	-----	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.59 0.58 0.58 0.56 0.56 0.55 0.55 0.55 0.55 0.56 0.57 0.57 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.59 0.58 0.58 0.56 0.56 0.55 0.55 0.55 0.55 0.56 0.57 0.57 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.62	$\times 1/[1/(1.4) + 0.04] =$	8.78		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			1.58	$\times 1/[1/(1.4) + 0.04] =$	2.09		(27)
Walls	49.66	16.08	33.58	$\times 0.18 =$	6.04		(29)
Total area of elements, m²			49.66				(31)
Party wall			47.23	$\times 0 =$	0		(32)
Party floor			90.5				(32a)
Party ceiling			90.5				(32b)

* 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) = 27.36 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9294.58 (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 3.73 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 31.09 (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=	43.75	43.5	43.26	42.11	41.89	40.89	40.89	40.71	41.28	41.89	42.33	42.78

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 74.84 74.59 74.35 73.2 72.99 71.99 71.99 71.8 72.37 72.99 73.42 73.88
Average = Sum(39)_{1...12} /12= 73.2 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.83	0.82	0.82	0.81	0.81	0.8	0.8	0.79	0.8	0.81	0.81	0.82		
Average = Sum(40) _{1...12} /12=													0.81	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.63

(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

96.72

(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=	106.39	102.53	98.66	94.79	90.92	87.05	87.05	90.92	94.79	98.66	102.53	106.39		
Total = Sum(44) _{1...12} =													1160.66	(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=	157.78	137.99	142.4	124.15	119.12	102.79	95.25	109.3	110.61	128.9	140.71	152.8		
Total = Sum(45) _{1...12} =													1521.81	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.67	20.7	21.36	18.62	17.87	15.42	14.29	16.4	16.59	19.34	21.11	22.92		(46)
--------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

TER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	50.96	46.03	50.27	46.74	46.33	42.93	44.36	46.33	46.74	50.27	49.32	50.96	(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=	208.74	184.02	192.67	170.89	165.45	145.72	139.61	155.63	157.35	179.18	190.02	203.76	(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=	208.74	184.02	192.67	170.89	165.45	145.72	139.61	155.63	157.35	179.18	190.02	203.76	
Output from water heater (annual) _{1...12}												2093.06	(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=	65.2	57.39	59.92	52.96	51.19	44.91	42.76	47.93	48.46	55.43	59.11	63.55	(65)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.9	19.45	15.82	11.98	8.95	7.56	8.17	10.61	14.25	18.09	21.11	22.51	(67)
--------	------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	239.99	242.48	236.21	222.85	205.98	190.13	179.54	177.05	183.33	196.69	213.55	229.41	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	(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=	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	(71)
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Water heating gains (Table 5)

(72)m=	87.64	85.4	80.53	73.56	68.8	62.38	57.47	64.42	67.31	74.5	82.1	85.41	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	415.02	412.82	398.05	373.87	349.23	325.55	310.67	317.57	330.37	354.77	382.26	402.81	(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)	
Northeast 0.9x	0.77	x	6.62	x	11.28	x	0.63	x	0.7	=	22.83	(75)
Northeast 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast 0.9x	0.77	x	6.62	x	22.97	x	0.63	x	0.7	=	46.47	(75)
Northeast 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast 0.9x	0.77	x	6.62	x	41.38	x	0.63	x	0.7	=	83.72	(75)

TER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast 0.9x	0.77	x	6.62	x	67.96	x	0.63	x	0.7	=	137.49	(75)
Northeast 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast 0.9x	0.77	x	6.62	x	91.35	x	0.63	x	0.7	=	184.81	(75)
Northeast 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast 0.9x	0.77	x	6.62	x	97.38	x	0.63	x	0.7	=	197.02	(75)
Northeast 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast 0.9x	0.77	x	6.62	x	91.1	x	0.63	x	0.7	=	184.31	(75)
Northeast 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast 0.9x	0.77	x	6.62	x	72.63	x	0.63	x	0.7	=	146.94	(75)
Northeast 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast 0.9x	0.77	x	6.62	x	50.42	x	0.63	x	0.7	=	102.01	(75)
Northeast 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast 0.9x	0.77	x	6.62	x	28.07	x	0.63	x	0.7	=	56.78	(75)
Northeast 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast 0.9x	0.77	x	6.62	x	14.2	x	0.63	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast 0.9x	0.77	x	6.62	x	9.21	x	0.63	x	0.7	=	18.64	(75)
Northeast 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)
Northwest 0.9x	0.77	x	1.58	x	11.28	x	0.63	x	0.7	=	10.9	(81)
Northwest 0.9x	0.77	x	1.58	x	22.97	x	0.63	x	0.7	=	22.18	(81)
Northwest 0.9x	0.77	x	1.58	x	41.38	x	0.63	x	0.7	=	39.96	(81)
Northwest 0.9x	0.77	x	1.58	x	67.96	x	0.63	x	0.7	=	65.63	(81)
Northwest 0.9x	0.77	x	1.58	x	91.35	x	0.63	x	0.7	=	88.22	(81)
Northwest 0.9x	0.77	x	1.58	x	97.38	x	0.63	x	0.7	=	94.05	(81)
Northwest 0.9x	0.77	x	1.58	x	91.1	x	0.63	x	0.7	=	87.98	(81)
Northwest 0.9x	0.77	x	1.58	x	72.63	x	0.63	x	0.7	=	70.14	(81)
Northwest 0.9x	0.77	x	1.58	x	50.42	x	0.63	x	0.7	=	48.69	(81)
Northwest 0.9x	0.77	x	1.58	x	28.07	x	0.63	x	0.7	=	27.11	(81)
Northwest 0.9x	0.77	x	1.58	x	14.2	x	0.63	x	0.7	=	13.71	(81)
Northwest 0.9x	0.77	x	1.58	x	9.21	x	0.63	x	0.7	=	8.9	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 55.45 112.86 203.35 333.95 448.9 478.57 447.69 356.91 247.78 137.93 69.77 45.28 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 470.46 525.69 601.39 707.83 798.13 804.13 758.37 674.48 578.15 492.7 452.03 448.09 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	1	0.99	0.95	0.79	0.57	0.42	0.49	0.8	0.98	1	1

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 20.14 20.25 20.47 20.76 20.95 21 21 21 20.96 20.69 20.37 20.12 (87)

TER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.23	20.23	20.23	20.25	20.25	20.26	20.26	20.26	20.25	20.25	20.24	20.24	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.93	0.74	0.5	0.35	0.41	0.74	0.97	1	1	(89)
--------	---	---	------	------	------	-----	------	------	------	------	---	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.06	19.23	19.54	19.97	20.2	20.25	20.26	20.26	20.22	19.88	19.41	19.05	(90)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.28 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.36	19.51	19.8	20.18	20.41	20.46	20.46	20.46	20.42	20.11	19.68	19.34	(92)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.36	19.51	19.8	20.18	20.41	20.46	20.46	20.46	20.42	20.11	19.68	19.34	(93)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.93	0.75	0.52	0.37	0.43	0.75	0.97	1	1	(94)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	469.6	523.5	592.5	656.36	601.77	419.29	277.84	291.19	434.44	477.4	450.1	447.49	(95)
--------	-------	-------	-------	--------	--------	--------	--------	--------	--------	-------	-------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	1127.2	1090.08	988.78	826.09	635.38	421.76	278.03	291.73	457.76	693.84	923.3	1118.76	(97)
--------	--------	---------	--------	--------	--------	--------	--------	--------	--------	--------	-------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	489.25	380.75	294.84	122.2	25	0	0	0	0	161.03	340.71	499.42	(98)
--------	--------	--------	--------	-------	----	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 2313.19 \quad (98)$$

Space heating requirement in kWh/m²/year

$$25.56 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.4 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

489.25	380.75	294.84	122.2	25	0	0	0	0	161.03	340.71	499.42
--------	--------	--------	-------	----	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

523.82	407.65	315.67	130.84	26.77	0	0	0	0	172.4	364.78	534.71
--------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 2476.65 \quad (211)$$

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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$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

208.74	184.02	192.67	170.89	165.45	145.72	139.61	155.63	157.35	179.18	190.02	203.76
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Efficiency of water heater

80.3 (216)

(217)m= 87.12 86.84 86.12 84.22 81.5 80.3 80.3 80.3 80.3 84.78 86.5 87.22 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	239.59	211.91	223.73	202.9	203.02	181.47	173.86	193.82	195.96	211.34	219.67	233.61
---------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} =

2490.88 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2476.65

Water heating fuel used

2490.88

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75

(231)

Electricity for lighting

386.74

(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	534.96	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	538.03	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1072.99	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	200.72	(268)
Total CO2, kg/year				sum of (265)...(271) =	1312.63	(272)

TER =

14.5 (273)

APPENDIX 2.0

SAP 10 Spreadsheet for 'Be Lean' case

Be Lean Carbon Emissions Spreadsheet (Using SAP 10 Carbon Factors)

Project Former Victoria Public House, 32 North Hyde Road, Hayes
Client North Hyde Investments Ltd and FJC Developments Ltd
Date Dec-21
Rev A



	Carbon Factor		Carbon Factor
SAP 2012		SAP 10	
Gas	0.216	Gas	0.210
Grid Elec	0.519	Grid Elec	0.233

TER Energy Demand - kWh per year

Plot	Ref	No. of Ext Walls	Orientation	Bedrooms	Floor Area	Location	Space Htg	Water Htg	Pumps/Lighting	Emissions
1	B1-0-01	2	NE/NW	3	90.5	GND	3405	2473	462	1342.0
2	B1-0-02	2	NE	3	81.2	GND	3055	2219	414	1204.1
3	B1-0-03	2	SW	2	67.1	GND	2020	2177	371	967.6
4	B1-0-04	2	SW	2	69.8	GND	2101	2264	386	1006.5
5	B2-0-01	3	NW/NE/SE	2	63.2	GND	1902	2050	349	911.4
6	B2-0-02	1	SE	1	51.7	GND	1994	1982	317	908.7
7	B2-0-03	2	SE	St	41.4	GND	1485	1827	277	760.0
8	B2-0-04	3	SW/SE	2	62.8	GND	1890	2037	347	905.6
9	B2-0-05	2	NW/SW	2	61.8	GND	1860	2005	342	891.2
10	B2-0-06	1	NW	2	73.7	GND	2218	2391	407	1062.8
11	B2-0-07	1	NW	St	39.6	GND	1421	1747	265	727.0
12	B2-0-08	2	NE/NW	2	75.9	GND	2284	2462	420	1094.5
13	B1-01-01	2	NE/NW	3	90.5	MID	2477	2491	462	1150.8
14	B1-01-02	2	NE	3	81.2	MID	2222	2235	414	1032.5
15	B1-01-03	2	SW	3	90.2	MID	2468	2483	460	1147.0
16	B1-01-04	2	SW/NW	2	69.2	MID	1405	2275	383	862.1
17	B2-01-01	3	NW/NE/SE	2	67.5	MID	1370	2219	374	840.9
18	B2-01-02	1	SE	1	51.3	MID	1383	1982	314	780.0
19	B2-01-03	1	SE	St	38.4	MID	577	1759	267	552.7
20	B2-01-04	3	SW/SE	3	88.1	MID	2411	2425	449	1120.2
21	B2-01-05	2	SW/NW	2	62.2	MID	1263	2045	345	774.9
22	B2-01-06	1	NW	2	73.7	MID	1496	2423	408	918.2
23	B2-01-07	1	NW	1	50.2	MID	1354	1940	308	763.3
24	B2-01-08	2	NE/NW	2	69.5	MID	1411	2285	385	865.9
25	B1-02-01	2	NE/NW	3	90.5	MID	2477	2491	462	1150.8
26	B1-02-02	2	NE	3	81.2	MID	2222	2235	414	1032.5
27	B1-02-03	2	SW	3	90.2	MID	2468	2483	460	1147.0
28	B1-02-04	2	SW/NW	2	69.2	MID	1405	2275	383	862.1
29	B2-02-01	3	NW/NE/SE	2	67.5	TOP	2545	2244	382	1094.6
30	B2-02-02	1	SE	1	51.3	TOP	1978	1967	314	901.7
31	B2-02-03	1	SE	St	38.4	TOP	936	1742	267	624.8
32	B2-02-04	3	SW/SE	3	88.1	MID	2411	2425	449	1120.2
33	B2-02-05	2	SW/NW	2	62.2	MID	1263	2045	345	774.9
34	B2-02-06	1	NW	2	74.4	MID	1510	2446	412	926.9
35	B2-02-07	1	NW	1	50.2	TOP	1936	1924	308	882.3
36	B2-02-08	2	NE/NW	2	70.0	TOP	2639	2327	396	1135.2
37	B1-03-01	2	NE	2	66.0	TOP	2488	2194	373	1070.3
38	B1-03-02	2	NE	2	70.4	TOP	2654	2340	398	1141.7
39	B1-03-03	2	SW	1	55.5	TOP	2140	2128	340	975.5
40	B1-03-04	2	SW	1	50.2	TOP	1936	1924	308	882.3
41	B2-03-01	3	SW	2	73.5	TOP	2771	2443	416	1191.9
2759.5							81251	89829	15355	
							29.44	32.55	5.56	39504.6

DER Energy Demand - kWh per year based on GAS

Ref	Space Htg	Water Htg	Pumps/Lighting	Emissions
B1-0-01	2310	2103	655	1079.3
B1-0-02	2073	1887	588	968.4
B1-0-03	1307	1868	514	786.5
B1-0-04	1360	1943	535	818.2
B2-0-01	1231	1759	484	740.8
B2-0-02	1518	1762	427	788.4
B2-0-03	985	1659	365	640.5
B2-0-04	1223	1748	481	736.1
B2-0-05	1204	1720	474	724.4
B2-0-06	1436	2051	565	863.9
B2-0-07	943	1587	349	612.7
B2-0-08	1479	2112	582	889.7
B1-01-01	1381	2108	655	885.4
B1-01-02	1239	1891	588	794.4
B1-01-03	1377	2101	653	882.4
B1-01-04	658	1942	531	669.8
B2-01-01	642	1894	518	653.3
B2-01-02	736	1754	424	621.6
B2-01-03	134	1583	349	11.4
B2-01-04	1345	2052	638	861.9
B2-01-05	591	1746	477	602.0
B2-01-06	701	2068	566	713.3
B2-01-07	720	1716	415	608.2
B2-01-08	661	1950	533	672.7
B1-02-01	1381	2108	655	885.4
B1-02-02	1239	1891	588	794.4
B1-02-03	1377	2101	653	882.4
B1-02-04	658	1942	531	669.8
B2-02-01	1890	1942	526	927.2
B2-02-02	1506	1749	424	782.3
B2-02-03	474	1578	349	512.3
B2-02-04	1345	2052	638	861.9
B2-02-05	591	1746	477	602.0
B2-02-06	707	2088	571	720.1
B2-02-07	1474	1711	415	765.6
B2-02-08	1960	2014	546	961.6
B1-03-01	1848	1899	514	906.6
B1-03-02	1971	2026	549	967.1
B1-03-03	1630	1892	459	846.4
B1-03-04	1474	1711	415	765.6
B2-03-01	2057	2115	573	1009.7
50835		77572	21247	
18.42		28.11	7.70	31485.4

Total Site Target Emissions	39,505	kgCO ₂ per year
Total Site Design Emissions (Be Lean)	31,485	kgCO ₂ per year
Total Reduction	8,019	kgCO ₂ per year
% Reduction	20.30%	

APPENDIX 3.0

TER and DER Worksheets for 'Be Green' case based on communal ASHPs

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes ST GND 40 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	39.6 (1a)	2.5 (2a)	99 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	39.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	99 (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				0	0 (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) =	0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0 (9)
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Additional infiltration	0 (10)
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Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0 (11)
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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)
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If no draught lobby, enter 0.05, else enter 0	0 (13)
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Percentage of windows and doors draught stripped	0 (14)
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Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0 (15)
---------------------	------------------------------------

Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0 (16)
-------------------	---

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.5 (17)
---	----------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.18 (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	0.85 (20)
----------------	-----------

Infiltration rate incorporating shelter factor	0.15 (21)
--	-----------

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.3	$\times 1/[1/(1.4) + 0.04] =$	8.35		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Floor			39.6	$\times$	0.13		5.148 (28)
Walls	14.3	9.45	4.85	$\times$	0.18		0.87 (29)
Total area of elements, m²			53.9				(31)
Party wall			48.47	$\times$	0		0 (32)
Party ceiling			39.6				(32b)

* 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) = 18.55 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5418.3 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.27 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 24.82 (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=	9.76	9.64	9.51	8.91	8.79	8.18	8.18	8.06	8.42	8.79	9.03	9.27

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	34.57	34.45	34.33	33.72	33.6	32.99	32.99	32.87	33.24	33.6	33.84	34.09
Average = Sum(39) _{1...12} /12=												33.69 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.87	0.87	0.87	0.85	0.85	0.83	0.83	0.83	0.84	0.85	0.85	0.86		
	Average = Sum(40) _{1...12} /12=												0.85	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.4

(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

67.35

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	74.08	71.39	68.7	66	63.31	60.61	60.61	63.31	66	68.7	71.39	74.08		
	Total = Sum(44) _{1...12} =												808.19	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	109.86	96.09	99.15	86.44	82.95	71.58	66.33	76.11	77.02	89.76	97.98	106.4		
	Total = Sum(45) _{1...12} =												1059.66	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	16.48	14.41	14.87	12.97	12.44	10.74	9.95	11.42	11.55	13.46	14.7	15.96		(46)
--------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0.54

(48)

Temperature factor from Table 2b

0.648

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.65

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(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=	129.95	114.23	119.24	105.88	103.03	91.02	86.41	96.2	96.46	109.85	117.42	126.49	(62)
--------	--------	--------	--------	--------	--------	-------	-------	------	-------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	129.95	114.23	119.24	105.88	103.03	91.02	86.41	96.2	96.46	109.85	117.42	126.49	
Output from water heater (annual) _{1...12}												1296.18	(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=	36.53	31.95	32.97	28.74	27.58	23.8	22.05	25.31	25.61	29.84	32.58	35.38	(65)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	10.75	9.54	7.76	5.88	4.39	3.71	4.01	5.21	6.99	8.88	10.36	11.04	(67)
--------	-------	------	------	------	------	------	------	------	------	------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	120.53	121.78	118.63	111.92	103.45	95.49	90.17	88.92	92.07	98.78	107.25	115.21	(68)
--------	--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	(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=	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	49.1	47.54	44.31	39.92	37.07	33.05	29.64	34.01	35.57	40.11	45.25	47.55	(72)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	224.31	222.8	214.64	201.65	188.85	176.19	167.75	172.08	178.57	191.71	206.79	217.74	(73)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northwest 0.9x	0.77	x	6.3	x	11.28	x	0.63	x	0.7	=	21.72	(81)
Northwest 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	10.86	(81)
Northwest 0.9x	0.77	x	6.3	x	22.97	x	0.63	x	0.7	=	44.22	(81)
Northwest 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	22.11	(81)
Northwest 0.9x	0.77	x	6.3	x	41.38	x	0.63	x	0.7	=	79.67	(81)

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Northwest 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(81)
Northwest 0.9x	0.77	x	6.3	x	67.96	x	0.63	x	0.7	=	130.84	(81)
Northwest 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(81)
Northwest 0.9x	0.77	x	6.3	x	91.35	x	0.63	x	0.7	=	175.87	(81)
Northwest 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(81)
Northwest 0.9x	0.77	x	6.3	x	97.38	x	0.63	x	0.7	=	187.5	(81)
Northwest 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(81)
Northwest 0.9x	0.77	x	6.3	x	91.1	x	0.63	x	0.7	=	175.4	(81)
Northwest 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(81)
Northwest 0.9x	0.77	x	6.3	x	72.63	x	0.63	x	0.7	=	139.83	(81)
Northwest 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(81)
Northwest 0.9x	0.77	x	6.3	x	50.42	x	0.63	x	0.7	=	97.08	(81)
Northwest 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(81)
Northwest 0.9x	0.77	x	6.3	x	28.07	x	0.63	x	0.7	=	54.04	(81)
Northwest 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(81)
Northwest 0.9x	0.77	x	6.3	x	14.2	x	0.63	x	0.7	=	27.33	(81)
Northwest 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(81)
Northwest 0.9x	0.77	x	6.3	x	9.21	x	0.63	x	0.7	=	17.74	(81)
Northwest 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	32.59	66.33	119.5	196.26	263.81	281.25	263.1	209.75	145.62	81.06	41	26.61	(83)
--------	-------	-------	-------	--------	--------	--------	-------	--------	--------	-------	----	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	256.89	289.13	334.14	397.91	452.66	457.44	430.86	381.83	324.18	272.77	247.79	244.35	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21

(85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.88	0.67	0.46	0.34	0.4	0.68	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.36	20.45	20.63	20.84	20.94	20.96	20.96	20.96	20.94	20.79	20.53	20.34	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.19	20.2	20.21	20.21	20.22	20.22	20.23	20.22	20.21	20.21	20.2	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.96	0.85	0.62	0.41	0.28	0.33	0.62	0.93	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.32	19.47	19.73	20.02	20.13	20.16	20.16	20.17	20.15	19.96	19.6	19.31	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

fLA = Living area ÷ (4) =

0.63

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.97	20.09	20.3	20.54	20.64	20.66	20.67	20.67	20.65	20.48	20.19	19.96	(92)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

DER WorkSheet: New dwelling design stage

(93)m=	19.97	20.09	20.3	20.54	20.64	20.66	20.67	20.67	20.65	20.48	20.19	19.96	(93)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	1	0.99	0.97	0.86	0.65	0.44	0.31	0.37	0.65	0.93	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	255.67	286.05	322.48	342.06	292.97	199.6	134.09	140.13	212.08	254.97	245.13	243.47	(95)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	541.93	523.38	473.73	392.61	300.5	200.09	134.14	140.25	217.71	332.01	442.92	537.23	(97)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	212.98	159.48	112.53	36.39	5.6	0	0	0	0	57.32	142.41	218.56	
--------	--------	--------	--------	-------	-----	---	---	---	---	-------	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 945.27 (98)

Space heating requirement in $kWh/m^2/year$

23.87 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

111.83 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

212.98	159.48	112.53	36.39	5.6	0	0	0	0	57.32	142.41	218.56
--------	--------	--------	-------	-----	---	---	---	---	-------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

190.45	142.61	100.62	32.54	5.01	0	0	0	0	51.25	127.34	195.43
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 845.24 (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 ($kWh/year$) = $Sum(215)_{1..5,10..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

129.95	114.23	119.24	105.88	103.03	91.02	86.41	96.2	96.46	109.85	117.42	126.49
--------	--------	--------	--------	--------	-------	-------	------	-------	--------	--------	--------

Efficiency of water heater

311.7 (216)

(217)m=	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7		(217)
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	41.69	36.65	38.26	33.97	33.06	29.2	27.72	30.86	30.95	35.24	37.67	40.58	
---------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	--

Total = $Sum(219a)_{1..12} =$ 415.85 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

845.24

DER WorkSheet: New dwelling design stage

Water heating fuel used		415.85	
Electricity for pumps, fans and electric keep-hot mechanical ventilation - balanced, extract or positive input from outside		84.55	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	84.55	(231)
Electricity for lighting		189.76	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	438.68	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	215.83	(264)
Space and water heating	(261) + (262) + (263) + (264) =			654.51	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	43.88	(267)
Electricity for lighting	(232) x	0.519	=	98.49	(268)
Total CO2, kg/year			sum of (265)...(271) =	796.87	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	20.12	(273)
El rating (section 14)				87	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes ST GND 40 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	39.6 (1a)	2.5 (2a)	99 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	39.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	99 (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				2	20 (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) =	20 ÷ (5) = 0.2 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0 (9)
Additional infiltration	[(9)-1]x0.1 = 0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 (12)

If no draught lobby, enter 0.05, else enter 0 (13)

