# NW Bicester Masterlan

Masterplan Energy Strategy



#### Hyder Consulting (UK) Limited

2212959

Manning House 22 Carlisle Place London SW1P 1JA United Kingdom

Tel: +44 (0)20 3014 9000 Fax: +44 (0)20 7828 8428 www.hyderconsulting.com



## A2Dominion

# **NW Bicester**

# Masterplan Energy Strategy

Author Umer Uzair

**Checker** Philip Harker

**Approver** Philip Harker

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#### 1 Introduction

The masterplan and related documents set out the spatial vision to provide up to 6000 new homes at NW Bicester.

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

#### The Role of this Document

This strategy is one of a number of documents prepared on behalf of A2Dominion in support of the masterplan plan. The Planning Policy Statement: Eco-Towns A Supplement to Planning Policy Statement 1 (July 2009) requires the preparation and submission of a master plan to demonstrate the eco town standards, as set out in the PPS1 supplement, will be addressed.

The master plan will therefore provide the context for the formulation and preparation of subsequent planning applications. It is open to the Council to adopt the master plan for development control purposes.

The purpose of the Energy Strategy is to sets out the overarching energy strategy for the NW Bicester Masterplan. It demonstrates how the development will achieve true zero carbon as defined in the PPS1 Eco town supplement.

Arriving at the final energy strategy for NW Bicester has involved an iterative process of development and testing of proposals, discussions with Local Authority officers and consultation with wider stakeholders. The details of the strategy will continue to be confirmed as planning applications are prepared and submitted. This document represents a summary of the overarching strategy to aid understanding and consideration of the Masterplan.

# 2 Development Overview

#### 2.1.1 Background and Context

In July 2009, the Department for Communities and Local Government published 'Planning Policy Statement (PPS): eco-towns' as a supplement to PPS1 Delivering Sustainable Development. The PPS1 supplement includes requirements on sustainability, waste reduction, zero carbon buildings and sustainable public transport.

Within the PPS1 supplement, eco-towns are defined as sustainable developments of at least 5,000 homes. In July 2009, four 'first wave' locations were identified with the potential to be an Eco-town; one of which was NW Bicester.

The Eco-towns PPS outlines the Government's objectives for planning that are set out in PPS1:

1. "To promote sustainable development by:

ensuring that eco-towns achieve sustainability standards significantly above equivalent levels of development in existing towns and cities by setting out a range of challenging and stretching minimum standards for their development, in particular by:

providing a good quantity of green space of the highest quality in close proximity to the natural environment offering opportunities for space within and around the dwellings promoting healthy and sustainable environments through 'Active Design' principles and healthy living choices enabling opportunities for infrastructure that make best use of technologies in energy generation and conservation in ways that are not always practical or economic in other developments delivering a locally appropriate mix of housing type and tenure to meet the needs of all income groups and household size, and taking advantage of significant economies of scale and increases in land value to deliver new technology and infrastructure such as for transport, energy and community facilities.

2. To reduce the carbon footprint of development by:

ensuring that households and individuals in eco-towns are able to reduce their carbon footprint to a low level and achieve a more sustainable way of living."

The National Planning Policy Framework (NPPF) published on 27 March 2012 replaced all the previous Planning Policy Statements, however, the eco towns supplement to PPS1 is still in existence.

The NW Bicester development lies within the jurisdiction of Cherwell District Council (CDC), and the Masterplan for the site is being progressed by A2 Dominion. Cherwell District Council granted planning permission for the Exemplar Phase of NWB for 393 new homes, local facilities and land for a primary school in 2012. This Energy Strategy is in relation to the proposed entire NW Bicester development.

## 2.2 Description of the Masterplan

#### **Development Context**

The town of Bicester lies approximately 24km to the north-east of Oxford, and 28km to the southeast of Banbury. The M40 runs approximately 2km to the southwest, with Junction 9 providing access to the town via the A41.

The Site lies to the north-west of Bicester, approximately 1.5km from the town centre, and comprises an area of approximately 400 ha. The villages of Bucknell and Caversfield are located to the north and east of the site respectively.

Figure 2-1 illustrates the site boundary for the Masterplan and framework of the proposed development. This site lies wholly within the area identified by CDC for the NW Bicester Eco development. The Masterplan Site boundary runs alongside the B4030, A4095 and B4100, and lies within the parish of Caversfield.

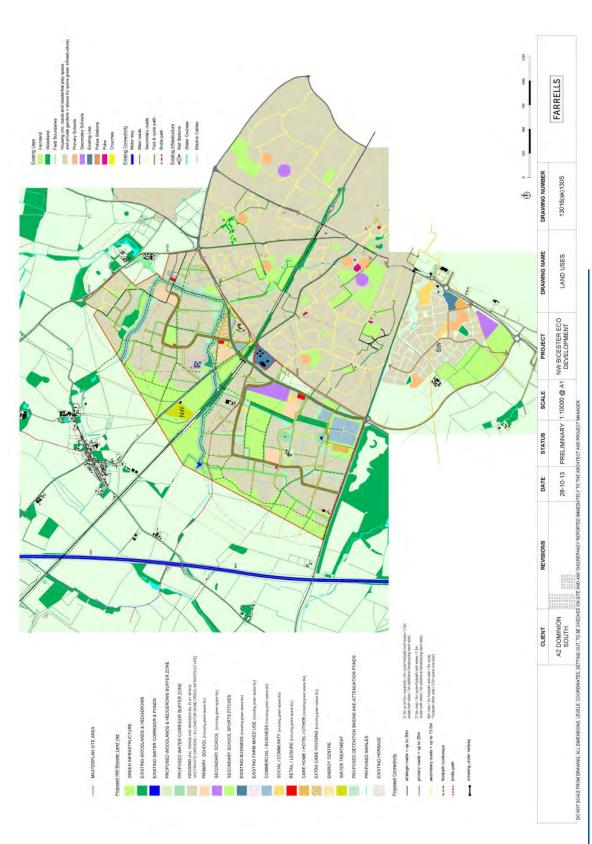
#### The Masterplan Site

NW Bicester is being promoted as a site for up to 6,000 new homes, after previously being identified as an Eco-town location within the Planning Policy Statement (PPS) 1 supplement entitled Eco-Towns A Supplement to Planning Policy Statement 1 (July 2009) (PPS 1 Supplement). In addition, the development proposal includes non-residential areas comprising commercial floorspace, leisure facilities and social and community facilities including office, industry, warehousing, retail, care, and hospitality and community spaces.

Forty percent of the total area of land at NW Bicester is to be allocated to green space of which half should be public spaces. A network of well-managed high quality green/open spaces which are linked to the wider countryside will be provided. Green spaces will be multifunctional: accessible for play and recreation, walking or cycling and supporting wildlife, urban cooling and flood management.

The Masterplan framework layout is shown on Figure 2-1 below.

Figure 2-1 Masterplan Framework



# 3 Planning Policy and Project Requirements

# 3.1 Introduction

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

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

This section sets out the difference between the zero carbon homes standard that the Government is developing as a minimum standard for all new homes and the true zero carbon standard set out in the PPS1 on Eco Towns that is being adopted for NW Bicester.

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

The Government is committed to ensure that as a minimum standard for the building industry, all new domestic buildings should be zero carbon (defined as regulated energy only) compliant by 2016 and, similarly, that all new non-domestic buildings should be zero carbon from 2019. This effectively means that the Government's zero carbon standards should be in place and apply to all new homes by the time any construction of NW Bicester homes begin. The Government's commitment to achieving zero carbon is based on the following hierarchical approach to achieving zero carbon targets:

- Ensure energy efficiency by energy efficient building design and fabric efficiency (expressed in terms of energy demand (kWh/m2/year)
- Reduce carbon emissions through on-site low carbon and renewable energy technologies and near-site heat networks; referred to as on-site carbon compliance (expressed as kgCO<sub>2</sub>/m<sup>2</sup>/year).

 Reduce the remaining carbon emissions to zero; through further low carbon and renewable energy technologies and/or the use of allowable solutions.

However, NW Bicester remains listed in the PPS1 Eco town planning document, which remains current, and sets a unique precedent for this development.

# 3.2 National Planning and Policy Requirements

#### 3.2.1 The Climate Change Act (2008)

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

In Budget 2009 the first three carbon budgets were announced which set out a binding 34% CO2 reduction by 2020 and the Government has now proposed that the fourth carbon budget will be a 50% CO2 reduction by 2025. The CCC also produces annual reports to monitor progress in meeting these carbon budgets. As a result of the Climate Change Act, a raft of policy at national and local level has been developed aimed at reducing carbon emissions.

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

### 3.2.2 UK Low Carbon Transition Plan (2009)

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

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

#### 3.2.3 National Planning Policy Framework

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

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

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

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

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

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

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

# 3.3 Planning Policy Statement 1 Eco town supplement

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

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

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

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

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

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

- (a) emissions associated with the use of locally produced energy
- (b) emissions associated with production of energy imported from centralised energy networks, taking account of the carbon intensity of those imports as set out in the Government's Standard Assessment Procedure, and
- (c) emissions displaced by exports of locally produced energy to centralised energy networks where that energy is produced from a plant (1) whose primary purpose is to support the needs of the eco

town and (2) has a production capacity reasonably related to the overall energy requirement of the eco town."

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

## 3.4 Building Regulations

Currently, Part L 2010 requires all new buildings to calculate their carbon dioxide emissions from fixed building services (regulated emissions). It is proposed that future revisions to this regulation will use the same model, but will ask for a higher reduction in carbon dioxide emissions compared to the previous version of the building regulations.

Up until 2006 it has been possible to meet the carbon targets by using efficient conventional systems. The 2010  $CO_2$  emissions targets can still be largely met by an energy efficient approach to design although additional low carbon or renewable systems may be needed (or preferred) in some buildings.

The further changes that will be brought in under the 2013 Building Regulations (to be implemented in April 2014) will likely make low carbon and renewable systems necessary in virtually all new buildings; along with the enhanced fabric efficiency.

The jump to zero carbon planned for 2016 represents a major step change and will almost certainly require a change in approach to how Part L is implemented. The traditional approach of building regulations is to assess the performance of a building considering only the energy use of the building and only those technologies attached to it and so directly affecting its carbon performance. If this approach were taken to zero carbon buildings, around half would not be able to meet the target and many of those that could meet the target would be extremely costly. This is because if the target were implemented in this way it would rely on small scale renewable electricity generation which is commonly expensive.

Current thinking is that the minimum performance standards required for individual buildings will remain similar between 2013 and 2016. There will be an option for some sites to further improve their on-site carbon performance and reduce emissions but there will also be alternative approaches (referred to as allowable measures) to reducing carbon by other means including:

- Remote wind turbines (or other forms of renewable electricity generation) with some form of long-term legal association to the development
- Extension of onsite low carbon heating systems to replace high carbon heating systems in existing buildings on neighbouring sites
- Programmes of improvement works to remote buildings (e.g. insulating cavity wall and lofts or installing external insulation on hard to treat solid walled rural homes)

The recent revision of building regulations and the announcement of Part L 2013 identify further improvement in carbon dioxide emissions of around 6% for domestic buildings and 9% (on aggregate) for non-domestic buildings. The tendency of carbon reduction will continue until a zero carbon target is adopted. It is anticipated that the zero carbon target will come into force in 2016 for domestic buildings and in 2019 for non-domestic buildings (2018 for public buildings).

This trajectory to zero carbon was first announced by the government in 2006 and there is still a considerable amount of work to be done to make it a reality. The current understanding of the trajectory to zero carbon for domestic and non-domestic buildings is presented in Table 3-1.

Table 3-1 Carbon reduction requirements based on Part L revisions 2006

Buildings type	2010	2013 (now April 2014)	2016	2018	2019
Domestic	25%	31% (6% improvement to 2010 BR)	Zero Carbon t	Zero Carbon	Zero Carbon
Non – domestic	25%	34% (9% aggregated improvement to 2010 BR)	further improvement t	Zero Carbon (Public Buildings)	Zero Carbon

# 3.5 Achieving Zero Carbon

The Government has announced its commitment to ensure that all domestic buildings should be zero carbon compliant. The Government has an ambition to make all new non-domestic buildings should be zero carbon from 2019.

In the 2011 Budget 'The Plan for Growth' document, the Government set out its new definition of "zero carbon" to be limited to regulated energy only (i.e. excluding unregulated energy – appliances and cooking). This means that the zero carbon definition is now only to include the regulated emissions covered by Building Regulations (heating, fixed lighting, hot water and building services). Emissions from cooking and appliances, such as computers and televisions, are excluded from the definition. This will be achieved by progressive tightening of standards with final enforcement expected through 2016 and 2019 Building Regulations respectively.

The Government's commitment to achieving zero carbon is based on the following hierarchical approach to achieving zero carbon targets (as presented in Figure 3-1 below):

- Ensure energy efficiency by energy efficient building design.
- Reduce carbon emissions through on-site low carbon and renewable energy technologies and near-site heat networks; referred to as on-site carbon compliance.
- Mitigate the remaining carbon emissions through use of allowable solutions.

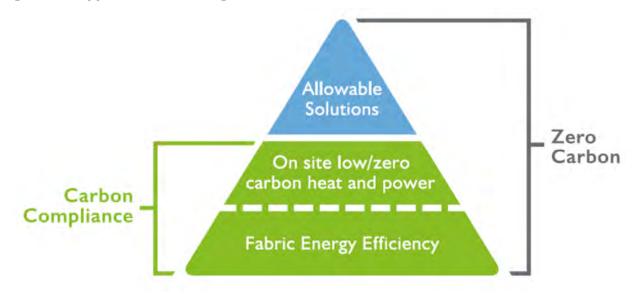


Figure 3-1 Approach to achieving Zero Carbon homes

Following a study by the Zero Carbon Hub in which further consultations were undertaken with house builders, consultants and other key stakeholders, it is suggested that the 70% level initially proposed for minimum carbon compliance may be difficult to achieve for many houses and developments.

As a result, the Zero Carbon Hub have produced an Interim Report, dated December 2010, in which further amendments to the level of carbon compliance, which are considered to be more achievable, are suggested. Further, differing levels are proposed for 3 basic different dwelling types – detached house; end terrace house and low rise apartment block.

In addition, it was considered that the previous method of calculating carbon compliance level was confusing and now suggest that an absolute limit in terms of kWh/m2/yr and kgCO $_2$  /m2/yr is set (see Figure 3-2 and Table 3-2 below).

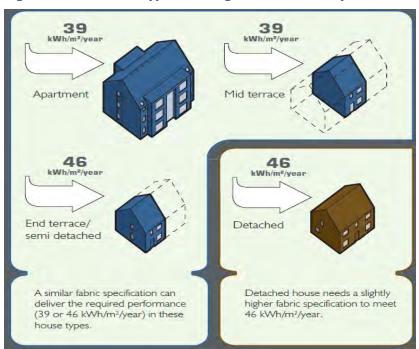


Figure 3-2 ZCH unit type showing Fabric Efficiency Standard

**Table 3-2 Fabric Efficiency & Carbon Compliance targets** 

Built Form	Fabric Standard (kWh/m2/yr)	Carbon Compliance (kgCO2/m2/yr)
Detached houses	46	10
Semi-detached houses	46	11
End of terrace	46	11
Mid terrace	39	11
Apartment block	39	14

#### 3.5.1 Allowable Solutions

Allowable solutions have been introduced to offer flexibility to developers, providing them with an option to offset remaining emissions, when other on-site options are not considered technically and commercially feasible.

Allowable solutions are to become central to the overall policy of ensuring that achieving zero carbon is affordable.

The Government has not yet defined the scope or price of allowable solutions. It is also unclear as to how allowable solutions may be delivered. However, Zero Carbon Hub has recently announced its proposals for a framework for allowable solutions which provide some indication of what might be expected from the final policy.

According to these proposals, the allowable solutions are split into three areas:

- On-site allowable solutions This might include measures such as smart appliances, site-based heat storage, electricity storage, waste management systems, LED street lights, flexible demand systems, etc
- Near-site allowable solutions This might include measures such as retrofitting low/zero carbon technologies to communal buildings, creation of local sustainable energy projects/infrastructure such as district heating or wind turbines, communal waste management, local energy storage, electric vehicle charging, etc.
- 3. Off-site allowable solutions This might include measures such as investing in energy from waste plants, low carbon electricity generation, district heating pipe-work, low carbon cooling, energy storage, flexible demand projects to counterbalance intermittent renewable energy provision, etc.

Allowable solutions will need to deliver the residual carbon emissions equal to that emitted by any new development. It is understood that the housing developers would pay an allowable solutions provider to deliver the required reductions. Recent DCLG consultation document discusses potential price cap strategy; of which some options would encourage competition between allowable solution providers ensuring that money is invested in the most cost-effective solutions. At present, a price cap has not been defined, however the DCLG consultation document proposes costs of between £36/tCO $_2$  to £90/tCO $_2$ ; which can make considerable difference to the total cost of zero carbon and the final energy strategy for the development.

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

At this stage, the option to consider the future incorporation of "Allowable Solutions" in the resulting energy strategy is consistent with the overall strategy and appropriate for this stage in the design of the development.

## 3.6 Local Policy

The existing Cherwell Local Plan 1996, saved polices do not specifically consider energy and carbon emissions.

The following policies are contained within the emerging Cherwell Local Plan 2006 - 2031 that was submitted to the Secretary of State for Examination in Public on 31<sup>st</sup> January 2014; and as such have yet to be formally adopted.

#### **Policy ESD 2 - Energy Hierarchy**

"In seeking to achieve carbon emissions reductions, we will promote an 'energy hierarchy' as follows:

- Prioritise being LEAN use less energy, in particular by the use of sustainable design and construction measures
- Then CLEAN supply energy efficiently and give priority to decentralised energy supply, and
- Then GREEN use renewable energy.

The Council's approach to the use of allowable solutions will be developed through the Development Management DPD and the Sustainable Buildings SPD."

#### **Policy ESD 3 - Sustainable Construction**

"All new homes will be expected to meet at least Code Level 4 of the Code for Sustainable Homes with immediate effect, unless exceeded by the standards set for NW Bicester eco-town (See Policy Bicester 1).

Achieving higher Code levels in the water and energy use categories will be particularly encouraged.

All new non-residential development will be expected to meet at least BREEAM 'Very Good' with immediate effect.

On the strategic sites allocated for development in this Local Plan, the Council expects to see the achievement of higher levels of on-site "carbon compliance" (carbon emissions reductions through energy efficiency and the use of renewable energy) than required through national building regulations.

Proposals for conversion and refurbishment will be expected to show high quality design and high environmental standards, demonstrating sustainable construction methods including but not limited to:

- Minimising both energy demands and energy loss
- Maximising passive solar lighting and natural ventilation
- Maximising resource efficiency
- Incorporating the use of recycled and energy efficient materials
- Reducing waste and pollution and making adequate provision for the recycling of waste
- Making use of sustainable drainage methods
- Reducing the impact on the external environment and maximising opportunities for cooling and shading (by the provision of open space and water, planting, and green roofs, for example); and
- Making use of the embodied energy within buildings wherever possible and re-using materials where proposals involve demolition or redevelopment.

Should the promoters of development consider that individual proposals would be unviable with the above requirements, 'openbook' financial analysis of proposed developments will be expected so that an in house economic viability assessment can be undertaken. Where it is agreed that an external economic viability assessment is required, the cost shall be met by the promoter."

#### **Policy ESD 4 - Decentralised Energy Systems**

"The use of decentralised energy systems, providing either heating (District Heating (DH)) or heating and power (Combined Heat and Power (CHP)) will be encouraged in all new developments.

A feasibility assessment for DH/CHP, including consideration of biomass fuelled CHP, will be required for:

- All residential developments for 400 dwellings or more
- All residential developments in off-gas areas for 50 dwellings or more
- All applications for non domestic developments above 1000m2 floorspace

The feasibility assessment should be informed by the renewable energy map at Appendix 5 'Maps' and the national mapping of heat demand densities undertaken by the Department for Energy and Climate Change (DECC) (see Appendix 3: Evidence Base).