Percentage of windows and doors draught stripped (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.45 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.38 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (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 0.57 0.59 0.59 0.6 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.62 0.62 0.61 0.59 0.59 0.57 0.57 0.56 0.57 0.59 0.59 0.6 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.3	$\times 1/[1/(1.4) + 0.04] =$	8.35		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Floor			39.6	$\times$	0.13		(28)
Walls	14.3	9.45	4.85	$\times$	0.18		(29)
Total area of elements, m²			53.9				(31)
Party wall			48.47	$\times$	0		(32)
Party ceiling			39.6				(32b)

* 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) = 18.55 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5418.3 (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 3.64 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 22.19 (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=	20.26	20.1	19.95	19.25	19.12	18.51	18.51	18.4	18.75	19.12	19.39	19.66

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	42.44	42.29	42.14	41.44	41.31	40.7	40.7	40.58	40.93	41.31	41.57	41.85
Average = Sum(39) _{1...12} /12=												41.44 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.07	1.07	1.06	1.05	1.04	1.03	1.03	1.02	1.03	1.04	1.05	1.06		
Average = Sum(40) _{1...12} /12=													1.05	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.4

(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

67.35

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	74.08	71.39	68.7	66	63.31	60.61	60.61	63.31	66	68.7	71.39	74.08		
Total = Sum(44) _{1...12} =													808.19	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	109.86	96.09	99.15	86.44	82.95	71.58	66.33	76.11	77.02	89.76	97.98	106.4		
Total = Sum(45) _{1...12} =													1059.66	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	16.48	14.41	14.87	12.97	12.44	10.74	9.95	11.42	11.55	13.46	14.7	15.96		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.75

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.75

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 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 × (41)m

(61)m=	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=	156.46	138.17	145.75	131.54	129.54	116.67	112.92	122.7	122.11	136.35	143.07	152.99	(62)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	156.46	138.17	145.75	131.54	129.54	116.67	112.92	122.7	122.11	136.35	143.07	152.99	
Output from water heater (annual) _{1...12}												1608.28	(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=	73.81	65.62	70.24	64.82	64.86	59.87	59.33	62.58	61.68	67.12	68.65	72.65	(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 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	69.79	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	10.75	9.54	7.76	5.88	4.39	3.71	4.01	5.21	6.99	8.88	10.36	11.04	(67)
--------	-------	------	------	------	------	------	------	------	------	------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	120.53	121.78	118.63	111.92	103.45	95.49	90.17	88.92	92.07	98.78	107.25	115.21	(68)
--------	--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	29.98	(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=	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	-55.83	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	99.2	97.65	94.41	90.02	87.17	83.16	79.74	84.12	85.67	90.22	95.35	97.65	(72)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	277.41	275.9	267.74	254.75	241.95	229.29	220.86	225.18	231.67	244.81	259.89	270.84	(73)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northwest 0.9x	0.77	x	6.3	x	11.28	x	0.63	x	0.7	=	21.72	(81)
Northwest 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	10.86	(81)
Northwest 0.9x	0.77	x	6.3	x	22.97	x	0.63	x	0.7	=	44.22	(81)
Northwest 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	22.11	(81)
Northwest 0.9x	0.77	x	6.3	x	41.38	x	0.63	x	0.7	=	79.67	(81)

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Northwest 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(81)
Northwest 0.9x	0.77	x	6.3	x	67.96	x	0.63	x	0.7	=	130.84	(81)
Northwest 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(81)
Northwest 0.9x	0.77	x	6.3	x	91.35	x	0.63	x	0.7	=	175.87	(81)
Northwest 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(81)
Northwest 0.9x	0.77	x	6.3	x	97.38	x	0.63	x	0.7	=	187.5	(81)
Northwest 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(81)
Northwest 0.9x	0.77	x	6.3	x	91.1	x	0.63	x	0.7	=	175.4	(81)
Northwest 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(81)
Northwest 0.9x	0.77	x	6.3	x	72.63	x	0.63	x	0.7	=	139.83	(81)
Northwest 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(81)
Northwest 0.9x	0.77	x	6.3	x	50.42	x	0.63	x	0.7	=	97.08	(81)
Northwest 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(81)
Northwest 0.9x	0.77	x	6.3	x	28.07	x	0.63	x	0.7	=	54.04	(81)
Northwest 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(81)
Northwest 0.9x	0.77	x	6.3	x	14.2	x	0.63	x	0.7	=	27.33	(81)
Northwest 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(81)
Northwest 0.9x	0.77	x	6.3	x	9.21	x	0.63	x	0.7	=	17.74	(81)
Northwest 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	32.59	66.33	119.5	196.26	263.81	281.25	263.1	209.75	145.62	81.06	41	26.61	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	310	342.23	387.24	451.01	505.76	510.54	483.96	434.93	377.28	325.87	300.9	297.45	(84)
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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21

(85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.89	0.71	0.5	0.37	0.43	0.7	0.94	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.04	20.17	20.43	20.75	20.94	20.99	21	21	20.96	20.7	20.32	20.02	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.02	20.03	20.03	20.04	20.05	20.06	20.06	20.06	20.06	20.05	20.04	20.04	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.85	0.65	0.43	0.29	0.34	0.62	0.91	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.75	18.96	19.32	19.77	19.99	20.06	20.06	20.06	20.03	19.72	19.18	18.74	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.63

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.56	19.73	20.02	20.39	20.59	20.65	20.65	20.65	20.61	20.34	19.9	19.55	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

TER WorkSheet: New dwelling design stage

(93)m=	19.56	19.73	20.02	20.39	20.59	20.65	20.65	20.65	20.61	20.34	19.9	19.55	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.99	0.98	0.96	0.87	0.69	0.48	0.34	0.4	0.67	0.92	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	-----	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	306.76	335.95	370.06	390.73	347.04	243.78	164.64	171.95	253.6	299.32	294.76	294.9	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	647.78	626.96	569.8	476.21	367.27	246.09	164.93	172.58	266.65	402.16	532.16	642.21	(97)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	253.72	195.56	148.61	61.55	15.05	0	0	0	0	76.51	170.93	258.4	
--------	--------	--------	--------	-------	-------	---	---	---	---	-------	--------	-------	--

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 1180.33 (98)

Space heating requirement in $kWh/m^2/year$

29.81 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

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)

253.72	195.56	148.61	61.55	15.05	0	0	0	0	76.51	170.93	258.4
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	-------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

271.36	209.15	158.94	65.82	16.1	0	0	0	0	81.83	182.82	276.36
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 1262.38 (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 ($kWh/year$) = $Sum(215)_{1..5,10..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

156.46	138.17	145.75	131.54	129.54	116.67	112.92	122.7	122.11	136.35	143.07	152.99
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

Efficiency of water heater

79.8 (216)

(217)m=	86.1	85.74	84.87	82.93	80.79	79.8	79.8	79.8	79.8	83.34	85.29	86.2	(217)
---------	------	-------	-------	-------	-------	------	------	------	------	-------	-------	------	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	181.73	161.15	171.74	158.62	160.33	146.2	141.5	153.77	153.02	163.61	167.75	177.48
---------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------

Total = $Sum(219a)_{1..12} =$ 1936.9 (219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

1262.38

TER WorkSheet: New dwelling design stage

Water heating fuel used		1936.9	
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		189.76	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	272.67 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	418.37 (264)
Space and water heating	(261) + (262) + (263) + (264) =		691.05 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	98.49 (268)
Total CO2, kg/year	sum of (265)...(271) =		828.46 (272)
TER =			30.52 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes ST MID 38 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	38.4 (1a)	2.5 (2a)	96 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	38.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	96 (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				0	0 (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) =	0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0 (9)
--	-------

Additional infiltration	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)
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Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.5 (17)
---	----------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.18 (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	0.85 (20)
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Infiltration rate incorporating shelter factor	0.15 (21)
--	-----------

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	13.5	6.3	7.2	$\times 0.18 =$	1.3		(29)
Total area of elements, m²			13.5				(31)
Party wall			52.65	$\times 0 =$	0		(32)
Party floor			38.4				(32a)
Party ceiling			38.4				(32b)

* 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) = 9.65 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4173 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 2.12 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 11.77 (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=	9.46	9.34	9.23	8.64	8.52	7.93	7.93	7.81	8.17	8.52	8.75	8.99

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	21.23	21.11	20.99	20.4	20.29	19.7	19.7	19.58	19.93	20.29	20.52	20.76
Average = Sum(39) _{1...12} /12=												20.37 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.55	0.55	0.55	0.53	0.53	0.51	0.51	0.51	0.52	0.53	0.53	0.54		
	Average = Sum(40) _{1...12} /12=												0.53	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.36

(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

66.61

(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=	73.27	70.6	67.94	65.27	62.61	59.95	59.95	62.61	65.27	67.94	70.6	73.27		
	Total = Sum(44) _{1...12} =												799.28	(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=	108.65	95.03	98.06	85.49	82.03	70.79	65.59	75.27	76.17	88.77	96.9	105.22		
	Total = Sum(45) _{1...12} =												1047.98	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	16.3	14.25	14.71	12.82	12.3	10.62	9.84	11.29	11.43	13.32	14.53	15.78		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0.54

(48)

Temperature factor from Table 2b

0.648

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.65

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(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=	128.74	113.17	118.15	104.93	102.12	90.23	85.68	95.36	95.61	108.86	116.34	125.31	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	128.74	113.17	118.15	104.93	102.12	90.23	85.68	95.36	95.61	108.86	116.34	125.31	
Output from water heater (annual) _{1...12}												1284.5	(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=	36.13	31.6	32.61	28.43	27.28	23.54	21.81	25.03	25.33	29.52	32.22	34.99	(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=	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	10.88	9.66	7.86	5.95	4.45	3.75	4.06	5.27	7.08	8.99	10.49	11.18	(67)
--------	-------	------	------	------	------	------	------	------	------	------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	117.53	118.75	115.68	109.13	100.88	93.11	87.93	86.71	89.78	96.32	104.58	112.35	(68)
--------	--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	(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=	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	48.56	47.02	43.82	39.48	36.66	32.69	29.31	33.64	35.18	39.67	44.75	47.03	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	220.44	218.9	210.83	198.03	185.45	173.02	164.77	169.09	175.5	188.45	203.29	214.02	(73)
--------	--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)

DER WorkSheet: New dwelling design stage

Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	70.84	120.67	165.1	204.57	229.14	227.48	219.32	200.99	178.77	133.37	84.85	60.63	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	291.28	339.57	375.93	402.6	414.59	400.51	384.08	370.08	354.27	321.81	288.14	274.65	(84)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	0.97	0.9	0.79	0.61	0.45	0.31	0.23	0.24	0.39	0.65	0.9	0.98	

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.82	20.9	20.95	20.97	20.97	20.97	20.97	20.97	20.97	20.97	20.92	20.81	(87)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.47	20.48	20.48	20.49	20.49	20.51	20.51	20.51	20.5	20.49	20.49	20.48	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.89	0.76	0.59	0.43	0.29	0.2	0.22	0.36	0.62	0.88	0.97	(89)
--------	------	------	------	------	------	------	-----	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	20.24	20.35	20.42	20.45	20.45	20.47	20.47	20.47	20.46	20.45	20.39	20.23	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.65 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.62	20.71	20.77	20.79	20.79	20.8	20.8	20.8	20.79	20.79	20.73	20.6	(92)
--------	-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

DER WorkSheet: New dwelling design stage

(93)m=	20.62	20.71	20.77	20.79	20.79	20.8	20.8	20.8	20.79	20.79	20.73	20.6	(93)
--------	-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.96	0.9	0.78	0.6	0.44	0.3	0.22	0.23	0.38	0.64	0.89	0.97	(94)
--------	------	-----	------	-----	------	-----	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	280.34	304.28	291.67	241.85	184.38	122.06	82.67	86.11	133.43	205.7	257.1	267.06	(95)
--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	-------	-------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	346.4	333.77	299.47	242.56	184.42	122.06	82.67	86.11	133.43	206.68	279.76	340.48	(97)
--------	-------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	49.15	19.82	5.8	0.51	0.03	0	0	0	0	0.74	16.31	54.62	
Total per year (kWh/year) = Sum(98) _{1..5,9..12} =												146.97	(98)

Space heating requirement in $kWh/m^2/year$

3.83	(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

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

71.54	(206)
-------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

49.15	19.82	5.8	0.51	0.03	0	0	0	0	0.74	16.31	54.62
-------	-------	-----	------	------	---	---	---	---	------	-------	-------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

68.7	27.7	8.1	0.71	0.04	0	0	0	0	1.03	22.8	76.35
------	------	-----	------	------	---	---	---	---	------	------	-------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} =$$

205.43	(211)
--------	-------

Space heating fuel (secondary), $kWh/month$

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

128.74	113.17	118.15	104.93	102.12	90.23	85.68	95.36	95.61	108.86	116.34	125.31
--------	--------	--------	--------	--------	-------	-------	-------	-------	--------	--------	--------

Efficiency of water heater

311.7	(216)
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(217)m=	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	41.3	36.31	37.91	33.67	32.76	28.95	27.49	30.59	30.67	34.92	37.32	40.2
---------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$\text{Total} = \text{Sum}(219a)_{1..12} =$$

412.1	(219)
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Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year	205.43
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Water heating fuel used		412.1	
Electricity for pumps, fans and electric keep-hot mechanical ventilation - balanced, extract or positive input from outside		81.98	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	81.98	(231)
Electricity for lighting		192.12	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	106.62	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	213.88	(264)
Space and water heating	(261) + (262) + (263) + (264) =			320.5	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	42.55	(267)
Electricity for lighting	(232) x	0.519	=	99.71	(268)
Total CO2, kg/year			sum of (265)...(271) =	462.76	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	12.05	(273)
El rating (section 14)				93	(274)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes ST MID 38 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	38.4 (1a)	2.5 (2a)	96 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	38.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	96 (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				2	20 (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) =	20 ÷ (5) = 0.21 (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)
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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)
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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)
--	-----------

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	0.85 (20)
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Infiltration rate incorporating shelter factor	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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	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) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (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)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	13.5	6.3	7.2	$\times 0.18 =$	1.3		(29)
Total area of elements, m²			13.5				(31)
Party wall			52.65	$\times 0 =$	0		(32)
Party floor			38.4				(32a)
Party ceiling			38.4				(32b)

* 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) = 9.65 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4173 (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 1.4 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 11.05 (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=	19.75	19.6	19.45	18.75	18.62	18.01	18.01	17.9	18.24	18.62	18.88	19.16

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	30.79	30.64	30.49	29.8	29.66	29.06	29.06	28.94	29.29	29.66	29.93	30.21
Average = Sum(39) _{1...12} /12=												29.79 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.8	0.8	0.79	0.78	0.77	0.76	0.76	0.75	0.76	0.77	0.78	0.79		
	Average = Sum(40) _{1...12} /12=												0.78	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.36

(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

66.61

(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=	73.27	70.6	67.94	65.27	62.61	59.95	59.95	62.61	65.27	67.94	70.6	73.27		
	Total = Sum(44) _{1...12} =												799.28	(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=	108.65	95.03	98.06	85.49	82.03	70.79	65.59	75.27	76.17	88.77	96.9	105.22		
	Total = Sum(45) _{1...12} =												1047.98	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	16.3	14.25	14.71	12.82	12.3	10.62	9.84	11.29	11.43	13.32	14.53	15.78		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.75

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.75

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 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 × (41)m

(61)m=	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=	155.25	137.11	144.66	130.58	128.63	115.88	112.19	121.87	121.26	135.36	141.99	151.82	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	155.25	137.11	144.66	130.58	128.63	115.88	112.19	121.87	121.26	135.36	141.99	151.82	
Output from water heater (annual) _{1...12}												1596.6	(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=	73.4	65.27	69.88	64.5	64.55	59.61	59.09	62.3	61.4	66.79	68.29	72.26	(65)
--------	------	-------	-------	------	-------	-------	-------	------	------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	10.88	9.66	7.86	5.95	4.45	3.75	4.06	5.27	7.08	8.99	10.49	11.18	(67)
--------	-------	------	------	------	------	------	------	------	------	------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	117.53	118.75	115.68	109.13	100.88	93.11	87.93	86.71	89.78	96.32	104.58	112.35	(68)
--------	--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	(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=	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	98.66	97.12	93.93	89.58	86.76	82.79	79.42	83.74	85.28	89.77	94.85	97.13	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	273.54	272	263.93	251.13	238.55	226.13	217.87	222.19	228.6	241.55	256.39	267.12	(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)	
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)

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Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	70.84	120.67	165.1	204.57	229.14	227.48	219.32	200.99	178.77	133.37	84.85	60.63	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	344.38	392.67	429.03	455.71	467.69	453.61	437.18	423.18	407.38	374.92	341.24	327.75	(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)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	0.98	0.95	0.89	0.75	0.58	0.41	0.29	0.31	0.49	0.78	0.94	0.98	

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.54	20.68	20.84	20.95	20.99	21	21	21	21	20.95	20.75	20.51	(87)
--------	-------	-------	-------	-------	-------	----	----	----	----	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.25	20.26	20.26	20.27	20.28	20.29	20.29	20.29	20.29	20.28	20.27	20.26	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.94	0.86	0.72	0.54	0.36	0.25	0.27	0.44	0.73	0.93	0.98	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.65	19.86	20.07	20.23	20.27	20.29	20.29	20.29	20.28	20.23	19.97	19.63	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.65 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.23	20.4	20.57	20.7	20.74	20.75	20.75	20.75	20.75	20.7	20.48	20.21	(92)
--------	-------	------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	20.23	20.4	20.57	20.7	20.74	20.75	20.75	20.75	20.75	20.7	20.48	20.21	(93)
--------	-------	------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.97	0.94	0.87	0.74	0.57	0.39	0.28	0.3	0.48	0.76	0.93	0.98	(94)
--------	------	------	------	------	------	------	------	-----	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	334.39	368.53	374.23	336.5	265.82	178.61	120.65	125.99	194.2	284.59	318.14	320.13	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	490.48	474.86	429.01	351.6	268.19	178.76	120.66	126	194.75	299.66	400.46	483.47	(97)
--------	--------	--------	--------	-------	--------	--------	--------	-----	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	116.13	71.45	40.76	10.87	1.76	0	0	0	0	11.21	59.28	121.53	
Total per year (kWh/year) = Sum(98) _{1..5,9..12} =												432.98	(98)

Space heating requirement in $kWh/m^2/year$

11.28	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

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)

116.13	71.45	40.76	10.87	1.76	0	0	0	0	11.21	59.28	121.53
--------	-------	-------	-------	------	---	---	---	---	-------	-------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

124.2	76.42	43.59	11.63	1.89	0	0	0	0	11.99	63.4	129.98
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$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} =$$

463.09	(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
---------	---	---	---	---	---	---	---	---	---	---	---

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

155.25	137.11	144.66	130.58	128.63	115.88	112.19	121.87	121.26	135.36	141.99	151.82
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

79.8	(216)
------	-------

(217)m=	84.05	83.17	81.93	80.53	79.93	79.8	79.8	79.8	79.8	80.53	82.68	84.23	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	184.7	164.86	176.56	162.15	160.93	145.21	140.59	152.71	151.96	168.09	171.74	180.25
---------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

$$\text{Total} = \text{Sum}(219a)_{1..12} =$$

1959.76	(219)
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Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

463.09

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Water heating fuel used		1959.76	
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		192.12	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	100.03	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	423.31	(264)
Space and water heating	(261) + (262) + (263) + (264) =				523.34	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	99.71	(268)
Total CO2, kg/year	sum of (265)...(271) =				661.97	(272)
TER =					24.73	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes ST TOP 38 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	38.4 (1a)	2.5 (2a)	96 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	38.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	96 (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				0	0 (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) =	0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.18 (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) = 0.15 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	13.5	6.3	7.2	$\times$ 0.18	1.3		(29)
Roof	38.4	0	38.4	$\times$ 0.15	5.76		(30)
Total area of elements, m²			51.9				(31)
Party wall			52.65	$\times$ 0	0		(32)
Party floor			38.4				(32a)

* 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) = 15.41 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 3366.6 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 3.85 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 19.25 (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=	9.46	9.34	9.23	8.64	8.52	7.93	7.93	7.81	8.17	8.52	8.75	8.99

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	28.72	28.6	28.48	27.89	27.77	27.18	27.18	27.07	27.42	27.77	28.01	28.24
Average = Sum(39) _{1...12} /12=												27.86 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.75	0.74	0.74	0.73	0.72	0.71	0.71	0.7	0.71	0.72	0.73	0.74		
	Average = Sum(40) _{1...12} /12=												0.73	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.36

(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

66.61

(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=	73.27	70.6	67.94	65.27	62.61	59.95	59.95	62.61	65.27	67.94	70.6	73.27		
	Total = Sum(44) _{1...12} =												799.28	(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=	108.65	95.03	98.06	85.49	82.03	70.79	65.59	75.27	76.17	88.77	96.9	105.22		
	Total = Sum(45) _{1...12} =												1047.98	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	16.3	14.25	14.71	12.82	12.3	10.62	9.84	11.29	11.43	13.32	14.53	15.78		(46)
--------	------	-------	-------	-------	------	-------	------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0.54

(48)

Temperature factor from Table 2b

0.648

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.65

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

128.74	113.17	118.15	104.93	102.12	90.23	85.68	95.36	95.61	108.86	116.34	125.31
--------	--------	--------	--------	--------	-------	-------	-------	-------	--------	--------	--------

 (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=

128.74	113.17	118.15	104.93	102.12	90.23	85.68	95.36	95.61	108.86	116.34	125.31
--------	--------	--------	--------	--------	-------	-------	-------	-------	--------	--------	--------

Output from water heater (annual)_{1...12}

1284.5

 (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=

36.13	31.6	32.61	28.43	27.28	23.54	21.81	25.03	25.33	29.52	32.22	34.99
-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=

10.88	9.66	7.86	5.95	4.45	3.75	4.06	5.27	7.08	8.99	10.49	11.18
-------	------	------	------	------	------	------	------	------	------	-------	-------

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

117.53	118.75	115.68	109.13	100.88	93.11	87.93	86.71	89.78	96.32	104.58	112.35
--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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=

-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

48.56	47.02	43.82	39.48	36.66	32.69	29.31	33.64	35.18	39.67	44.75	47.03
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

220.44	218.9	210.83	198.03	185.45	173.02	164.77	169.09	175.5	188.45	203.29	214.02
--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------

 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast	0.9x	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast	0.9x	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast	0.9x	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast	0.9x	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)

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Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	70.84	120.67	165.1	204.57	229.14	227.48	219.32	200.99	178.77	133.37	84.85	60.63	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	291.28	339.57	375.93	402.6	414.59	400.51	384.08	370.08	354.27	321.81	288.14	274.65	(84)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	0.99	0.97	0.92	0.79	0.62	0.43	0.31	0.34	0.53	0.83	0.97	0.99	

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.58	20.7	20.83	20.92	20.96	20.96	20.96	20.96	20.96	20.92	20.74	20.56	(87)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.3	20.3	20.3	20.32	20.32	20.33	20.33	20.34	20.33	20.32	20.31	20.31	(88)
--------	------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.96	0.9	0.76	0.57	0.39	0.26	0.29	0.48	0.79	0.96	0.99	(89)
--------	------	------	-----	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.74	19.91	20.09	20.22	20.26	20.28	20.28	20.28	20.27	20.22	19.99	19.72	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.65 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.29	20.43	20.57	20.68	20.71	20.73	20.73	20.73	20.72	20.68	20.48	20.27	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	20.29	20.43	20.57	20.68	20.71	20.73	20.73	20.73	20.72	20.68	20.48	20.27	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.99	0.96	0.9	0.78	0.6	0.42	0.29	0.32	0.51	0.81	0.96	0.99	(94)
--------	------	------	-----	------	-----	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	287.14	326.61	340.13	312.04	247.95	166.38	112.14	117.09	180.97	261.06	277.27	271.82	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	459.19	444.04	400.67	328.55	250.36	166.51	112.15	117.11	181.56	279.83	374.73	453.88	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	128	78.91	45.05	11.89	1.79	0	0	0	0	13.97	70.17	135.45	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												485.23	(98)