Where feasibility assessments demonstrate that decentralised energy systems are deliverable and viable, such systems will be required as part of the development unless an alternative solution would deliver the same or increased benefit."

#### Policy ESD 5 - Renewable Energy

The Council supports renewable and low carbon energy provision wherever any adverse impacts can be addressed satisfactorily. The potential local environmental, economic and community benefits of renewable energy schemes will be a material consideration in determining planning applications.

Planning applications involving renewable energy development will be encouraged provided that there is no unacceptable adverse impact, including cumulative impact, on the following issues, which are considered to be of particular local significance in Cherwell:

- Landscape and biodiversity including designations, protected habitats and species, and Conservation Target Areas
- Visual impacts on local landscapes
- The historic environment including designated and non designated assets and their settings
- The Green Belt, particularly visual impacts on openness
- Aviation activities
- Highways and access issues, and
- Residential amenity.

A feasibility assessment of the potential for significant on site renewable energy provision (above any provision required to meet national building standards) will be required for:

- All residential developments for 400 dwellings or more
- All residential developments in off-gas areas for 50 dwellings or more
- All applications for non-domestic developments above 1000m2 floorspace

Where feasibility assessments demonstrate that on site renewable energy provision is deliverable and viable, this will be required as part of the development unless an alternative solution would deliver the same or increased benefit. This may include consideration of 'allowable solutions' as Government Policy evolves.

#### Policy Bicester 1 - North West Bicester Eco-Town

This policy contains a number of elements that directly relate to the use of energy and resultant carbon emissions from the NW Bicester site; these are abstracted from the policy below:

"Development Description: A new exemplar zero carbon (as defined in the Eco-Towns Supplement to PPSS1) eco development will be developed on land identified at NW Bicester."

"New non-residential buildings will be BREEAM excellent."

"Homes to be constructed to a minimum of Level 5 of the Code for Sustainable Homes including being equipped to meet the water consumption requirement of Code Level 5."

"Have real time energy monitoring systems, real time public transport information and high speed broadband access, including next generation broadband where possible. Consideration should also be given to digital access to support assisted living and smart energy management systems."

"Utilities – Utilities and infrastructure which allow for zero carbon and water neutrality on the site and the consideration of sourcing waste heat from Ardley Energy from Waste facility."

"Zero Carbon (see PPS definition) water neutral development is sought."

"High quality exemplary development and design standards including zero carbon development, Code Level 5 for dwellings at a minimum and the use of low embodied carbon in construction materials." In addition to the above, CDC has confirmed their expectation that the PPS1 Eco town zero carbon target will be primarily met through on-site measures; and that significant reliance upon Allowable Solutions should not form part of the energy strategy.

# 4 Baseline Energy Demand and Carbon Emissions

To determine the baseline energy demand for the proposed NW Bicester development a series of building performance energy models were undertaken (see Technical Note ref 5020-UA005241-ESD-R-1, presented in Appendix A).

Whilst the PPS1 Eco town supplement requires that all homes achieve CSH level 4, with associated FEE standards; due to the anticipated progressive improvements in Building Regulations planned by 2016, it was considered more appropriate, as well as a client aspiration, to target these planned FEE standard. As such the adopted standards for NW Bicester are equivalent to the CSH level 5/6 FEE standards for residential dwellings as a minimum and effectively set the baseline energy demands for the NW Bicester site.

The baseline energy demand based for both residential and commercial units are presented in Table 4-1 below (based on the number of residential units and types of commercial development in masterplan schedule 13016(sk) 130L v6 dated 24-12-13).

Table 4-1 Energy Demand

Energy	Demand	Section
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	Residential (Level 5/6 option)	Commercial	Total
Regulated Electricity Demand	3,195,610 kWh	4,722,889 kWh	7,918,498 kWh
Unregulated Electricity Demand	17,563,741 kWh	5,189,988 kWh	22,753,729 kWh
Total Electricity Demand	20,759,351 kWh	9,912,876 kWh	30,672,227 kWh
Regulated Gas Demand	27,398,887 kWh	11,770,040 kWh	39,168,927 kWh
UnRegulated Gas Demand	-	3,997,125 kWh	
Total Thermal Demand	27,398,887 kWh	15,767,165 kWh	43,166,052 kWh
Total Energy Demand	48,158,238 kWh	21,682,916 kWh	69,841,154 kWh
Regulated Energy Demand	30,594,496 kWh	16,492,929 kWh	47,087,425 kWh

The corresponding carbon emissions are presented in Table 4-2 below.

**Table 4-2 Carbon Emissions** 

#### **Carbon Emissions Section**

	Residential (Level 5/6 option)	Commercial	Total
Regulated Electricity	1,659 tonnes CO2	2,451 tonnes CO2	4,110 tonnes CO2
Unregulated Electricity	9,116 tonnes CO2	2,694 tonnes CO2	11,809 tonnes CO2
Total Electricity	10,774 tonnes CO2	5,145 tonnes CO2	15,919 tonnes CO2
Regulated Gas	5,918 tonnes CO2	2,542 tonnes CO2	8,460 tonnes CO2
Unregulated Gas	-	863 tonnes CO2	-
Total Thermal	5,918 tonnes CO2	3,406 tonnes CO2	9,324 tonnes CO2
Total Energy	16,692 tonnes CO2	7,687 tonnes CO2	24,379 tonnes CO2
Sub Total Regulated Energy	7,577 tonnes CO2	4,994 tonnes CO2	12,570 tonnes CO2

# 5 Approach to Energy and Carbon Emission Reduction

This report considers the strategic low and zero carbon energy strategies that may be adopted at the site to meet policy and regulatory requirements as well as client aspiration. The proposed technologies and approaches considered seek to meet the energy and carbon requirements, and describe the technical feasibility and economic viability of meeting the required targets. The strategies considered follow the energy hierarchy principles; which are:

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

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

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



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

## 5.1 Lean Energy

Part L of the 2006 Building Regulations for domestic dwellings highlights the need to ensure energy efficiency in design. The introduction of the Code for Sustainable Homes in 2007 has moved this agenda further forward and has focused on ensuring buildings are well insulated and airtight (as far as practically possible), to retain warmth and reduce the need for heating.

The NW Bicester development will adopt appropriate Code for Sustainable Homes and BREEAM building standards to ensure energy efficiency is the first priority in achieving its zero carbon sustainability objectives.

A range of measures to reduce carbon emissions and increase resilience to climate change can be incorporated into building design; some of these are outlined in Table 5-1 below.

Table 5-1 - Building Energy Efficiency Measures

<b>Design Feature</b>	<b>Adaptation Measure</b>	Technology
Air tightness	Green roofs	A rated appliances
Insulation	Passive cooling	Automatic controls and monitoring
Reduce thermal bridging	High performance glazing	Energy management systems
Passive solar orientation		Energy efficient lighting
Solar shading		Mechanical ventilation
Use of natural daylight		
Natural ventilation		

# 5.2 Clean and Green Energy

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

- Using generated energy more efficiently by reducing distribution losses
- Contributing to security of energy supply by increasing local energy production

- Increasing reliability of supply providing the opportunity to operate 'on or off grid'
- Reducing carbon emissions through more efficient use of fossil fuels and greater use of locally generated renewable energy
- Provides the opportunity to create stronger links between energy production and consumption.
- Can be linked to fund complementary programmes of work, such as retrofitting micro generation equipment in existing housing stock.
- Provides a visible message of commitment to sustainable energy

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

Energy from waste is considered to be low carbon. While municipal waste combustion contains small elements of things like plastics, the bulk of the material is still organic in nature. Some energy from waste processes can be completely zero carbon, for instance the anaerobic digestion of organic wastes to biogas.

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

To achieve these carbon emission reductions low carbon and/or renewable energy generation options and approaches will need to be utilised. The table (Table 5-2) below identifies those options that are feasible relative to the NW Bicester site; those that are questionable and those that are not. Some technologies can be applied at the building scale (micro), whilst others are larger scale (macro) by their nature.

Table 5-2 Feasible Macro and Micro scale LZC technologies

Macro Solutions (typically district scale or larger)	Feasible	Micro Solutions (typically building related)	Feasible )	
Anaerobic Digestion CHP	?	Air source heat pumps	Υ	
Energy from Waste CHP	Υ	Ground source heat pumps	Υ	
Gas CHP	Υ	Solar Thermal (building mounted)	Y	
Biomass CHP	Y	Solar Photovoltaic (building mounted)	Y	
Large scale PV array	Υ	Wind energy (building mounted)	Υ	
Large scale wind energy	?			
Hydro power (wave, tidal or flow)	N			

These options have been considered in the Strategic Options Appraisal report (see Appendix B: Strategic Energy Options Appraisal, February 2014, Report No.: 5021-UA005241-ESD-R-2) which concluded that whilst certain technologies may go a considerable way to meeting demands and creating carbon savings; no one technology can fulfil the site's total energy demand and carbon reduction target. Therefore a combined technology solution will be required.

# 6 NW Bicester Energy Strategy

The following strategy identifies the approach that is envisaged to be adopted at NW Bicester. This strategy has been derived following consultation with the client and Cherwell District Council relative to what may be considered acceptable.

The strategy follows the energy hierarchy, firstly considering energy efficiency followed by the incorporation of low and zero carbon technologies.

# 6.1 Be Lean - Energy Efficiency Strategy

Enhanced Fabric Energy Efficiency (FEE) Standard have been developed specifically in response to developing a strategy for the 2016 zero carbon homes requirement by the Zero Carbon Hub in 2009. This FEE methodology was adopted within the Code for Sustainable Homes (November 2010 version) under Energy section Ene2, with up to 9 credits available for achievement of a range of specific fabric performance levels.

The FEE methodology considers minimising the space heating and cooling (if any) demands of a dwelling through the improvement in building fabric efficiency. This includes enhanced improvements in the following construction procedures to achieve the required FEE levels:

- Building fabric U-values
- Thermal bridging
- Air permeability
- Thermal mass
- Features which affect lighting and solar gains

The FEE is measured in kWh/m²/yr (as shown in Figure 6-1 below), and is not influenced by building services, for example heating system, fixed lighting or ventilation strategy. It is a performance standard, meaning that different combinations of fabric specification can be used to reach a particular level. This allows flexibility when developing a fabric specification. There are different FEE standards proposed in building regulations for different types of dwelling, i.e. detached, semi-detached, end terrace and mid terrace dwellings.

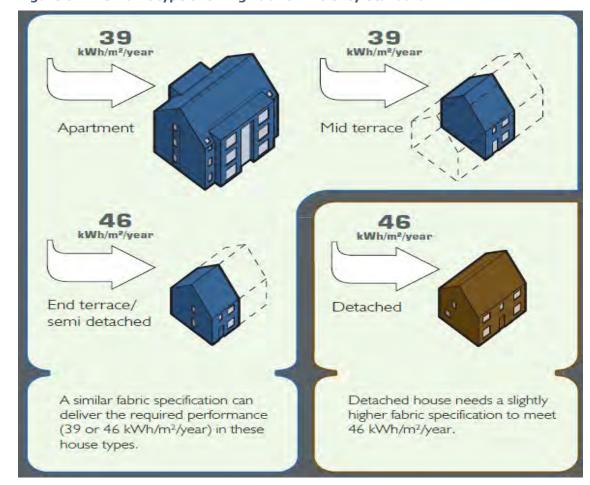


Figure 6-1 ZCH unit type showing Fabric Efficiency Standard

The PPS1 Eco town supplement requires that all homes achieve CSH level 4 including its associated FEE standards. However, with the progressive improvements in Building Regulations planned by 2016, it would be more appropriate to target a higher FEE standard as previously discussed in section 4. Therefore, the adopted building fabric standards will be equivalent to the CSH level 5/6 FEE standards.

Designing to Passihaus standards is another, alternative, approach. The Passivhaus FEE standards reduce the space heating energy demand to below 15kWh/m2/yr. On face value this is significantly lower than the shared CSH 5/6 and 2016 Building Regulation standards; which range from 39 to 46 kWh/m2/yr; however Passivhaus can introduces a 15kWh/m2/yr typical demand relative to cooling; which may be required during the summer months.

It is clear that progressive savings in regulated energy demand can be obtained from adopting higher FEE standards over existing building regulations standards (see Figure 6-2 below) and CSH level 4 FEE (see Figure 6-3 below). Figure 6-2 shows progressive energy demand savings over Building Regulation 2010 relative to CSH FEE level 4 (17.70%), CSH FEE level 5/6 (23.77%) and Passivhaus FEE (49.50%) standards.

Figure 6-3 shows progressive energy demand savings over CSH FEE level 4 relative to, CSH FEE level 5/6 (7.39%) and Passivhaus FEE (38.65%) standards.

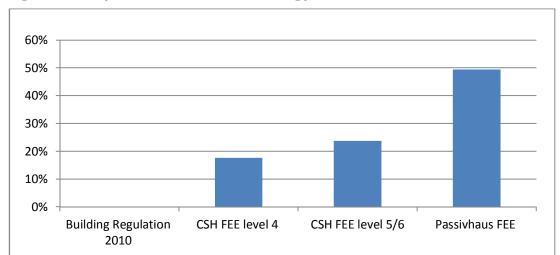
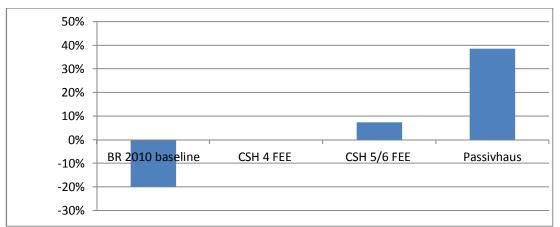


Figure 6-2 Improvements in reduced energy demand relative to BR 2010





However, as increased building fabric would result in increased build costs and in some instances additional energy may be required to mechanically ventilate buildings that would otherwise be able to rely on natural ventilation.

As identified above, whilst the PPS1 Eco town supplement requires that all homes achieve CSH level 4; due to the anticipated progressive improvements in Building Regulations planned by 2016 for residential and 2019 for commercial, it is considered more appropriate to target these anticipated FEE standard as a minimum, which are equivalent to the CSH level 5/6 FEE standards.

In addition, the client has derived significant experience with regard to this level of fabric efficiency, as the first phase of NW Bicester has been designed to these standards. Taking the learning and experience from this first phase will be beneficial for the remaining masterplan area.

As such, the remaining carbon emissions across the masterplan will be circa 24,379 tonnes CO2.

# 6.2 Clean and Green – Low & Zero Carbon Technology Strategy

This energy strategy builds on the Strategic Options Appraisal report (ref: Strategic Energy Options Appraisal, February 2014, Report No.: 5021-UA005241-ESD-R-2) which concluded that whilst certain technologies may go a considerable way to meeting demands and creating carbon savings; no one technology can fulfil the site's total energy demand and carbon reduction target. Therefore a combined technology solution will be required.

The sections below identify various combined technology solutions that seek to achieve the zero carbon target. As previously discussed, they are focused on primarily achieving this target through predominantly on-site and/or direct near site technology rather than a significant reliance on off-site/off-set allowable solution.

Whilst the options below are strategic in nature, they are considered robust enough to demonstrate how the relevant carbon emissions can be achieved. Refinement of these options will be subject to detailed design, testing and optimisation which will be undertaken in tandem with the further development of the masterplan as the scheme progresses towards submission of outline and reserved matter planning applications.

As refinement and optimisation of the options will continue to progress, we have not sought, at this stage, to provide detailed design justification for each element of each option; due to the fact that detailed design has not yet been progressed. Rather the options adopt a strategic approach relative to determination of such elements, such as engine sizing and roof area available for PV etc.

In addition to these energy generating technology options, further exploration of SMART grid technology will continue as the masterplan develops; to explore ways in which energy generated on site can be stored, balanced and used most efficiently, getting maximum benefit from investments in on site generation and minimising the impact of NW Bicester on the local grid.

# 6.2.1 Option 1 – DHN powered by Biomass CHP, Gas CHP and Gas Boiler plus Building PV

This option is based on the following elements:

- Enhanced FEE Standards (equivalent to CSH level 5/6 for residential)
- Site wide District Heat Network providing all thermal demand across the site
- Biomass CHP sized to provide circa 60% of the thermal demand
- Gas CHP sized to provide circa 30% of the thermal demand
- Gas boiler sized to provide circa 10% of thermal demand (primarily peak / top up and back up)
- Thermal demand regulated by inclusion of thermal stores
- Plus 50% residential and 60% non-residential of total roof space to be used for PV(orientated in southerly direction)

The table below (Option 1) shows the energy generation and carbon emission savings from this approach.

	<b>Energy Dema</b>	nd Section		
Technologies	Thermal Generation Capacity	Electrical Generation Capacity	% Total Thermal demands	% Total Electrical demands
Biomass CHP	12,949,816 kWh	6,166,579 kWh	30%	20%
Gas CHP	25,899,631 kWh	11,935,314 kWh	60%	39%
Gas Boiler	4,316,605 kWh	0 kWh	10%	0%
Building Scale PV (50% roof)	0 kWh	22,076,458 kWh	0%	72%
Totals	43,166,052 kWh	40,178,351 kWh	100%	131%
Carbon	Emissions Sec	tion		
Technologies	Total Carbon Savings	% Total (Regulated & Un-Regulated) Emissions Savings	% Regulated Emissions Savings	
	5,820 tonnes CO2	24%	46%	
Biomass CHP (sized to meet % ofthermal demands)	3,020 torrics CO2			
,	7,037 tonnes CO2	29%	56%	
Gas CHP (sized to meet % ofthermal demands)	,	29% 0%	56% 0%	
Biomass CHP (sized to meet % ofthermal demands) Gas CHP (sized to meet % ofthermal demands) Gas Boiler Building Scale PV (50% of Roof space)	7,037 tonnes CO2			

As can be seen, this option achieves the true zero carbon emission reduction through the use of on-site LZC alone.

# 6.2.2 Option 2 – DHN powered by connection to Ardley EfW and Gas Boiler plus Building PV

This option is based on the following elements:

- Enhanced FEE Standards (equivalent to CSH level 5/6 for residential)
- Site wide District Heat Network providing all thermal demand across the site
- Connection of DHN to Ardley EfW waste heat assumed to provide circa 90% of the thermal demand
- Gas boiler sized to provide circa 10% of thermal demand (primarily peak / top up and back up)
- Thermal demand regulated by inclusion of thermal stores
- Plus 50% residential and 60% non-residential of total roof space to be used for PV(orientated in southerly direction)

The table below (Option 2) shows the energy generation and carbon emission savings from this approach.

Option 2 - EfW, Boiler Roof and PV (	50% Resi, 60% N	Ion-resi)		
	<b>Energy Dema</b>	nd Section		
Technologies	Thermal Generation Capacity	Electrical Generation Capacity	% Total Thermal demands	% Total Electrical demands
Ardley (EfW)	38,849,447 kWh	0 kWh	90%	0%
Gas Boiler	4,316,605 kWh	0 kWh	10%	0%
Building Scale PV (50% roof)	0 kWh	22,076,458 kWh	0%	72%
Totals	43,166,052 kWh	22,076,458 kWh	100%	72%
Carbon	<b>Emissions Sec</b>	tion		
Technologies	Total Carbon Savings	% Total (Regulated & Un-Regulated) Emissions Savings	% Regulated Emissions Savings	
Ardley (EfW)	8,391 tonnes CO2	34%	67%	
Gas Boiler	0 tonnes CO2	0%	0%	
Building Scale PV (50% roof)	11,458 tonnes CO2	47%	91%	
Total Carbon Saving	19,849 tonnes CO2	81%	158%	
Residual Emissions:	4,530 tonnes CO2			

As can be seen, this option does not achieve true zero carbon emission reduction through the use of on-site LZC alone. The remaining residual carbon emissions from this option would therefore need to be off-set through additional means, such as a near site PV land array and/or other form of allowable solution.

# 6.2.3 Option 3 - CSH level 5/6 FEES, Biomass boiler, Gas CHP and Gas boiler with Building PV

This option is based on the following elements:

- Enhanced FEE Standards (equivalent to CSH level 5/6 for residential)
- Site wide District Heat Network providing all thermal demand across the site
- Biomass boiler sized to provide circa 30% of the thermal demand
- Gas CHP sized to provide circa 60% of the thermal demand
- Gas boiler sized to provide circa 10% of thermal demand (primarily peak / top up and back up)
- Thermal demand regulated by inclusion of thermal stores
- Plus 50% residential and 60% non-residential of total roof space to be used for PV(orientated in southerly direction)

The table below (Option 3) shows the energy generation and carbon emission savings from this approach.

Energy Demand Section							
Technologies Thermal Generation Electrical Generation % Total Thermal % Total Electrical							
Capacity	Capacity	demands	demands				
8,633,210 kWh	0 kWh	20%	0%				
30,216,236 kWh	13,924,533 kWh	70%	45%				
4,316,605 kWh	0 kWh	10%	0%				
0 kWh	22,076,458 kWh	0%	72%				
als 43,166,052 kWh	36,000,991 kWh	100%	117%				
	Thermal Generation	Thermal Generation Capacity Capacity 8,633,210 kWh 0 kWh 30,216,236 kWh 13,924,533 kWh 4,316,605 kWh 0 kWh 22,076,458 kWh	Thermal Generation         Electrical Generation         % Total Thermal demands           Capacity         Capacity         demands           8,633,210 kWh         0 kWh         20%           30,216,236 kWh         13,924,533 kWh         70%           4,316,605 kWh         0 kWh         10%           0 kWh         22,076,458 kWh         0%				

Carbon Emissions Section				
Technologies	Total Carbon Savings	% Total (Regulated & Un-Regulated) Emissions Savings	% Regulated Emissions Savings	
Biomass Boiler	1,702 tonnes CO2	7%	14%	
Gas CHP	8,210 tonnes CO2	34%	65%	
Gas Boiler	0 tonnes CO2	0%	0%	
Building Scale PV (50% roof)	11,458 tonnes CO2	47%	91%	
Total Carbon Saving	21,370 tonnes CO2	88%	170%	
Residual Emissions	3,009 tonnes CO2			

As can be seen, this option does not achieve true zero carbon emission reduction through the use of on-site LZC alone. The remaining residual carbon emissions from this option would therefore need to be off-set through additional means, such as a near site PV land array and/or other form of allowable solution.

# 6.2.4 Option 4 – CSH level 5/6 FEES, Gas CHP and Gas boiler with Building PV

This option is based on the following elements:

- Enhanced FEE Standards (equivalent to CSH level 5/6 for residential)
- Site wide District Heat Network providing all thermal demand across the site
- Gas CHP sized to provide circa 90% of the thermal demand
- Gas boiler sized to provide circa 10% of thermal demand (primarily peak / top up and back up)
- Thermal demand regulated by inclusion of thermal stores
- Plus 50% residential and 60% non-residential of total roof space to be used for PV(orientated in southerly direction)

The table below (Option 4) shows the energy generation and carbon emission savings from this approach.

Option 4 - Gas CHP, Gas boiler ar	nd Roof PV (50% Res	si, 60% Non-resi)				
Energy Demand Section						
Technologies	Thermal Generation Capacity	Electrical Generation Capacity	% Total Thermal demands	% Total Electrica demands		
Gas CHP	38,849,447 kWh	17,902,971 kWh	90%	58%		
Gas Boiler	4,316,605 kWh	0 kWh	10%	0%		
Building Scale PV (50% roof)	0 kWh	22,076,458 kWh	0%	72%		
Totals	43,166,052 kWh	39,979,429 kWh	100%	130%		
Cark	on Emissions Sec	tion				
Technologies	Total Carbon Savings	% Total (Regulated & Un-Regulated) Emissions Savings	% Regulated Emissions Savings			
Gas CHP	10,556 tonnes CO2	43%	84%			
Gas Boiler	0 tonnes CO2	0%	0%			
Building Scale PV (50% roof)	11,458 tonnes CO2	47%	91%			
<b>Total Carbon Saving</b>	22,014 tonnes CO2	90%	175%			
Residual Emissions	2,366 tonnes CO2					

As can be seen, this option does not achieve true zero carbon emission reduction through the use of on-site LZC alone. The remaining residual carbon emissions from this option would therefore need to be off-set through additional means, such as a near site PV land array and/or other form of allowable solution.

## 6.2.5 Option 5 – CSH level 5/6 FEES, Individual unit Biomass Boiler & Mono pitch roof with PV

This option is a radical departure from the current design ethos but is included to demonstrate how other approaches may be used. This option is based on the following elements:

- Enhanced FEE Standards (equivalent to CSH level 5/6 for residential)
- Mono pitch residential roof design to enable 70% of total roof space, plus 60% non-residential of total roof space to be used for PV (orientated in southerly direction)
- Individual (domestic and non-domestic) biomass boilers installed in all buildings

The table below (Option 5) shows the energy generation and carbon emission savings from this approach. The below table also shows a secondary option based on using individual unit high efficiency gas boilers (5a).

Option 5 (& 5a) - Level 5/6 Standards, mono pitch roof PV (70% Resi, 60% Non-resi) & individual Biomass boilers

Biomass boilers					
	<b>Energy Dema</b>	nd Section			
Technologies	Thermal Generation	Electrical Generation	% Total Thermal	% Total Electrical	
	Capacity	Capacity	demands	demands	
Building Scale PV (70% roof)	0 kWh	28,381,159 kWh	0%	93%	
Biomass Boiler (to meet thermal demands)	43,166,052 kWh	0 kWh	100%	0%	
Totals	43,166,052 kWh	28,381,159 kWh	100%	93%	
Total (with standard gas boilers)	43,166,052 kWh	28,381,159 kWh	100%	93%	
Carbon Emissions Section					
Technologies	Total Carbon Savings	% Total (Regulated & Un-Regulated) Emissions Savings	% Regulated Emissions Savings		
Building Scale PV (70% roof)	14,730 tonnes CO2	60%	117%		
Biomass Boiler (to meet thermal demands)	8,511 tonnes CO2	35%	68%		
Total Carbon Saving	23,241 tonnes CO2	95%	185%		
Carbon Saving (with standard gas boilers)	14,730 tonnes CO2	60%	117%		
Residual Emissions	1,138 tonnes CO2	Residual	with gas boiler	9,650 tonnes CO2	

As can be seen, this option does not achieve true zero carbon emission reduction through the use of on-site LZC alone. The remaining residual carbon emissions from this option would therefore need to be off-set through additional means, such as a near site PV land array and/or other form of allowable solution.

### 6.2.6 Option 6 – Passivhaus standards, Individual unit Biomass Boiler & Mono pitch roof with PV

This option is a further radical departure from the current design ethos but is included to demonstrate how other approaches may be used. This option is based on the following elements:

- All residential units are built to Passihaus FEE design standards this results in a reduction in total carbon emission from 24,622 tonnes CO2 to 22,705 tonnes CO2
- Mono pitch residential roof design to enable 70% of total roof space, plus 60% non-residential of total roof space to be used for PV (orientated in southerly direction)
- Individual (domestic and non-domestic) biomass boilers installed in all buildings

The table below (Option 6) shows the energy generation and carbon emission savings from this approach. The below table also shows a secondary option based on using individual unit high efficiency gas boilers (6a).

Option 6 (& 6a) - Pasivhaus Standards, mono pitch roof PV (70% Resi, 60% Non-resi) & individual Biomass boilers

Biomass boilers				
	<b>Energy Dema</b>	nd Section		
Technologies	Thermal Generation Capacity	Electrical Generation Capacity	% Total Thermal demands	% Total Electrical demands
Building Scale PV (70% roof	0 kWh	28,381,159 kWh	0%	88%
Biomass Boiler (sized to meet thermal demands)	27,805,909 kWh	0 kWh	100%	0%
Totals	27,805,909 kWh	28,381,159 kWh	100%	88%
Total (with standard gas boilers)	27,805,909 kWh	28,381,159 kWh	100%	88%
Carbon	Emissions Sec	tion		
Technologies	Total Carbon Savings	% Total (Regulated & Un-Regulated) Emissions Savings	% Regulated Emissions Savings	
Building Scale PV (70% of Roof space)	14,730 tonnes CO2	65%	135%	
Biomass Boiler (sized to meet thermal demands)	5,483 tonnes CO2	24%	50%	
Total Carbon Saving	20,212 tonnes CO2	89%	186%	
Carbon Saving (with standard gas boilers)	14,730 tonnes CO2	65%	135%	
Residual Emissions	2,493 tonnes CO2	Residual	with gas boiler	7,975 tonnes CO2

As can be seen, this option does not achieve true zero carbon emission reduction through the use of on-site LZC alone. The remaining residual carbon emissions from this option would therefore need to be off-set through additional means, such as a near site PV land array and/or other form of allowable solution.

# 6.3 Summary of Options

The below table summarises the strategic options identified in the preceding sections.

		Energy Demands	mands			Carbon Emissions	missions	
Options:	Thermal Generation Capacity	Electrical Generation Capacity	% Total Thermal demands	% Total Electrical de mands	Total Carbon Savings	% Total (Regulated & Un-Regulated) Emissions Savings	% Regulated Emissions Savings	Residual emissions
Option 1 - Biomass CHP, Gas CHP, Boiler and Roof PV (50% Resi, 60% Non-resi)	43,166,052 kWh	40,178,351 kWh	100%	131%	24,315 tonnes CO2	2 100%	193%	0 tonnes CO2
Option 2 - EfW, Boiler Roof and PV (50% Resi, 60% Non-resi)	43,166,052 kWh	22,076,458 kWh	100%	72%	19,849 tonnes CO2	2 81%	728%	4,530 tonnes CO2
Option 3 - Biomass boiler, Gas CHP, Gas Boiler and Roof PV (50% Resi, 60% Non-resi)	43,166,052 kWh	36,000,991 kWh	100%	117%	21,370 tonnes CO2	2 88%	710%	3,009 tonnes CO2
Option 4 - Gas CHP, Gas boiler and Roof PV (50% Resi, 60% Non-resi)	43,166,052 kWh	39,979,429 kWh	100%	130%	22,014 tonnes CO2	2 80%	%2/1	2,366 tonnes CO2
Option 5 - Level 5/6 Standards, mono pitch roof PV (70% Resi, 60% Non-resi) & individual	43,166,052 kWh	28,381,159 kWh	100%	93%	23,241 tonnes CO2	2 95%	782%	1,138 tonnes CO2
Option 5a - as above but with individual Gas boilers	43,166,052 kWh	28,381,159 kWh	100%	93%	14,730 tonnes CO2	2 60%	117%	9,650 tonnes CO2
Option 6 - Pasivhaus Standards, mono pitch roof PV (70% Resi, 60% Non-resi) & individual	27,805,909 kWh	28,381,159 kWh	100%	%88	20,212 tonnes CO2	2 89%	186%	2,493 tonnes CO2
Option 6a - as above but with individual Gas boilers	27,805,909 kWh	28,381,159 kWh	100%	%88	14,730 tonnes CO2	2 65%	135%	7,975 tonnes CO2

The above summary identifies that some options contribute to meeting total energy demands more thoroughly than other options, in relation to total electrical demands. These options also perform better in relation to their total carbon emission savings contribution (namely option 1 and 4).

All of the options meet all regulated emission savings, however, only one option clearly meets all regulated and unregulated emission savings - that is option 1. However, as mentioned earlier, it is recognised that a process of refinement, optimisation and further detailed design will need to be applied as the masterplan progresses toward outline and reserved matters planning application stage.

#### 6.4 Preferred Strategic Approach

The above option scenarios identify various combined technology approaches that seek to achieve the zero carbon target. This recognises that whilst certain technologies may go a considerable way to meeting demands and creating carbon savings; no one technology can fulfil the site's total energy demand and carbon reduction target. Therefore a combined technology solution will be required. As previously discussed, these options are focused on primarily achieving this target through predominantly on-site technology rather than a significant reliance on off-site/off-set allowable solutions.

The above technology combination options demonstrate that true zero carbon can be met through the application of predominantly onsite technology.

Recognising that further optimisation of the available technical solutions will continue as detailed design progresses; such as refinement of available roof area for PV, selection and sizing of CHP engines and associated thermal store to optimise delivery of the thermal demand carbon emission reductions; the preferred approach to enable the true zero carbon target to be met for the NW Bicester development will be based on the following:

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

This approach will enable the true zero carbon target to be met predominantly on-site. The technology combinations presented in Section 6.2 above have identified that Option 1 is able to achieve the true zero target without the need to off-set any residual carbon emissions. This option includes:

- Enhanced FEE Standards (equivalent to CSH level 5/6 for residential)
- Site wide District Heat Network providing all thermal demand across the site

- Biomass CHP sized to provide circa 60% of the thermal demand
- Gas CHP sized to provide circa 30% of the thermal demand
- Gas boiler sized to provide circa 10% of thermal demand (primarily peak / top up and back up)
- Thermal demand regulated by inclusion of thermal stores
- Plus 50% residential and 60% non-residential of total roof space to be used for PV(orientated in southerly direction)

As mentioned above, with continued refinement and optimisation of technology combinations other options are also anticipated to be able to meet the true zero carbon target. This anticipation stems from the experience and learning from the first phase Exemplar site of NW Bicester, which effectively utilises the approach considered under Option 4 in Section 6.2 above.

The strategic approach has been selected because:

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

#### 7 Summary

NW Bicester will be required to meet PPS 1 Eco-town supplement zero carbon target; which states that "over a year the net carbon dioxide emissions from all energy use within the buildings on the ecotown development as a whole are zero or below".

This means that NW Bicester has to consider both the regulated and unregulated energy use within buildings; which is beyond that required under the current national zero carbon definition that only considers the regulated energy. In addition, discussion with CDC has confirmed their expectation that this target will be primarily met through on-site / near site measures rather than a significant reliance upon off-site / Allowable Solutions.

Together, these aspects make NW Bicester unique in its aspiration to achieve true zero carbon through mainly on-site measures. To achieve this target the NW Bicester masterplan energy strategy follows the energy hierarchy principles of:

Be Lean
 Be Clean
 Be Clean (use less energy)
 Be Clean (use low carbon & renewable energy)

This energy strategy tested a number of technology solutions. The preferred approach includes building homes and non-domestic buildings to enhanced fabric energy efficiency standards, continuing to develop an on-site heat network across the site powered by a series of on-site energy centres incorporating various low and zero carbon technologies, together with the provision of roof mounted PV on every building. The key elements of this strategy are summaries below:

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

This approach is favoured due to a number of factors; these being:

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

# Appendix A Energy Strategy

**Baseline Energy Demand** 

Report ref: 5020-UA005241-ESD-R-1





#### **Technical Note**

Date 09 September 2013

Reference 5020-UA005241-ESD-R-1
From Hyder Consulting (UK) Ltd.

To A2 Dominion, NW Bicester project team

Author Umer Uzair
Approver Philip Harker

#### Subject Baseline Energy Demand

This technical note presents the **baseline energy demand** for the NW Bicester Masterplan for Residential and Commercial Units; based on current energy demands. The baseline is set against compliance with building regulations, calculated using Standard Assessment Procedures (SAP) for residential and the Chartered Institute of Building Services Engineers (CIBSE) energy benchmarks for commercial, without projections for energy efficiencies and future energy use trends.

Further energy demand scenarios are then provided relative to achieving:

- Code for Sustainable Homes (CSH) level 4 fabric energy efficiency (FEE) standards
- CSH level 5&6 FEE
- Passivhaus FEE
- Predicted commercial energy efficiency savings

#### 1 Background:

The baseline energy demands for the proposed NW Bicester master plan site; is based on 5,607 Residential units with various Commercial units. The energy demand calculations are area weighted and mainly dependent upon building area, hence this report utilises the unit areas from the NW Bicester master plan proposed option 6 – Masterplan 13016(sk) 110 REV F V2 11/07/2013 (see table 1 below)

Table 1-1 Bicester Master plan Proposed Options Table

NW BICESTER MASTER		USES				FARRELLS
ОРПОN 6 - MASERPLAN 13016(sk) 111 V2 11/07/2013	REV F					
AREAS	EMPLOYMENT	NON RES NIA m2	NON RES GIA m2	Houses	SITE AREA (ha)	NOTES
						(based on density 35/ha & population 2.6/house)
housing	1354			6022	179.4	Home working at 17.75% - SQW June 13 jobs budget
secondary school	45.00		4500.00		4.5	
primary school	61.88		16500.00		8.3	8-9 CLASSES / YEAR jobs etc to be confirmed
care home / hotel in hubs	75.00		7500.00		1.25	based on 20m2 per resident and one job per 100 m2
care home	90.00		9000.00		2.5	based on 20m2 per resident and one job per 100 m2
B 1 office in hubs	127.06	640.00	2000.00		0.3	assumed on one job per 12m2 NIA
Eco business in hubs	325.16	2880.00	5400.00		0.9	assumed one job per 15.5m2 NIA
B1 office	1080	12960.00	16200.00		2.7	assumed based on one job per 12m2 NIA
B2 B8 commercail	995		35805.00		6.2	assumed based on one job per 36m2 GIA
retail in hubs	222.22	1920.00	4400.00		1.10	assumed based on one job per 25m2 NIA
other retail leisure	133.33	1920.00	2400.00		0.6	assumed based on one job per 25m2 NIA
Mixed commercial existing farms	108.44		4880.00		4.88	assumed based on one job per 45 m2
nursery community centre in hubs	36.00		3600.00		0.6	assumed based on one jpb per 100m2
other community	123.00		12300.00		2.05	assumed based on one job per 100 m2
energy centre in hubs	14.00		2800.00		0.6	assumed based on one job per 200m2
Energy water infrastructure					2.1	
Road Infrastructure					12	
GREEN I NFRASTRUCTURE					151.7538	
public amenity and recreation greenspace						
private amenity and recreation greenspace	•					
TOTAL WITHOUT GREEN INFRASTRUCT	URE				229.93	
TOTAL DEVELOPEMNT SITE AREA	4789		127285		381.6838	

[Note: the residential dwelling number has been changed to 5607 units; to reflect a 6000 unit scheme minus the existing Exemplar site (393 units)].

Calculation of the baseline energy demand for Residential units has utilised the SAP 2009 version 9.90 methodologies for the different unit types; from 1 bedroom to 5 bedrooms detached / semi-detached and terrace dwellings. Further energy demand scenarios based upon the Code for Sustainable Homes (CSH) and Passivhaus Fabric Energy Efficiency (FEE) levels for all the residential unit types have also been undertaken to advise on the different energy demands at different FEE levels. The Commercial units energy demands derives from the Chartered Institute of Building Services Engineers (CIBSE) Energy Benchmarks published under reference document TM46 version 2008. A further commercial energy demand scenario has also been modelled taking account of improvements that have occurred between the 2006 and 2010 building regulation.

The above methodologies have been utilised and the results have been taken to estimate the likely energy demands in terms of electricity and fossil fuel (i.e. gas) for the masterplan area. The aim of this note is to demonstrate the energy demand requirements, at a compliance level, without the inclusion of additional energy efficiency, passive measures and/or the application of Low or Zero Carbon technologies etc.

Further energy efficiency scenarios have been calculated, including the CSH level 4 FEE, in recognition that the PPS1 requires all dwellings to meet this level as a minimum and therefore effectively sets the baseline demands of CSH level 4 as the NW Bicester baseline compliance standard.

#### 2 Methodology:

To estimate the energy demands for the proposed Bicester Eco Town we have adopted the following compliance methodologies,

- **a** The Government's Standard Assessment Procedure (SAP) for Energy Rating of Dwellings.
- **b** CIBSE Energy Benchmark TM 46 2008

#### 2.1 Standard Assessment Procedure (SAP)

The Standard Assessment Procedure (SAP) is adopted by Government as the UK compliance methodology for calculating the energy performance of dwellings. The calculation is based on the energy balance taking into account a range of factors that contribute to energy efficiency, including:

- Material Used for construction of the dwelling
- Thermal insulation of the building fabric
- Ventilation characteristics of the dwelling and ventilation equipment
- Efficiency and control of the heating systems
- Impact of Solar gain through the opening
- Impact of fuel utilised to provide space heating, hot water, ventilation and lighting
- Impact of Renewable energy technologies

The procedure used for calculation is based on the BRE Domestic Energy Model (BREDEM) which provides a framework for the calculation of energy use in dwellings. The procedure is consistent with the standard BS EN ISO 13790.