Space heating requirement in $kWh/m^2/year$

12.64	(99)
-------	------

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

94.75	(206)
-------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	$kWh/year$
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	------------

Space heating requirement (calculated above)

128	78.91	45.05	11.89	1.79	0	0	0	0	13.97	70.17	135.45
-----	-------	-------	-------	------	---	---	---	---	-------	-------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

135.09	83.28	47.54	12.54	1.89	0	0	0	0	14.74	74.06	142.95
--------	-------	-------	-------	------	---	---	---	---	-------	-------	--------

$$Total (kWh/year) = Sum(211)_{1..5,10..12} =$$

512.1	(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
---------	---	---	---	---	---	---	---	---	---	---	---

$$Total (kWh/year) = Sum(215)_{1..5,10..12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

128.74	113.17	118.15	104.93	102.12	90.23	85.68	95.36	95.61	108.86	116.34	125.31
--------	--------	--------	--------	--------	-------	-------	-------	-------	--------	--------	--------

Efficiency of water heater

311.7	(216)
-------	-------

(217)m=	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	41.3	36.31	37.91	33.67	32.76	28.95	27.49	30.59	30.67	34.92	37.32	40.2
---------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$Total = Sum(219a)_{1..12} =$$

412.1	(219)
-------	-------

Annual totals

Space heating fuel used, main system 1

$kWh/year$

$kWh/year$

512.1

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Water heating fuel used		412.1	
Electricity for pumps, fans and electric keep-hot mechanical ventilation - balanced, extract or positive input from outside		81.98	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	81.98	(231)
Electricity for lighting		192.12	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	265.78	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	213.88	(264)
Space and water heating	(261) + (262) + (263) + (264) =			479.66	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	42.55	(267)
Electricity for lighting	(232) x	0.519	=	99.71	(268)
Total CO2, kg/year			sum of (265)...(271) =	621.92	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	16.2	(273)
El rating (section 14)				90	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes ST TOP 38 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	38.4 (1a)	2.5 (2a)	96 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	38.4 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	96 (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				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.21 (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)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.46 (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) = 0.39 (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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

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:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (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)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	13.5	6.3	7.2	$\times$ 0.18	= 1.3		(29)
Roof	38.4	0	38.4	$\times$ 0.13	= 4.99		(30)
Total area of elements, m²			51.9				(31)
Party wall			52.65	$\times$ 0	= 0		(32)
Party floor			38.4				(32a)

* 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) = 14.64 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 3366.6 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 2.48 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 17.12 (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=	19.75	19.6	19.45	18.75	18.62	18.01	18.01	17.9	18.24	18.62	18.88	19.16

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	36.87	36.71	36.57	35.87	35.74	35.13	35.13	35.02	35.36	35.74	36	36.28
Average = Sum(39) _{1...12} /12=												35.87 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.96	0.96	0.95	0.93	0.93	0.91	0.91	0.91	0.92	0.93	0.94	0.94		
	Average = Sum(40) _{1...12} /12=												0.93	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.36

(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

66.61

(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=	73.27	70.6	67.94	65.27	62.61	59.95	59.95	62.61	65.27	67.94	70.6	73.27		
	Total = Sum(44) _{1...12} =												799.28	(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=	108.65	95.03	98.06	85.49	82.03	70.79	65.59	75.27	76.17	88.77	96.9	105.22		
	Total = Sum(45) _{1...12} =												1047.98	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	16.3	14.25	14.71	12.82	12.3	10.62	9.84	11.29	11.43	13.32	14.53	15.78		(46)
--------	------	-------	-------	-------	------	-------	------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.75

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.75

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 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 × (41)m

(61)m=	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=	155.25	137.11	144.66	130.58	128.63	115.88	112.19	121.87	121.26	135.36	141.99	151.82	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	155.25	137.11	144.66	130.58	128.63	115.88	112.19	121.87	121.26	135.36	141.99	151.82	
Output from water heater (annual) _{1...12}												1596.6	(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=	73.4	65.27	69.88	64.5	64.55	59.61	59.09	62.3	61.4	66.79	68.29	72.26	(65)
--------	------	-------	-------	------	-------	-------	-------	------	------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	68.22	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	10.88	9.66	7.86	5.95	4.45	3.75	4.06	5.27	7.08	8.99	10.49	11.18	(67)
--------	-------	------	------	------	------	------	------	------	------	------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	117.53	118.75	115.68	109.13	100.88	93.11	87.93	86.71	89.78	96.32	104.58	112.35	(68)
--------	--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	29.82	(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=	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	-54.58	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	98.66	97.12	93.93	89.58	86.76	82.79	79.42	83.74	85.28	89.77	94.85	97.13	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	273.54	272	263.93	251.13	238.55	226.13	217.87	222.19	228.6	241.55	256.39	267.12	(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)	
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	36.79	x	0.63	x	0.7	=	35.42	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	62.67	x	0.63	x	0.7	=	60.33	(77)
Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)

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Southeast 0.9x	0.77	x	3.15	x	85.75	x	0.63	x	0.7	=	82.55	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	106.25	x	0.63	x	0.7	=	102.29	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	119.01	x	0.63	x	0.7	=	114.57	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	118.15	x	0.63	x	0.7	=	113.74	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	113.91	x	0.63	x	0.7	=	109.66	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	104.39	x	0.63	x	0.7	=	100.49	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	92.85	x	0.63	x	0.7	=	89.39	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	69.27	x	0.63	x	0.7	=	66.68	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	44.07	x	0.63	x	0.7	=	42.43	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)
Southeast 0.9x	0.77	x	3.15	x	31.49	x	0.63	x	0.7	=	30.31	(77)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	70.84	120.67	165.1	204.57	229.14	227.48	219.32	200.99	178.77	133.37	84.85	60.63	(83)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	344.38	392.67	429.03	455.71	467.69	453.61	437.18	423.18	407.38	374.92	341.24	327.75	(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)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	0.98	0.97	0.93	0.83	0.68	0.49	0.35	0.38	0.59	0.85	0.96	0.99	

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.3	20.46	20.66	20.86	20.96	21	21	21	20.99	20.87	20.56	20.27	(87)
--------	------	-------	-------	-------	-------	----	----	----	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.12	20.12	20.12	20.14	20.14	20.15	20.15	20.16	20.15	20.14	20.14	20.13	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.91	0.8	0.63	0.43	0.29	0.31	0.52	0.81	0.95	0.98	(89)
--------	------	------	------	-----	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.21	19.44	19.72	19.99	20.11	20.15	20.15	20.16	20.14	20.01	19.6	19.18	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

fLA = Living area ÷ (4) =

0.65 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.92	20.11	20.34	20.56	20.67	20.7	20.7	20.71	20.69	20.57	20.23	19.89	(92)
--------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.92	20.11	20.34	20.56	20.67	20.7	20.7	20.71	20.69	20.57	20.23	19.89	(93)
--------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.98	0.96	0.91	0.82	0.66	0.47	0.33	0.36	0.56	0.83	0.96	0.98	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	337.22	376.3	392.41	372.32	309.1	213.13	144.08	150.57	229.62	312.6	325.93	322.28	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	575.77	558.35	505.93	418.2	320.45	214.33	144.19	150.76	233.14	356.19	472.61	569.28	(97)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	177.48	122.34	84.46	33.03	8.45	0	0	0	0	32.44	105.61	183.77	
--------	--------	--------	-------	-------	------	---	---	---	---	-------	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 747.58 (98)

Space heating requirement in $kWh/m^2/year$

19.47 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

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)

177.48	122.34	84.46	33.03	8.45	0	0	0	0	32.44	105.61	183.77
--------	--------	-------	-------	------	---	---	---	---	-------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

189.82	130.84	90.33	35.33	9.03	0	0	0	0	34.69	112.96	196.54
--------	--------	-------	-------	------	---	---	---	---	-------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 799.55 (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 ($kWh/year$) = $Sum(215)_{1..5,10..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

155.25	137.11	144.66	130.58	128.63	115.88	112.19	121.87	121.26	135.36	141.99	151.82
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

79.8 (216)

(217)m=	85.17	84.51	83.44	81.75	80.39	79.8	79.8	79.8	79.8	81.67	84.04	85.32	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	182.28	162.24	173.37	159.73	160.01	145.21	140.59	152.71	151.96	165.75	168.96	177.93
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = $Sum(219a)_{1..12} =$ 1940.75 (219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

799.55

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Water heating fuel used		1940.75	
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		192.12	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	172.7	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	419.2	(264)
Space and water heating	(261) + (262) + (263) + (264) =				591.91	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	99.71	(268)
Total CO2, kg/year	sum of (265)...(271) =				730.54	(272)
TER =					27.5	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 1BF MID 50 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50.2 (1a) x	2.5 (2a) =	125.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	125.5 (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				0 x 10 =	0 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) = 0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.18 (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) = 0.15 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			9.45	$\times 1/[1/(1.4) + 0.04] =$	12.53		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	24.73	12.6	12.13	$\times 0.18 =$	2.18		(29)
Total area of elements, m²			24.73				(31)
Party wall			45.62	$\times 0 =$	0		(32)
Party floor			50.2				(32a)
Party ceiling			50.2				(32b)

* 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) = 18.89 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5153.95 (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 3.68 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 22.56 (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=	12.37	12.21	12.06	11.29	11.14	10.37	10.37	10.21	10.67	11.14	11.44	11.75

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 34.93 34.78 34.63 33.86 33.7 32.93 32.93 32.78 33.24 33.7 34.01 34.32
Average = Sum(39)_{1...12} /12= 33.82 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.7	0.69	0.69	0.67	0.67	0.66	0.66	0.65	0.66	0.67	0.68	0.68		
	Average = Sum(40) _{1...12} /12=												0.67	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.7

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

74.48

(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=	81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93		
	Total = Sum(44) _{1...12} =												893.76	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.5	106.26	109.65	95.6	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66		
	Total = Sum(45) _{1...12} =												1171.86	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.22	15.94	16.45	14.34	13.76	11.87	11	12.63	12.78	14.89	16.25	17.65		(46)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0.54

(48)

Temperature factor from Table 2b

0.648

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.65

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=

141.58	124.41	129.74	115.04	111.82	98.59	93.44	104.26	104.61	119.35	127.79	137.75
--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------

 (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=

141.58	124.41	129.74	115.04	111.82	98.59	93.44	104.26	104.61	119.35	127.79	137.75
--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------

Output from water heater (annual)_{1...12}

1408.38

 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=

40.4	35.33	36.46	31.79	30.5	26.32	24.39	27.99	28.32	33	36.03	39.12
------	-------	-------	-------	------	-------	-------	-------	-------	----	-------	-------

 (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

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=

13.17	11.7	9.51	7.2	5.38	4.55	4.91	6.38	8.57	10.88	12.7	13.54
-------	------	------	-----	------	------	------	------	------	-------	------	-------

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=

147.75	149.29	145.42	137.2	126.81	117.06	110.54	109	112.87	121.09	131.48	141.23
--------	--------	--------	-------	--------	--------	--------	-----	--------	--------	--------	--------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=

31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=

-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

(72)m=

54.3	52.58	49	44.15	40.99	36.55	32.78	37.62	39.33	44.36	50.04	52.58
------	-------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=

263.66	262	252.38	236.99	221.63	206.6	196.67	201.44	209.21	224.77	242.65	255.8
--------	-----	--------	--------	--------	-------	--------	--------	--------	--------	--------	-------

 (73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)							
Northwest 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>9.45</td></tr></table>	9.45	x	<table><tr><td>11.28</td></tr></table>	11.28	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>32.59</td></tr></table>	32.59	(81)
0.77																		
9.45																		
11.28																		
0.63																		
0.7																		
32.59																		
Northwest 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.15</td></tr></table>	3.15	x	<table><tr><td>11.28</td></tr></table>	11.28	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>10.86</td></tr></table>	10.86	(81)
0.77																		
3.15																		
11.28																		
0.63																		
0.7																		
10.86																		
Northwest 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>9.45</td></tr></table>	9.45	x	<table><tr><td>22.97</td></tr></table>	22.97	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>66.33</td></tr></table>	66.33	(81)
0.77																		
9.45																		
22.97																		
0.63																		
0.7																		
66.33																		
Northwest 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.15</td></tr></table>	3.15	x	<table><tr><td>22.97</td></tr></table>	22.97	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>22.11</td></tr></table>	22.11	(81)
0.77																		
3.15																		
22.97																		
0.63																		
0.7																		
22.11																		
Northwest 0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>9.45</td></tr></table>	9.45	x	<table><tr><td>41.38</td></tr></table>	41.38	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>119.5</td></tr></table>	119.5	(81)
0.77																		
9.45																		
41.38																		
0.63																		
0.7																		
119.5																		

DER WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(81)
Northwest 0.9x	0.77	x	9.45	x	67.96	x	0.63	x	0.7	=	196.26	(81)
Northwest 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(81)
Northwest 0.9x	0.77	x	9.45	x	91.35	x	0.63	x	0.7	=	263.81	(81)
Northwest 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(81)
Northwest 0.9x	0.77	x	9.45	x	97.38	x	0.63	x	0.7	=	281.25	(81)
Northwest 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(81)
Northwest 0.9x	0.77	x	9.45	x	91.1	x	0.63	x	0.7	=	263.1	(81)
Northwest 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(81)
Northwest 0.9x	0.77	x	9.45	x	72.63	x	0.63	x	0.7	=	209.75	(81)
Northwest 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(81)
Northwest 0.9x	0.77	x	9.45	x	50.42	x	0.63	x	0.7	=	145.62	(81)
Northwest 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(81)
Northwest 0.9x	0.77	x	9.45	x	28.07	x	0.63	x	0.7	=	81.06	(81)
Northwest 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(81)
Northwest 0.9x	0.77	x	9.45	x	14.2	x	0.63	x	0.7	=	41	(81)
Northwest 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(81)
Northwest 0.9x	0.77	x	9.45	x	9.21	x	0.63	x	0.7	=	26.61	(81)
Northwest 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	43.45	88.44	159.34	261.68	351.75	375	350.81	279.67	194.16	108.08	54.67	35.48	(83)
--------	-------	-------	--------	--------	--------	-----	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	307.11	350.44	411.72	498.67	573.38	581.6	547.47	481.11	403.37	332.85	297.32	291.28	(84)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.95	0.78	0.54	0.36	0.26	0.31	0.57	0.91	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.54	20.64	20.8	20.94	20.96	20.97	20.97	20.97	20.96	20.89	20.69	20.53	(87)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.34	20.35	20.35	20.36	20.37	20.38	20.38	20.38	20.37	20.37	20.36	20.36	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.94	0.75	0.51	0.33	0.23	0.27	0.52	0.88	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.72	19.87	20.09	20.28	20.31	20.33	20.33	20.33	20.32	20.24	19.96	19.71	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.5 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.13	20.25	20.44	20.61	20.64	20.65	20.65	20.65	20.64	20.56	20.32	20.12	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	20.13	20.25	20.44	20.61	20.64	20.65	20.65	20.65	20.64	20.56	20.32	20.12	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	1	0.99	0.94	0.76	0.52	0.34	0.24	0.29	0.54	0.89	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	305.59	345.57	388.06	381	300.32	199.11	133.27	139.25	216.74	296.71	293.27	290.25	(95)
--------	--------	--------	--------	-----	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	552.98	533.88	482.77	396.37	301.21	199.13	133.27	139.25	217.46	335.76	449.61	546.25	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	184.06	126.54	70.46	11.07	0.66	0	0	0	0	29.05	112.57	190.46	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												724.88	(98)

Space heating requirement in $kWh/m^2/year$

14.44	(99)
-------	------

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

112.19	(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)

184.06	126.54	70.46	11.07	0.66	0	0	0	0	29.05	112.57	190.46
--------	--------	-------	-------	------	---	---	---	---	-------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

164.07	112.79	62.81	9.87	0.59	0	0	0	0	25.9	100.34	169.77
--------	--------	-------	------	------	---	---	---	---	------	--------	--------

$$Total (kWh/year) = Sum(211)_{1..5,10..12} =$$

646.13	(211)
--------	-------

Space heating fuel (secondary), $kWh/month$

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---

$$Total (kWh/year) = Sum(215)_{1..5,10..12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

141.58	124.41	129.74	115.04	111.82	98.59	93.44	104.26	104.61	119.35	127.79	137.75
--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------

Efficiency of water heater

311.7	(216)
-------	-------

(217)m=	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	45.42	39.91	41.62	36.91	35.87	31.63	29.98	33.45	33.56	38.29	41	44.19
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------

$$Total = Sum(219a)_{1..12} =$$

451.84	(219)
--------	-------

Annual totals

Space heating fuel used, main system 1

$kWh/year$

$kWh/year$

646.13

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Water heating fuel used		451.84	
Electricity for pumps, fans and electric keep-hot mechanical ventilation - balanced, extract or positive input from outside		107.18	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	107.18	(231)
Electricity for lighting		232.63	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	335.34	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	234.51	(264)
Space and water heating	(261) + (262) + (263) + (264) =			569.85	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	55.62	(267)
Electricity for lighting	(232) x	0.519	=	120.73	(268)
Total CO2, kg/year			sum of (265)...(271) =	746.21	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	14.86	(273)
El rating (section 14)				89	(274)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 1BF MID 50 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50.2 (1a)	2.5 (2a)	125.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	125.5 (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				2	20 (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) =	20 ÷ (5) = 0.16 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.41 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.35 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			9.41	$\times 1/[1/(1.4) + 0.04] =$	12.48		(27)
Windows Type 2			3.14	$\times 1/[1/(1.4) + 0.04] =$	4.16		(27)
Walls	24.73	12.55	12.18	$\times 0.18 =$	2.19		(29)
Total area of elements, m²			24.73				(31)
Party wall			45.62	$\times 0 =$	0		(32)
Party floor			50.2				(32a)
Party ceiling			50.2				(32b)

* 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) = 18.83 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5156.95 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 2.24 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 21.07 (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=	24.78	24.62	24.47	23.74	23.6	22.97	22.97	22.85	23.21	23.6	23.88	24.17

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 45.85 45.69 45.54 44.81 44.67 44.04 44.04 43.92 44.28 44.67 44.95 45.24
Average = Sum(39)_{1...12} /12= 44.81 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.91	0.91	0.91	0.89	0.89	0.88	0.88	0.87	0.88	0.89	0.9	0.9		
Average = Sum(40) _{1...12} /12=													0.89	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.7

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

74.48

(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=	81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93		
Total = Sum(44) _{1...12} =													893.76	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.5	106.26	109.65	95.6	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66		
Total = Sum(45) _{1...12} =													1171.86	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.22	15.94	16.45	14.34	13.76	11.87	11	12.63	12.78	14.89	16.25	17.65		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.75

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.75

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 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 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	168.09	148.35	156.25	140.69	138.32	124.25	119.94	130.76	130.27	145.86	153.44	164.26	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	168.09	148.35	156.25	140.69	138.32	124.25	119.94	130.76	130.27	145.86	153.44	164.26	
Output from water heater (annual) _{1...12}												1720.47	(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=	77.67	69	73.74	67.86	67.78	62.39	61.66	65.26	64.39	70.28	72.1	76.4	(65)
--------	-------	----	-------	-------	-------	-------	-------	-------	-------	-------	------	------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.17	11.7	9.51	7.2	5.38	4.55	4.91	6.38	8.57	10.88	12.7	13.54	(67)
--------	-------	------	------	-----	------	------	------	------	------	-------	------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.75	149.29	145.42	137.2	126.81	117.06	110.54	109	112.87	121.09	131.48	141.23	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-----	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	104.4	102.68	99.11	94.25	91.1	86.66	82.88	87.72	89.44	94.46	100.14	102.69	(72)
--------	-------	--------	-------	-------	------	-------	-------	-------	-------	-------	--------	--------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	316.77	315.11	305.48	290.09	274.74	259.7	249.77	254.55	262.31	277.88	295.75	308.9	(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)	
Northwest 0.9x	0.77	x	9.41	x	11.28	x	0.63	x	0.7	=	32.45	(81)
Northwest 0.9x	0.77	x	3.14	x	11.28	x	0.63	x	0.7	=	10.83	(81)
Northwest 0.9x	0.77	x	9.41	x	22.97	x	0.63	x	0.7	=	66.05	(81)
Northwest 0.9x	0.77	x	3.14	x	22.97	x	0.63	x	0.7	=	22.04	(81)
Northwest 0.9x	0.77	x	9.41	x	41.38	x	0.63	x	0.7	=	119	(81)

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Northwest 0.9x	0.77	x	3.14	x	41.38	x	0.63	x	0.7	=	39.71	(81)
Northwest 0.9x	0.77	x	9.41	x	67.96	x	0.63	x	0.7	=	195.43	(81)
Northwest 0.9x	0.77	x	3.14	x	67.96	x	0.63	x	0.7	=	65.21	(81)
Northwest 0.9x	0.77	x	9.41	x	91.35	x	0.63	x	0.7	=	262.69	(81)
Northwest 0.9x	0.77	x	3.14	x	91.35	x	0.63	x	0.7	=	87.66	(81)
Northwest 0.9x	0.77	x	9.41	x	97.38	x	0.63	x	0.7	=	280.06	(81)
Northwest 0.9x	0.77	x	3.14	x	97.38	x	0.63	x	0.7	=	93.45	(81)
Northwest 0.9x	0.77	x	9.41	x	91.1	x	0.63	x	0.7	=	261.99	(81)
Northwest 0.9x	0.77	x	3.14	x	91.1	x	0.63	x	0.7	=	87.42	(81)
Northwest 0.9x	0.77	x	9.41	x	72.63	x	0.63	x	0.7	=	208.86	(81)
Northwest 0.9x	0.77	x	3.14	x	72.63	x	0.63	x	0.7	=	69.69	(81)
Northwest 0.9x	0.77	x	9.41	x	50.42	x	0.63	x	0.7	=	145	(81)
Northwest 0.9x	0.77	x	3.14	x	50.42	x	0.63	x	0.7	=	48.38	(81)
Northwest 0.9x	0.77	x	9.41	x	28.07	x	0.63	x	0.7	=	80.72	(81)
Northwest 0.9x	0.77	x	3.14	x	28.07	x	0.63	x	0.7	=	26.93	(81)
Northwest 0.9x	0.77	x	9.41	x	14.2	x	0.63	x	0.7	=	40.83	(81)
Northwest 0.9x	0.77	x	3.14	x	14.2	x	0.63	x	0.7	=	13.62	(81)
Northwest 0.9x	0.77	x	9.41	x	9.21	x	0.63	x	0.7	=	26.5	(81)
Northwest 0.9x	0.77	x	3.14	x	9.21	x	0.63	x	0.7	=	8.84	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	43.28	88.09	158.71	260.64	350.35	373.51	349.41	278.56	193.39	107.65	54.45	35.34	(83)
--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	360.04	403.19	464.19	550.73	625.09	633.21	599.18	533.1	455.7	385.53	350.21	344.24	(84)
--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)	21	(85)
--	----	------

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.96	0.85	0.65	0.44	0.32	0.38	0.65	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.2	20.34	20.58	20.86	20.98	21	21	21	20.98	20.79	20.45	20.18	(87)
--------	------	-------	-------	-------	-------	----	----	----	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.16	20.16	20.16	20.17	20.18	20.19	20.19	20.19	20.18	20.18	20.17	20.17	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.82	0.59	0.39	0.26	0.31	0.58	0.9	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	-----	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.1	19.3	19.64	20.02	20.16	20.19	20.19	20.19	20.17	19.95	19.47	19.08	(90)
--------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.5 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.65	19.82	20.11	20.44	20.57	20.59	20.59	20.59	20.58	20.37	19.96	19.63	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

TER WorkSheet: New dwelling design stage

(93)m=	19.65	19.82	20.11	20.44	20.57	20.59	20.59	20.59	20.58	20.37	19.96	19.63	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.99	0.98	0.95	0.83	0.62	0.42	0.29	0.35	0.62	0.91	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	357	396.28	441.3	458.34	387.13	263.16	175.73	183.98	280.63	350.2	343.76	341.94	(95)
--------	-----	--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]$