The current version of SAP document is SAP 2009 version 9.90 which was published in March 2010 with the Reduced Data SAP applied in April 2011. This document is the compliance tool and mainly utilised within the industry for calculating energy use and the carbon dioxide emissions along with the associated running cost based upon the fuel type to be used by the proposed dwelling.

For the purpose of this baseline we have modelled one, two, three, four and five bedrooms mid terrace, detached and semi-detached dwellings by utilising the SAP compliance software. We have estimated the number of units of each house type based upon the percentage of each dwelling type; and have appraised on the basis of unit type typical size. The table (Table 2.1) below presents the breakdown of dwelling types and their associated areas; assuming a total of 5607 Residential units.

Unit Type	% of Unit Type	Total No. of Unit Type	Unit Area (m2)	Total Unit Area (per Unit Type) (m2)
1bed	12%	672.84	62.99	42,382
2beds	40%	2242.80	82.63	185,323
3beds	35%	1962.45	97.54	191,417
4beds	9%	504.63	113.34	57,195
5beds	4%	224.28	150.00	33,642

The above typical unit areas are taken from the NW Bicester Exemplar housing mix and the percentage of each type have been taken from various workshop/meetings discussions; and which are currently the best known working mix for the proposed masterplan. The above areas and percentages are indicative and can be updated when a final unit type and mix are decided.

The above methodology has been adopted to estimate the likely energy demands from the proposed 5607 residential units in compliance with Building Regulations Part L1A. The calculation details and relevant results are provided within the following sections of this report.

#### 2.2 CIBSE Energy Benchmark

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

CIBSE carried out various studies and develop the benchmark proposals based upon CIBSE Guide F and Energy Consumption guide ECG19. There are currently 29 benchmark categories listed under this document, which also sets the energy consumption benchmarks of a typical building type. The benchmarks are expressed in terms of delivered energy used per unit of floor area, (i.e. kWh/m²) for both electrical and fossil fuel of energy use. This generally covers lighting, heating, cooling, appliances, standard IT and small tea rooms/spaces.

The typical areas of differing commercial classification types are provided within the NW Bicester masterplan 13016(sk) 110REV F V2 proposed option 6 total – v2 -11-07-13. These have reproduced in accordance with building classifications and converted from hectares into square meters; table 2.2 below lists all the proposed commercial classification types and their corresponding areas,

Table 2-2 Breakdown of Electricity and Fossil Fuel Demands for whole Eco Town

<b>Building Classification</b>	Area (ha)	Area (m²)
Secondary School	4.5	45,000.00
Primary School	8.3	83,000.00
Care home/ hotel in hubs	1.25	12,500.00
Care home	2.5	25,000.00
B1 Office in hubs	0.3	3,000.00
Eco business in hubs	0.9	9,000.00
B1 Office	2.7	27,000.00
B2 to B8 Commercial	6.2	62,000.00
Retail Hubs	1.1	11,000.00
Other Retail Leisure	0.6	6,000.00
Nursery Community centre in hubs	0.6	6,000.00
other community	2.05	20,500.00
energy centre in hubs	0.6	6,000.00

CONVERSION FACTOR: 1 HECTARE = 10,000M2

The areas listed in Table 2.2 have been utilised to estimate the commercial uses energy demands on the basis of CIBSE TM46. The TM46 document sets the benchmarks against various commercial buildings and. listed benchmark figures covers all the building types listed above and considered within NW Bicester masterplan.

The section below provides detail of the calculations undertaken to estimate the total energy demand for the proposed NW Bicester development.

#### 3 Baseline Energy Demand – Building Regulations Part L Compliance

#### 3.1 Residential Dwellings:

This section describes the potential energy demand profiles for the proposed 5,607 residential units. As discussed above we have utilised SAP calculation methodology for the residential units to estimate the energy demands, the demand includes the lighting, pumps & fans, space heating and hot water. To get these demands we have modelled 1 to 5 bedroom detached and semi-detached houses on the basis of typical dwelling areas. To demonstrates the building regulations compliance we have established the following key performance criteria for each house type and predicts the energy demand on this basis,

Table 3-1 SAPs building Regulations Part L1A compliance Scenario

		1 Bedroom	2 Bedroom	3 Bedroom	4 Bedroom	5 Bedroom
	External Wall	0.25	0.25	0.25	0.20	0.20
	Party Wall	0.00	0.00	0.00	0.00	0.00
Fabric	Roof	0.20	0.20	0.20	0.20	0.20
U Values	Floor	0.24	0.24	0.24	0.20	0.20
(W/m <sup>2</sup> K)	Door	1.40 Solid	1.40 Solid	1.40 Solid	1.40 Solid	1.40 Solid
	Window Glazing	1.50 Double Glazed	1.50 Double Glazed	1.50 Double Glazed	1.50 Double Glazed	1.50 Double Glazed
(Y (W	al Bridging Value) //m² K)	0.08	0.10	0.08	0.10	0.08
Air L	₋eakage n²@50Pa			6.1		
Li	ghting		1	00% Energy Effi	cient	
Ver	ntilation			Natural		
	Fuel Type			Natural Gas Bo	ler	
	Efficiency	88.8%	88.8%	88.8%	88.8%	88.8%
Heating	Controls	Time	and Temperatu	ıre Zone Control	, Weather Comp	ensator
	Hot Water Cylinder Size	130	145	150	175	215
Hot Water	Insulation Thickness (mm)	65	65	65	65	65

The above combinations have been used within the calculation software which produces the SAP worksheet reports, to predict the regulated energy demands, i.e. heating, hot water, pumps & fans and lighting for each of the house type and the CO2 emissions for the unregulated (Appliances and Cooking). From this calculation we have taken the total baseline (Building Regulations Compliance) energy demand for the residential component of the NW Bicester master plan.

required for running the lighting, pumps & fans, heating and hot water systems within the proposed dwelling. Table 3-2 below shows the breakdown of energy The SAP output provides the overall annual regulated energy demands in kWh for each house type. The regulated energy demand includes the energy demand for each house type along with the total demand for all 5,607 units,

Table 3-2 Regulated energy demand for 5,607 Units

						ANNU	ANNUAL REGULATED DEMAND SECTION	DEMAND SECTIC	NC		
Туре	Units Break down	Total Housing Unit area (m²)	Area Weighte d Pumps & Fans Demand (kWh/m²)	Pumps & Fans Demand (kWh)	Area Weighted Lighting Demand (KWh/m²)	Lighting Demand (kWh)	Area Weighted Space Heating Demand (KWh/m²)	space Heating Demand (kWh)	Area Weighted Hot Water Demand (KWh/m²)	Hot Water Demand (kWh)	Total Demand (kWh)
1bed	829	42,382	2.79	118,367.12	4.51	191,254.21	51.24	2,171,853.97	33.19	1,406,722.16	3,888,197.45
2beds	2243	185,323	2.11	390,740.35	4.54	841,208.14	44.68	8,279,899.57	27.64	5,121,980.75	14,633,828.81
3beds	1962	191,417	1.79	343,428.75	4.09	782,311.07	47.43	9,079,019.81	24.41	4,672,573.83	14,877,333.45
4beds	202	57,195	1.54	88,310.25	4.54	259,384.87	47.90	2,739,464.70	21.40	1,223,969.97	4,311,129.78
2beds	224	33,642	1.17	39,249.00	4.03	135,572.77	51.17	1,721,378.16	15.77	530,386.32	2,426,586.25
Total	2607	509958.89	9.41	980,095.46	21.70	2,209,731.06	242.42	23,991,616.19	122.41	12,955,633.02	40,137,075.74

Table 3-2 presents the regulated demands of each residential unit type; providing the area weighted demand and the overall demand of electricity and fossil fuel for each residential units. The total energy demand for all residential units is summarised below,

- Fossil Fuel / Gas = 36,947,249.22 kWh (this includes space heating and hot water)
- Electricity = 3,189,826.52 kWh (this includes lighting, pumps and fans)

The SAP worksheets are provided under Appendix A of this report.

Estimate of the annual unregulated demands, i.e. from appliances and cooking; have been calculated on the basis of SAP methodology and derived from the formula below,

- A. Calculate the non-regulated carbon emissions (appliances & cooking) by:
  - i. For elec oven, elec hob:

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

ii. For elec oven, gas hob:

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

iii. For gas oven, gas hob:

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

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

THE ÆBOVE FORMULA HAS BEEN TAKEN FROM CARBON COMPLIANCE ZERO CARBON HUB'S DOCUMENT, MODELLING 2016 USING SAP 2009 TECHNICAL GUIDE

The above depicts differing scenarios which have been adopted to estimate the unregulated energy demands relevant to appliances and cooking. We have separated these out to provide the following:

- Electrical appliances
- Cooking three options:
  - electric oven / electric hob,
  - electric oven / gas hob and
  - gas oven / gas hob.

Tables 3.3 to 3.6 below show the results for each of the above scenarios,

Table 3-3 Electrical Appliances demand for 5,607 Units

House Type	TFA	Total Electric Appliances Demand (kWh/m2)	Total Electric Appliances Demand (kWh)
1bed	42,382	32.67	1384436.88
2beds	185,323	31.13	5769996.83
3beds	191,417	29.56	5658081.92
4beds	57,195	27.86	1593235.66
5beds	33,642	24.42	821523.82
Total	509,959	145.64	15,227,275.11

THE ABOVE TABLE IS BASED UPON 207.8X(NXTFA)^0.4714 X 0.517

Table 3.3 shows that the total unregulated electrical demand for Appliance for all 5607 units = 15,227,275.11 kWh

Table 3-4 Electric Oven & Electric Hob Demand for 5,000 Units

House Type	TFA	Total Cooking (All Electric) (kWh/m2)	Total Cooking (All Electric) (kWh)
1bed	42,382	6.16	261108.35
2beds	185,323	5.00	927289.02
3beds	191,417	4.35	832781.36
4beds	57,195	3.80	217416.05
5beds	33,642	2.91	97871.53
Total	509,959	22.23	2,336,466.31

THE ABOVE TABLE IS BASED UPON (275+(55X N))X0.517

Table 3.4 shows that the total unregulated cooking demand based upon an all-electric scenario = 2,336,466.31 kWh

Table 3-5 Electric Oven & Gas Hob Demand

House Type	TFA	Total Cooking (half electric, half gas) (kWh/m2)	Total Cooking (half electric, half gas) (kWh)
1bed	42,382	9.10	385888.05
2beds	185,323	7.26	1344834.90
3beds	191,417	6.29	1204807.99
4beds	57,195	5.49	314100.40
5beds	33,642	4.20	141229.68
Total	509,959	32.35	3,390,861.02

THE ABOVE TABLE IS BASED UPON (137.5+(27.5XN)X0.517)+(280.5+(48.15XN)X0.198)

Table 3.5 shows that the total unregulated cooking demand based upon electric oven, gas hob scenario = 3,390,861.02 kWh

Table 3-6 Gas Oven & Gas Hob

House Type	TFA	Total Cooking (All Gas) (kWh/m2)	Total Cooking (All Gas) (kWh)
1bed	42,382	10.78	456840.56
2beds	185,323	8.75	1622477.38
3beds	191,417	7.61	1457143.22
4beds	57,195	6.65	380423.42
5beds	33,642	5.09	171252.01
Total	509,959	38.89	4,088,136.60

THE ABOVE TABLE IS BASED UPQAB1+ (96.3XN) X0.198

Table 3.6 shows that the total unregulated cooking demand based upon an all gas scenario = 4,088,136.60 kWh

The above scenarios shows the unregulated energy demands of appliances and cooking based upon the proposed NW Bicester masterplan option of 5607 residential units. Below is the summary of the unregulated energy demands:

- Total unregulated appliance demands = 15,227,275.11 kWh
- Total unregulated cooking demand (all electric) = 2,336,446.31 kWh
- Total unregulated cooking demand (electric oven, gas hob) = 3,390,861.02 kWh
- Total unregulated cooking demand (all gas) = 4,088,136.60 kWh

#### 3.2 Commercial Properties:

The NW Bicester masterplan includes range of commercial buildings and this section describes the potential energy demands for the baseline scheme based upon established energy benchmarks. Table 3-7 below lists the anticipated energy demands taken from CIBSE TM46 document which are consistent with Building Regulations Part L 2006.

Table 3-7 Commercial Units Area breakdown

Building Classification	Fossil Fuel Benchmark (kWh/m²) PA	Electricity Benchmark (kWh/m²) PA
A1 – Retail Hub	105	400
A1 – Other Retail Leisure	170	70
B2 – B8 Commercial	120	95
B1 Office in Hubs	120	95
Eco Business in Hubs	120	95
B1 Office	120	95
Care Home/ Hotel in hubs	330	105
Care Home	420	65
Primary Schools	150	40
Secondary School	150	40
Nursery Community Centre in Hubs	200	70
Other Community	105	20
Energy Centre in Hubs	180	35

The above benchmarks have been used within the calculations to estimate the energy demands of each of the above commercial building. The above fossil fuel and electricity benchmarks and based upon the annual benchmarks and are indicative at this stage. However, as these are based on values consistent with 2006 Building Regulations it is likely that the NW Bicester eco development demands would be lower than the above estimated. This is further discussed in Section 4.

Table 3-8 below, lists the proposed building gross external areas of the commercial building types that are anticipated to form part of the masterplan; and are therefore included within the energy demand assessment.

Table 3-8 Breakdown of Areas for Commercial Units

<b>Building Classification</b>	Area (ha)	Area (m <sup>2</sup> )
Secondary School	4.5	45,000.00
Primary School	8.3	83,000.00
Care home/ hotel in hubs	1.25	12,500.00
Care home	2.5	25,000.00
B1 Office in hubs	0.3	3,000.00
Eco business in hubs	0.9	9,000.00
B1 Office	2.7	27,000.00
B2 to B8 Commercial	6.2	62,000.00
Retail Hubs	1.1	11,000.00
Other Retail Leisure	0.6	6,000.00
Nursery Community centre in hubs	0.6	6,000.00
other community	2.05	20,500.00
energy centre in hubs	0.6	6,000.00

CONVERSION FACTOR: 1 HECTARE = 10,000M2

The above gross external areas have been taken from the NW Bicester Masterplan options schedule (see Table 1) and also utilised within the calculations to estimate the commercial buildings energy demands. As the energy benchmark data is provided in the form of fossil fuel and electricity; the energy estimation is in line with the above standard.

The following table 3-9 shows the fossil fuel and electricity demands of each of the building type,

Table 3-9 Baseline Electricity and Fossil Fuel Demands for Commercial Units

Building Classification	Description	Total Proposed Site Area (m²)	GIA Area (m²)	Typical Annual Electricity Benchmarks (kWh/m²)	Typical Annual Electricity Demand (kWh)	Typical Annual Fossil Fuel Benchmarks (kWh/m²)	Typical Annual Fossil Fuel Demand (kWh)
7	Shops						
¥	Retail Hub	11,000	4,400	400	1,760,000	105	392,700
	other Retail Leisure	000′9	2,400	70	168,000	170	346,800
B2 to B8	Commercial	62,000	35,805	95	3,401,475	120	3,652,110
B1	Offices						
	B1 Office in hubs	3,000	2,000	95	190,000	120	204,000
	Eco business in hubs	000′6	5,400	95	513,000	120	250,800
	B1 Office	27,000	16,200	95	1,539,000	120	1,652,400
C2	Residential Institutions						
	Care home/ hotel in hubs	12,500	7,500	105	787,500	330	2,103,750
	Care home	25,000	000'6	65	585,000	420	3,213,000
	Public Buildings						
	Primary Schools	83,000	16,500	40	000'099	150	2,103,750
	Secondary School	45,000	4,500	40	180,000	150	573,750
	Others Non Residential Buildings						
	Nursery Community centre in hubs	000'9	3,600	70	252,000	200	612,000
	Other Community	20,500	12,300	20	246,000	105	1,097,775
	energy centre in hubs	6,000	2,800	35	98,000	180	428,400
		Total	122,405		10,379,975		16,931,235

THE HEATING DEMAND HAS BEEN CAICULATED BY UTILSING 85% BOILER EFFICIENCY FACTOR

Bicester master plan proposed options 6 - v2 -01-07-2013. The above table list the total energy demands of each of the building types and also the The above benchmarks have been taken from "CIBSE TM 46 - table 1" Benchmark categories and the Gross internal areas are taken from the NW total for the total commercial aspect of the NW Bicester eco development. The total demands are summarised below:

- Typical Annual total Electricity Demand = 10,379,975 kWh
- Typical Annual total Fossil Fuel Demand = 16,931,235 kWh
- Hence the total energy demand of the total commercial development = 27,311,210 kWh

The above energy demand is indicative and based upon the areas listed above however if the proposed areas change then the annual demand should also be changed.

# 4 Enhanced Fabric Energy Efficiency (FEE) Standards

As mentioned previously the baseline has been considered to demonstrate compliance with current (2010) Building Regulations. However to meet the PPS 1 planning requirement; CSH level 4 FEE criteria should be adopted. In addition, understanding the extent to which differing FEE standards influence the total energy demand from the development forms an integral part of determining which zero carbon solution may be adopted.

#### 4.1 CSH Level 4 FEE standards

To demonstrate the CSH FEE level compliance for CSH level 4, we have followed the requirements of the CSH Technical Guidance (2010); as shown below.

Dwe	lling Type*1		
Apartment Blocks, Mid-Terrace	End Terrace, Semi- Detached & Detached		
Fabric Energy E	fficiency kWh/m²/year	Credits*2	Mandatory Levels
≤ 48	≤60	3	
45	≤ 55	4	
≤ 43	≤ 52	5*3	
≤ 41	≤ 49	6	2000
≤ 39	≤ 46	7	Levels 5 & 6
≤ 35	≤ 42	8	777
≤ 32	≤ 38	9	

To enable the above FEE standards to be met (Apartment blocks and Mid terrace dwellings =≤43 kWh/m2/year and End Terrance, Semi Detached and Detached =≤52 kWh/m2/year); we have established the following key performance criteria for each house type and predict the energy demand on this basis.

Table 4-1 SAPs CSH FEE Level 4 compliance scenario

		1 Bedroom	2 Bedroom	3 Bedroom	4 Bedroom	5 Bedroom
	External Wall	0.18	0.18	0.2	0.18	0.18
	Party Wall	0	0	0	0	0
Fabric U	Roof	0.13	0.13	0.18	0.18	0.18
Values	Floor	0.15	0.15	0.2	0.2	0.2
$(W/m^2 K)$	Door	1.2	1.2	1.4	1.4	1.4
	DOOI	Solid	Solid	Solid	Solid	Solid
	Window	1.4	1.4	1.4	1.4	1.5
	Glazing	Double Glazed	Double Glazed	Double Glazed	Double Glazed	Double Glazed
Thermal (Y V: (W/n	0 0	0.08	0.04	0.06	0.08	0.04
Air Le m3/h/m2	akage 2@50Pa	4.8	4.8	5.1	4.8	5.8

The above combinations have been used within the calculation software which produces the SAP worksheet reports, to predict the regulated energy demands, i.e. heating, hot water, pumps & fans and lighting for each house type. From this calculation we have taken the total CSH Level 4 compliance energy demand for the residential component of the NW Bicester masterplan based on 5607 units.

required for running the lighting, pumps & fans, heating and hot water systems within the proposed dwelling to meet the CSH level 4 FEE compliance. Table The SAP output provides the overall annual regulated energy demands in kWh, for each house types. The regulated energy demand includes the energy 4-2 below shows the breakdown of energy demand for each house type along with the total demand based on 5,607 units.