(97)m=	703.72	681.61	619.81	517.02	396.02	263.8	175.78	184.13	286.73	436.27	578.05	697.86	(97)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	257.96	191.74	132.81	42.25	6.61	0	0	0	0	64.03	168.69	264.8	
--------	--------	--------	--------	-------	------	---	---	---	---	-------	--------	-------	--

Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$ 1128.89 (98)

Space heating requirement in $kWh/m^2/year$

22.49 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

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)

257.96	191.74	132.81	42.25	6.61	0	0	0	0	64.03	168.69	264.8
--------	--------	--------	-------	------	---	---	---	---	-------	--------	-------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

275.89	205.07	142.05	45.19	7.07	0	0	0	0	68.48	180.42	283.21
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

Total ($kWh/year$) = $Sum(211)_{1..5,10..12} =$ 1207.37 (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 ($kWh/year$) = $Sum(215)_{1..5,10..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

168.09	148.35	156.25	140.69	138.32	124.25	119.94	130.76	130.27	145.86	153.44	164.26
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

79.8 (216)

(217)m=	85.95	85.5	84.38	82.04	80.23	79.8	79.8	79.8	79.8	82.79	85.07	86.08	(217)
---------	-------	------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	195.56	173.51	185.16	171.49	172.4	155.7	150.3	163.86	163.24	176.18	180.38	190.82
---------	--------	--------	--------	--------	-------	-------	-------	--------	--------	--------	--------	--------

Total = $Sum(219a)_{1..12} =$ 2078.61 (219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

1207.37

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Water heating fuel used		2078.61	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		232.63	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	260.79	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	448.98	(264)
Space and water heating	(261) + (262) + (263) + (264) =				709.77	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	120.73	(268)
Total CO2, kg/year	sum of (265)...(271) =				869.43	(272)
TER =					25.1	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 1BF TOP 50 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50.2 (1a)	2.5 (2a)	125.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	125.5 (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				0	0 (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) =	0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.18 (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) = 0.15 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			9.45	$\times 1/[1/(1.4) + 0.04] =$	12.53		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	24.73	12.6	12.13	$\times$ 0.18	2.18		(29)
Roof	50.2	0	50.2	$\times$ 0.15	7.53		(30)
Total area of elements, m²			74.93				(31)
Party wall			45.62	$\times$ 0	0		(32)
Party floor			50.2				(32a)

* 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) = 26.42 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4099.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8.85 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 35.27 (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=	12.37	12.21	12.06	11.29	11.14	10.37	10.37	10.21	10.67	11.14	11.44	11.75

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	47.63	47.48	47.33	46.56	46.4	45.63	45.63	45.48	45.94	46.4	46.71	47.02
Average = Sum(39) _{1...12} /12=												46.52 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.95	0.95	0.94	0.93	0.92	0.91	0.91	0.91	0.92	0.92	0.93	0.94		
	Average = Sum(40) _{1...12} /12=												0.93	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.7

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

74.48

(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=	81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93		
	Total = Sum(44) _{1...12} =												893.76	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.5	106.26	109.65	95.6	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66		
	Total = Sum(45) _{1...12} =												1171.86	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.22	15.94	16.45	14.34	13.76	11.87	11	12.63	12.78	14.89	16.25	17.65		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0.54

(48)

Temperature factor from Table 2b

0.648

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.65

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(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=	141.58	124.41	129.74	115.04	111.82	98.59	93.44	104.26	104.61	119.35	127.79	137.75	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	141.58	124.41	129.74	115.04	111.82	98.59	93.44	104.26	104.61	119.35	127.79	137.75	
Output from water heater (annual) _{1...12}												1408.38	(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=	40.4	35.33	36.46	31.79	30.5	26.32	24.39	27.99	28.32	33	36.03	39.12	(65)
--------	------	-------	-------	-------	------	-------	-------	-------	-------	----	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.17	11.7	9.51	7.2	5.38	4.55	4.91	6.38	8.57	10.88	12.7	13.54	(67)
--------	-------	------	------	-----	------	------	------	------	------	-------	------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.75	149.29	145.42	137.2	126.81	117.06	110.54	109	112.87	121.09	131.48	141.23	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-----	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	54.3	52.58	49	44.15	40.99	36.55	32.78	37.62	39.33	44.36	50.04	52.58	(72)
--------	------	-------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	263.66	262	252.38	236.99	221.63	206.6	196.67	201.44	209.21	224.77	242.65	255.8	(73)
--------	--------	-----	--------	--------	--------	-------	--------	--------	--------	--------	--------	-------	------

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northwest 0.9x	0.77	x	9.45	x	11.28	x	0.63	x	0.7	=	32.59	(81)
Northwest 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	10.86	(81)
Northwest 0.9x	0.77	x	9.45	x	22.97	x	0.63	x	0.7	=	66.33	(81)
Northwest 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	22.11	(81)
Northwest 0.9x	0.77	x	9.45	x	41.38	x	0.63	x	0.7	=	119.5	(81)

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Northwest 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	39.83	(81)
Northwest 0.9x	0.77	x	9.45	x	67.96	x	0.63	x	0.7	=	196.26	(81)
Northwest 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	65.42	(81)
Northwest 0.9x	0.77	x	9.45	x	91.35	x	0.63	x	0.7	=	263.81	(81)
Northwest 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	87.94	(81)
Northwest 0.9x	0.77	x	9.45	x	97.38	x	0.63	x	0.7	=	281.25	(81)
Northwest 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	93.75	(81)
Northwest 0.9x	0.77	x	9.45	x	91.1	x	0.63	x	0.7	=	263.1	(81)
Northwest 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	87.7	(81)
Northwest 0.9x	0.77	x	9.45	x	72.63	x	0.63	x	0.7	=	209.75	(81)
Northwest 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	69.92	(81)
Northwest 0.9x	0.77	x	9.45	x	50.42	x	0.63	x	0.7	=	145.62	(81)
Northwest 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	48.54	(81)
Northwest 0.9x	0.77	x	9.45	x	28.07	x	0.63	x	0.7	=	81.06	(81)
Northwest 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	27.02	(81)
Northwest 0.9x	0.77	x	9.45	x	14.2	x	0.63	x	0.7	=	41	(81)
Northwest 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	13.67	(81)
Northwest 0.9x	0.77	x	9.45	x	9.21	x	0.63	x	0.7	=	26.61	(81)
Northwest 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	8.87	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	43.45	88.44	159.34	261.68	351.75	375	350.81	279.67	194.16	108.08	54.67	35.48	(83)
--------	-------	-------	--------	--------	--------	-----	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	307.11	350.44	411.72	498.67	573.38	581.6	547.47	481.11	403.37	332.85	297.32	291.28	(84)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.9	0.71	0.5	0.37	0.43	0.74	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.24	20.35	20.54	20.79	20.92	20.95	20.96	20.95	20.93	20.72	20.43	20.23	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.13	20.13	20.13	20.14	20.15	20.16	20.16	20.16	20.15	20.15	20.14	20.14	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.88	0.66	0.43	0.3	0.36	0.67	0.95	0.99	1	(89)
--------	---	------	------	------	------	------	-----	------	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.1	19.26	19.54	19.89	20.05	20.09	20.09	20.1	20.07	19.81	19.4	19.09	(90)
--------	------	-------	-------	-------	-------	-------	-------	------	-------	-------	------	-------	------

fLA = Living area ÷ (4) =

0.5 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.67	19.8	20.04	20.34	20.49	20.52	20.52	20.52	20.5	20.26	19.92	19.66	(92)
--------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.67	19.8	20.04	20.34	20.49	20.52	20.52	20.52	20.5	20.26	19.92	19.66	(93)
--------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	1	0.99	0.97	0.88	0.68	0.46	0.33	0.39	0.7	0.95	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	-----	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	306.03	347.61	400.42	440.6	390.95	268.82	178.88	187.19	280.71	316.5	295.02	290.51	(95)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	732.18	707.54	640.81	532.54	407.65	270.18	179.01	187.55	293.8	448.31	598.62	726.7	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	317.06	241.88	178.85	66.2	12.42	0	0	0	0	98.07	218.59	324.52	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												1457.6	(98)

Space heating requirement in $kWh/m^2/year$

29.04	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

146.67	(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)

317.06	241.88	178.85	66.2	12.42	0	0	0	0	98.07	218.59	324.52
--------	--------	--------	------	-------	---	---	---	---	-------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

216.18	164.92	121.95	45.14	8.47	0	0	0	0	66.86	149.04	221.27
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

$$Total (kWh/year) = Sum(211)_{1..5,10..12} =$$

993.82	(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
---------	---	---	---	---	---	---	---	---	---	---	---

$$Total (kWh/year) = Sum(215)_{1..5,10..12} =$$

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

141.58	124.41	129.74	115.04	111.82	98.59	93.44	104.26	104.61	119.35	127.79	137.75
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Efficiency of water heater

311.7	(216)
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(217)m=	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	45.42	39.91	41.62	36.91	35.87	31.63	29.98	33.45	33.56	38.29	41	44.19
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------

$$Total = Sum(219a)_{1..12} =$$

451.84	(219)
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Annual totals

Space heating fuel used, main system 1

$kWh/year$

$kWh/year$

993.82

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Water heating fuel used		451.84	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside		107.18	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	107.18	(231)
Electricity for lighting		232.63	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	515.79	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	234.51	(264)
Space and water heating	(261) + (262) + (263) + (264) =			750.3	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	55.62	(267)
Electricity for lighting	(232) x	0.519	=	120.73	(268)
Total CO2, kg/year			sum of (265)...(271) =	926.66	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	18.46	(273)
EI rating (section 14)				87	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 1BF TOP 50 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	50.2 (1a)	2.5 (2a)	125.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	125.5 (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				2	20 (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) =	20 ÷ (5) = 0.16 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0 (9)
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Additional infiltration	[(9)-1]x0.1 = 0 (10)
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Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0 (11)
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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)
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If no draught lobby, enter 0.05, else enter 0	0 (13)
---	--------

Percentage of windows and doors draught stripped	0 (14)
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Window infiltration	0.25 - [0.2 x (14) ÷ 100] = 0 (15)
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Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) = 0 (16)
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Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
---	--------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.41 (18)
--	-----------

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered	2 (19)
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Shelter factor	0.85 (20)
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Infiltration rate incorporating shelter factor	0.35 (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
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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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TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.6 0.59 0.59 0.57 0.57 0.55 0.55 0.55 0.56 0.57 0.58 0.58 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			9.41	x1/[1/(1.4)+0.04] =	12.48		(27)
Windows Type 2			3.14	x1/[1/(1.4)+0.04] =	4.16		(27)
Walls	24.73	12.55	12.18	x 0.18 =	2.19		(29)
Roof	50.2	0	50.2	x 0.13 =	6.53		(30)
Total area of elements, m²			74.93				(31)
Party wall			45.62	x 0 =	0		(32)
Party floor			50.2				(32a)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 25.36 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4102.75 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.22 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 30.57 (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=	24.78	24.62	24.47	23.74	23.6	22.97	22.97	22.85	23.21	23.6	23.88	24.17

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	55.36	55.2	55.04	54.32	54.18	53.54	53.54	53.43	53.79	54.18	54.45	54.74
Average = Sum(39) _{1...12} /12=												54.31 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.1	1.1	1.1	1.08	1.08	1.07	1.07	1.06	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)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.7

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

74.48

(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=	81.93	78.95	75.97	72.99	70.01	67.03	67.03	70.01	72.99	75.97	78.95	81.93		
	Total = Sum(44) _{1...12} =												893.76	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.5	106.26	109.65	95.6	91.73	79.15	73.35	84.17	85.17	99.26	108.35	117.66		
	Total = Sum(45) _{1...12} =												1171.86	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.22	15.94	16.45	14.34	13.76	11.87	11	12.63	12.78	14.89	16.25	17.65		(46)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.75

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.75

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 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 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	168.09	148.35	156.25	140.69	138.32	124.25	119.94	130.76	130.27	145.86	153.44	164.26	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	168.09	148.35	156.25	140.69	138.32	124.25	119.94	130.76	130.27	145.86	153.44	164.26	
Output from water heater (annual) _{1...12}												1720.47	(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=	77.67	69	73.74	67.86	67.78	62.39	61.66	65.26	64.39	70.28	72.1	76.4	(65)
--------	-------	----	-------	-------	-------	-------	-------	-------	-------	-------	------	------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.17	11.7	9.51	7.2	5.38	4.55	4.91	6.38	8.57	10.88	12.7	13.54	(67)
--------	-------	------	------	-----	------	------	------	------	------	-------	------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.75	149.29	145.42	137.2	126.81	117.06	110.54	109	112.87	121.09	131.48	141.23	(68)
--------	--------	--------	--------	-------	--------	--------	--------	-----	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	-67.84	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	104.4	102.68	99.11	94.25	91.1	86.66	82.88	87.72	89.44	94.46	100.14	102.69	(72)
--------	-------	--------	-------	-------	------	-------	-------	-------	-------	-------	--------	--------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	316.77	315.11	305.48	290.09	274.74	259.7	249.77	254.55	262.31	277.88	295.75	308.9	(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)	
Northwest 0.9x	0.77	x	9.41	x	11.28	x	0.63	x	0.7	=	32.45	(81)
Northwest 0.9x	0.77	x	3.14	x	11.28	x	0.63	x	0.7	=	10.83	(81)
Northwest 0.9x	0.77	x	9.41	x	22.97	x	0.63	x	0.7	=	66.05	(81)
Northwest 0.9x	0.77	x	3.14	x	22.97	x	0.63	x	0.7	=	22.04	(81)
Northwest 0.9x	0.77	x	9.41	x	41.38	x	0.63	x	0.7	=	119	(81)

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Northwest 0.9x	0.77	x	3.14	x	41.38	x	0.63	x	0.7	=	39.71	(81)
Northwest 0.9x	0.77	x	9.41	x	67.96	x	0.63	x	0.7	=	195.43	(81)
Northwest 0.9x	0.77	x	3.14	x	67.96	x	0.63	x	0.7	=	65.21	(81)
Northwest 0.9x	0.77	x	9.41	x	91.35	x	0.63	x	0.7	=	262.69	(81)
Northwest 0.9x	0.77	x	3.14	x	91.35	x	0.63	x	0.7	=	87.66	(81)
Northwest 0.9x	0.77	x	9.41	x	97.38	x	0.63	x	0.7	=	280.06	(81)
Northwest 0.9x	0.77	x	3.14	x	97.38	x	0.63	x	0.7	=	93.45	(81)
Northwest 0.9x	0.77	x	9.41	x	91.1	x	0.63	x	0.7	=	261.99	(81)
Northwest 0.9x	0.77	x	3.14	x	91.1	x	0.63	x	0.7	=	87.42	(81)
Northwest 0.9x	0.77	x	9.41	x	72.63	x	0.63	x	0.7	=	208.86	(81)
Northwest 0.9x	0.77	x	3.14	x	72.63	x	0.63	x	0.7	=	69.69	(81)
Northwest 0.9x	0.77	x	9.41	x	50.42	x	0.63	x	0.7	=	145	(81)
Northwest 0.9x	0.77	x	3.14	x	50.42	x	0.63	x	0.7	=	48.38	(81)
Northwest 0.9x	0.77	x	9.41	x	28.07	x	0.63	x	0.7	=	80.72	(81)
Northwest 0.9x	0.77	x	3.14	x	28.07	x	0.63	x	0.7	=	26.93	(81)
Northwest 0.9x	0.77	x	9.41	x	14.2	x	0.63	x	0.7	=	40.83	(81)
Northwest 0.9x	0.77	x	3.14	x	14.2	x	0.63	x	0.7	=	13.62	(81)
Northwest 0.9x	0.77	x	9.41	x	9.21	x	0.63	x	0.7	=	26.5	(81)
Northwest 0.9x	0.77	x	3.14	x	9.21	x	0.63	x	0.7	=	8.84	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	43.28	88.09	158.71	260.64	350.35	373.51	349.41	278.56	193.39	107.65	54.45	35.34	(83)
--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	360.04	403.19	464.19	550.73	625.09	633.21	599.18	533.1	455.7	385.53	350.21	344.24	(84)
--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21

(85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.9	0.74	0.53	0.39	0.46	0.74	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.93	20.08	20.35	20.7	20.92	20.99	21	21	20.94	20.63	20.22	19.91	(87)
--------	-------	-------	-------	------	-------	-------	----	----	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.02	20.02	20.03	20.03	20.03	20.02	20.02	20.01	20.01	(88)
--------	----	----	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.88	0.68	0.46	0.31	0.36	0.66	0.93	0.99	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.59	18.8	19.19	19.68	19.95	20.02	20.03	20.03	19.98	19.6	19.02	18.56	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.5

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.26	19.43	19.76	20.19	20.43	20.5	20.51	20.51	20.46	20.11	19.62	19.23	(92)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.26	19.43	19.76	20.19	20.43	20.5	20.51	20.51	20.46	20.11	19.62	19.23	(93)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.99	0.99	0.96	0.88	0.71	0.49	0.35	0.41	0.7	0.94	0.99	0.99	(94)
--------	------	------	------	------	------	------	------	------	-----	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	357.34	397.55	447.3	485.85	441.2	312.15	208.91	218.48	319.85	360.59	345.03	342.16	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	827.93	802.29	730.15	613.09	473.07	316.07	209.41	219.6	341.98	515.36	681.8	822.9	(97)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	-------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	350.12	271.99	210.44	91.61	23.71	0	0	0	0	115.15	242.47	357.67	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												1663.17	(98)

Space heating requirement in $kWh/m^2/year$

33.13	(99)
-------	------

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

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)

350.12	271.99	210.44	91.61	23.71	0	0	0	0	115.15	242.47	357.67
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

374.46	290.89	225.07	97.98	25.36	0	0	0	0	123.16	259.33	382.54
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1...5,10...12} =$$

1778.79	(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...5,10...12} =												0	(215)

Water heating

Output from water heater (calculated above)

168.09	148.35	156.25	140.69	138.32	124.25	119.94	130.76	130.27	145.86	153.44	164.26
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

79.8	(216)
------	-------

(217)m=	86.73	86.41	85.61	83.7	81.21	79.8	79.8	79.8	79.8	84.19	86.03	86.84	(217)
---------	-------	-------	-------	------	-------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	193.81	171.68	182.51	168.08	170.34	155.7	150.3	163.86	163.24	173.24	178.36	189.16	
Total = Sum(219a) _{1...12} =												2060.29	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year	1778.79
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Water heating fuel used		2060.29	
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		232.63	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	384.22	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	445.02	(264)
Space and water heating	(261) + (262) + (263) + (264) =				829.24	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	120.73	(268)
Total CO2, kg/year	sum of (265)...(271) =				988.9	(272)
TER =					28.78	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 2BF GND 70 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	69.8 (1a) x	2.5 (2a) =	174.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	69.8 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	174.5 (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				0 x 10 =	0 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) = 0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.18 (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) = 0.15 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.46	$\times 1/[1/(1.4) + 0.04] =$	7.24		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			2.84	$\times 1/[1/(1.4) + 0.04] =$	3.77		(27)
Floor			69.8	x 0.13 =	9.074		(28)
Walls	39.88	14.6	25.27	x 0.18 =	4.55		(29)
Total area of elements, m²			109.68				(31)
Party wall			43.59	x 0 =	0		(32)
Party ceiling			69.8				(32b)

* 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) = 32.98 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9717.25 (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 9.07 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 42.05 (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=	17.2	16.98	16.77	15.7	15.48	14.41	14.41	14.2	14.84	15.48	15.91	16.34

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 59.25 59.03 58.82 57.75 57.53 56.46 56.46 56.25 56.89 57.53 57.96 58.39
Average = Sum(39)_{1...12} /12= 57.69 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.85	0.85	0.84	0.83	0.82	0.81	0.81	0.81	0.82	0.82	0.83	0.84		
	Average = Sum(40) _{1...12} /12=												0.83	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.24

(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

87.43

(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=	96.17	92.68	89.18	85.68	82.18	78.69	78.69	82.18	85.68	89.18	92.68	96.17		
	Total = Sum(44) _{1...12} =												1049.16	(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=	142.62	124.74	128.72	112.22	107.68	92.92	86.1	98.8	99.98	116.52	127.19	138.12		
	Total = Sum(45) _{1...12} =												1375.61	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.39	18.71	19.31	16.83	16.15	13.94	12.92	14.82	15	17.48	19.08	20.72		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0.54

(48)

Temperature factor from Table 2b

0.648

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.65

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(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=	162.71	142.88	148.81	131.66	127.77	112.36	106.19	118.89	119.42	136.61	146.63	158.21	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	162.71	142.88	148.81	131.66	127.77	112.36	106.19	118.89	119.42	136.61	146.63	158.21	
Output from water heater (annual) _{1...12}												1612.13	(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=	47.42	41.48	42.8	37.31	35.8	30.9	28.63	32.85	33.24	38.74	42.29	45.93	(65)
--------	-------	-------	------	-------	------	------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.6	15.63	12.71	9.62	7.19	6.07	6.56	8.53	11.45	14.54	16.97	18.09	(67)
--------	------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	196.83	198.87	193.73	182.77	168.94	155.94	147.25	145.21	150.36	161.31	175.15	188.15	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	(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=	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	63.74	61.72	57.53	51.82	48.12	42.91	38.48	44.16	46.17	52.07	58.74	61.73	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	334.79	332.84	320.58	300.84	280.87	261.54	248.91	254.52	264.6	284.55	307.47	324.58	(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)	
Southwest _{0.9x}	0.77	x	5.46	x	36.79		0.63	x	0.7	=	61.4	(79)
Southwest _{0.9x}	0.77	x	3.15	x	36.79		0.63	x	0.7	=	70.84	(79)
Southwest _{0.9x}	0.77	x	5.46	x	62.67		0.63	x	0.7	=	104.58	(79)
Southwest _{0.9x}	0.77	x	3.15	x	62.67		0.63	x	0.7	=	120.67	(79)
Southwest _{0.9x}	0.77	x	5.46	x	85.75		0.63	x	0.7	=	143.09	(79)

DER WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	3.15	x	85.75	0.63	x	0.7	=	165.1	(79)
Southwest	0.9x	0.77	x	5.46	x	106.25	0.63	x	0.7	=	177.3	(79)
Southwest	0.9x	0.77	x	3.15	x	106.25	0.63	x	0.7	=	204.57	(79)
Southwest	0.9x	0.77	x	5.46	x	119.01	0.63	x	0.7	=	198.59	(79)
Southwest	0.9x	0.77	x	3.15	x	119.01	0.63	x	0.7	=	229.14	(79)
Southwest	0.9x	0.77	x	5.46	x	118.15	0.63	x	0.7	=	197.15	(79)
Southwest	0.9x	0.77	x	3.15	x	118.15	0.63	x	0.7	=	227.48	(79)
Southwest	0.9x	0.77	x	5.46	x	113.91	0.63	x	0.7	=	190.07	(79)
Southwest	0.9x	0.77	x	3.15	x	113.91	0.63	x	0.7	=	219.32	(79)
Southwest	0.9x	0.77	x	5.46	x	104.39	0.63	x	0.7	=	174.19	(79)
Southwest	0.9x	0.77	x	3.15	x	104.39	0.63	x	0.7	=	200.99	(79)
Southwest	0.9x	0.77	x	5.46	x	92.85	0.63	x	0.7	=	154.94	(79)
Southwest	0.9x	0.77	x	3.15	x	92.85	0.63	x	0.7	=	178.77	(79)
Southwest	0.9x	0.77	x	5.46	x	69.27	0.63	x	0.7	=	115.58	(79)
Southwest	0.9x	0.77	x	3.15	x	69.27	0.63	x	0.7	=	133.37	(79)
Southwest	0.9x	0.77	x	5.46	x	44.07	0.63	x	0.7	=	73.54	(79)
Southwest	0.9x	0.77	x	3.15	x	44.07	0.63	x	0.7	=	84.85	(79)
Southwest	0.9x	0.77	x	5.46	x	31.49	0.63	x	0.7	=	52.54	(79)
Southwest	0.9x	0.77	x	3.15	x	31.49	0.63	x	0.7	=	60.63	(79)
Northwest	0.9x	0.77	x	2.84	x	11.28	0.63	x	0.7	=	9.79	(81)
Northwest	0.9x	0.77	x	2.84	x	22.97	0.63	x	0.7	=	19.93	(81)
Northwest	0.9x	0.77	x	2.84	x	41.38	0.63	x	0.7	=	35.91	(81)
Northwest	0.9x	0.77	x	2.84	x	67.96	0.63	x	0.7	=	58.98	(81)
Northwest	0.9x	0.77	x	2.84	x	91.35	0.63	x	0.7	=	79.28	(81)
Northwest	0.9x	0.77	x	2.84	x	97.38	0.63	x	0.7	=	84.52	(81)
Northwest	0.9x	0.77	x	2.84	x	91.1	0.63	x	0.7	=	79.07	(81)
Northwest	0.9x	0.77	x	2.84	x	72.63	0.63	x	0.7	=	63.04	(81)
Northwest	0.9x	0.77	x	2.84	x	50.42	0.63	x	0.7	=	43.76	(81)
Northwest	0.9x	0.77	x	2.84	x	28.07	0.63	x	0.7	=	24.36	(81)
Northwest	0.9x	0.77	x	2.84	x	14.2	0.63	x	0.7	=	12.32	(81)
Northwest	0.9x	0.77	x	2.84	x	9.21	0.63	x	0.7	=	8	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 142.03 245.18 344.11 440.85 507.01 509.16 488.46 438.22 377.47 273.31 170.71 121.17 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 476.82 578.03 664.69 741.69 787.88 770.7 737.37 692.73 642.07 557.85 478.18 445.75 (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	0.98	0.95	0.84	0.66	0.47	0.34	0.37	0.6	0.9	0.99	1

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 20.41 20.55 20.72 20.88 20.94 20.96 20.96 20.96 20.95 20.85 20.6 20.39 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.21	20.21	20.22	20.23	20.23	20.25	20.25	20.25	20.24	20.23	20.23	20.22	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.93	0.81	0.61	0.41	0.28	0.31	0.54	0.87	0.98	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.42	19.62	19.86	20.08	20.16	20.19	20.19	20.19	20.18	20.06	19.71	19.39	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =	0.36	(91)
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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.77	19.96	20.17	20.37	20.44	20.46	20.46	20.46	20.45	20.34	20.03	19.75	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.77	19.96	20.17	20.37	20.44	20.46	20.46	20.46	20.45	20.34	20.03	19.75	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.93	0.81	0.63	0.43	0.3	0.33	0.56	0.87	0.98	1	(94)
--------	------	------	------	------	------	------	-----	------	------	------	------	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	473.42	565.03	620.66	604.01	493.22	330.37	218.09	228.57	358.06	485.82	468.84	443.56	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m – (96)m]

(97)m=	916.68	888.77	804.13	662.23	502.86	331.01	218.13	228.65	361.51	560.65	749.29	907.78	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	329.78	217.55	136.5	41.92	7.17	0	0	0	0	55.67	201.92	345.38	(98)
--------	--------	--------	-------	-------	------	---	---	---	---	-------	--------	--------	------

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	1335.89	(98)
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Space heating requirement in kWh/m²/year

19.14	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
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Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

174.3	(206)
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Efficiency of secondary/supplementary heating system, %

0	(208)
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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

329.78	217.55	136.5	41.92	7.17	0	0	0	0	55.67	201.92	345.38
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(211)m = {[(98)m x (204)] } x 100 ÷ (206)	(211)
---	-------

189.21	124.82	78.32	24.05	4.11	0	0	0	0	31.94	115.85	198.16
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Total (kWh/year) = Sum(211) _{1...5,10...12} =	766.45	(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	(215)
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Total (kWh/year) = Sum(215) _{1...5,10...12} =	0	(215)
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DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

162.71	142.88	148.81	131.66	127.77	112.36	106.19	118.89	119.42	136.61	146.63	158.21
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

311.7 (216)

(217)m= 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

52.2	45.84	47.74	42.24	40.99	36.05	34.07	38.14	38.31	43.83	47.04	50.76
------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Total = Sum(219a)_{1..12} =

517.21 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

766.45

Water heating fuel used

517.21

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

149.02

(230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

149.02 (231)

Electricity for lighting

310.83 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519 =	397.79 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.519 =	268.43 (264)
Space and water heating	(261) + (262) + (263) + (264) =		666.22 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	77.34 (267)
Electricity for lighting	(232) x	0.519 =	161.32 (268)
Total CO2, kg/year		sum of (265)...(271) =	904.89 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	12.96 (273)
El rating (section 14)			89 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 2BF GND 70 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	69.8 (1a)	2.5 (2a)	174.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	69.8 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	174.5 (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				2	20 (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) =	0.11 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0 (9)
--	-------

Additional infiltration	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 (15)
---------------------	--------

Infiltration rate	0 (16)
-------------------	--------

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
---	--------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.36 (18)
--	-----------

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered	2 (19)
---------------------------	--------

Shelter factor	0.85 (20)
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Infiltration rate incorporating shelter factor	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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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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TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.4	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36
-----	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.46	$\times 1/[1/(1.4) + 0.04] =$	7.24		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			2.84	$\times 1/[1/(1.4) + 0.04] =$	3.77		(27)
Floor			69.8	x 0.13 =	9.074		(28)
Walls	39.88	14.6	25.27	x 0.18 =	4.55		(29)
Total area of elements, m²			109.68				(31)
Party wall			43.59	x 0 =	0		(32)
Party ceiling			69.8				(32b)

* 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) = 32.98 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9717.25 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.01 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 38.99 (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=	33.29	33.11	32.94	32.14	31.99	31.29	31.29	31.16	31.56	31.99	32.29	32.61

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 72.27 72.1 71.93 71.13 70.97 70.27 70.27 70.15 70.54 70.97 71.28 71.6
Average = Sum(39)_{1...12} /12= 71.12 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.04	1.03	1.03	1.02	1.02	1.01	1.01	1	1.01	1.02	1.02	1.03		
	Average = Sum(40) _{1...12} /12=												1.02	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.24

(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

87.43

(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=	96.17	92.68	89.18	85.68	82.18	78.69	78.69	82.18	85.68	89.18	92.68	96.17		
	Total = Sum(44) _{1...12} =												1049.16	(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=	142.62	124.74	128.72	112.22	107.68	92.92	86.1	98.8	99.98	116.52	127.19	138.12		
	Total = Sum(45) _{1...12} =												1375.61	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.39	18.71	19.31	16.83	16.15	13.94	12.92	14.82	15	17.48	19.08	20.72		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.75

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.75

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 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 × (41)m

(61)m=	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=	189.22	166.82	175.31	157.31	154.27	138.01	132.7	145.4	145.07	163.12	172.28	184.72	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	189.22	166.82	175.31	157.31	154.27	138.01	132.7	145.4	145.07	163.12	172.28	184.72	
Output from water heater (annual) _{1...12}												1924.23	(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=	84.7	75.14	80.07	73.39	73.08	66.97	65.9	70.13	69.32	76.02	78.36	83.2	(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=	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	112.06	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.6	15.63	12.71	9.62	7.19	6.07	6.56	8.53	11.45	14.54	16.97	18.09	(67)
--------	------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	196.83	198.87	193.73	182.77	168.94	155.94	147.25	145.21	150.36	161.31	175.15	188.15	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	34.21	(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=	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	-89.65	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	113.84	111.82	107.63	101.93	98.22	93.01	88.58	94.26	96.27	102.18	108.84	111.83	(72)
--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	--------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	387.89	385.95	373.68	353.94	333.97	314.64	302.02	307.62	317.7	337.65	360.57	377.68	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest _{0.9x}	0.77	x	5.46	x	36.79		0.63	x	0.7	=	61.4	(79)
Southwest _{0.9x}	0.77	x	3.15	x	36.79		0.63	x	0.7	=	70.84	(79)
Southwest _{0.9x}	0.77	x	5.46	x	62.67		0.63	x	0.7	=	104.58	(79)
Southwest _{0.9x}	0.77	x	3.15	x	62.67		0.63	x	0.7	=	120.67	(79)
Southwest _{0.9x}	0.77	x	5.46	x	85.75		0.63	x	0.7	=	143.09	(79)

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Southwest	0.9x	0.77	x	3.15	x	85.75	0.63	x	0.7	=	165.1	(79)
Southwest	0.9x	0.77	x	5.46	x	106.25	0.63	x	0.7	=	177.3	(79)
Southwest	0.9x	0.77	x	3.15	x	106.25	0.63	x	0.7	=	204.57	(79)
Southwest	0.9x	0.77	x	5.46	x	119.01	0.63	x	0.7	=	198.59	(79)
Southwest	0.9x	0.77	x	3.15	x	119.01	0.63	x	0.7	=	229.14	(79)
Southwest	0.9x	0.77	x	5.46	x	118.15	0.63	x	0.7	=	197.15	(79)
Southwest	0.9x	0.77	x	3.15	x	118.15	0.63	x	0.7	=	227.48	(79)
Southwest	0.9x	0.77	x	5.46	x	113.91	0.63	x	0.7	=	190.07	(79)
Southwest	0.9x	0.77	x	3.15	x	113.91	0.63	x	0.7	=	219.32	(79)
Southwest	0.9x	0.77	x	5.46	x	104.39	0.63	x	0.7	=	174.19	(79)
Southwest	0.9x	0.77	x	3.15	x	104.39	0.63	x	0.7	=	200.99	(79)
Southwest	0.9x	0.77	x	5.46	x	92.85	0.63	x	0.7	=	154.94	(79)
Southwest	0.9x	0.77	x	3.15	x	92.85	0.63	x	0.7	=	178.77	(79)
Southwest	0.9x	0.77	x	5.46	x	69.27	0.63	x	0.7	=	115.58	(79)
Southwest	0.9x	0.77	x	3.15	x	69.27	0.63	x	0.7	=	133.37	(79)
Southwest	0.9x	0.77	x	5.46	x	44.07	0.63	x	0.7	=	73.54	(79)
Southwest	0.9x	0.77	x	3.15	x	44.07	0.63	x	0.7	=	84.85	(79)
Southwest	0.9x	0.77	x	5.46	x	31.49	0.63	x	0.7	=	52.54	(79)
Southwest	0.9x	0.77	x	3.15	x	31.49	0.63	x	0.7	=	60.63	(79)
Northwest	0.9x	0.77	x	2.84	x	11.28	0.63	x	0.7	=	9.79	(81)
Northwest	0.9x	0.77	x	2.84	x	22.97	0.63	x	0.7	=	19.93	(81)
Northwest	0.9x	0.77	x	2.84	x	41.38	0.63	x	0.7	=	35.91	(81)
Northwest	0.9x	0.77	x	2.84	x	67.96	0.63	x	0.7	=	58.98	(81)
Northwest	0.9x	0.77	x	2.84	x	91.35	0.63	x	0.7	=	79.28	(81)
Northwest	0.9x	0.77	x	2.84	x	97.38	0.63	x	0.7	=	84.52	(81)
Northwest	0.9x	0.77	x	2.84	x	91.1	0.63	x	0.7	=	79.07	(81)
Northwest	0.9x	0.77	x	2.84	x	72.63	0.63	x	0.7	=	63.04	(81)
Northwest	0.9x	0.77	x	2.84	x	50.42	0.63	x	0.7	=	43.76	(81)
Northwest	0.9x	0.77	x	2.84	x	28.07	0.63	x	0.7	=	24.36	(81)
Northwest	0.9x	0.77	x	2.84	x	14.2	0.63	x	0.7	=	12.32	(81)
Northwest	0.9x	0.77	x	2.84	x	9.21	0.63	x	0.7	=	8	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 142.03 245.18 344.11 440.85 507.01 509.16 488.46 438.22 377.47 273.31 170.71 121.17 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 529.92 631.13 717.79 794.79 840.98 823.8 790.48 745.83 695.17 610.96 531.29 498.85 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	0.99	0.98	0.96	0.88	0.73	0.54	0.39	0.43	0.67	0.92	0.98	1

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 20.07 20.26 20.51 20.78 20.94 20.99 21 21 20.97 20.75 20.36 20.03 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.05	20.06	20.06	20.07	20.07	20.08	20.08	20.08	20.07	20.07	20.07	20.06	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.94	0.85	0.67	0.46	0.31	0.35	0.59	0.88	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.82	19.1	19.46	19.82	20.01	20.07	20.08	20.08	20.05	19.8	19.25	18.77	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.36 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.27	19.51	19.83	20.16	20.34	20.4	20.41	20.41	20.38	20.14	19.65	19.22	(92)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.27	19.51	19.83	20.16	20.34	20.4	20.41	20.41	20.38	20.14	19.65	19.22	(93)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.94	0.85	0.69	0.49	0.34	0.38	0.62	0.89	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	524.42	615.31	674.43	676.01	580.49	403.6	267.14	280.38	429.39	542.23	518.78	494.95	(95)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	1081.66	1053.67	959.11	801.18	613.45	407.65	267.55	281.11	443.11	677.36	894.32	1075.51	(97)
--------	---------	---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	414.59	294.58	211.8	90.13	24.52	0	0	0	0	100.54	270.38	431.93	(98)
--------	--------	--------	-------	-------	-------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1838.47 \quad (98)$$

Space heating requirement in kWh/m²/year

$$26.34 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.5 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

414.59	294.58	211.8	90.13	24.52	0	0	0	0	100.54	270.38	431.93
--------	--------	-------	-------	-------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

443.41	315.06	226.53	96.39	26.23	0	0	0	0	107.53	289.18	461.96
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 1966.28 \quad (211)$$

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)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

189.22	166.82	175.31	157.31	154.27	138.01	132.7	145.4	145.07	163.12	172.28	184.72
--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------

Efficiency of water heater

79.8 (216)

(217)m= 86.85 86.32 85.32 83.39 81.12 79.8 79.8 79.8 79.8 83.57 86.01 87.01 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

217.86	193.27	205.48	188.64	190.19	172.94	166.29	182.2	181.8	195.19	200.3	212.3
--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	-------	-------

Total = Sum(219a)_{1...12} =

2306.47 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1966.28

Water heating fuel used

2306.47

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

310.83

(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	424.72	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	498.2	(264)
Space and water heating	(261) + (262) + (263) + (264) =					922.91 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	161.32	(268)
Total CO2, kg/year	sum of (265)...(271) =					1123.16 (272)

TER =

23.36 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 2BF MID 69 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	69.2 (1a)	2.5 (2a)	173 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	69.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	173 (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				0	0 (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) =				0	0 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)					
Number of storeys in the dwelling (ns)					0 (9)
Additional infiltration					0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction					0 (11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35					
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0					0 (12)
If no draught lobby, enter 0.05, else enter 0					0 (13)
Percentage of windows and doors draught stripped					0 (14)
Window infiltration				0.25 - [0.2 x (14) ÷ 100] =	0 (15)
Infiltration rate				(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area					3.5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)					0.18 (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) =	0.15 (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
---------	------	------	------	-----	------	------	------	------	---	------	------	------

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.46	$\times 1/[1/(1.4) + 0.04] =$	7.24		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			2.84	$\times 1/[1/(1.4) + 0.04] =$	3.77		(27)
Walls	39.88	14.6	25.27	$\times 0.18 =$	4.55		(29)
Total area of elements, m²			39.88				(31)
Party wall			43.59	$\times 0 =$	0		(32)
Party floor			69.2				(32a)
Party ceiling			69.2				(32b)

* 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) = 23.91 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7232.25 (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 4.84 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 28.75 (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=	17.05	16.84	16.63	15.56	15.35	14.29	14.29	14.08	14.71	15.35	15.78	16.2

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 45.8 45.59 45.38 44.31 44.1 43.04 43.04 42.83 43.47 44.1 44.53 44.95
Average = Sum(39)_{1...12} /12= 44.26 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.66	0.66	0.66	0.64	0.64	0.62	0.62	0.62	0.63	0.64	0.64	0.65		
Average = Sum(40) _{1...12} /12=													0.64	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.23

(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

87.08

(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=	95.79	92.31	88.82	85.34	81.86	78.37	78.37	81.86	85.34	88.82	92.31	95.79		
Total = Sum(44) _{1...12} =													1044.97	(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=	142.05	124.24	128.2	111.77	107.25	92.55	85.76	98.41	99.58	116.05	126.68	137.57		
Total = Sum(45) _{1...12} =													1370.12	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.31	18.64	19.23	16.77	16.09	13.88	12.86	14.76	14.94	17.41	19	20.64		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0.54

(48)

Temperature factor from Table 2b

0.648

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.65

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(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=	162.14	142.38	148.29	131.21	127.34	111.99	105.85	118.5	119.02	136.14	146.12	157.66	(62)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	162.14	142.38	148.29	131.21	127.34	111.99	105.85	118.5	119.02	136.14	146.12	157.66	
Output from water heater (annual) _{1...12}												1606.64	(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=	47.23	41.31	42.63	37.16	35.66	30.77	28.51	32.72	33.11	38.59	42.12	45.74	(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 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.46	15.51	12.61	9.55	7.14	6.03	6.51	8.47	11.36	14.43	16.84	17.95	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	195.42	197.45	192.34	181.46	167.73	154.82	146.2	144.17	149.28	160.16	173.89	186.8	(68)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	(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=	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	63.48	61.47	57.3	51.62	47.93	42.74	38.33	43.98	45.99	51.87	58.5	61.48	(72)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	332.77	330.83	318.65	299.03	279.2	259.99	247.44	253.01	263.03	282.85	305.63	322.63	(73)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest _{0.9x}	0.77	x	5.46	x	36.79		0.63	x	0.7	=	61.4	(79)
Southwest _{0.9x}	0.77	x	3.15	x	36.79		0.63	x	0.7	=	70.84	(79)
Southwest _{0.9x}	0.77	x	5.46	x	62.67		0.63	x	0.7	=	104.58	(79)
Southwest _{0.9x}	0.77	x	3.15	x	62.67		0.63	x	0.7	=	120.67	(79)
Southwest _{0.9x}	0.77	x	5.46	x	85.75		0.63	x	0.7	=	143.09	(79)

DER WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	3.15	x	85.75	0.63	x	0.7	=	165.1	(79)
Southwest	0.9x	0.77	x	5.46	x	106.25	0.63	x	0.7	=	177.3	(79)
Southwest	0.9x	0.77	x	3.15	x	106.25	0.63	x	0.7	=	204.57	(79)
Southwest	0.9x	0.77	x	5.46	x	119.01	0.63	x	0.7	=	198.59	(79)
Southwest	0.9x	0.77	x	3.15	x	119.01	0.63	x	0.7	=	229.14	(79)
Southwest	0.9x	0.77	x	5.46	x	118.15	0.63	x	0.7	=	197.15	(79)
Southwest	0.9x	0.77	x	3.15	x	118.15	0.63	x	0.7	=	227.48	(79)
Southwest	0.9x	0.77	x	5.46	x	113.91	0.63	x	0.7	=	190.07	(79)
Southwest	0.9x	0.77	x	3.15	x	113.91	0.63	x	0.7	=	219.32	(79)
Southwest	0.9x	0.77	x	5.46	x	104.39	0.63	x	0.7	=	174.19	(79)
Southwest	0.9x	0.77	x	3.15	x	104.39	0.63	x	0.7	=	200.99	(79)
Southwest	0.9x	0.77	x	5.46	x	92.85	0.63	x	0.7	=	154.94	(79)
Southwest	0.9x	0.77	x	3.15	x	92.85	0.63	x	0.7	=	178.77	(79)
Southwest	0.9x	0.77	x	5.46	x	69.27	0.63	x	0.7	=	115.58	(79)
Southwest	0.9x	0.77	x	3.15	x	69.27	0.63	x	0.7	=	133.37	(79)
Southwest	0.9x	0.77	x	5.46	x	44.07	0.63	x	0.7	=	73.54	(79)
Southwest	0.9x	0.77	x	3.15	x	44.07	0.63	x	0.7	=	84.85	(79)
Southwest	0.9x	0.77	x	5.46	x	31.49	0.63	x	0.7	=	52.54	(79)
Southwest	0.9x	0.77	x	3.15	x	31.49	0.63	x	0.7	=	60.63	(79)
Northwest	0.9x	0.77	x	2.84	x	11.28	0.63	x	0.7	=	9.79	(81)
Northwest	0.9x	0.77	x	2.84	x	22.97	0.63	x	0.7	=	19.93	(81)
Northwest	0.9x	0.77	x	2.84	x	41.38	0.63	x	0.7	=	35.91	(81)
Northwest	0.9x	0.77	x	2.84	x	67.96	0.63	x	0.7	=	58.98	(81)
Northwest	0.9x	0.77	x	2.84	x	91.35	0.63	x	0.7	=	79.28	(81)
Northwest	0.9x	0.77	x	2.84	x	97.38	0.63	x	0.7	=	84.52	(81)
Northwest	0.9x	0.77	x	2.84	x	91.1	0.63	x	0.7	=	79.07	(81)
Northwest	0.9x	0.77	x	2.84	x	72.63	0.63	x	0.7	=	63.04	(81)
Northwest	0.9x	0.77	x	2.84	x	50.42	0.63	x	0.7	=	43.76	(81)
Northwest	0.9x	0.77	x	2.84	x	28.07	0.63	x	0.7	=	24.36	(81)
Northwest	0.9x	0.77	x	2.84	x	14.2	0.63	x	0.7	=	12.32	(81)
Northwest	0.9x	0.77	x	2.84	x	9.21	0.63	x	0.7	=	8	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 142.03 245.18 344.11 440.85 507.01 509.16 488.46 438.22 377.47 273.31 170.71 121.17 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 474.8 576.02 662.76 739.88 786.2 769.14 735.9 691.23 640.5 556.16 476.34 443.79 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	0.99	0.97	0.89	0.71	0.52	0.36	0.26	0.29	0.47	0.79	0.97	0.99

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 20.64 20.77 20.89 20.95 20.97 20.97 20.97 20.97 20.97 20.95 20.79 20.62 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.37	20.38	20.38	20.39	20.4	20.41	20.41	20.41	20.4	20.4	20.39	20.39	(88)
--------	-------	-------	-------	-------	------	-------	-------	-------	------	------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.96	0.87	0.68	0.49	0.33	0.22	0.25	0.43	0.75	0.96	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.89	20.08	20.24	20.33	20.35	20.36	20.36	20.37	20.36	20.33	20.12	19.87	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =	0.36	(91)
---------------------------	------	------

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.16	20.33	20.47	20.56	20.57	20.58	20.58	20.58	20.58	20.55	20.36	20.14	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.16	20.33	20.47	20.56	20.57	20.58	20.58	20.58	20.58	20.55	20.36	20.14	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.96	0.87	0.69	0.5	0.33	0.23	0.26	0.44	0.76	0.96	0.99	(94)
--------	------	------	------	------	-----	------	------	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	469.18	550.86	575.89	508.17	390.61	257.43	171.36	179.16	281.37	424.11	457.97	440.3	(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=	726.36	703.2	634.04	516.58	391.22	257.44	171.36	179.17	281.53	438.81	590.58	716.38	(97)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	191.34	102.37	43.26	6.06	0.46	0	0	0	0	10.93	95.48	205.4	(98)
--------	--------	--------	-------	------	------	---	---	---	---	-------	-------	-------	------

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	655.3	(98)
---	-------	------

Space heating requirement in kWh/m²/year

9.47	(99)
------	------

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

140.79	(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)

191.34	102.37	43.26	6.06	0.46	0	0	0	0	10.93	95.48	205.4
--------	--------	-------	------	------	---	---	---	---	-------	-------	-------