Regulated energy demand for 5,607 Units to meet the CSH level 4 FEE Compliance Table 4-2

						ANNUA	ANNUAL REGULATED DEMAND SECTION	EMAND SECTIO	Z		
Туре	Units Break down	Total Housing Unit area (m²)	Area Weighted Pumps & Fans Demand (kWh/m²)	Pumps & Fans Demand (kWh)	Area Weighted Lighting Demand (kWh/m²)	Lighting Demand (kWh)	Area Weighted Space Heating Demand (kWh/m²)	space Heating Demand (kWh)	Area Weighted Hot Water Demand (KWh/m²)	Hot Water Demand (kWh)	Total Demand (kWh)
1bed	673	42,382	2.79	118,367.12	4.51	191,254.21	27.80	1,178,131.59	33.40	1,415,758.65	2,903,511.55
2beds	2243	185,323	2.11	390,740.35	4.54	841,208.14	27.33	5,064,776.36	27.80	5,151,610.03	11,448,334.88
3beds	1962	191,417	1.79	343,428.75	4.09	782,311.07	36.91	7,065,918.97	24.41	4,671,945.84	12,863,604.63
4beds	202	57,195	1.54	88,310.25	4.54	259,384.87	38.30	2,190,684.62	21.50	1,229,576.41	3,767,956.15
2beds	224	33,642	1.17	39,249.00	4.03	135,572.77	39.95	1,344,094.34	15.83	532,463.15	2,051,379.26
Total	2607	509958.89	9.41	980,095.46	21.70	2,209,731.06	170.30	16,843,605.88	122.94	13,001,354.08	33,034,786.48

Fable 4-2 presents the regulated demands of each residential unit type; providing the area weighted demand and the overall demand of electricity and fossil fuel. The total energy demand for all residential units is summarised below:

- Fossil Fuel / Gas = 29,844,959.95 kWh (this includes space heating and hot water)
- Electricity = 3,189,826.52 kWh (this includes lighting, pumps and fans)

The above table shows that the overall energy demand has been reduced from a Building Regulation 2010 baseline of 40,137,075.74kWh to 33,034,786.18kWh due to the improvements of fabric efficiency, air tightness and ventilation standards. This equates to an overall reduction in energy demand of 17.70% been achieved by adopting a CSH FEE level 4 compliant building fabric.

Copies of the CSH compliance SAP worksheet are provided under Appendix B of this report.

#### 4.2 CSH Level 5/6 FEE standards

To demonstrate the CSH FEE level compliance for CSH level 5/6, we have followed the requirements of the CSH Technical Guidance (2010); as shown below.

Dwe	lling Type*1		
Apartment Blocks, Mid-Terrace	End Terrace, Semi- Detached & Detached		
Fabric Energy E	fficiency kWh/m²/year	Credits*2	Mandatory Levels
≤ 48	≤60	3	
≤ 45	≤55	4	
≤ 43	≤ 52	5*3	
≤ 41	≤ 49	6	
≤ 39	≤ 46	7	Levels 5 & 6
≤ 35	≤ 42	8	
≤ 32	≤38	9	

To enable the above FEE standards to be met (Apartment blocks and Mid terrace dwellings =≤39 kWh/m2/year and End Terrance, Semi Detached and Detached =≤46 kWh/m2/year); we have established the following key performance criteria for each house type and predict the energy demand on this basis.

Table 4-3 SAPs CSH FEE Level 5 & 6 compliance scenario

		1 Bedroom	2 Bedroom	3 Bedroom	4 Bedroom	5 Bedroom
	External Wall	0.15	0.15	0.15	0.15	0.15
	Party Wall	0.00	0.00	0.00	0.00	0.00
Fabric U	Roof	0.13	0.13	0.13	0.13	0.13
Values (W/m <sup>2</sup> K)	Floor	0.15	0.15	0.18	0.15	0.15
	Door	1.2 Solid	1.2 Solid	1.40 Solid	1.40 Solid	1.40 Solid
	Window	1.0 Triple Glazed	1.20 Double Glazed	1.4 Double Glazed	1.4 Double Glazed	1.20 Double Glazed
(Y V	Bridging alue) n2 K)	0.04	0.05	0.08	0.05	0.04
	akage 2@50Pa	4.8	4.8	4.8	4.8	4.8

The above table 4-3 lists the proposed u values improvements for each of the dwelling types to meet the CSH level 5/6 compliance. Table 4.4 on next page shows the results obtained from the change of the above fabric efficiencies within the SAP model.

required for running the lighting, pumps & fans, heating and hot water systems within the proposed dwelling to meet the CSH level 5/6 FEE compliance. Table The SAP output provides the overall annual regulated energy demands in kWh, for each house types. The regulated energy demand includes the energy 4-4 below shows the breakdown of energy demand for each house type along with the total demand based on 5,607 units,

Regulated energy demand for 5,607 Units to meet the CSH level 5/6 FEE Compliance Table 4-4

						ANNO	ANNUAL REGULATED DEMAND SECTION	EMAND SECTIO	Z		
Туре	Units Break down	Total Housing Unit area (m²)	Area Weighted Pumps & Fans Demand (kWh/m²)	Pumps & Fans Demand (kWh)	Area Weighted Lighting Demand (KWh/m²)	Lighting Demand (kWh)	Area Weighted Space Heating Demand (KWh/m²)	space Heating Demand (kWh)	Area Weighted Hot Water Demand (KWh/m²)	Hot Water Demand (KWh)	Total Demand (kWh)
1bed	673	42,382	2.79	118,367.12	4.65	197,037.28	23.78	1,008,054.95	33.53	1,420,939.74	2,744,399.09
2beds	2243	185,323	2.11	390,740.35	4.54	841,208.14	23.52	4,359,389.56	27.90	5,170,588.85	10,761,926.90
3beds	1962	191,417	1.79	343,428.75	4.09	782,311.07	31.28	5,987,140.58	24.51	4,691,295.60	11,804,176.00
4beds	202	57,195	1.54	88,310.25	4.54	259,384.87	32.50	1,858,890.39	21.58	1,234,203.87	3,440,789.38
2beds	224	33,642	1.17	39,249.00	4.03	135,572.77	33.71	1,134,219.84	15.88	534,163.19	1,843,204.81
Total	2607	509958.89	9.41	980,095.46	21.84	2,215,514.14	144.80	14,347,695.33	123.39	13,051,191.25	30,594,496.18

Fable 4-4 presents the regulated demands of each residential unit type; providing the area weighted demand and the overall demand of electricity and fossil. The total energy demand for all residential units is summarised below:

- Fossil Fuel / Gas = 27,398,886.58 kWh (this includes space heating and hot water)
- Electricity = 3,195,609.60 kWh (this includes lighting, pumps and fans)

The above slight increase in electricity demand occurs due to the replacement of double glazed window to triple glazed in 1 bedroom dwellings, which reduces natural day lighting and thus increases artificial lighting demands. The overall energy demand has been reduced from a Building Regulation 2010 baseline of 40,137,075.74kWh to 30,594,496.18kWh. This equates to an overall reduction in energy demand of 23.77% been achieved from compliance to CSH FEE level 5/6. Reduction in energy demand between CSH FEE level 4 compliance of 33,034,786.48kWh to CSH FEE level 5/6 of 30,594,496.18kWh equals 7.39%

Copies of the CSH compliance SAP worksheet are provided under Appendix C of this report.

#### 4.3 Passivhaus FEE standards

We have further assessed the dwelling for Passivhaus standards and obtained the following results by further improving the fabric efficiencies, air tightness and ventilation standards, The table below is set of U values and other measures have been used within the SAP model to meet the passivhaus compliance standards,

Table 4-5 SAPs Passivhaus compliance scenario

		1 Bedroom	2 Bedroom	3 Bedroom	4 Bedroom	5 Bedroom
	External Wall	0.15	0.15	0.15	0.15	0.15
	Party Wall	0.00	0.00	0.00	0.00	0.00
	Roof	0.15	0.15	0.15	0.15	0.15
Fabric U Values	Floor	0.15	0.15	0.15	0.15	0.15
(W/m <sup>2</sup> K)	Door	1.2 Solid	1.2 Solid	1.2 Solid	1.2 Solid	1.2 Solid
	Window	0.80 Triple Glazed	0.80 Triple Glazed	0.80 Triple Glazed	0.80 Triple Glazed	0.80 Triple Glazed
(Y	al Bridging Value) /m2 K)	0.04	0.04	0.04	0.04	0.04

The above table 4-5 lists the proposed u values improvements for each of the dwelling types to meet the passivhaus compliance. The table on next page shows the results obtained from the change of the above fabric efficiencies within the SAP model.

required for running the lighting, pumps & fans, heating and hot water systems within the proposed dwelling to meet the passivhaus compliance. Table 4-6 The SAP output provides the overall annual regulated energy demands in kWh, for each house types. The regulated energy demand includes the energy below shows the breakdown of energy demand for each house type along with the total demand for the whole 5,607 units,

Regulated energy demand for 5,607 Units to meet the Passivhaus Compliance Table 4-6

			-	•	-	ANNUAL R	ANNUAL REGULATED DEMAND SECTION	AND SECTION	-		
Туре	Units Breakd own	Total Housing Unit area (m²)	Area Weighted Pumps & Fans Demand (KWh/m²)	Pumps & Fans Demand (kWh)	Area Weighted Lighting Demand (KWh/m²)	Lighting Demand (KWh)	Area Weighted Space Heating Demand (kWh/m²)	space Heating Demand (kWh)	Area Weighted Hot Water Demand (KWh/m²)	Hot Water Demand (KWh)	Total Demand (kWh)
1bed	673	31,495	4.65	197,037.28	4.65	197,037.28	4.54	192,512.28	34.49	1,461,691.85	2,048,278.70
2beds	2243	123,945	4.17	772,281.55	4.67	866,059.23	3.87	716,930.39	28.77	5,331,216.62	7,686,487.79
3beds	1962	195,080	3:55	679,125.45	4.15	794,988.50	4.20	803,701.77	25.43	4,868,308.59	7,146,124.30
4beds	505	85,005	3.56	203,880.61	4.65	266,091.40	7.88	450,917.18	22.28	1,274,261.40	2,195,150.59
5beds	224	37,500	3.45	116,206.20	4.13	138,925.76	11.58	389,442.03	16.26	546,886.59	1,191,460.59
Total	5607	473025	19.38	1,968,531.09	22.26	2,263,102.17	32.07	2,553,503.66	127.22	13,482,365.05	20,267,501.97

Table 4-6 presents the regulated demands of each residential unit type; providing the area weighted demand and the overall demand of electricity and fossil uel for each residential units. The total energy demand for all residential units is summarised below,

- Fossil Fuel / Gas = 16,035,868.71kWh (this includes space heating and hot water)
- Electricity = 4,231,633.26 kWh (this includes lighting, pumps and fans)

The above increase in electricity demand occur due to the replacement of double glazed window to triple glazed in all the dwelling types, as due to reduced natural day lighting the lighting demands have increased; plus mechanical ventilation the pumps & fans demand has also been increased.. The fossil fuel demand is generally only for the hot water demand (with very limited heating demand) and therefore represents a decrease in overall demand from the previous scenarios. The overall energy demand has been reduced from a Building Regulation 2010 baseline of 40,137,075.74kWh to 20,267,501.97 kWh. This equates to an overall reduction in energy demand of 49.50% been achieved from compliance to CSH FEE level 5/6. Reduction in energy demand between CSH FEE level 4 compliance of 33,034,786.48kWh to passivhaus FEE standards of 20,267,501.97 kWh equals 38.65%

Copies of the passivhaus compliance SAP worksheet are provided under Appendix D of this report.

#### 4.4 Summary of Enhanced FEE Scenarios

The regulated energy demand of each dwelling type have been assessed on the basis of differing CSH and Passivhaus FEE standards to establish the likely improvements above baseline demands. The savings in regulated energy demand shown are through in improvements in the fabric efficiency, ventilation, thermal bridging and air tightness proposed.

The charts below shows the impact of each change with regards to the % improvement in overall energy demands relative to Building regulation 2010 compliance (Chart 1) and against CSH level 4 FEE standards (Chart 2); which is effectively the baseline for the NW Bicester eco-development.

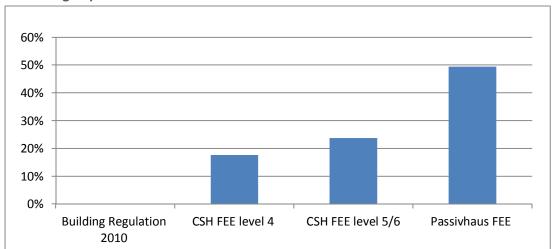


Chart 1 - Showing improvement relative to BR 2010 baseline

Chart 1 shows progressive energy demand savings over Building Regulation 2010 relative to CSH FEE level 4 (17.70%), CSH FEE level 5/6 (23.77%) and Passivhaus FEE (49.50%) standards.

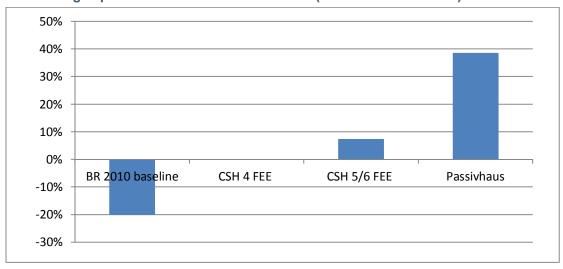


Chart 2 - Showing improvement relative to CSH level 4 (effective site baseline)

Chart 2 shows progressive energy demand savings over CSH FEE level 4 relative to, CSH FEE level 5/6 (7.39%) and Passivhaus FEE (38.65%) standards.

The above charts have been produce to highlight the potential improvements of adopting differing fabric efficiency standards for NW Bicester eco development; to attain appropriate compliance to achieve improved environmental savings.

#### 5 Summary

The residential demand has been calculated through SAP 2009 version 9.90 methodology and the commercial demands have been estimated on the basis of CIBSE TM46 benchmarks. Both of these methods have been used to derive the baseline compliance relative to Building Regulation 2010. This building regulation baseline is presented in Table 5.1 below.

Table 5-1 Baseline Energy Demands relative to Building Regulation 2010

Energy Demands	Residential (kWh)	Commercial (kWh)
Total Electricity Regulated Demand	3,189,826.52	
Total Electricity Unregulated (Appliances ) Demand	15,227,275.11	
Sub Total Electricity Demands	18,417,101.63	10,379,975
Total Fossil Fuel/Gas Regulated Demand	36,947,249.22	
Total Fossil Fuel/Gas Unregulated (All Gas Cooking) Demand	4,088,136.60	
Sub Total Fossil Fuel Demands	41,035,385.82	16,931,235
Total Energy Demand	59,452,487.45	27,311,210.00
Total Energy Demand (Electric & Gas) (kWh)	86,763	,697.45
Total Energy Demand (Electric & Gas) (MWh)	86,7	63.70

In addition, a series of improved fabric efficiency scenarios have been modelled. In accordance with the PPS1 Ecotown required, all residential dwellings should achieve a minimum of CSH level 4; and therefore this may be regarded as the NW Bicester eco development site based baseline. This is presented in Table 5.2 below.

The difference in total energy demand between the building regulation baseline and the CSH FEE level 4 baseline is 7,108 MWh. It should be remembered that whilst the regulated energy component may have reduced by 17.70%, the unregulated energy component will not have altered. Therefore the overall difference is only 8.19%.

Also refer to table 5-3 the difference in total energy demand between the building regulation baseline and the CSH FEE level 5/6 is 9,542 MWh. It should be remembered that whilst the regulated energy component may have reduced by 23.77%, the unregulated energy component will not have altered. Therefore the overall difference is only 11%.

Table 5-2 Baseline Energy Demands relative to CSH FEE Level 4

Energy Demands	Residential (kWh)	Commercial (kWh)
Total Electricity Regulated Demand	3,189,826.52	
Total Electricity Unregulated (Appliances ) Demand	15,227,275.11	
Sub Total Electricity Demands	18,417,101.63	10,379,975
Total Fossil Fuel/Gas Regulated Demand	29,844,959.95	
Total Fossil Fuel/Gas Unregulated (All Gas Cooking) Demand	4,088,136.60	
Sub Total Fossil Fuel Demands	33,933,096.55	16,931,235
Total Energy Demand	52,350,198.18	27,311,210.00
Total Energy Demand (Electric & Gas) (kWh)	79,661,	408.18
Total Energy Demand (Electric & Gas) (MWh)	79,66	51.41

Table 5-3 Baseline Energy Demands relative to CSH FEE Level 5/6

Energy Demands	Residential (kWh)	Commercial (kWh)
Total Electricity Regulated Demand	3,195,609.60	-
Total Electricity Unregulated (Appliances ) Demand	15,227,275.11	-
Sub Total Electricity Demands	18,422,884.71	10,379,975
Total Fossil Fuel/Gas Regulated Demand	27,398,886.58	-
Total Fossil Fuel/Gas Unregulated (All Gas Cooking) Demand	4,088,136.60	-
Sub Total Fossil Fuel Demands	31,487,023.18	16,931,235
Total Energy Demand	49,909,907.89	27,311,210.00
Total Energy Demand (Electric & Gas) (kWh)	77,221,	117.89
Total Energy Demand (Electric & Gas) (MWh)	77,22	21.12

The Appendix below contain the copies of supporting SAP 2009 calculations, the Unregulated emissions calculations, the copy of TM46 tables and the relevant calculations as listed throughout this document to estimate the demands.