(211)m = {[(98)m x (204)] } x 100 ÷ (206)	(211)
---	-------

135.9	72.71	30.73	4.3	0.33	0	0	0	0	7.77	67.81	145.89
-------	-------	-------	-----	------	---	---	---	---	------	-------	--------

Total (kWh/year) = Sum(211) _{1...5,10...12} =	465.43	(211)
--	--------	-------

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

Total (kWh/year) = Sum(215) _{1...5,10...12} =	0	(215)
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DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

162.14	142.38	148.29	131.21	127.34	111.99	105.85	118.5	119.02	136.14	146.12	157.66
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

Efficiency of water heater

311.7 (216)

(217)m= 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

52.02	45.68	47.58	42.1	40.85	35.93	33.96	38.02	38.19	43.68	46.88	50.58
-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------

Total = Sum(219a)_{1..12} =

515.45 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

465.43

Water heating fuel used

515.45

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

147.74

(230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

147.74

(231)

Electricity for lighting

308.42

(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519 =	241.56 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.519 =	267.52 (264)
Space and water heating	(261) + (262) + (263) + (264) =		509.08 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	76.68 (267)
Electricity for lighting	(232) x	0.519 =	160.07 (268)
Total CO2, kg/year		sum of (265)...(271) =	745.83 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	10.78 (273)
El rating (section 14)			91 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 2BF MID 69 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	69.2 (1a)	2.5 (2a)	173 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	69.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	173 (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				2	20 (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) =	0.12 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.37 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.31 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.4	0.39	0.38	0.34	0.33	0.3	0.3	0.29	0.31	0.33	0.35	0.37
-----	------	------	------	------	-----	-----	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			5.46	$\times 1/[1/(1.4) + 0.04] =$	7.24		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			2.84	$\times 1/[1/(1.4) + 0.04] =$	3.77		(27)
Walls	39.88	14.6	25.27	x 0.18	= 4.55		(29)
Total area of elements, m²			39.88				(31)
Party wall			43.59	x 0	= 0		(32)
Party floor			69.2				(32a)
Party ceiling			69.2				(32b)

* 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) = 23.91 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7232.25 (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 3.18 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 27.08 (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=	33.03	32.85	32.68	31.88	31.73	31.03	31.03	30.9	31.3	31.73	32.03	32.35

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 60.11 59.93 59.76 58.96 58.81 58.12 58.12 57.99 58.38 58.81 59.12 59.43
Average = Sum(39)_{1...12} /12= 58.96 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.87	0.87	0.86	0.85	0.85	0.84	0.84	0.84	0.84	0.85	0.85	0.86		
	Average = Sum(40) _{1...12} /12=												0.85	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.23

(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

87.08

(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=	95.79	92.31	88.82	85.34	81.86	78.37	78.37	81.86	85.34	88.82	92.31	95.79		
	Total = Sum(44) _{1...12} =												1044.97	(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=	142.05	124.24	128.2	111.77	107.25	92.55	85.76	98.41	99.58	116.05	126.68	137.57		
	Total = Sum(45) _{1...12} =												1370.12	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.31	18.64	19.23	16.77	16.09	13.88	12.86	14.76	14.94	17.41	19	20.64		(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.75

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.75

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 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 × (41)m

(61)m=	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=	188.65	166.32	174.8	156.86	153.84	137.64	132.35	145	144.68	162.65	171.77	184.16	(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 FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	188.65	166.32	174.8	156.86	153.84	137.64	132.35	145	144.68	162.65	171.77	184.16	
Output from water heater (annual) _{1...12}												1918.73	(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=	84.51	74.98	79.9	73.24	72.94	66.85	65.79	70	69.18	75.86	78.2	83.02	(65)
--------	-------	-------	------	-------	-------	-------	-------	----	-------	-------	------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	111.33	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	17.46	15.51	12.61	9.55	7.14	6.03	6.51	8.47	11.36	14.43	16.84	17.95	(67)
--------	-------	-------	-------	------	------	------	------	------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	195.42	197.45	192.34	181.46	167.73	154.82	146.2	144.17	149.28	160.16	173.89	186.8	(68)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	34.13	(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=	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	-89.06	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	113.59	111.57	107.4	101.72	98.03	92.84	88.43	94.08	96.09	101.97	108.6	111.58	(72)
--------	--------	--------	-------	--------	-------	-------	-------	-------	-------	--------	-------	--------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	385.87	383.94	371.75	352.13	332.3	313.09	300.54	306.12	316.13	335.95	358.73	375.73	(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)	
Southwest _{0.9x}	0.77	x	5.46	x	36.79		0.63	x	0.7	=	61.4	(79)
Southwest _{0.9x}	0.77	x	3.15	x	36.79		0.63	x	0.7	=	70.84	(79)
Southwest _{0.9x}	0.77	x	5.46	x	62.67		0.63	x	0.7	=	104.58	(79)
Southwest _{0.9x}	0.77	x	3.15	x	62.67		0.63	x	0.7	=	120.67	(79)
Southwest _{0.9x}	0.77	x	5.46	x	85.75		0.63	x	0.7	=	143.09	(79)

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Southwest	0.9x	0.77	x	3.15	x	85.75	0.63	x	0.7	=	165.1	(79)
Southwest	0.9x	0.77	x	5.46	x	106.25	0.63	x	0.7	=	177.3	(79)
Southwest	0.9x	0.77	x	3.15	x	106.25	0.63	x	0.7	=	204.57	(79)
Southwest	0.9x	0.77	x	5.46	x	119.01	0.63	x	0.7	=	198.59	(79)
Southwest	0.9x	0.77	x	3.15	x	119.01	0.63	x	0.7	=	229.14	(79)
Southwest	0.9x	0.77	x	5.46	x	118.15	0.63	x	0.7	=	197.15	(79)
Southwest	0.9x	0.77	x	3.15	x	118.15	0.63	x	0.7	=	227.48	(79)
Southwest	0.9x	0.77	x	5.46	x	113.91	0.63	x	0.7	=	190.07	(79)
Southwest	0.9x	0.77	x	3.15	x	113.91	0.63	x	0.7	=	219.32	(79)
Southwest	0.9x	0.77	x	5.46	x	104.39	0.63	x	0.7	=	174.19	(79)
Southwest	0.9x	0.77	x	3.15	x	104.39	0.63	x	0.7	=	200.99	(79)
Southwest	0.9x	0.77	x	5.46	x	92.85	0.63	x	0.7	=	154.94	(79)
Southwest	0.9x	0.77	x	3.15	x	92.85	0.63	x	0.7	=	178.77	(79)
Southwest	0.9x	0.77	x	5.46	x	69.27	0.63	x	0.7	=	115.58	(79)
Southwest	0.9x	0.77	x	3.15	x	69.27	0.63	x	0.7	=	133.37	(79)
Southwest	0.9x	0.77	x	5.46	x	44.07	0.63	x	0.7	=	73.54	(79)
Southwest	0.9x	0.77	x	3.15	x	44.07	0.63	x	0.7	=	84.85	(79)
Southwest	0.9x	0.77	x	5.46	x	31.49	0.63	x	0.7	=	52.54	(79)
Southwest	0.9x	0.77	x	3.15	x	31.49	0.63	x	0.7	=	60.63	(79)
Northwest	0.9x	0.77	x	2.84	x	11.28	0.63	x	0.7	=	9.79	(81)
Northwest	0.9x	0.77	x	2.84	x	22.97	0.63	x	0.7	=	19.93	(81)
Northwest	0.9x	0.77	x	2.84	x	41.38	0.63	x	0.7	=	35.91	(81)
Northwest	0.9x	0.77	x	2.84	x	67.96	0.63	x	0.7	=	58.98	(81)
Northwest	0.9x	0.77	x	2.84	x	91.35	0.63	x	0.7	=	79.28	(81)
Northwest	0.9x	0.77	x	2.84	x	97.38	0.63	x	0.7	=	84.52	(81)
Northwest	0.9x	0.77	x	2.84	x	91.1	0.63	x	0.7	=	79.07	(81)
Northwest	0.9x	0.77	x	2.84	x	72.63	0.63	x	0.7	=	63.04	(81)
Northwest	0.9x	0.77	x	2.84	x	50.42	0.63	x	0.7	=	43.76	(81)
Northwest	0.9x	0.77	x	2.84	x	28.07	0.63	x	0.7	=	24.36	(81)
Northwest	0.9x	0.77	x	2.84	x	14.2	0.63	x	0.7	=	12.32	(81)
Northwest	0.9x	0.77	x	2.84	x	9.21	0.63	x	0.7	=	8	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 142.03 245.18 344.11 440.85 507.01 509.16 488.46 438.22 377.47 273.31 170.71 121.17 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 527.9 629.12 715.86 792.98 839.31 822.24 789 744.33 693.6 609.26 529.45 496.9 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	0.99	0.98	0.93	0.82	0.64	0.45	0.32	0.36	0.57	0.87	0.98	0.99

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 20.31 20.5 20.71 20.9 20.98 21 21 21 20.99 20.88 20.56 20.28 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.2	20.2	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.21	20.2	(88)
--------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.97	0.91	0.78	0.59	0.4	0.27	0.3	0.51	0.83	0.97	0.99	(89)
--------	------	------	------	------	------	-----	------	-----	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.29	19.55	19.85	20.11	20.19	20.22	20.22	20.22	20.21	20.09	19.66	19.24	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.36 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.66	19.89	20.17	20.4	20.48	20.5	20.5	20.5	20.49	20.37	19.99	19.62	(92)
--------	-------	-------	-------	------	-------	------	------	------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.66	19.89	20.17	20.4	20.48	20.5	20.5	20.5	20.49	20.37	19.99	19.62	(93)
--------	-------	-------	-------	------	-------	------	------	------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.91	0.79	0.6	0.42	0.29	0.32	0.53	0.84	0.97	0.99	(94)
--------	------	------	------	------	-----	------	------	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	521.22	607.94	654.3	625.71	507.42	342.2	226.66	237.76	370.13	511.32	512.69	492.29	(95)
--------	--------	--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	923.12	898.67	816.7	677.8	516.33	342.87	226.71	237.86	373.26	574.8	761.75	916.19	(97)
--------	--------	--------	-------	-------	--------	--------	--------	--------	--------	-------	--------	--------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	299.02	195.37	120.82	37.5	6.63	0	0	0	0	47.23	179.32	315.38	(98)
--------	--------	--------	--------	------	------	---	---	---	---	-------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1201.28 \quad (98)$$

Space heating requirement in kWh/m²/year

$$17.36 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$93.5 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

299.02	195.37	120.82	37.5	6.63	0	0	0	0	47.23	179.32	315.38
--------	--------	--------	------	------	---	---	---	---	-------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

319.81	208.96	129.22	40.11	7.09	0	0	0	0	50.52	191.79	337.31
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 1284.79 \quad (211)$$

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)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

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Water heating

Output from water heater (calculated above)

188.65	166.32	174.8	156.86	153.84	137.64	132.35	145	144.68	162.65	171.77	184.16
--------	--------	-------	--------	--------	--------	--------	-----	--------	--------	--------	--------

Efficiency of water heater

79.8 (216)

(217)m= 86.04 85.24 83.85 81.66 80.19 79.8 79.8 79.8 79.8 81.98 84.93 86.24 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

219.26	195.12	208.46	192.09	191.84	172.48	165.86	181.71	181.3	198.4	202.26	213.56
--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	--------

Total = Sum(219a)_{1...12} =

2322.32 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1284.79

Water heating fuel used

2322.32

Electricity for pumps, fans and electric keep-hot

central heating pump:

30

(230c)

boiler with a fan-assisted flue

45

(230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75

(231)

Electricity for lighting

308.42

(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	277.52	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	501.62	(264)
Space and water heating	(261) + (262) + (263) + (264) =					779.14 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	160.07	(268)
Total CO2, kg/year	sum of (265)...(271) =					978.13 (272)

TER =

20.33 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 2BF TOP 66 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	66 (1a)	2.5 (2a)	165 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	165 (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				0	0 (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) =	0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.18 (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) = 0.15 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.62	$\times 1/[1/(1.4) + 0.04] =$	8.78		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	41.17	12.92	28.25	$\times$ 0.18	5.09		(29)
Roof	66	0	66	$\times$ 0.15	9.9		(30)
Total area of elements, m²			107.17				(31)
Party wall			41.03	$\times$ 0	0		(32)
Party floor			66				(32a)

* 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) = 32.11 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5749.8 (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 9.43 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 41.54 (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=	16.26	16.06	15.86	14.84	14.64	13.63	13.63	13.43	14.03	14.64	15.05	15.45

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	57.81	57.6	57.4	56.39	56.19	55.17	55.17	54.97	55.58	56.19	56.59	57
Average = Sum(39) _{1...12} /12=												56.34 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.88	0.87	0.87	0.85	0.85	0.84	0.84	0.83	0.84	0.85	0.86	0.86		
	Average = Sum(40) _{1...12} /12=												0.85	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.15

(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

85.15

(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=	93.66	90.26	86.85	83.45	80.04	76.63	76.63	80.04	83.45	86.85	90.26	93.66		
	Total = Sum(44) _{1...12} =												1021.79	(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=	138.9	121.48	125.36	109.29	104.87	90.49	83.86	96.23	97.38	113.48	123.87	134.52		
	Total = Sum(45) _{1...12} =												1339.73	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.84	18.22	18.8	16.39	15.73	13.57	12.58	14.43	14.61	17.02	18.58	20.18		(46)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0.54

(48)

Temperature factor from Table 2b

0.648

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.65

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	158.99	139.63	145.45	128.73	124.96	109.93	103.94	116.31	116.82	133.57	143.31	154.61	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	158.99	139.63	145.45	128.73	124.96	109.93	103.94	116.31	116.82	133.57	143.31	154.61	
Output from water heater (annual) _{1...12}												1576.25	(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=	46.18	40.39	41.68	36.34	34.87	30.09	27.88	32	32.38	37.73	41.19	44.73	(65)
--------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	16.9	15.01	12.21	9.24	6.91	5.83	6.3	8.19	10.99	13.96	16.29	17.37	(67)
--------	------	-------	-------	------	------	------	-----	------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	187.79	189.74	184.83	174.37	161.18	148.77	140.49	138.54	143.45	153.9	167.1	179.5	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	-------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	(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=	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	62.08	60.11	56.02	50.47	46.87	41.79	37.48	43	44.97	50.72	57.21	60.12	(72)
--------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	321.94	320.03	308.24	289.26	270.13	251.57	239.44	244.91	254.59	273.76	295.78	312.17	(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)	
Northeast 0.9x	0.77	x	6.62	x	11.28	x	0.63	x	0.7	=	22.83	(75)
Northeast 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast 0.9x	0.77	x	6.62	x	22.97	x	0.63	x	0.7	=	46.47	(75)
Northeast 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast 0.9x	0.77	x	6.62	x	41.38	x	0.63	x	0.7	=	83.72	(75)

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Northeast 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast 0.9x	0.77	x	6.62	x	67.96	x	0.63	x	0.7	=	137.49	(75)
Northeast 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast 0.9x	0.77	x	6.62	x	91.35	x	0.63	x	0.7	=	184.81	(75)
Northeast 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast 0.9x	0.77	x	6.62	x	97.38	x	0.63	x	0.7	=	197.02	(75)
Northeast 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast 0.9x	0.77	x	6.62	x	91.1	x	0.63	x	0.7	=	184.31	(75)
Northeast 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast 0.9x	0.77	x	6.62	x	72.63	x	0.63	x	0.7	=	146.94	(75)
Northeast 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast 0.9x	0.77	x	6.62	x	50.42	x	0.63	x	0.7	=	102.01	(75)
Northeast 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast 0.9x	0.77	x	6.62	x	28.07	x	0.63	x	0.7	=	56.78	(75)
Northeast 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast 0.9x	0.77	x	6.62	x	14.2	x	0.63	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast 0.9x	0.77	x	6.62	x	9.21	x	0.63	x	0.7	=	18.64	(75)
Northeast 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	44.55	90.68	163.38	268.32	360.68	384.52	359.71	286.77	199.09	110.82	56.06	36.38	(83)
--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	366.49	410.72	471.62	557.59	630.81	636.1	599.16	531.68	453.68	384.58	351.83	348.55	(84)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.94	0.77	0.55	0.4	0.47	0.78	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.29	20.37	20.55	20.77	20.92	20.95	20.96	20.96	20.93	20.72	20.46	20.27	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.19	20.19	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.2	20.2	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.98	0.92	0.72	0.49	0.33	0.39	0.72	0.96	1	1	(89)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.22	19.35	19.6	19.93	20.11	20.16	20.16	20.16	20.13	19.87	19.5	19.21	(90)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

fLA = Living area ÷ (4) =

0.38 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.62	19.74	19.96	20.25	20.42	20.46	20.46	20.46	20.43	20.19	19.86	19.61	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.62	19.74	19.96	20.25	20.42	20.46	20.46	20.46	20.43	20.19	19.86	19.61	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	1	0.99	0.98	0.92	0.74	0.51	0.36	0.42	0.74	0.96	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	365.65	408.61	463.29	511.35	464.42	321.42	212.98	222.98	334.13	370.93	350.01	347.96	(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, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	885.63	854.76	772.52	640.17	489.74	323.34	213.14	223.42	351.94	538.92	722.18	878.33	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	386.86	299.81	230.07	92.75	18.84	0	0	0	0	124.99	267.96	394.59	
Total per year (kWh/year) = Sum(98) _{1..5,9..12} =												1815.86	(98)

Space heating requirement in $kWh/m^2/year$

27.51	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

171.07	(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)

386.86	299.81	230.07	92.75	18.84	0	0	0	0	124.99	267.96	394.59
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206)$$

226.15	175.26	134.49	54.22	11.01	0	0	0	0	73.06	156.64	230.67
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} =$$

1061.49	(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		
Total (kWh/year) = Sum(215) _{1..5,10..12} =												0	(215)

Water heating

Output from water heater (calculated above)

158.99	139.63	145.45	128.73	124.96	109.93	103.94	116.31	116.82	133.57	143.31	154.61
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

311.7	(216)
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(217)m=	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7	311.7		(217)
---------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	51.01	44.8	46.66	41.3	40.09	35.27	33.35	37.32	37.48	42.85	45.98	49.6	
Total = Sum(219a) _{1..12} =												505.7	(219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year	
1061.49	

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Water heating fuel used		505.7	
Electricity for pumps, fans and electric keep-hot mechanical ventilation - balanced, extract or positive input from outside		140.91	(230a)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	140.91	(231)
Electricity for lighting		298.45	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	550.92	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	262.46	(264)
Space and water heating	(261) + (262) + (263) + (264) =			813.38	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	73.13	(267)
Electricity for lighting	(232) x	0.519	=	154.9	(268)
Total CO2, kg/year			sum of (265)...(271) =	1041.4	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	15.78	(273)
El rating (section 14)				87	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 2BF TOP 66 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	66 (1a)	2.5 (2a)	165 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	165 (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				2	20 (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) =	0.12 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0 (9)
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Additional infiltration	0 (10)
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Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0 (11)
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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)
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If no draught lobby, enter 0.05, else enter 0	0 (13)
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Percentage of windows and doors draught stripped	0 (14)
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Window infiltration	0 (15)
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Infiltration rate	0 (16)
-------------------	--------

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
---	--------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.37 (18)
--	-----------

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered	2 (19)
---------------------------	--------

Shelter factor	0.85 (20)
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Infiltration rate incorporating shelter factor	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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.4	0.39	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.35	0.37
-----	------	------	------	------	-----	-----	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.62	$\times 1/[1/(1.4) + 0.04] =$	8.78		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Walls	41.17	12.92	28.25	$\times$ 0.18	5.09		(29)
Roof	66	0	66	$\times$ 0.13	8.58		(30)
Total area of elements, m²			107.17				(31)
Party wall			41.03	$\times$ 0	0		(32)
Party floor			66				(32a)

* 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) = 30.79 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5749.8 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.98 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 36.78 (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=	31.63	31.46	31.29	30.5	30.36	29.67	29.67	29.54	29.94	30.36	30.66	30.97

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	68.41	68.24	68.07	67.28	67.14	66.45	66.45	66.32	66.71	67.14	67.43	67.75
Average = Sum(39) _{1...12} /12=												67.28 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.04	1.03	1.03	1.02	1.02	1.01	1.01	1	1.01	1.02	1.02	1.03		
Average = Sum(40) _{1...12} /12=													1.02	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.15

(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

85.15

(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=	93.66	90.26	86.85	83.45	80.04	76.63	76.63	80.04	83.45	86.85	90.26	93.66		
Total = Sum(44) _{1...12} =													1021.79	(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=	138.9	121.48	125.36	109.29	104.87	90.49	83.86	96.23	97.38	113.48	123.87	134.52		
Total = Sum(45) _{1...12} =													1339.73	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.84	18.22	18.8	16.39	15.73	13.57	12.58	14.43	14.61	17.02	18.58	20.18		(46)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.75

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.75

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 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 × (41)m

(61)m=	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=	185.5	163.57	171.96	154.38	151.46	135.59	130.45	142.82	142.47	160.08	168.97	181.11	(62)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	185.5	163.57	171.96	154.38	151.46	135.59	130.45	142.82	142.47	160.08	168.97	181.11	
Output from water heater (annual) _{1...12}												1888.35	(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=	83.46	74.06	78.96	72.41	72.14	66.16	65.16	69.27	68.45	75.01	77.26	82	(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=	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	107.26	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	16.9	15.01	12.21	9.24	6.91	5.83	6.3	8.19	10.99	13.96	16.29	17.37	(67)
--------	------	-------	-------	------	------	------	-----	------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	187.79	189.74	184.83	174.37	161.18	148.77	140.49	138.54	143.45	153.9	167.1	179.5	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	-------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	33.73	(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=	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	-85.81	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	112.18	110.21	106.13	100.57	96.97	91.89	87.58	93.11	95.07	100.82	107.31	110.22	(72)
--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	--------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	375.04	373.14	361.34	342.37	323.23	304.68	292.55	298.01	307.69	326.86	348.88	365.27	(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)	
Northeast 0.9x	0.77	x	6.62	x	11.28	x	0.63	x	0.7	=	22.83	(75)
Northeast 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast 0.9x	0.77	x	6.62	x	22.97	x	0.63	x	0.7	=	46.47	(75)
Northeast 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast 0.9x	0.77	x	6.62	x	41.38	x	0.63	x	0.7	=	83.72	(75)

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Northeast 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast 0.9x	0.77	x	6.62	x	67.96	x	0.63	x	0.7	=	137.49	(75)
Northeast 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast 0.9x	0.77	x	6.62	x	91.35	x	0.63	x	0.7	=	184.81	(75)
Northeast 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast 0.9x	0.77	x	6.62	x	97.38	x	0.63	x	0.7	=	197.02	(75)
Northeast 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast 0.9x	0.77	x	6.62	x	91.1	x	0.63	x	0.7	=	184.31	(75)
Northeast 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast 0.9x	0.77	x	6.62	x	72.63	x	0.63	x	0.7	=	146.94	(75)
Northeast 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast 0.9x	0.77	x	6.62	x	50.42	x	0.63	x	0.7	=	102.01	(75)
Northeast 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast 0.9x	0.77	x	6.62	x	28.07	x	0.63	x	0.7	=	56.78	(75)
Northeast 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast 0.9x	0.77	x	6.62	x	14.2	x	0.63	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast 0.9x	0.77	x	6.62	x	9.21	x	0.63	x	0.7	=	18.64	(75)
Northeast 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	44.55	90.68	163.38	268.32	360.68	384.52	359.71	286.77	199.09	110.82	56.06	36.38	(83)
--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	419.6	463.82	524.72	610.69	683.91	689.2	652.26	584.78	506.78	437.68	404.94	401.65	(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	0.94	0.81	0.6	0.45	0.52	0.8	0.97	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.95	20.07	20.32	20.65	20.89	20.98	21	20.99	20.92	20.6	20.22	19.93	(87)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.05	20.06	20.06	20.07	20.07	20.08	20.08	20.08	20.07	20.07	20.07	20.06	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.92	0.75	0.52	0.35	0.42	0.73	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=	18.65	18.83	19.19	19.66	19.97	20.07	20.08	20.08	20.01	19.61	19.06	18.62	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.38