#### Baseline SAP 2009 Worksheets for 1 to 5 Bedroom

				User D	etails:						
Assessor Name: Software Name:	Stroma Number: Stroma FSAP 2009 Software Version: Version										
			Р	roperty .	Address	: House	1				
Address :											
1. Overall dwelling dime	ensions:				4 0			1 1 4 1			
Ground floor				Area	<b>a(m²)</b> 75	(1a) x		eight(m) 2.5	(2a) =	Volume(m <sup>3</sup>	<b>')</b> [(3a)
First floor									<u></u>		ᆜ
	-> - (41-> - (4-> -	/4 .IV . /4V .		\	75	(1b) x		2.5	(2b) =	187.5	(3b)
Total floor area TFA = (1	a)+(1b)+(1c)+	(1d)+(1e)+	۲(1r	1)	150	(4)					_
Dwelling volume						(3a)+(3b	)+(3c)+(3c	d)+(3e)+	.(3n) =	375	(5)
2. Ventilation rate:	main	Sad	a a a da a	15. p	other		40401			m3 nor hou	
	heating	he	condar ating	· - –	otner		total			m³ per hou	ır —
Number of chimneys	0	+	0	_	0	_ = _	0		40 =	0	(6a)
Number of open flues	0	+	0	+	0	_ = _	0	x :	20 =	0	(6b)
Number of intermittent fa	ins						0	X '	10 =	0	(7a)
Number of passive vents							0	X '	10 =	0	(7b)
Number of flueless gas fi	res					Ī	0	X 4	40 =	0	(7c)
_											
						_			Air cr	nanges per ho	_
Infiltration due to chimne  If a pressurisation test has be	7					continuo fr	0		÷ (5) =	0	(8)
Number of storeys in the			, proceed	10 (17), (	ou iei wise (	Johanae II	OIII (9) 10 (	(10)		0	(9)
Additional infiltration		,						[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0						•	ruction			0	(11)
if both types of wall are p deducting areas of openi		•	onding to	the great	er wall are	a (after					
If suspended wooden			d) or 0.	1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, en	ter 0.05, else	enter 0								0	(13)
Percentage of window	s and doors di	aught stri	pped							0	(14)
Window infiltration					0.25 - [0.2			. (15) -		0	(15)
Infiltration rate  Air permeability value,	a50 everess	ad in cubic	matra	e nar ho			12) + (13) ·		area	0	(16)
If based on air permeabil				•	•	•	ietie oi e	rivelope	aica	0.3	(17)
Air permeability value applie	•						is being u	sed		0.0	()
Number of sides on which	h sheltered				(0.0)	(	. = \ =			0	(19)
Shelter factor $ (20) = 1 - [0.075 \times (19)] = $ Infiltration rate incorporating shelter factor $ (21) = (18) \times (20) = $ $ 0.3 $									(20)		
Infiltration rate incorporat	•				(21) = (18	) X (20) =				0.3	(21)
Infiltration rate modified f  Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1	
Monthly average wind sp			Juli	Jui	ı Aug	Годр	1 001	1 1404	l Dec	I	
(22)m= 5.4 5.1	5.1 4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1	l	

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m    0.41	Wind Factor (2	22a)m =	(22)m ÷	4										
Calculate effective air change rate for the applicable case  If mechanical vertitation:  If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)  If balanced with heat recovery; efficiency in % allowing for in-use factor (from Table 4h) =  a) If balanced mechanical vertitation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 - (23c) ÷ 100]  24a)m 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(22a)m= 1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27		
Calculate effective air change rate for the applicable case  If mechanical vertitation:  If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)  If balanced with heat recovery; efficiency in % allowing for in-use factor (from Table 4h) =  a) If balanced mechanical vertitation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 - (23c) ÷ 100]  24a)m 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m					
If mechanical ventilation:  If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)  If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)  a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 - (23c) ÷ 100]  24a)mm 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		1				1	<del></del>	· · · · ·	· · · · ·	0.34	0.37	0.39		
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)    If balanced with heat recovery, efficiency in % allowing for in-use factor (from Table 4th) =    a) If balanced mechanical ventilation with heat recovery (MVHR) (24a) = (22b) m + (23b) x [1 - (23c) ÷ 100]    24a)min 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			•	rate for t	he appli	cable ca	se	!	!	!	!	!		
if balanced with hear recovery, efficiency in % allowing for in-use factor (from Table 4h) =				andiv N (2	3h) - (23a	a) × Emy (e	aguation (N	VS)) othe	rwica (23h	) = (23a)				(23
a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 - (23c) + 100]  24a)m 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			0 11	, (	, (	, ,	• •	,, .	`	) = (25a)				
24a)m 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	, , , ,											1 – (23c)		(23
24b/m=0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		·					<del>-                                    </del>	<del>- ^ `</del>	ŕ	<del> </del>	<del></del>	<del>```</del>		(24
c) If whole house extract ventilation or positive input ventilation from outside if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)    24c/m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	b) If balance	ed mech	anical ve	entilation	without	heat red	covery (N	иV) (24b	)m = (22	2b)m + (	23b)			
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 0 0 0 0 0 0							<del>-                                    </del>	<del>r ´`</del>	ŕ	<del>r ´     `</del>	<del></del>	0		(24
24c m  = 0	c) If whole h	ouse ex	tract ver	tilation o	or positiv	re input v	ventilatio	on from o	outside				•	
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	if (22b)r	n < 0.5 ×	(23b), t	hen (24	c) = (23b	); other	wise (24	c) = (22t	o) m + 0.	5 × (23b	p)		•	
24d)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]  24d)m = 0.58	(24c)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
24d)m= 0.58	,					•				0.51				
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)  25)			<u>`</u>	,		<del>- `</del>	<del></del>		<del></del>	_	0.57	0.58		(24
3. Heat losses and heat loss parameter:  ELEMENT Gross Openings afea (m²)  Ooots  Net Area A, m² W/m2/K (W/K) kJ/m²-K kJ/K  Ooots  Nindows  6.25 x1/t1/(1.5)+0.04] = 8.84  Circor Type 1  Too Type 2  Nalls 150.18 14.5 135.68 x 0.2 = 15	` ' -									0.50	0.07	0.50		(=
3. Heat osses and heat loss parameter:  ELEMENT Gross area (m²) Openings (A , m²) W/m2K (W/K) (kJ/m²-K (kJ/K) (kJ/m²-K (kJ/m²-K (kJ/K) (kJ/m²-K (kJ/m²-K (kJ/K) (kJ/m²-K					` `	<u> </u>	· `		<u>` '</u>	0.56	0.57	0.58		(25
A X U   K-value   A X K   KJ/K														
A , m² W/m² K   (W/K)   kJ/m² K   kJ/K   (20						<b>N</b> 1 ( A				A >< 1.1			_	A 37 I
Mindows  6.25	ELEMENI				-						K)			
Floor Type 1  Floor Type 2  Walls  150.18  14.5  135.68  X  0.2  Elia  155  Cotal area of elements, m2  Total fabric heat loss  Total	Doors					2	x	1.4	-	2.8	ή			(26)
Toor Type 2	Windows					6.25	x1.	/[1/( 1.5 )+	0.04] =	8.84	一			(27)
Nalls	Floor Type 1					75	x	0.2	i	15	Ħ ſ			(28)
Roof   75	Floor Type 2					75	x	0.2	<del>-</del>	15	Ħ i		7 F	(28)
Total area of elements, m <sup>2</sup> 375.18  (376 re 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)  **Include the areas on both sides of internal walls and partitions  **Fabric heat loss, W/K = S (A x U)  **Include the areas on both sides of internal walls and partitions  **Fabric heat loss, W/K = S (A x U)  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and partitions  **Include the areas on both sides of internal walls and parti	Walls	150.	18	14.5		135.6	8 x	0.2		27.14	F i		7 F	(29)
* 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) =  (28)(30) + (32) + (32a)(32e) =  (32) 40329.1986  (34)  Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K  Indicative Value: High  450  (35)  For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f  tean be used instead of a detailed calculation.  Thermal bridges: S (L x Y) calculated using Appendix K  if details of thermal bridging are not known (36) = 0.15 x (31)  Total fabric heat loss  Ventilation heat loss calculated monthly  (38)m = 0.33 × (25)m × (5)  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  38)m= 72.37 71.23 71.23 69.16 67.92 67.35 66.8 66.8 68.22 69.16 70.16 71.23  Heat transfer coefficient, W/K  (39)m = (37) + (38)m  195 193.87 193.87 193.87 191.8 190.56 189.99 189.44 189.44 190.86 191.8 192.8 193.87	Roof	75		0		75	x	0.2		15			7 F	(30)
# include the areas on both sides of internal walls and partitions  Fabric heat loss, W/K = S (A x U)  Heat capacity Cm = S(A x k)  (26)(30) + (32) =  (28)(30) + (32) + (32a)(32e) =  (32e) 40329.1986  (35e) 450  (36e) 450  (37e) 450  (37e) 450  (38e) 450  (37e) 450  (38e) 450	Total area of e	elements	, m²			375.1	8							(31)
Fabric heat loss, W/K = S (A x U)  (26)(30) + (32) =  (32) (32) (32) (32) (33) (32) (32) (32)	* for windows and	l roof wind	ows, use e	effective wi	ndow U-va	alue calcul	ated using	formula 1	/[(1/U-valu	ıe)+0.04] a	as given in	paragraph	3.2	
Heat capacity Cm = S(A x k )  ((28)(30) + (32) + (32a)(32e) = 40329.1986 (34)  ((38)(30) + (32) + (32a)(32e) = 45.0 (38)  ((38)(30) + (32) + (32a)(32e) = 40329.1986 (34)  ((38)(30) + (32) + (32a)(32e) = 40329(32e)  ((38)(30) + (32) + (32a)(32e) = 40329(32e)  ((38)(30) + (32) + (32a)(32e) = 40329(32e)  ((38)(30) + (32) + (32a)(32e)  ((38)(30) + (32a)(32e)  ((3					ls and pan	titions		(22)	(00)					
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K  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  If details of thermal bridging are not known (36) = 0.15 x (31)  Total fabric heat loss  Ventilation heat loss calculated monthly  (38)m = 0.33 × (25)m × (5)  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (38)m = 72.37 71.23 71.23 69.16 67.92 67.35 66.8 66.8 68.22 69.16 70.16 71.23  Heat transfer coefficient, W/K  (39)m = (37) + (38)m  Separate Value: High  450  (36)  (37)  (38)  (38)  (39)  (39)  (30)  (30)  (30)  (31)  (32)  (32)  (33)  (34)  (35)  (35)  (36)  (37)  (38)  (38)  (39)  (30)  (30)  (30)  (30)  (31)  (32)  (32)  (33)  (34)  (35)  (34)  (35)  (36)  (36)  (37)  (38)  (38)  (39)  (38)  (39)  (39)  (39)  (39)  (30)		•	`	U)				(26)(30)		,,	_, ,,		92.62	(33)
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  30.01  (36)  If details of thermal bridging are not known (36) = 0.15 x (31)  Total fabric heat loss  (33) + (36) =  (38)m = 0.33 x (25)m x (5)  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  38)m=  72.37  71.23  71.23  71.23  69.16  67.92  67.35  66.8  66.8  66.8  68.22  69.16  70.16  71.23  (36)  Heat transfer coefficient, W/K  (39)m = (37) + (38)m  39)m=  195  193.87  193.87  193.87  191.8  190.56  189.99  189.44  189.44  190.86  191.8  192.8  193.87		,	,						,	, , ,	, , ,	(32e) =	40329.19	
Can be used instead of a detailed calculation.  Thermal bridges: S (L x Y) calculated using Appendix K  If details of thermal bridging are not known (36) = 0.15 x (31)  Total fabric heat loss  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 = 72.37 71.23 71.23 69.16 67.92 67.35 66.8 66.8 68.22 69.16 70.16 71.23  Heat transfer coefficient, W/K  (39)m = (37) + (38)m  39)m = 195 193.87 193.87 191.8 190.56 189.99 189.44 189.44 190.86 191.8 192.8 193.87		-						ooioolu thu			· ·	abla 1f	450	(35)
f details of thermal bridging are not known (36) = 0.15 x (31)  Total fabric heat loss	J				construct	ion are noi	t known pr	ecisely the	е іпаісаті е	values of	TIMP IN T	аріе 11		
Total fabric heat loss (33) + (36) = 122.64 (37)  Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m × (5)    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec	Thermal bridge	es : S (L	x Y) cal	culated ı	using Ap	pendix l	<						30.01	(36)
Ventilation heat loss calculated monthly  (38)m = 0.33 × (25)m × (5)    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec			are not kn	own (36) =	= 0.15 x (3	1)								
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  38)m= 72.37 71.23 71.23 69.16 67.92 67.35 66.8 66.8 68.22 69.16 70.16 71.23  Heat transfer coefficient, W/K  (39)m = (37) + (38)m  39)m= 195 193.87 193.87 191.8 190.56 189.99 189.44 189.44 190.86 191.8 192.8 193.87													122.64	(37
38)m= 72.37 71.23 71.23 69.16 67.92 67.35 66.8 66.8 68.22 69.16 70.16 71.23 (36)m= (37) + (38)m  39)m= 195 193.87 193.87 191.8 190.56 189.99 189.44 189.44 190.86 191.8 192.8 193.87		<del> </del>		·				· -			1		Ī	
Heat transfer coefficient, W/K (39)m = (37) + (38)m  39)m= 195 193.87 193.87 191.8 190.56 189.99 189.44 189.44 190.86 191.8 192.8 193.87		-						<del></del>	<u> </u>	1	<del> </del>			(20)
39)m= 195 193.87 193.87 191.8 190.56 189.99 189.44 189.44 190.86 191.8 192.8 193.87				69.16	67.92	67.35	66.8	66.8	<u> </u>	<u> </u>	<u> </u>	/1.23		(38)
Strong ESAD 2000 Varsian 1 F 0 40 (SAD 0.00) http://www.strong.com				40.5	100 ==	465					1	465 ==	İ	
	· ,							189.44	<u> </u>		<u> </u>	<u> </u>	10. P	age 2 of 7

leat lo	ss para	meter (H	ILP), W	m²K					(40)m	= (39)m ÷	(4)			
10)m=	1.3	1.29	1.29	1.28	1.27	1.27	1.26	1.26	1.27	1.28	1.29	1.29		_
امطعيا	r of dov	o in mor	oth (Tob	lo 1o\					1	Average =	Sum(40) <sub>1</sub>	.12 /12=	1.28	(4
iumbei T		Feb	nth (Tab Mar		Mov	lup	Jul	Λιια	Son	Oct	Nov	Dec		
11)m=	Jan 31	28	31	Apr 30	May 31	Jun 30	31	Aug 31	Sep 30	31	30	31		(4
	<u> </u>	20	31	30	<u> </u>		<u> </u>		30	31	30	31		( '
4 Wat	er heati	ng ener	gy requi	rement:								kWh/ye	ar.	
				rement.								RVVIII y C	ar.	
if TF	ed occu A > 13.9 A £ 13.9	, N = 1		[1 - exp	(-0.0003	349 x (TF	A -13.9	)2)] + 0.0	0013 x (T	ΓFA -13.		342		(4
nnual	average	e hot wa				ay Vd,av					109.	3547		(4
		_				lwelling is hot and co	-	to achieve	a water us	se target o	f			
Γ	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
L ot wate						ctor from 7			ОСР	Oct	1407	DCC		
4)m=	120.29	115.92	111.54	107.17	102.79	98.42	98.42	102.79	107.17	111.54	115.92	120.29		
						ļ					m(44) <sub>112</sub> =		1312.2566	(
nergy co	ontent of I	hot water	used - cal	culated mo	onthly $= 4$ .	190 x Vd,r	n x nm x E	Tm / 3600	kWh/mon	th (see Ta	bles 1b, 1	c, 1d)		
5)m=	178.81	156.39	161.38	140.7	135	116.5	107.95	123.88	125.35	146.09	159.47	173.17		
notanta	aneous w	ator hoatii	na at noint	of use (no	hot water	r storage),	enter () in	haves (46		Γotal = Su	n(45) <sub>112</sub> =	[	1724.6917	(
										04.04	00.00	05.00		,
	26.82 storage	23.46 OSS:	24.21	21.1	20.25	17.47	16.19	18.58	18.8	21.91	23.92	25.98		(-
	_		clared lo	ss facto	r is knov	vn (kWh	/day):				0.0	)24		(
emper	rature fa	ctor fro	m Table	2b							0.	54		(
nergy	lost from	n water	storage	, kWh/ye	ear			(47) x (48)	=		0.0	)13		(-
			,			s not kno								
•		` '	•	0 ,		age with					(	0		(
	-	_		_		litres in bo eous comb		enter '0' in	box (50)					
						h/litre/da			()			o		(!
	factor f	•		om rabi	0 2 (1111)	11/11(10)(40	· <b>y</b> /					0		(
			m Table	2b								5		(
nergy	lost from	n water	storage	, kWh/ye	ear			((50) x (51	) x (52) x (	(53) =				(
	19) or (5		_									)13		(
ater s	storage	loss cal	culated f	or each	month			((56)m = (	55) × (41)r	m				
6)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(
cylinder	r contains	dedicated	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Appendi	хН	
7)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(
∟ imarv	, circuit	loss (an	nual) fro	m Table	3	!					36	50		(
-						59)m = (	(58) ÷ 36	65 × (41)	m					•
-					,	solar wat	,	, ,		thermo	stat)			
•	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		(!
9)m=	00.00													
9)m=				month (	(61)m =	(60) ÷ 36	65 × (41	)m						

Total heat required for water he	eating calculated	I for each month	$(62)$ m = $0.85 \times (4)$	45)m + (46)m +	(57)m +	(59)m + (61)m					
(62)m= 209.79 184.37 192.36	170.67 165.98	146.47 138.93	154.85 155.33	177.07 189.45	204.15	(62)					
Solar DHW input calculated using App	endix G or Appendix	H (negative quantit	y) (enter '0' if no solar	contribution to water	er 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= 209.79 184.37 192.36	170.67 165.98	146.47 138.93	154.85 155.33	177.07 189.45	204.15						
		l l	Output from wa	nter heater (annual)	112	2089.4221 (64)					
Heat gains from water heating,	kWh/month 0.25	5 ´ [0.85 × (45)m	n + (61)m] + 0.8 x	[(46)m + (57)m	+ (59)m	]					
(65)m= 84.24 74.38 78.44	70.76 69.67	62.72 60.68	65.97 65.66	73.36 77.01	82.36	(65)					
include (57)m in calculation of	of (65)m only if c	ylinder is in the	dwelling or hot wa	ater is from com	munity h	neating					
5. Internal gains (see Table 5	5 and 5a):										
Metabolic gains (Table 5), Wat	ts										
Jan Feb Mar	Apr May	Jun Jul	Aug Sep	Oct Nov	Dec						
(66)m= 176.05 176.05 176.05	176.05 176.05	176.05 176.05	176.05 176.05	176.05 176.05	176.05	(66)					
Lighting gains (calculated in Ap	ppendix L, equati	ion L9 or L9a), a	ilso see Table 5	-	•	•					
(67)m= 85.57 76 61.81	46.79 34.98	29.53 31.91	41.48 55.67	70.69 82.5	87.95	(67)					
Appliances gains (calculated in	Appendix L, eq	uation L13 or L1	3a), also see Tab	ole 5							
(68)m= 478.39 483.36 470.85	444.22 410.6	379 357.89	352.93 365.44	392.07 425.69	457.28	(68)					
Cooking gains (calculated in A	ppendix L, equat	ion L15 or L15a	), also see Table	5							
(69)m= 55.54 55.54 55.54	55.54 55.54	55.54 55.54	55.54 55.54	55.54 55.54	55.54	(69)					
Pumps and fans gains (Table 5	ōa)										
(70)m= 10 10 10	10 10	10 10	10 10	10 10	10	(70)					
Losses e.g. evaporation (negative	tive values) (Tab	le 5)				_					
(71)m= -117.37 -117.37 -117.37	-117.37 -117.37	-117.37 -117.37	-117.37 -117.37	-117.37 -117.37	-117.37	(71)					
Water heating gains (Table 5)											
(72)m= 113.22 110.69 105.43	98.28 93.64	87.11 81.55	88.67 91.2	98.6 106.95	110.7	(72)					
Total internal gains =		(66)m + (67)n	n + (68)m + (69)m + (7	70)m + (71)m + (72)	)m						
(73)m= 801.41 794.27 762.31	713.52 663.44	619.86 595.58	607.3 636.53	685.58 739.36	780.16	(73)					
6. Solar gains:											
Solar gains are calculated using solar	r flux from Table 6a	and associated equa	ations to convert to the	e applicable orienta	tion.						
Orientation: Access Factor	Area	Flux	g_ Table Ch	FF		Gains					
Table 6d	m²	Table 6a	Table 6b	Table 6c		(W)					
South 0.9x 0.77 x		x 47.32	x 0.76	X 0.7	=	218.09 (78)					
South 0.9x 0.77 x	6.25	× 77.18	X 0.76	× 0.7	=	355.69 (78)					
South 0.9x 0.77 x	6.25	x 94.25	× 0.76	X 0.7	=	434.33 (78)					
South 0.9x 0.77 x		× 105.11	× 0.76	X 0.7	=	484.41 (78)					
South 0.9x 0.77 x	6.25	x 108.55	× 0.76	X 0.7	=	500.25 (78)					
South 0.9x 0.77 x	6.25	x 108.9	× 0.76	x 0.7	=	501.85 (78)					
South 0.9x 0.77 x	6.25	x 107.14	× 0.76	x 0.7	=	493.74 (78)					
South 0.9x 0.77 x	6.25	x 103.88	x 0.76	x 0.7	=	478.74 (78)					