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.14	19.3	19.61	20.04	20.32	20.41	20.43	20.42	20.36	19.98	19.5	19.12	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.14	19.3	19.61	20.04	20.32	20.41	20.43	20.42	20.36	19.98	19.5	19.12	(93)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	1	0.99	0.98	0.92	0.77	0.55	0.39	0.45	0.76	0.96	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	417.62	459.79	512.64	561.39	525.75	379.56	253.41	265.12	382.91	418.19	401.11	400.15	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	1015.3	982.89	892.74	749.32	578.7	386.36	254.2	266.92	417.54	629.94	836.05	1010.62	(97)
--------	--------	--------	--------	--------	-------	--------	-------	--------	--------	--------	--------	---------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	444.67	351.53	282.8	135.31	39.39	0	0	0	0	157.54	313.15	454.19	
Total per year ($kWh/year$) = $Sum(98)_{1..5,9..12} =$												2178.57	(98)

Space heating requirement in $kWh/m^2/year$

33.01	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
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Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

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)

444.67	351.53	282.8	135.31	39.39	0	0	0	0	157.54	313.15	454.19
--------	--------	-------	--------	-------	---	---	---	---	--------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$

475.59	375.97	302.46	144.71	42.13	0	0	0	0	168.49	334.92	485.76
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$Total (kWh/year) = Sum(211)_{1..5,10..12} =$$

2330.03	(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		
Total ($kWh/year$) = $Sum(215)_{1..5,10..12} =$												0	(215)

Water heating

Output from water heater (calculated above)

185.5	163.57	171.96	154.38	151.46	135.59	130.45	142.82	142.47	160.08	168.97	181.11
-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

79.8	(216)
------	-------

(217)m=	87.06	86.8	86.13	84.46	81.8	79.8	79.8	79.8	79.8	84.77	86.44	87.17	(217)
---------	-------	------	-------	-------	------	------	------	------	------	-------	-------	-------	-------

Fuel for water heating, $kWh/month$

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	213.06	188.44	199.64	182.78	185.17	169.91	163.47	178.97	178.53	188.83	195.48	207.78	
Total = $Sum(219a)_{1..12} =$												2252.06	(219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

2330.03

TER WorkSheet: New dwelling design stage

Water heating fuel used		2252.06	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		298.45	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x		0.216	=	503.29	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	486.44	(264)
Space and water heating	(261) + (262) + (263) + (264) =				989.73	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	154.9	(268)
Total CO2, kg/year	sum of (265)...(271) =				1183.55	(272)

TER =

26.18 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 3BF GND 91 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	90.5 (1a) x	2.5 (2a) =	226.25 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.5 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	226.25 (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				0 x 10 =	0 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) = 0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.18 (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) = 0.15 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.62	$\times 1/[1/(1.4) + 0.04] =$	8.78		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			1.58	$\times 1/[1/(1.4) + 0.04] =$	2.09		(27)
Floor			90.5	$\times$ 0.13	= 11.765		(28)
Walls	49.66	16.08	33.58	$\times$ 0.18	= 6.04		(29)
Total area of elements, m²			140.16				(31)
Party wall			47.23	$\times$ 0	= 0		(32)
Party ceiling			90.5				(32b)

* 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) = 39.13 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 12462.08 (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 10.38 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 49.5 (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=	22.3	22.02	21.74	20.35	20.08	18.69	18.69	18.41	19.24	20.08	20.63	21.19

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 71.8 71.53 71.25 69.86 69.58 68.19 68.19 67.92 68.75 69.58 70.14 70.69
Average = Sum(39)_{1...12} /12= 69.79 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.79	0.79	0.79	0.77	0.77	0.75	0.75	0.75	0.76	0.77	0.77	0.78		
	Average = Sum(40) _{1...12} /12=												0.77	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.63

(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

96.72

(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=	106.39	102.53	98.66	94.79	90.92	87.05	87.05	90.92	94.79	98.66	102.53	106.39		
	Total = Sum(44) _{1...12} =												1160.66	(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=	157.78	137.99	142.4	124.15	119.12	102.79	95.25	109.3	110.61	128.9	140.71	152.8		
	Total = Sum(45) _{1...12} =												1521.81	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.67	20.7	21.36	18.62	17.87	15.42	14.29	16.4	16.59	19.34	21.11	22.92		(46)
--------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0.54

(48)

Temperature factor from Table 2b

0.648

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.65

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(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=	177.87	156.14	162.49	143.59	139.21	122.23	115.34	129.39	130.05	148.99	160.15	172.89	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	177.87	156.14	162.49	143.59	139.21	122.23	115.34	129.39	130.05	148.99	160.15	172.89	
Output from water heater (annual) _{1...12}												1758.33	(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=	52.46	45.88	47.35	41.28	39.61	34.18	31.67	36.34	36.78	42.86	46.79	50.81	(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=	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.9	19.45	15.82	11.98	8.95	7.56	8.17	10.61	14.25	18.09	21.11	22.51	(67)
--------	------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	239.99	242.48	236.21	222.85	205.98	190.13	179.54	177.05	183.33	196.69	213.55	229.41	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	(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=	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	70.51	68.28	63.64	57.33	53.24	47.47	42.57	48.85	51.08	57.61	64.98	68.29	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	394.89	392.7	378.15	354.64	330.66	307.65	292.77	299	311.14	334.88	362.14	382.69	(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)	
Northeast 0.9x	0.77	x	6.62	x	11.28	x	0.63	x	0.7	=	22.83	(75)
Northeast 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast 0.9x	0.77	x	6.62	x	22.97	x	0.63	x	0.7	=	46.47	(75)
Northeast 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast 0.9x	0.77	x	6.62	x	41.38	x	0.63	x	0.7	=	83.72	(75)

DER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast 0.9x	0.77	x	6.62	x	67.96	x	0.63	x	0.7	=	137.49	(75)
Northeast 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast 0.9x	0.77	x	6.62	x	91.35	x	0.63	x	0.7	=	184.81	(75)
Northeast 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast 0.9x	0.77	x	6.62	x	97.38	x	0.63	x	0.7	=	197.02	(75)
Northeast 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast 0.9x	0.77	x	6.62	x	91.1	x	0.63	x	0.7	=	184.31	(75)
Northeast 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast 0.9x	0.77	x	6.62	x	72.63	x	0.63	x	0.7	=	146.94	(75)
Northeast 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast 0.9x	0.77	x	6.62	x	50.42	x	0.63	x	0.7	=	102.01	(75)
Northeast 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast 0.9x	0.77	x	6.62	x	28.07	x	0.63	x	0.7	=	56.78	(75)
Northeast 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast 0.9x	0.77	x	6.62	x	14.2	x	0.63	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast 0.9x	0.77	x	6.62	x	9.21	x	0.63	x	0.7	=	18.64	(75)
Northeast 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)
Northwest 0.9x	0.77	x	1.58	x	11.28	x	0.63	x	0.7	=	10.9	(81)
Northwest 0.9x	0.77	x	1.58	x	22.97	x	0.63	x	0.7	=	22.18	(81)
Northwest 0.9x	0.77	x	1.58	x	41.38	x	0.63	x	0.7	=	39.96	(81)
Northwest 0.9x	0.77	x	1.58	x	67.96	x	0.63	x	0.7	=	65.63	(81)
Northwest 0.9x	0.77	x	1.58	x	91.35	x	0.63	x	0.7	=	88.22	(81)
Northwest 0.9x	0.77	x	1.58	x	97.38	x	0.63	x	0.7	=	94.05	(81)
Northwest 0.9x	0.77	x	1.58	x	91.1	x	0.63	x	0.7	=	87.98	(81)
Northwest 0.9x	0.77	x	1.58	x	72.63	x	0.63	x	0.7	=	70.14	(81)
Northwest 0.9x	0.77	x	1.58	x	50.42	x	0.63	x	0.7	=	48.69	(81)
Northwest 0.9x	0.77	x	1.58	x	28.07	x	0.63	x	0.7	=	27.11	(81)
Northwest 0.9x	0.77	x	1.58	x	14.2	x	0.63	x	0.7	=	13.71	(81)
Northwest 0.9x	0.77	x	1.58	x	9.21	x	0.63	x	0.7	=	8.9	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 55.45 112.86 203.35 333.95 448.9 478.57 447.69 356.91 247.78 137.93 69.77 45.28 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 450.34 505.57 581.5 688.6 779.56 786.22 740.46 655.91 558.92 472.8 431.9 427.97 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	1	0.99	0.95	0.78	0.55	0.4	0.48	0.79	0.98	1	1

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 20.34 20.42 20.58 20.8 20.93 20.96 20.96 20.96 20.94 20.74 20.5 20.33 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.26	20.26	20.26	20.28	20.28	20.29	20.29	20.3	20.29	20.28	20.28	20.27	(88)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.93	0.73	0.49	0.34	0.4	0.73	0.97	1	1	(89)
--------	---	---	------	------	------	------	------	-----	------	------	---	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.35	19.48	19.71	20.03	20.19	20.24	20.24	20.24	20.21	19.96	19.61	19.35	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =	0.28	(91)
---------------------------	------	------

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.62	19.74	19.95	20.24	20.4	20.44	20.44	20.44	20.41	20.18	19.86	19.62	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.62	19.74	19.95	20.24	20.4	20.44	20.44	20.44	20.41	20.18	19.86	19.62	(93)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.93	0.74	0.5	0.35	0.42	0.74	0.97	1	1	(94)
--------	---	---	------	------	------	-----	------	------	------	------	---	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	449.75	503.92	574.01	638.53	578.82	396.47	261.61	274.05	415.44	459.64	430.51	427.57	(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=	1100.35	1061.36	958.38	792.34	605.15	397.99	261.71	274.36	433.93	666.49	894.92	1089.92	(97)
--------	---------	---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	---------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	484.05	374.6	285.98	110.75	19.59	0	0	0	0	153.9	334.37	492.79	(98)
--------	--------	-------	--------	--------	-------	---	---	---	---	-------	--------	--------	------

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	2256.02	(98)
---	---------	------

Space heating requirement in kWh/m²/year

24.93	(99)
-------	------

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

201.7	(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)

484.05	374.6	285.98	110.75	19.59	0	0	0	0	153.9	334.37	492.79
--------	-------	--------	--------	-------	---	---	---	---	-------	--------	--------

(211)m = {[(98)m x (204)] } x 100 ÷ (206)	(211)
---	-------

239.98	185.72	141.78	54.91	9.71	0	0	0	0	76.3	165.78	244.31
--------	--------	--------	-------	------	---	---	---	---	------	--------	--------

Total (kWh/year) = Sum(211) _{1...5,10...12} =	1118.49	(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)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

Total (kWh/year) = Sum(215) _{1...5,10...12} =	0	(215)
--	---	-------

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

177.87	156.14	162.49	143.59	139.21	122.23	115.34	129.39	130.05	148.99	160.15	172.89
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

311.7 (216)

(217)m= 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

57.06	50.09	52.13	46.07	44.66	39.22	37	41.51	41.72	47.8	51.38	55.47
-------	-------	-------	-------	-------	-------	----	-------	-------	------	-------	-------

Total = Sum(219a)_{1..12} =

564.12 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1118.49

Water heating fuel used

564.12

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

193.22

(230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

193.22

(231)

Electricity for lighting

386.74

(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519 =	580.5 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.519 =	292.78 (264)
Space and water heating	(261) + (262) + (263) + (264) =		873.27 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	100.28 (267)
Electricity for lighting	(232) x	0.519 =	200.72 (268)
Total CO2, kg/year		sum of (265)...(271) =	1174.27 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	12.98 (273)
El rating (section 14)			88 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 3BF GND 91 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	90.5 (1a) x	2.5 (2a) =	226.25 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.5 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	226.25 (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) = 0.13 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.38 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.85 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.33 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.41	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.38
------	------	-----	------	------	------	------	-----	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.59 0.58 0.58 0.56 0.56 0.55 0.55 0.55 0.55 0.56 0.57 0.57 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.59 0.58 0.58 0.56 0.56 0.55 0.55 0.55 0.55 0.56 0.57 0.57 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.62	$\times 1/[1/(1.4) + 0.04] =$	8.78		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			1.58	$\times 1/[1/(1.4) + 0.04] =$	2.09		(27)
Floor			90.5	x 0.13 =	11.765		(28)
Walls	49.66	16.08	33.58	x 0.18 =	6.04		(29)
Total area of elements, m²			140.16				(31)
Party wall			47.23	x 0 =	0		(32)
Party ceiling			90.5				(32b)

* 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) = 39.13 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 12462.08 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 7.03 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 46.16 (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=	43.75	43.5	43.26	42.11	41.89	40.89	40.89	40.71	41.28	41.89	42.33	42.78

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 89.91 89.66 89.41 88.27 88.05 87.05 87.05 86.87 87.44 88.05 88.49 88.94
Average = Sum(39)_{1...12} /12= 88.27 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.99	0.99	0.99	0.98	0.97	0.96	0.96	0.96	0.97	0.97	0.98	0.98		
Average = Sum(40) _{1...12} /12=													0.98	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.63

(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

96.72

(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=	106.39	102.53	98.66	94.79	90.92	87.05	87.05	90.92	94.79	98.66	102.53	106.39		
Total = Sum(44) _{1...12} =													1160.66	(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=	157.78	137.99	142.4	124.15	119.12	102.79	95.25	109.3	110.61	128.9	140.71	152.8		
Total = Sum(45) _{1...12} =													1521.81	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.67	20.7	21.36	18.62	17.87	15.42	14.29	16.4	16.59	19.34	21.11	22.92		(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.75

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.75

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 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 × (41)m

(61)m=	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=	204.37	180.08	188.99	169.24	165.72	147.88	141.85	155.9	155.7	175.5	185.8	199.4	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	204.37	180.08	188.99	169.24	165.72	147.88	141.85	155.9	155.7	175.5	185.8	199.4	
Output from water heater (annual) _{1...12}												2070.43	(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=	89.74	79.55	84.62	77.35	76.88	70.25	68.95	73.62	72.85	80.14	82.86	88.08	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.9	19.45	15.82	11.98	8.95	7.56	8.17	10.61	14.25	18.09	21.11	22.51	(67)
--------	------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	239.99	242.48	236.21	222.85	205.98	190.13	179.54	177.05	183.33	196.69	213.55	229.41	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	(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=	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	120.62	118.38	113.74	107.43	103.34	97.57	92.67	98.95	101.18	107.71	115.08	118.39	(72)
--------	--------	--------	--------	--------	--------	-------	-------	-------	--------	--------	--------	--------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	448	445.8	431.26	407.75	383.76	360.75	345.87	352.11	364.25	387.98	415.24	435.79	(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)	
Northeast 0.9x	0.77	x	6.62	x	11.28	x	0.63	x	0.7	=	22.83	(75)
Northeast 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast 0.9x	0.77	x	6.62	x	22.97	x	0.63	x	0.7	=	46.47	(75)
Northeast 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast 0.9x	0.77	x	6.62	x	41.38	x	0.63	x	0.7	=	83.72	(75)

TER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast 0.9x	0.77	x	6.62	x	67.96	x	0.63	x	0.7	=	137.49	(75)
Northeast 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast 0.9x	0.77	x	6.62	x	91.35	x	0.63	x	0.7	=	184.81	(75)
Northeast 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast 0.9x	0.77	x	6.62	x	97.38	x	0.63	x	0.7	=	197.02	(75)
Northeast 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast 0.9x	0.77	x	6.62	x	91.1	x	0.63	x	0.7	=	184.31	(75)
Northeast 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast 0.9x	0.77	x	6.62	x	72.63	x	0.63	x	0.7	=	146.94	(75)
Northeast 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast 0.9x	0.77	x	6.62	x	50.42	x	0.63	x	0.7	=	102.01	(75)
Northeast 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast 0.9x	0.77	x	6.62	x	28.07	x	0.63	x	0.7	=	56.78	(75)
Northeast 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast 0.9x	0.77	x	6.62	x	14.2	x	0.63	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast 0.9x	0.77	x	6.62	x	9.21	x	0.63	x	0.7	=	18.64	(75)
Northeast 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)
Northwest 0.9x	0.77	x	1.58	x	11.28	x	0.63	x	0.7	=	10.9	(81)
Northwest 0.9x	0.77	x	1.58	x	22.97	x	0.63	x	0.7	=	22.18	(81)
Northwest 0.9x	0.77	x	1.58	x	41.38	x	0.63	x	0.7	=	39.96	(81)
Northwest 0.9x	0.77	x	1.58	x	67.96	x	0.63	x	0.7	=	65.63	(81)
Northwest 0.9x	0.77	x	1.58	x	91.35	x	0.63	x	0.7	=	88.22	(81)
Northwest 0.9x	0.77	x	1.58	x	97.38	x	0.63	x	0.7	=	94.05	(81)
Northwest 0.9x	0.77	x	1.58	x	91.1	x	0.63	x	0.7	=	87.98	(81)
Northwest 0.9x	0.77	x	1.58	x	72.63	x	0.63	x	0.7	=	70.14	(81)
Northwest 0.9x	0.77	x	1.58	x	50.42	x	0.63	x	0.7	=	48.69	(81)
Northwest 0.9x	0.77	x	1.58	x	28.07	x	0.63	x	0.7	=	27.11	(81)
Northwest 0.9x	0.77	x	1.58	x	14.2	x	0.63	x	0.7	=	13.71	(81)
Northwest 0.9x	0.77	x	1.58	x	9.21	x	0.63	x	0.7	=	8.9	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 55.45 112.86 203.35 333.95 448.9 478.57 447.69 356.91 247.78 137.93 69.77 45.28 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 503.44 558.67 634.6 741.7 832.66 839.32 793.56 709.01 612.03 525.91 485 481.07 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	1	0.99	0.96	0.84	0.64	0.48	0.55	0.85	0.98	1	1

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 19.93 20.05 20.29 20.62 20.88 20.98 21 20.99 20.91 20.57 20.2 19.92 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.09	20.09	20.09	20.1	20.11	20.12	20.12	20.12	20.11	20.11	20.1	20.1	(88)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------	------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.94	0.8	0.56	0.38	0.45	0.78	0.97	1	1	(89)
--------	---	---	------	------	-----	------	------	------	------	------	---	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.65	18.83	19.17	19.65	19.99	20.1	20.11	20.11	20.04	19.6	19.05	18.63	(90)
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.28 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.01	19.17	19.48	19.92	20.23	20.34	20.36	20.36	20.28	19.87	19.37	18.99	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.01	19.17	19.48	19.92	20.23	20.34	20.36	20.36	20.28	19.87	19.37	18.99	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.99	0.94	0.8	0.58	0.41	0.48	0.79	0.97	0.99	1	(94)
--------	---	------	------	------	-----	------	------	------	------	------	------	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	502.12	555.79	625.14	697.49	670.21	489.84	326.02	341.1	486.35	510.18	482.35	480.09	(95)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	1322.3	1279.24	1160.55	972.5	751.28	500.1	327.14	343.73	540.14	815.8	1085.82	1315.25	(97)
--------	--------	---------	---------	-------	--------	-------	--------	--------	--------	-------	---------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	610.22	486.15	398.35	198.01	60.31	0	0	0	0	227.38	434.49	621.35	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 3036.26 \quad (98)$$

Space heating requirement in kWh/m²/year

$$33.55 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

$$1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

$$1 \quad (204)$$

Efficiency of main space heating system 1

$$93.5 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

610.22	486.15	398.35	198.01	60.31	0	0	0	0	227.38	434.49	621.35
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

652.64	519.95	426.04	211.77	64.51	0	0	0	0	243.19	464.7	664.55
--------	--------	--------	--------	-------	---	---	---	---	--------	-------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 3247.34 \quad (211)$$

Space heating fuel (secondary), kWh/month

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

204.37	180.08	188.99	169.24	165.72	147.88	141.85	155.9	155.7	175.5	185.8	199.4
--------	--------	--------	--------	--------	--------	--------	-------	-------	-------	-------	-------

Efficiency of water heater

79.8 (216)

(217)m= 87.55 87.33 86.76 85.23 82.4 79.8 79.8 79.8 79.8 85.51 87.01 87.64 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	233.43	206.2	217.84	198.56	201.11	185.32	177.75	195.36	195.11	205.25	213.55	227.5
---------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Total = Sum(219a)_{1...12} =

2456.99 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

3247.34

Water heating fuel used

2456.99

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

386.74 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	701.43 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	530.71 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1232.13 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	200.72 (268)
Total CO2, kg/year		sum of (265)...(271) =	1471.78 (272)

TER = 23.75 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 3BF MID 91 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	90.5 (1a) x	2.5 (2a) =	226.25 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.5 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	226.25 (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				0 x 10 =	0 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) = 0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.18 (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) = 0.15 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.62	$\times 1/[1/(1.4) + 0.04] =$	8.78		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			1.58	$\times 1/[1/(1.4) + 0.04] =$	2.09		(27)
Walls	49.66	16.08	33.58	$\times 0.18 =$	6.04		(29)
Total area of elements, m²			49.66				(31)
Party wall			47.23	$\times 0 =$	0		(32)
Party floor			90.5				(32a)
Party ceiling			90.5				(32b)

* 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) = 27.36 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9294.58 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.96 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.32 (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=	22.3	22.02	21.74	20.35	20.08	18.69	18.69	18.41	19.24	20.08	20.63	21.19

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 56.62 56.34 56.06 54.68 54.4 53.01 53.01 52.73 53.56 54.4 54.95 55.51
Average = Sum(39)_{1...12} /12= 54.61 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.63	0.62	0.62	0.6	0.6	0.59	0.59	0.58	0.59	0.6	0.61	0.61		
Average = Sum(40) _{1...12} /12=													0.6	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.63

(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

96.72

(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=	106.39	102.53	98.66	94.79	90.92	87.05	87.05	90.92	94.79	98.66	102.53	106.39		
Total = Sum(44) _{1...12} =													1160.66	(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=	157.78	137.99	142.4	124.15	119.12	102.79	95.25	109.3	110.61	128.9	140.71	152.8		
Total = Sum(45) _{1...12} =													1521.81	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.67	20.7	21.36	18.62	17.87	15.42	14.29	16.4	16.59	19.34	21.11	22.92		(46)
--------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0.54

(48)

Temperature factor from Table 2b

0.648

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.65

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	20.09	18.14	20.09	19.44	20.09	19.44	20.09	20.09	19.44	20.09	19.44	20.09		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	(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=	177.87	156.14	162.49	143.59	139.21	122.23	115.34	129.39	130.05	148.99	160.15	172.89	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	177.87	156.14	162.49	143.59	139.21	122.23	115.34	129.39	130.05	148.99	160.15	172.89	
Output from water heater (annual) _{1...12}												1758.33	(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=	52.46	45.88	47.35	41.28	39.61	34.18	31.67	36.34	36.78	42.86	46.79	50.81	(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=	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.9	19.45	15.82	11.98	8.95	7.56	8.17	10.61	14.25	18.09	21.11	22.51	(67)
--------	------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	239.99	242.48	236.21	222.85	205.98	190.13	179.54	177.05	183.33	196.69	213.55	229.41	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	(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=	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	70.51	68.28	63.64	57.33	53.24	47.47	42.57	48.85	51.08	57.61	64.98	68.29	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	394.89	392.7	378.15	354.64	330.66	307.65	292.77	299	311.14	334.88	362.14	382.69	(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)	
Northeast 0.9x	0.77	x	6.62	x	11.28	x	0.63	x	0.7	=	22.83	(75)
Northeast 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast 0.9x	0.77	x	6.62	x	22.97	x	0.63	x	0.7	=	46.47	(75)
Northeast 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast 0.9x	0.77	x	6.62	x	41.38	x	0.63	x	0.7	=	83.72	(75)

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Northeast 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast 0.9x	0.77	x	6.62	x	67.96	x	0.63	x	0.7	=	137.49	(75)
Northeast 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast 0.9x	0.77	x	6.62	x	91.35	x	0.63	x	0.7	=	184.81	(75)
Northeast 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast 0.9x	0.77	x	6.62	x	97.38	x	0.63	x	0.7	=	197.02	(75)
Northeast 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast 0.9x	0.77	x	6.62	x	91.1	x	0.63	x	0.7	=	184.31	(75)
Northeast 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast 0.9x	0.77	x	6.62	x	72.63	x	0.63	x	0.7	=	146.94	(75)
Northeast 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast 0.9x	0.77	x	6.62	x	50.42	x	0.63	x	0.7	=	102.01	(75)
Northeast 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast 0.9x	0.77	x	6.62	x	28.07	x	0.63	x	0.7	=	56.78	(75)
Northeast 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast 0.9x	0.77	x	6.62	x	14.2	x	0.63	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast 0.9x	0.77	x	6.62	x	9.21	x	0.63	x	0.7	=	18.64	(75)
Northeast 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)
Northwest 0.9x	0.77	x	1.58	x	11.28	x	0.63	x	0.7	=	10.9	(81)
Northwest 0.9x	0.77	x	1.58	x	22.97	x	0.63	x	0.7	=	22.18	(81)
Northwest 0.9x	0.77	x	1.58	x	41.38	x	0.63	x	0.7	=	39.96	(81)
Northwest 0.9x	0.77	x	1.58	x	67.96	x	0.63	x	0.7	=	65.63	(81)
Northwest 0.9x	0.77	x	1.58	x	91.35	x	0.63	x	0.7	=	88.22	(81)
Northwest 0.9x	0.77	x	1.58	x	97.38	x	0.63	x	0.7	=	94.05	(81)
Northwest 0.9x	0.77	x	1.58	x	91.1	x	0.63	x	0.7	=	87.98	(81)
Northwest 0.9x	0.77	x	1.58	x	72.63	x	0.63	x	0.7	=	70.14	(81)
Northwest 0.9x	0.77	x	1.58	x	50.42	x	0.63	x	0.7	=	48.69	(81)
Northwest 0.9x	0.77	x	1.58	x	28.07	x	0.63	x	0.7	=	27.11	(81)
Northwest 0.9x	0.77	x	1.58	x	14.2	x	0.63	x	0.7	=	13.71	(81)
Northwest 0.9x	0.77	x	1.58	x	9.21	x	0.63	x	0.7	=	8.9	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 55.45 112.86 203.35 333.95 448.9 478.57 447.69 356.91 247.78 137.93 69.77 45.28 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 450.34 505.57 581.5 688.6 779.56 786.22 740.46 655.91 558.92 472.8 431.9 427.97 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	1	0.98	0.88	0.64	0.43	0.31	0.37	0.66	0.96	1	1

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 20.54 20.62 20.76 20.92 20.97 20.97 20.97 20.97 20.97 20.87 20.68 20.53 (87)

DER WorkSheet: New dwelling design stage

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.41	20.41	20.41	20.43	20.43	20.44	20.44	20.45	20.44	20.43	20.42	20.42	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.98	0.85	0.61	0.39	0.28	0.33	0.6	0.94	1	1	(89)
--------	---	---	------	------	------	------	------	------	-----	------	---	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.78	19.9	20.1	20.33	20.38	20.4	20.4	20.4	20.39	20.27	19.99	19.77	(90)
--------	-------	------	------	-------	-------	------	------	------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.28 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.99	20.1	20.28	20.49	20.54	20.56	20.56	20.56	20.55	20.44	20.18	19.98	(92)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.99	20.1	20.28	20.49	20.54	20.56	20.56	20.56	20.55	20.44	20.18	19.98	(93)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	1	0.98	0.86	0.61	0.4	0.28	0.33	0.61	0.94	1	1	(94)
--------	---	---	------	------	------	-----	------	------	------	------	---	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	449.6	503.12	567.61	589.1	478.18	315.66	209.69	219.25	343.53	445.98	429.76	427.49	(95)
--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x [(93)m - (96)m]

(97)m=	888.25	856.14	772.62	633.65	480.96	315.71	209.69	219.26	345.44	535.09	718.97	876.13	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	326.35	237.23	152.52	32.07	2.07	0	0	0	0	66.29	208.23	333.79	(98)
--------	--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 1358.57 \quad (98)$$

Space heating requirement in kWh/m²/year

$$15.01 \quad (99)$$

9a. Energy requirements – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

$$0 \quad (201)$$

Fraction of space heat from main system(s)

$$(202) = 1 - (201) = 1 \quad (202)$$

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] = 1 \quad (204)$$

Efficiency of main space heating system 1

$$166.89 \quad (206)$$

Efficiency of secondary/supplementary heating system, %

$$0 \quad (208)$$

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

kWh/year

Space heating requirement (calculated above)

326.35	237.23	152.52	32.07	2.07	0	0	0	0	66.29	208.23	333.79
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

195.55	142.14	91.39	19.22	1.24	0	0	0	0	39.72	124.77	200
--------	--------	-------	-------	------	---	---	---	---	-------	--------	-----

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 814.03 \quad (211)$$

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)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

$$\text{Total (kWh/year)} = \text{Sum}(215)_{1..5,10..12} = 0 \quad (215)$$

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

177.87	156.14	162.49	143.59	139.21	122.23	115.34	129.39	130.05	148.99	160.15	172.89
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

311.7 (216)

(217)m= 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 311.7 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

57.06	50.09	52.13	46.07	44.66	39.22	37	41.51	41.72	47.8	51.38	55.47
-------	-------	-------	-------	-------	-------	----	-------	-------	------	-------	-------

Total = Sum(219a)_{1..12} =

564.12 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

814.03

Water heating fuel used

564.12

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

193.22

(230a)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

193.22

(231)

Electricity for lighting

386.74

(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519 =	422.48 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.519 =	292.78 (264)
Space and water heating	(261) + (262) + (263) + (264) =		715.26 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	100.28 (267)
Electricity for lighting	(232) x	0.519 =	200.72 (268)
Total CO2, kg/year		sum of (265)...(271) =	1016.26 (272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	11.23 (273)
El rating (section 14)			90 (274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.26

Property Address: Hayes 3BF MID 91 ASHP

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	90.5 (1a)	2.5 (2a)	226.25 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.5 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	226.25 (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				3	30 (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) =	0.13 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0 (9)
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Additional infiltration	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)
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If no draught lobby, enter 0.05, else enter 0	0 (13)
---	--------

Percentage of windows and doors draught stripped	0 (14)
--	--------

Window infiltration	0 (15)
---------------------	--------

Infiltration rate	0 (16)
-------------------	--------

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5 (17)
---	--------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.38 (18)
--	-----------

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered	2 (19)
---------------------------	--------

Shelter factor	0.85 (20)
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Infiltration rate incorporating shelter factor	0.33 (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
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TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.41	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.38
------	------	-----	------	------	------	------	-----	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.59 0.58 0.58 0.56 0.56 0.55 0.55 0.55 0.55 0.56 0.57 0.57 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.59 0.58 0.58 0.56 0.56 0.55 0.55 0.55 0.55 0.56 0.57 0.57 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Windows Type 1			6.62	$\times 1/[1/(1.4) + 0.04] =$	8.78		(27)
Windows Type 2			3.15	$\times 1/[1/(1.4) + 0.04] =$	4.18		(27)
Windows Type 3			1.58	$\times 1/[1/(1.4) + 0.04] =$	2.09		(27)
Walls	49.66	16.08	33.58	x 0.18 =	6.04		(29)
Total area of elements, m²			49.66				(31)
Party wall			47.23	x 0 =	0		(32)
Party floor			90.5				(32a)
Party ceiling			90.5				(32b)

* 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) = 27.36 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9294.58 (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 3.73 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 31.09 (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=	43.75	43.5	43.26	42.11	41.89	40.89	40.89	40.71	41.28	41.89	42.33	42.78

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 74.84 74.59 74.35 73.2 72.99 71.99 71.99 71.8 72.37 72.99 73.42 73.88
Average = Sum(39)_{1...12} /12= 73.2 (39)

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Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.83	0.82	0.82	0.81	0.81	0.8	0.8	0.79	0.8	0.81	0.81	0.82		
Average = Sum(40) _{1...12} /12=													0.81	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.63

(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

96.72

(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=	106.39	102.53	98.66	94.79	90.92	87.05	87.05	90.92	94.79	98.66	102.53	106.39		
Total = Sum(44) _{1...12} =													1160.66	(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=	157.78	137.99	142.4	124.15	119.12	102.79	95.25	109.3	110.61	128.9	140.71	152.8		
Total = Sum(45) _{1...12} =													1521.81	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	23.67	20.7	21.36	18.62	17.87	15.42	14.29	16.4	16.59	19.34	21.11	22.92		(46)
--------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	--	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.75

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.75

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33		(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--	------

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 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 × (41)m

(61)m=	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=	204.37	180.08	188.99	169.24	165.72	147.88	141.85	155.9	155.7	175.5	185.8	199.4	(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	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	204.37	180.08	188.99	169.24	165.72	147.88	141.85	155.9	155.7	175.5	185.8	199.4	
Output from water heater (annual) _{1...12}												2070.43	(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=	89.74	79.55	84.62	77.35	76.88	70.25	68.95	73.62	72.85	80.14	82.86	88.08	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	131.63	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	21.9	19.45	15.82	11.98	8.95	7.56	8.17	10.61	14.25	18.09	21.11	22.51	(67)
--------	------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------	------

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	239.99	242.48	236.21	222.85	205.98	190.13	179.54	177.05	183.33	196.69	213.55	229.41	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	36.16	(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=	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	-105.3	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	120.62	118.38	113.74	107.43	103.34	97.57	92.67	98.95	101.18	107.71	115.08	118.39	(72)
--------	--------	--------	--------	--------	--------	-------	-------	-------	--------	--------	--------	--------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	448	445.8	431.26	407.75	383.76	360.75	345.87	352.11	364.25	387.98	415.24	435.79	(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)	
Northeast 0.9x	0.77	x	6.62	x	11.28	x	0.63	x	0.7	=	22.83	(75)
Northeast 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast 0.9x	0.77	x	6.62	x	22.97	x	0.63	x	0.7	=	46.47	(75)
Northeast 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast 0.9x	0.77	x	6.62	x	41.38	x	0.63	x	0.7	=	83.72	(75)

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Northeast 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast 0.9x	0.77	x	6.62	x	67.96	x	0.63	x	0.7	=	137.49	(75)
Northeast 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast 0.9x	0.77	x	6.62	x	91.35	x	0.63	x	0.7	=	184.81	(75)
Northeast 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast 0.9x	0.77	x	6.62	x	97.38	x	0.63	x	0.7	=	197.02	(75)
Northeast 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast 0.9x	0.77	x	6.62	x	91.1	x	0.63	x	0.7	=	184.31	(75)
Northeast 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast 0.9x	0.77	x	6.62	x	72.63	x	0.63	x	0.7	=	146.94	(75)
Northeast 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast 0.9x	0.77	x	6.62	x	50.42	x	0.63	x	0.7	=	102.01	(75)
Northeast 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast 0.9x	0.77	x	6.62	x	28.07	x	0.63	x	0.7	=	56.78	(75)
Northeast 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast 0.9x	0.77	x	6.62	x	14.2	x	0.63	x	0.7	=	28.72	(75)
Northeast 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast 0.9x	0.77	x	6.62	x	9.21	x	0.63	x	0.7	=	18.64	(75)
Northeast 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)
Northwest 0.9x	0.77	x	1.58	x	11.28	x	0.63	x	0.7	=	10.9	(81)
Northwest 0.9x	0.77	x	1.58	x	22.97	x	0.63	x	0.7	=	22.18	(81)
Northwest 0.9x	0.77	x	1.58	x	41.38	x	0.63	x	0.7	=	39.96	(81)
Northwest 0.9x	0.77	x	1.58	x	67.96	x	0.63	x	0.7	=	65.63	(81)
Northwest 0.9x	0.77	x	1.58	x	91.35	x	0.63	x	0.7	=	88.22	(81)
Northwest 0.9x	0.77	x	1.58	x	97.38	x	0.63	x	0.7	=	94.05	(81)
Northwest 0.9x	0.77	x	1.58	x	91.1	x	0.63	x	0.7	=	87.98	(81)
Northwest 0.9x	0.77	x	1.58	x	72.63	x	0.63	x	0.7	=	70.14	(81)
Northwest 0.9x	0.77	x	1.58	x	50.42	x	0.63	x	0.7	=	48.69	(81)
Northwest 0.9x	0.77	x	1.58	x	28.07	x	0.63	x	0.7	=	27.11	(81)
Northwest 0.9x	0.77	x	1.58	x	14.2	x	0.63	x	0.7	=	13.71	(81)
Northwest 0.9x	0.77	x	1.58	x	9.21	x	0.63	x	0.7	=	8.9	(81)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 55.45 112.86 203.35 333.95 448.9 478.57 447.69 356.91 247.78 137.93 69.77 45.28 (83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m= 503.44 558.67 634.6 741.7 832.66 839.32 793.56 709.01 612.03 525.91 485 481.07 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	1	0.99	0.93	0.77	0.54	0.4	0.46	0.77	0.97	1	1

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m= 20.18 20.29 20.5 20.79 20.96 21 21 21 20.97 20.73 20.41 20.16 (87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.23	20.23	20.23	20.25	20.25	20.26	20.26	20.26	20.25	20.25	20.24	20.24	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.98	0.91	0.72	0.48	0.33	0.39	0.7	0.96	1	1	(89)
--------	---	---	------	------	------	------	------	------	-----	------	---	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.12	19.28	19.59	20	20.21	20.25	20.26	20.26	20.23	19.92	19.46	19.1	(90)
--------	-------	-------	-------	----	-------	-------	-------	-------	-------	-------	-------	------	------

fLA = Living area ÷ (4) =	0.28	(91)
---------------------------	------	------

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.41	19.56	19.84	20.22	20.41	20.46	20.46	20.46	20.43	20.15	19.72	19.39	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.41	19.56	19.84	20.22	20.41	20.46	20.46	20.46	20.43	20.15	19.72	19.39	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.91	0.73	0.5	0.35	0.41	0.72	0.96	0.99	1	(94)
--------	---	------	------	------	------	-----	------	------	------	------	------	---	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	502.1	555.44	622.41	677.4	608.11	419.89	277.89	291.35	440.27	504.07	481.98	480.1	(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=	1130.8	1093.62	992.11	828.37	636.01	421.82	278.03	291.74	458.33	696.76	926.79	1122.33	(97)
--------	--------	---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	---------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	467.75	361.66	275.06	108.69	20.76	0	0	0	0	143.36	320.26	477.81	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	2175.36	(98)
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Space heating requirement in kWh/m²/year

24.04	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

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)

467.75	361.66	275.06	108.69	20.76	0	0	0	0	143.36	320.26	477.81
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

(211)m = {[(98)m x (204)] } x 100 ÷ (206)	(211)
---	-------

500.27	386.8	294.18	116.25	22.2	0	0	0	0	153.32	342.53	511.03
--------	-------	--------	--------	------	---	---	---	---	--------	--------	--------

Total (kWh/year) = Sum(211) _{1...5,10...12} =	2326.58	(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)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

Total (kWh/year) = Sum(215) _{1...5,10...12} =	0	(215)
--	---	-------

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Water heating

Output from water heater (calculated above)

204.37	180.08	188.99	169.24	165.72	147.88	141.85	155.9	155.7	175.5	185.8	199.4
--------	--------	--------	--------	--------	--------	--------	-------	-------	-------	-------	-------

Efficiency of water heater

79.8 (216)

(217)m= 86.95 86.64 85.81 83.67 80.86 79.8 79.8 79.8 79.8 84.28 86.25 87.06 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	235.04	207.85	220.24	202.27	204.93	185.32	177.75	195.36	195.11	208.23	215.41	229.03
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} =

2476.55 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2326.58

Water heating fuel used

2476.55

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

386.74 (232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.216 =	502.54 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	534.93 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1037.48 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	38.93 (267)
Electricity for lighting	(232) x	0.519 =	200.72 (268)
Total CO2, kg/year		sum of (265)...(271) =	1277.12 (272)

TER = 20.42 (273)

APPENDIX 4.0

SAP 10 Spreadsheet for 'Be Green' case

Be Green Carbon Emissions Spreadsheet (Using SAP 10 Carbon Factors)

Project Former Victoria Public House, 32 North Hyde Road, Hayes
 Client North Hyde Investments Ltd and FJC Developments Ltd
 Date Dec-21
 Rev A



	Carbon		Carbon
SAP 2012	Factor	SAP 10	Factor
Gas	0.216	Gas	0.210
Grid Elec	0.519	Grid Elec	0.233

TER Energy Demand - kWh per year

Plot	Ref	No. of Ext Walls	Orientaion	Bedrooms	Floor Area	Location	Space Htg	Water Htg	Pumps/Lighting	Emissions
1	B1-0-01	2	NE/NW	3	90.5	GND	3247	2457	462	1305.5
2	B1-0-02	2	NE	3	81.2	GND	2914	2205	414	1171.3
3	B1-0-03	2	SW	2	67.1	GND	1890	2217	371	949.0
4	B1-0-04	2	SW	2	69.8	GND	1966	2306	386	987.2
5	B2-0-01	3	NW/NE/SE	2	63.2	GND	1780	2088	349	893.8
6	B2-0-02	1	SE	1	51.7	GND	1832	2122	317	904.1
7	B2-0-03	2	SE	St	41.4	GND	1320	2025	277	766.9
8	B2-0-04	3	SW/SE	2	62.8	GND	1769	2075	347	888.2
9	B2-0-05	2	NW/SW	2	61.8	GND	1741	2042	342	874.0
10	B2-0-06	1	NW	2	73.7	GND	2076	2435	407	1042.3
11	B2-0-07	1	NW	St	39.6	GND	1262	1937	265	733.5
12	B2-0-08	2	NE/NW	2	75.9	GND	2138	2508	420	1073.4
13	B1-01-01	2	NE/NW	3	90.5	MID	2327	2477	462	1116.2
14	B1-01-02	2	NE	3	81.2	MID	2087	2222	414	1001.5
15	B1-01-03	2	SW	3	90.2	MID	2319	2468	460	1112.5
16	B1-01-04	2	SW/NW	2	69.2	MID	1285	2322	383	846.8
17	B2-01-01	3	NW/NE/SE	2	67.5	MID	1253	2265	374	826.0
18	B2-01-02	1	SE	1	51.3	MID	1234	2124	314	778.4
19	B2-01-03	1	SE	St	38.4	MID	463	1960	267	571.0
20	B2-01-04	3	SW/SE	3	88.1	MID	2265	2411	449	1086.6
21	B2-01-05	2	SW/NW	2	62.2	MID	1155	2087	345	761.2
22	B2-01-06	1	NW	2	73.7	MID	1368	2473	408	901.9
23	B2-01-07	1	NW	1	50.2	MID	1207	2079	308	761.7
24	B2-01-08	2	NE/NW	2	69.5	MID	1290	2332	385	850.5
25	B1-02-01	2	NE/NW	3	90.5	MID	2327	2477	462	1116.2
26	B1-02-02	2	NE	3	81.2	MID	2087	2222	414	1001.5
27	B1-02-03	2	SW	3	90.2	MID	2319	2468	460	1112.5
28	B1-02-04	2	SW/NW	2	69.2	MID	1285	2322	383	846.8
29	B2-02-01	3	NW/NE/SE	2	67.5	TOP	2383	2303	382	1073.1
30	B2-02-02	1	SE	1	51.3	TOP	1818	2105	314	897.1
31	B2-02-03	1	SE	St	38.4	TOP	800	1941	267	637.7
32	B2-02-04	3	SW/SE	3	88.1	MID	2265	2411	449	1086.6
33	B2-02-05	2	SW/NW	2	62.2	MID	1155	2087	345	761.2
34	B2-02-06	1	NW	2	74.4	MID	1381	2497	412	910.5
35	B2-02-07	1	NW	1	50.2	TOP	1779	2060	308	877.9
36	B2-02-08	2	NE/NW	2	70.0	TOP	2471	2389	396	1112.8
37	B1-03-01	2	NE	2	66.0	TOP	2330	2252	373	1049.3
38	B1-03-02	2	NE	2	70.4	TOP	2485	2402	398	1119.2
39	B1-03-03	2	SW	1	55.5	TOP	1967	2278	340	970.6
40	B1-03-04	2	SW	1	50.2	TOP	1779	2060	308	877.9
41	B2-03-01	3	SW	2	73.5	TOP	2595	2508	416	1168.5
					2759.5		75415	92422	15355	
							27.33	33.49	5.56	38823.4

DER Energy Demand - kWh per year based on GAS

Ref	Space Htg	Water Htg	Pumps/ Lighting	Emissions
B1-0-01	1118	564	580	527.2
B1-0-02	1004	506	520	473.0
B1-0-03	737	497	442	390.5
B1-0-04	766	517	460	406.2
B2-0-01	694	468	416	367.8
B2-0-02	1024	465	350	428.4
B2-0-03	884	435	287	374.0
B2-0-04	690	465	414	365.5
B2-0-05	679	458	407	359.7
B2-0-06	809	546	486	428.9
B2-0-07	845	416	274	357.7
B2-0-08	833	562	500	441.7
B1-01-01	814	564	580	456.2
B1-01-02	730	506	520	409.4
B1-01-03	811	562	578	454.7
B1-01-04	465	515	456	334.8
B2-01-01	454	503	445	326.6
B2-01-02	660	462	347	342.3
B2-01-03	205	412	274	207.7
B2-01-04	792	549	565	444.1
B2-01-05	418	463	410	301.0
B2-01-06	496	549	486	356.6
B2-01-07	646	452	340	335.0
B2-01-08	467	518	458	336.3
B1-02-01	814	564	580	456.2
B1-02-02	730	506	520	409.4
B1-02-03	811	562	578	454.7
B1-02-04	465	515	456	334.8
B2-02-01	1086	517	449	478.2
B2-02-02	1016	462	347	425.1
B2-02-03	512	412	274	279.2
B2-02-04	792	549	565	444.1
B2-02-05	418	463	410	301.0
B2-02-06	500	554	490	360.0
B2-02-07	994	452	340	416.0
B2-02-08	1126	536	466	495.9
B1-03-01	1061	506	439	467.5
B1-03-02	1132	539	469	498.7
B1-03-03	1099	500	376	459.9
B1-03-04	994	452	340	416.0
B2-03-01	1182	563	489	520.7
	31777	20610	18184	
	11.52	7.47	6.59	16443.1

Total Site Target Emissions - from Be Lean (based on gas) **39,505** kgCO₂ per year
 Total Site Design Emissions (Be Green) **16,443** kgCO₂ per year
 Total Reduction **23,062** kgCO₂ per year
 % Reduction **58.38%**

APPENDIX 5.0

Roof Plan showing Indicative Photovoltaic Panel Layout



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1:200
0 4 8 12m



0104 ROOF LEVEL
1:200

03	Design Freeze Issue	DV	NC	20/11/2021
01	Planning Interim Issue	DV	NC	19/11/2021
00	FOR INFORMATION	DV	NC	09/09/2021

REV	DESCRIPTION	DRAWN	CHECKED	DATE
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CREATE
DESIGN + ARCHITECTURE
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CLIENT: Curwen Group

PROJECT: The Former Victoria Pub
BUILDING: Sadow Crescent
ADDRESS: UB8 3QH

DRAWING NAME: PROPOSAL ROOF LEVEL

DRAWING SERIES: SITE PLAN

CDA REF: 000 SCALE(S): 1:200 ORIGINAL PAPER SIZE: A1

REVISION: 03 REVISION DESCRIPTION: Design Freeze Issue

PROJECT	ORGANIZATION	VOLUME	LEVEL	TYPE	ROLE	CLASS	NUMBER
637	- CDA	- XX	- 04	- DR	- A	- 01	- 0104