South	0.9x	0.77	X	6.2	.5	x	9	9.99	x		0.76	х	0.7	=	460.8	(78)
South	0.9x	0.77	x	6.2	25	x	8	5.29	x		0.76	_ x _	0.7	=	393.06	(78)
South	0.9x	0.77	х	6.2	25	x	5	6.07	х		0.76	_ x _	0.7	=	258.39	(78)
South	0.9x	0.77	x	6.2	25	x	4	0.89	x		0.76	x	0.7	=	188.44	(78)
	L															
Solar	ains in	watts, ca	alculated	for eacl	n month				(83)m	ı = Sı	um(74)m	(82)m				
(83)m=	218.09	355.69	434.33	484.41	500.25	50	01.85	493.74	478	.74	460.8	393.06	258.39	188.44		(83)
Total g	ains – i	nternal a	nd sola	(84)m =	(73)m ·	+ (8	33)m	, watts		•					ı	
(84)m=	1019.49	1149.97	1196.64	1197.93	1163.69	11	21.71	1089.32	1086	5.04	1097.33	1078.64	997.76	968.6		(84)
7. Me	an inter	nal temp	erature	(heating	season	)				•						
		during h					area f	from Tah	ole 9	Th′	1 (°C)				21	(85)
•		tor for g	0.			•			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,	. ( •)				21	(/
Otilise	Jan	Feb	Mar	Apr	May	È	Jun	Jul	Δ	ug	Sep	Oct	Nov	Dec		
(86)m=	1	1	1	1	0.99	$\vdash$	0.92	0.7	0.7	<del>-</del>	0.94	0.99	1	1		(86)
				<u> </u>		<u> </u>						0.00	'	<u> </u>		(==)
		l temper												I	Ī	(07)
(87)m=	20.17	20.26	20.41	20.56	20.76	2	0.93	20.99	20.	99	20.91	20.67	20.36	20.19		(87)
Temp	erature	during h	eating p	eriods ir	rest of	dw	elling	from Ta	ble 9	9, Th	n2 (°C)				-	
(88)m=	19.84	19.85	19.85	19.86	19.87	1	9.87	19.87	19.	87	19.87	19.86	19.86	19.85		(88)
Utilisa	ation fac	tor for g	ains for	rest of d	welling,	h2,	m (se	e Table	9a)						_	
(89)m=	1	1	1	0.99	0.97		).83	0.52	0.5	2	0.87	0.99	1	1		(89)
Mean	interna	l temper	ature in	the rest	of dwalli	na	T2 (f	allow ste	ne 3	to 7	in Tabl	a 9c)				
(90)m=	18.75	18.89	19.11	19.33	19.63	Ť	9.83	19.87	19.	-	19.8	19.49	19.04	18.78		(90)
(5-5)													g area ÷ (4	L	0.33	(91)
								4							0.00	` ′
		temper	· •			_			Ė	-		40.00	10.40	40.05	. —	(92)
(92)m=	19.23	19.35	19.54	19.74	20.01		20.2	20.25	20.:		20.17	19.88	19.48	19.25		(92)
(93)m=	19.08	nent to th	19.39	19.59	19.86	_	0.05	m rable 20.1	4e,	T	20.02	19.73	19.33	19.1	]	(93)
					19.00		0.05	20.1	20.	. '	20.02	19.73	19.55	19.1		(33)
		ting requ mean int			o obtair	مط	at eta	on 11 of	Tahl	o Oh	so that	t Ti m-/	76\m an	d re-calc	sulato	
		factor fo				icu	ai si	5p 11 01	iabi	6 36	, 30 tria	· 11,111—(	r Ojili ali	u re-caic	Julate	
	Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm	1:	-	•	-							•	•	
(94)m=	1	1	1	0.99	0.97	(	).84	0.55	0.5	55	0.88	0.99	1	1		(94)
Usefu	ıl gains,	hmGm ,	W = (9	4)m x (84	4)m						•					
(95)m=	1019.17	1148.96	1193.62	1190.05	1127.91	94	47.57	602.23	602	.16	966.62	1066.05	996.88	968.34		(95)
Month	nly aver	age exte	rnal tem	perature	from T	abl	e 8								-	
(96)m=	4.5	5	6.8	8.7	11.7	Ĺ	14.6	16.9	16.	.9	14.3	10.8	7	4.9		(96)
Heat	loss rate	e for mea	an intern	al tempe	erature,	Lm	, W =	=[(39)m	x [(93	3)m-	- (96)m	]			•	
(97)m=	2842.39	2752.91	2441.73	2089.24	1554.48	10	34.61	605.35	605	.34	1092.03	1713.01	2376.46	2753.1		(97)
Space		g require		r each n	nonth, k	Νh	/mont	h = 0.02	4 x [	(97)	m – (95)	)m] x (4 <sup>-</sup>	1)m	•	1	
(98)m=	1356.47	1077.85	928.59	647.42	317.37		0	0	0		0	481.33	993.29	1327.86		_
										Total	per year (	(kWh/year	) = Sum(9	8) <sub>15,912</sub> =	7130.2	(98)
Space	e heatin	g require	ement in	kWh/m²	/year										47.53	(99)

9a. Energy requirements – Individual heating	g systems includir	ng micro-C	HP)					
Space heating:			,				_	
Fraction of space heat from secondary/sup			(201) -				0	(201)
Fraction of space heat from main system(s)		(202) = 1 -	. ,	(000)1			1	(202)
Fraction of total heating from main system	I	(204) = (20	)2) <b>x</b> [1 –	(203)] =			1	(204)
Efficiency of main space heating system 1							92.9	(206)
Efficiency of secondary/supplementary hea	<del> </del>	1. 1	_		l		0	(208)
Jan Feb Mar Apr Ma Space heating requirement (calculated abo	<u> </u>	Aug	Sep	Oct	Nov	Dec	kWh/y	ear
1356.47 1077.85 928.59 647.42 317.3	<del>- i</del>	0	0	481.33	993.29	1327.86		
$(211)m = \{[(98)m \times (204)] + (210)m \} \times 100 \div$	· (206)	_			<u> </u>			(211)
1460.14 1160.23 999.56 696.9 341.6	<del>`   `                                  </del>	0	0	518.12	1069.21	1429.35		(= : : )
	'	Total	l (kWh/yea	ar) =Sum(	211) <sub>15,1012</sub>		7675.13	(211)
Space heating fuel (secondary), kWh/mont	า					!		
= {[(98)m x (201)] + (214) m } x 100 ÷ (208)	<u> </u>	<del>                                     </del>			T -	<u> </u>	ſ	
(215)m= 0 0 0 0 0	0 0	0 Total	0	0	0 215) <sub>15.1013</sub>	0		7(045)
Matan hasting		Total	i (Kvvii/yea	ar) =Surri(	215) <sub>15,1012</sub>	2=	0	(215)
<b>Water heating</b> Output from water heater (calculated above)								
209.79 184.37 192.36 170.67 165.9	98 146.47 138.93	154.85	155.33	177.07	189.45	204.15		
Efficiency of water heater							82.8	(216)
(217)m= 91.41 91.27 91 90.59 89.1	7 82.8 82.8	82.8	82.8	89.95	91.12	91.41		(217)
Fuel for water heating, kWh/month $(219)m = (64)m \times 100 \div (217)m$								
(219)m= 229.51 202 211.39 188.39 186.	15 176.9 167.79	187.02	187.6	196.85	207.91	223.32		
		Total	I = Sum(2	19a) <sub>112</sub> =			2364.84	(219)
Annual totals				k	Wh/yeaı	r	kWh/yea	ar
Space heating fuel used, main system 1							7675.13	_
Water heating fuel used							2364.84	
Electricity for pumps, fans and electric keep-	hot							
central heating pump:						130		(2300
boiler with a fan-assisted flue						45		(230
Total electricity for the above, kWh/year		sum	of (230a).	(230g) =	:		175	(231)
Electricity for lighting							604.48	(232)
10a. Fuel costs - individual heating systems	S:							
	Fuel			Fuel P	rice		Fuel Cos	t
	kWh/yea	r		(Table			£/year	-
Space heating - main system 1	(211) x			3.	1	x 0.01 =	237.929	(240)
Space heating - main system 2	(213) x					x 0.01 =	0	(241)
Space heating - secondary	(215) x					x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)			3.		x 0.01 =	73.31	(247)
Table Hodging Cook (Cition 1401)	· -/				<u> </u>		10.01	(241)

Pumps, fans and electric keep-hot	(231)	11.46 × 0.01 =	20.06 (249)
(if off-peak tariff, list each of (230a) to (230g) se			
Energy for lighting	(232)	11.46 X 0.01 =	09.21 (200)
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254)			
	247) + (250)(254) =		506.5673 (255)
11a. SAP rating - individual heating systems			
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF) [(255) x	$(256)] \div [(4) + 45.0] =$		1.221 (257)
SAP rating (Section 12)			82.9676 (258)
12a. CO2 emissions – Individual heating syste	ms including micro-CHP		
	Energy	<b>Emission factor</b>	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating (main system 1)	(211) x	0.198 =	1519.68 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Water heating	(219) x	0.198	468.24 (264)
Space and water heating	(261) + (262) + (263) + (2	(64) =	1987.91 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517 =	90.48 (267)
Electricity for lighting	(232) x	0.517 =	312.52 (268)
Total CO2, kg/year		sum of (265)(271) =	2390.9 (272)
CO2 emissions per m²		(272) ÷ (4) =	15.94 (273)
El rating (section 14)			84 (274)
13a. Primary Energy			
	Energy	Primary	P. Energy
	kWh/year	factor	kWh/year
Space heating (main system 1)	(211) x	1.02 =	7828.63 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Energy for water heating	(219) x	1.02 =	2412.14 (264)
Space and water heating	(261) + (262) + (263) + (2	(64) =	10240.77 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92 =	511 (267)
Electricity for lighting	(232) x	0 =	1765.08 (268)
'Total Primary Energy		sum of (265)(271) =	12516.85 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	83.45 (273)

				User D	etails:						
Assessor Name:					Strom	a Num	ber:				
Software Name:	Stroma FS	SAP 200	9		Softwa	are Ve	rsion:		Versio	on: 1.5.0.49	
			P	roperty i	Address	: House	1				
Address :											
1. Overall dwelling dime	ensions:										
0 10					a(m²)	1		ight(m)	-	Volume(m <sup>3</sup>	_
Ground floor				5	6.67	(1a) x	2	2.5	(2a) =	141.675	(;
First floor				5	6.67	(1b) x	2	2.5	(2b) =	141.675	(;
Total floor area TFA = (1	a)+(1b)+(1c)+	(1d)+(1e	e)+(1n	1) 1	13.34	(4)					
Dwelling volume						(3a)+(3b	)+(3c)+(3d	)+(3e)+	.(3n) =	283.35	<u>ا</u> (؛
2. Ventilation rate:											
	main		econdar	у	other		total			m³ per hou	r
Number of chimneys	heating 0	+ [ <sup>'</sup>	neating 0	+	0	<b> </b> =	0	x ·	40 =	0	((
Number of open flues	0	╣ + ┝	0		0	 	0	x	20 =	0	<u> </u>
Number of intermittent fa	ıns						0	x	10 =	0	<u> </u>
Number of passive vents						L	0		10 =	0	
		$\neg$				Ļ			40 =		
Number of flueless gas fi	iles					L	0			0	(
									Air ch	nanges per ho	ur
Infiltration due to chimne	ys, flues and f	ans = (6	a)+(6b)+(7	a)+(7b)+(	7c) =	Г	0	Н	÷ (5) =	0	<b>—</b> (8
If a pressurisation test has b	7					continue fr	om (9) to (		( )		`
Number of storeys in the	he dw <mark>elling</mark> (n	s)								0	(9
Additional infiltration			_					[(9)	-1]x0.1 =	0	(
Structural infiltration: 0 if both types of wall are p						-	ruction			0	(
deducting areas of openi			ponding to	ille great	er wan are	a (anter					
If suspended wooden to	floor, enter 0.2	2 (unseal	ed) or 0.	1 (seale	d), else	enter 0				0	(
If no draught lobby, en	•									0	(
Percentage of window	s and doors d	raught st	ripped							0	(
Window infiltration						2 x (14) ÷ 1				0	(
Infiltration rate							12) + (13) +			0	(
Air permeability value,				•	•	•	etre of e	nvelope	area	6.1	
f based on air permeabil  Air permeability value applie	-						is beina us	sed		0.3	(
Number of sides on whic		on toot nat	, Doon wor	o or a deg	, oo an pe	cability	.s somy us	,,,,		1	<del>ا</del> (
Shelter factor					(20) = 1 -	[0.075 x (1	19)] =			0.92	(2
nfiltration rate incorporate	ting shelter fac	ctor			(21) = (18	) x (20) =				0.28	
nfiltration rate modified f	or monthly wi	nd speed	<u> </u>								
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	]	
Monthly average wind sp	eed from Tab	le 7								_	
22)m= 5.4 5.1	5.1 4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1		

Wind Factor (22a)m = (22)m ÷ 4	
(22a)m= 1.35 1.27 1.27 1.12 1.02 0.98 0.92 0.92 1.05 1.12 1.2 1.27	
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m	
0.38	
Calculate effective air change rate for the applicable case  If mechanical ventilation:	(22a)
If mechanical ventilation: $0$ If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a) $0$	(23a) (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	(23c)
a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]	(200)
(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 $(22b)m < 0.5 \times (23b)$ , then $(24c) = (23b)$ ; otherwise $(24c) = (22b)m + 0.5 \times (23b)$	
(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0	(24c)
d) If natural ventilation or whole house positive input ventilation from loft if $(22b)m = 1$ , then $(24d)m = (22b)m$ otherwise $(24d)m = 0.5 + [(22b)m^2 \times 0.5]$	
	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)	
(25)m= 0.57 0.56 0.56 0.55 0.54 0.54 0.53 0.53 0.54 0.55 0.56 0.56	(25)
area (m²)	X k J/K
Doors 2 x 1.4 = 2.8	(26)
Windows $10.125 \times 1/[1/(1.5) + 0.04] = 14.33$	(27)
Floor Type 1	(28)
Floor Type 2 56.67 × 0.2 = 11.334	(28)
Walls 113.52 12.12 101.39 x 0.2 = 20.28	(29)
Roof 56.67 0 56.67 x 0.2 = 11.33	(30)
Total area of elements, m <sup>2</sup> 283.53	(31)
Party wall 10 x 0 = 0	(32)
* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2  ** include the areas on both sides of internal walls and partitions	
Fabric heat loss, W/K = S (A x U) $(26)(30) + (32) =$ 71.41	(33)
Heat capacity $Cm = S(A \times k)$ $((28)(30) + (32) + (32a)(32e) = 27842.1791$	(34)
Thermal mass parameter (TMP = Cm $\div$ TFA) in kJ/m <sup>2</sup> K Indicative Value: High 450	(35)
For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.	_
Thermal bridges : S (L x Y) calculated using Appendix K	(36)
if details of thermal bridging are not known (36) = $0.15 \times (31)$ Total fabric heat loss (33) + (36) = 94.09	(37)
Ventilation heat loss calculated monthly $ (38)m = 0.33 \times (25)m \times (5) $	
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	

(38)m= 53.53	52.8	52.8	51.46	50.66	50.29	49.94	49.94	50.86	51.46	52.11	52.8		(38)
Heat transfer of	Coefficie	nt W/K							= (37) + (3	38)m			, ,
(39)m= 147.63	146.89	146.89	145.55	144.75	144.38	144.03	144.03	144.95	145.55	146.2	146.89		
Heat loss para	meter (l	-II P) W/	/m²K						Average = = (39)m ÷	Sum(39) <sub>1</sub> .	12 /12=	145.65	(39)
(40)m= 1.3	1.3	1.3	1.28	1.28	1.27	1.27	1.27	1.28	1.28	1.29	1.3		
, ,	<u> </u>				<u> </u>	<u> </u>		,	Average =	Sum(40) <sub>1</sub>	12 /12=	1.28	(40)
Number of day	i	<u>`</u>	le 1a)				l .	_				1	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(41)
(41)m= 31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Water hea	ting ene	rav regui	irement								kWh/ye	ear:	
			nomoni.									Jan.	
Assumed occu if TFA > 13.9 if TFA £ 13.9	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.0	0013 x (	ΓFA -13.		3335		(42)
Annual averag	e hot wa										.8364		(43)
Reduce the annua	•		0,		•	•	to achieve	a water us	se target o	f		l	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i							(43)	Seb	Oct	INOV	Dec		
(44)m= 117.52	113.25	108.97	104.7	100.43	96.15	96.15	100.43	104.7	108.97	113.25	117.52		
Energy content of	hot water	used cal	culated me	onthly - 1	100 v Vd r	n v nm v [	Tm / 2600			m(44) <sub>112</sub> =		1282.037	(44)
(45)m= 174.7	152.79	157.67	137.46	131.89	113.81	105.47	121.02	122.47	142.72	155.8	169.18		
(43)111= 174.7	132.79	137.07	137.40	131.09	113.01	103.47	121.02			m(45) <sub>112</sub> =		1684.9743	(45)
If instantaneous v	vater heati	ng at point	of use (no	hot water	r storage),	enter 0 in	boxes (46			_ ( - /			<b>_</b>
(46)m= 26.2 Water storage	22.92	23.65	20.62	19.78	17.07	15.82	18.15	18.37	21.41	23.37	25.38		(46)
a) If manufacti		clared lo	ss facto	r is knov	vn (kWh	/day):				0.0	024		(47)
Temperature f	actor fro	m Table	2b							0.	.54		(48)
Energy lost fro		•	-				(47) x (48)	) =		0.0	013		(49)
If manufacture Cylinder volum		•									0	· [	(50)
If community h	•	•	•		_		•				0		(50)
Otherwise if no	_		_				enter '0' in	box (50)					
Hot water stor	age loss	factor fr	om Tabl	e 2 (kW	h/litre/da	ay)					0		(51)
Volume factor	from Ta	ble 2a									0		(52)
Temperature f	actor fro	m Table	2b								0		(53)
Energy lost fro		_	, kWh/ye	ear			((50) x (51	l) x (52) x	(53) =		0		(54)
Enter (49) or (	, ,	•	for each	month			((56)m - (	55) × (41)ı	m	0.0	013		(55)
Water storage (56)m= 0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(56)
If cylinder contains			<u> </u>	<u> </u>								 ix H	(30)
(57)m= 0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(57)
, ,						<u> </u>		1					

Primary circuit loss calculated for each month (59)m = (58) + 365 x (41)m (modified by factor from Table 5 ls of them the size of water heating and a cylinder thermostat)  (59)m= (0.58)   77.62   0.058   29.59   0.058   29.59   0.058   29.59   0.058   28.59   0.058   0.		
Primary circuit  loss calculated for each month (59)m = (68) + 365 x (41) m	Primary circuit loss (annual) from Table 3	360 (58)
Combi   Cost		
Combi loss calculated for each month (61)m = (60) + 365 x (41)m  (61)m = 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(modified by factor from Table H5 if there is solar water heating and a cylinder thermo	ostat)
Column   D	(59)m= 30.58 27.62 30.58 29.59 30.58 29.59 30.58 29.59 30.58	29.59 30.58 (59)
Column   D	Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m	
(62)   (62)   (62)   (62)   (63)   (6		0 0 (61)
(62)   (62)   (62)   (62)   (63)   (6	Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m +	- (46)m + (57)m + (59)m + (61)m
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		
Compute   Comp	Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribu	ution to water heating)
Cosime 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		3,
Compute   Comp		0 0 (63)
Compute   Comp	Output from water heater	
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= 82.55		185.77 200.16
(65)ma	Output from water heate	er (annual) <sub>112</sub> 2049.7047 (64)
(65)m= 82.55   72.9   76.88   69.38   68.31   61.51   59.53   64.7   64.39   71.92   75.77   80.71   (65)	Heat gains from water heating, kWh/month 0.25 $^{\prime}$ [0.85 $\times$ (45)m + (61)m] + 0.8 $\times$ [(46)m	n + (57)m + (59)m l
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating  5. Internal gains (See Table 5 and 5a):  Metabolic gains (Table 5). Watts  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (66)m= 170.01 170		<del>, ` ´ , ` ´ ,</del>
Metabolic gains (Table 5). Wats   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec		from community heating
Metabolic gains (Table 5). Watts    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec		nom commany nearing
Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec		
(66)   170.01   170.0		Nov Doc
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5  (67)m= 72.76		
(67) m= 72.76 64.63 52.56 39.79 29.74 25.11 27.13 35.27 47.34 60.11 70.15 74.79  Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5  (68) m= 412.34 416.62 405.84 382.88 353.91 326.68 308.48 304.2 314.99 337.94 366.92 394.15  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69) m= 54.83 (69)  Pumps and fans gains (Table 5a)  (70) m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		170.01
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5  (68)m= 412.34		70 15 74 79 (67)
(68)m= 412.34 416.62 405.84 382.88 353.91 326.68 308.48 304.2 314.99 337.94 366.92 394.15 (68)  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m= 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 (69)  Pumps and fans gains (Table 5a) (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		70.13
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69)m= 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 (69)  Pumps and fans gains (Table 5a)  (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		720000 20445 (68)
(69)   54.83		366.92 394.15
Pumps and fans gains (Table 5a)  (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		T (00)
(70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		54.83 54.83 (69)
Losses e.g. evaporation (negative values) (Table 5) (71)m= -113.34 -11		
(71)m= -113.34	(70)m= 0 0 0 0 0 0 0 0 0	0 0 (70)
Water heating gains (Table 5) (72)m= 110.95		
(72)m= 110.95 108.48 103.34 96.36 91.82 85.44 80.01 86.96 89.43 96.66 104.82 108.49 (72)  Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m= 707.56 701.23 673.24 630.53 586.98 548.73 527.13 537.94 563.26 606.21 653.4 688.92 (73)  6. Solar gains:  Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Area Flux g_ FF Gains Table 6d Table 6d Table 6c (W)  South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x 0.7 = 176.65 (78)	(71)m= -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34	-113.34 -113.34 (71)
Total internal gains =	Water heating gains (Table 5)	
(73)m=       707.56       701.23       673.24       630.53       586.98       548.73       527.13       537.94       563.26       606.21       653.4       688.92       (73)         6. Solar gains:         Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.         Orientation: Access Factor Area Table 6d       Flux g_ FF       Gains Table 6c       (W)         South 0.9x 0.77       x 10.12       x 47.32       x 0.76       x 0.7       = 176.65       (78)	(72)m= 110.95 108.48 103.34 96.36 91.82 85.44 80.01 86.96 89.43 96.66	104.82 108.49 (72)
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 Area Flux g_ FF Gains Table 6d m² Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x 0.7 = 176.65 (78)	<b>Total internal gains =</b> $(66)m + (67)m + (68)m + (69)m + (70)m + (70)m + (68)m + (69)m + (69$	71)m + (72)m
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Area Flux g_ FF Gains Table 6d m² Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x 0.7 = 176.65 (78)	(73)m= 707.56 701.23 673.24 630.53 586.98 548.73 527.13 537.94 563.26 606.21	653.4 688.92 (73)
Orientation: Access Factor Area Flux $g_{-}$ FF Gains Table 6d $m^2$ Table 6a Table 6b Table 6c (W)  South $0.9 \times 0.77$ × $10.12$ × $47.32$ × $0.76$ × $0.7$ = $176.65$ (78)	6. Solar gains:	
Table 6d $m^2$ Table 6a Table 6b Table 6c (W)  South $0.9x$ $0.77$ $\times$ $10.12$ $\times$ $47.32$ $\times$ $0.76$ $\times$ $0.7$ = 176.65 (78)	Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applica	able orientation.
South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x 0.7 = 176.65 (78)	<b>0</b>	
0.11	l able 6d m² l able 6a l able 6b l	i able 6C (W)
South 0.9x 0.77 x 10.12 x 77.18 x 0.76 x 0.7 = 288.11 (78)	South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x	0.7 = 176.65 (78)
	South 0.9x 0.77 x 10.12 x 77.18 x 0.76 x	0.7 = 288.11 (78)

										_							
South	0.9x	0.77		× [	10.1	12	X	9	4.25	X		0.76	X	0.7	=	351.81	(78)
South	0.9x	0.77		x	10.1	12	X	10	05.11	X		0.76	X	0.7	=	392.38	(78)
South	0.9x	0.77		x	10.1	12	X	10	08.55	X		0.76	X	0.7	=	405.2	(78)
South	0.9x	0.77		x	10.1	12	X	1	08.9	X		0.76	X	0.7	=	406.5	(78)
South	0.9x	0.77		x	10.1	12	X	10	07.14	x		0.76	X	0.7	=	399.93	(78)
South	0.9x	0.77		x [	10.1	12	X	10	03.88	X		0.76	X	0.7	=	387.78	(78)
South	0.9x	0.77		x [	10.1	12	X	9	9.99	x		0.76	X	0.7	=	373.25	(78)
South	0.9x	0.77		x [	10.1	12	X	8	5.29	x		0.76	x	0.7	=	318.38	(78)
South	0.9x	0.77		x [	10.1	12	X	5	6.07	x		0.76	X	0.7	=	209.3	(78)
South	0.9x	0.77		x [	10.1	12	X	4	0.89	x		0.76	x	0.7	=	152.64	(78)
	_			-													
Solar g	ains in	watts, ca	lculate	ed 1	for each	n mont	h			(83)m	ı = Sı	um(74)m .	(82)m				
(83)m=	176.65	288.11	351.81	T	392.38	405.2	7	106.5	399.93	387	.78	373.25	318.3	3 209.3	152.64	]	(83)
Total ga	ains – i	nternal a	nd sol	ar (	(84)m =	(73)m	+ (	83)m	, watts						•	4	
(84)m=	884.21	989.34	1025.0	5	1022.91	992.18	9	55.22	927.06	925	.72	936.51	924.5	862.69	841.56	]	(84)
7 Mea	an inter	nal temp	eratur	e (1	heating	seaso	n)									-	
		during h			Ĭ			area f	from Tab	ole 9.	. Th	1 (°C)				21	(85)
•		ctor for ga	_	•			_					. ( -)	-		_		
	Jan	Feb	Mar	-	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
(86)m=	1	1	1	Ť	0.99	0.97		0.87	0.63	0.6		0.9	0.99	1	1	1	(86)
Moon	intorno	Ltompor	aturo ii	Liv	vina ora	22 T1 (	follo	w cto	nc 2 to 7	7 in T	able	00)				4	
(87)m=	20.23	l tempera	20.47	1 III	20.61	20.81		20.95	21	2		20.93	20.71	20.41	20.24	1	(87)
				-									20.71	20.41	20.24	J	(=-)
i r		during h		pe		$\overline{}$	$\overline{}$			ı			40.00	40.05	10.05	1	(88)
(88)m=	19.84	19.85	19.85		19.86	19.86		19.86	19.87	19.	87	19.86	19.86	19.85	19.85		(88)
		tor for g	ains fo	r re	T				I	T -					T	7	
(89)m=	1	1	1		0.99	0.94		0.76	0.46	0.4	16	0.81	0.98	1	1		(89)
Mean	interna	l tempera	ature ii	n th	ne rest o	of dwe	lling	T2 (f	ollow ste	eps 3	to 7	in Tabl	e 9c)				
(90)m=	18.83	18.97	19.19	Т	19.41	19.68	1	9.84	19.87	19.	87	19.82	19.55	19.11	18.86	]	(90)
_					•		•		•	•		f	LA = Liv	ring area ÷ (	4) =	0.4	(91)
Mean	interna	l tempera	ature (	for	the wh	ole dw	ماالم	a) – fl	Δ <b>v</b> T1	<b>±</b> (1	_ fl	Δ) <b>v</b> T2					
(92)m=	19.39	19.51	19.7	Ť	19.89	20.13	$\overline{}$	20.28	20.31	20.	$\overline{}$	20.26	20.01	19.62	19.4	1	(92)
L		nent to th		L an i					<u> </u>	L					1	J	, ,
(93)m=	19.39	19.51	19.7	Τ	19.89	20.13	_	20.28	20.31	20.		20.26	20.01	T T	19.4	1	(93)
_		iting requ		nt										7 0 1 0			
					peratur	e obta	ined	l at ste	en 11 of	Tabl	e 9h	so tha	t Ti m:	=(76)m an	id re-cal	culate	
		factor fo			•			· at ott	ор II о.	· ab	0 0.0	,, 00 1110	,	(10) a	ia io can	Juliato	
	Jan	Feb	Mar	T	Apr	May	T	Jun	Jul	Α	ug	Sep	Oct	Nov	Dec	]	
Utilisa	tion fac	tor for ga	ains, h	m:					•						•	_	
(94)m=	1	1	1		0.99	0.95		0.81	0.53	0.5	53	0.84	0.98	1	1		(94)
Useful	gains,	hmGm ,	W = (	94)	m x (84	1)m										_	
(95)m=	883.58	987.57	1020.1	2	1010.97	945	7	69.84	489.9	489	.88	790.79	906.0	861.11	841.05		(95)
Month	ly aver	age exte	rnal te	mp	erature	from	ГaЫ	e 8								- -	
(96)m=	4.5	5	6.8		8.7	11.7		14.6	16.9	16	.9	14.3	10.8	7	4.9	]	(96)

Heather to form a fatour land of the MC (20) of (20) o	
Heat loss rate for mean internal temperature, Lm , W = $[(39)\text{m x}](93)\text{m}$ - $(96)\text{m}$ ] (97)m = $2197.45$   $2131.17$   $1894.7$   $1628.13$   $1220.2$   $820.36$   $491.83$   $491.83$   $864.55$   $1341.15$   $1845.54$   $2130.69$   $(97)$	<b>)</b>
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m	,
(98)m= 977.52 768.5 650.69 444.35 204.75 0 0 0 0 323.69 708.79 959.5	
Total per year (kWh/year) = Sum(98) <sub>15,912</sub> = 5037.79 (98)	)
Space heating requirement in kWh/m²/year 44.45 (99)	)
9a. Energy requirements – Individual heating systems including micro-CHP)	
Space heating:	
Fraction of space heat from secondary/supplementary system  0 (20)	
Fraction of space heat from main system(s)  (202) = 1 - (201) =  1 (202)	
Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] = 1$	
Efficiency of main space heating system 1 92.8 (206	
Efficiency of secondary/supplementary heating system, % 0 (208	8)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec kWh/year	
Space heating requirement (calculated above)  977.52 768.5 650.69 444.35 204.75 0 0 0 0 323.69 708.79 959.5	
$ (211)m = \{[(98)m \times (204)] + (210)m \} \times 100 \div (206) $ (211)	1)
1053.36 828.13 701.18 478.83 220.64 0 0 0 348.8 763.78 1033.94	,
Total (kWh/year) = Sum(211) <sub>15,1012</sub> 5428.66 (211)	1)
Space heating fuel (secondary), kWh/month	
$= \{[(98)m \times (201)] + (214) m \} \times 100 \div (208)$	
(215)m= 0 0 0 0 0 0 0 0 0 0 0	
Total (kWh/year) = $Sum(215)_{15,1012}$ 0 (215)	5)
Water heating Output from water heater (colouleted shave)	
Output from water heater (calculated above)  205.67   180.77   188.64   167.43   162.87   143.79   136.44   152   152.45   173.7   185.77   200.16	
Efficiency of water heater 79.1 (216	6)
(217)m= 87.74 87.54 87.15 86.59 84.72 79.1 79.1 79.1 79.1 85.75 87.35 87.75 (217)	7)
Fuel for water heating, kWh/month	
$ (219)m = (64)m \times 100 \div (217)m $ $ (219)m = 234.42  206.49  216.46  193.36  192.24  181.78  172.49  192.16  192.73  202.57  212.69  228.1 $	
Total = $Sum(219a)_{112}$ = 2425.48 (219)	9)
Annual totals kWh/year kWh/year	,
Space heating fuel used, main system 1 5428.66	
Water heating fuel used 2425.48	
Electricity for pumps, fans and electric keep-hot	
central heating pump: 130 (230	0c)
boiler with a fan-assisted flue	0e)
Total electricity for the above, kWh/year sum of (230a)(230g) = 175 (237a)	1)
Electricity for lighting 514.01 (232	2)
10a. Fuel costs - individual heating systems:	

	<b>Fuel</b> kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	3.1 x 0.01	168.2884 (240)
Space heating - main system 2	(213) x	0 x 0.01 :	0 (241)
Space heating - secondary	(215) x	0 x 0.01 :	0 (242)
Water heating cost (other fuel)	(219)	3.1 x 0.01	75.19 (247)
Pumps, fans and electric keep-hot	(231)	11.46 × 0.01	20.06 (249)
(if off-peak tariff, list each of (230a) to (230g) sep Energy for lighting	parately as applicable and a	apply fuel price according to	
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254) a <b>Total energy cost</b> (245)(24	ns needed 17) + (250)(254) =		428.4383 (255)
11a. SAP rating - individual heating systems			
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF) [(255) x (2	256)] ÷ [(4) + 45.0] =		1.2717 (257)
SAP rating (Section 12)			82.2593 (258)
12a. CO2 emissions – Individual heating system  Space heating (main system 1)	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (secondary)	(215) x	0.198 =	0 (263)
Water heating	(219) x	0.198 =	480.24 (264)
Space and water heating	(261) + (262) + (263) + (264)		1555.12 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517 =	90.48 (267)
Electricity for lighting	(232) x	0.517 =	265.74 (268)
Total CO2, kg/year	\$	sum of (265)(271) =	1911.34 (272)
CO2 emissions per m <sup>2</sup>	(	(272) ÷ (4) =	16.86 (273)
EI rating (section 14)			84 (274)
13a. Primary Energy			
	<b>Energy</b> kWh/year	Primary factor	<b>P. Energy</b> kWh/year
Space heating (main system 1)	(211) x	1.02 =	5537.23 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Energy for water heating	(219) x	1.02 =	2473.99 (264)

(231) x

Electricity for pumps, fans and electric keep-hot

(267)

Electricity for lighting (232)  $\times$  0 = 1500.9 (268) (268) (Total Primary Energy sum of (265)...(271) = 10023.12 (272) (272) (272) Primary energy kWh/m²/year (272)  $\div$  (4) = 88.43 (273)

# DRAE

				User D	etails:						
Assessor Name:					Strom						
Software Name:	Stroma FS	AP 200			Softwa				Versio	n: 1.5.0.49	
			Р	roperty	Address	: House	1				
Address: 1. Overall dwelling dime	neione:										
1. Overall dwelling diffier	11310113.			Δre	a(m²)		Ave He	eight(m)		Volume(m³	3)
Ground floor						(1a) x		2.5	(2a) =	121.925	<b>)</b> (3a)
First floor				4	8.77	(1b) x		2.5	](2b) =	121.925	 (3b
Total floor area TFA = (1a	a)+(1b)+(1c)+	(1d)+(1e	)+(1r	n)	7.54	] [(4)	<u> </u>		J		
Dwelling volume						J	o)+(3c)+(3c	d)+(3e)+	.(3n) =	243.85	(5)
2. Ventilation rate:										2.0.00	
2. Verillation rate.	main		econda	у	other		total			m³ per hou	r
Number of chimneys	heating 0	_ +	eating 0	7 + [	0	] = [	0	x ·	40 =	0	(6a
Number of open flues	0	<b>-</b>   +   -	0	Ī + Ē	0		0	x	20 =	0	(6b)
Number of intermittent far	าร						0	x	10 =	0	(7a
Number of passive vents						Ī	0	X '	10 =	0	(7b
Number of flueless gas fir	es					Ţ	0	x -	40 =	0	(7c
						_					
									Air ch	anges per ho	our
Infiltration due to chimney							0		÷ (5) =	0	(8)
If a pressurisation test has be Number of storeys in th			a, procee	d to (17),	otherwise (	continue fi	rom (9) to	(16)		0	(9)
Additional infiltration	o awoming (in	3)						<b>[</b> (9)	-1]x0.1 =	0	$ \begin{pmatrix} (3) \\ (10) \end{pmatrix}$
Structural infiltration: 0.	25 for steel o	r timber f	rame or	0.35 fo	r masoni	ry const	ruction	• ,		0	(11
if both types of wall are pr			oonding to	the great	er wall are	a (after					
deducting areas of openin  If suspended wooden fl			ed) or 0	1 (seale	ad) else	enter ()				0	\(12
If no draught lobby, ent		•	cu) or o	i (Scarc	<i>Ju</i> ), 0130	Critor 0				0	=\\(\)(13
Percentage of windows			ripped							0	=\(\)(14
Window infiltration		a.a.g			0.25 - [0.2	2 x (14) ÷ 1	100] =			0	(15
Infiltration rate					(8) + (10)	+ (11) + (	12) + (13)	+ (15) =		0	(16
Air permeability value,	q50, expresse	ed in cub	ic metre	s per ho	our per s	quare m	netre of e	envelope	area	6.1	(17
If based on air permeabili	ty value, then	(18) = [(17	7) ÷ 20]+(8	3), otherw	ise (18) = (	(16)		·		0.3	(18
Air permeability value applies	s if a pressurisati	on test has	been dor	ne or a de	gree air pe	rmeability	is being u	sed			_
Number of sides on which	n sheltered				(20) = 1 -	[0 075 v (	10)] _			1	(19
Shelter factor	na chaltar fac	etor			(20) = 13 (21) = (18)		. 5/1 –			0.92	= (20
Infiltration rate incorporati	•				(21) = (10	) X (20) =				0.28	(21
Infiltration rate modified fo		<del>' </del>		11	Λ	C = =	0-4	Nai			
1	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spe	eed from Tab	e /					4.5			•	

Wind Factor (2	22a)m =	(22)m ÷	4										
(22a)m= 1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27	]	
Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m				_	
0.38	0.36	0.36	0.32	0.29	0.28	0.26	0.26	0.3	0.32	0.34	0.36	]	
Calculate effe		•	rate for t	he appli	cable ca	se		l					<del></del>
If mechanic			andin N. (O	noh) (00-	·	(N	VIC)\		) (00-)			0	(23a
If exhaust air h		0		, ,	,	. `	,, .	`	) = (23a)			0	(23b
a) If balance		,	,	J		`		,	2b)m + (	23b) <b>x</b> [	1 – (23c)	0 - 1001	(23c
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0	]	(24a
b) If balance	ed mech	anical ve	ntilation	without	heat red	covery (N	л ЛV) (24t	m = (22)	2b)m + (	23b)	<u> </u>	J	
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0	]	(24b
c) If whole h	ouse ex	tract ver	ntilation o	or positiv	re input v	ventilatio	on from o	utside	!	!	!	J	
,		(23b), t		•					.5 × (23b	o)			
(24c)m= 0	0	0	0	0	0	0	0	0	0	0	0	]	(24c)
d) If natural				•	•				1				
(24d)m= 0.57	n = 1, th	en (24d) <sub>0.56</sub>	m = (221)	0.54	0.54	(4d)m = 0.53	$0.5 + [(2)]_{0.53}$	2b)m² x 0.54	0.5]	0.56	0.56		(24d
Effective air								<u> </u>	0.55	0.30	0.50		(240
(25)m= 0.57	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.54	0.55	0.56	0.56	1	(25)
					9.01	0.00	0.00	0.01	0.00	0.00	0.00	1	(==)
3. Heat losse									_			_	
ELEMENT	Gros		Openin m	-	Net Ar A ,r		U-val W/m2		A X U (W/	K)	k-value kJ/m²-l		A X k kJ/K
Doors	urou	,,,			2	×	1.4		2.8		NO/III	``	(26)
Windows					10.12	5 x1.	/[1/( 1.5 )+	0.04] =	14.33	Ħ			(27)
Floor Type 1					48.77	=	0.24		11.704				(28)
Floor Type 2					48.77	, x	0.24	╡┇	11.704			7 F	(28)
Walls	97.7	72	22.2	5	75.47	=	0.25	<b>=</b>	18.87			7 F	(29)
Roof	48.7		0		48.77	=	0.2	<del>-</del>	9.75	<b>=</b>		<b>-</b>	(30)
Total area of e					244.0	=	U.2		0.10				(31)
* for windows and		•	effective wi	ndow U-va			formula 1	/[(1/U-valu	ıe)+0.04] á	as given in	paragraph	n 3.2	(01)
** include the are								- '	, -	J	, , ,		
Fabric heat lo	ss, W/K	= S (A x	U)				(26)(30)	) + (32) =				83.49	(33)
Heat capacity	Cm = S(	(Axk)						((28)	(30) + (32	2) + (32a).	(32e) =	17942.88	(34)
Thermal mass	parame	eter (TMF	P = Cm ÷	: TFA) ir	n kJ/m²K			Indica	tive Value	: High		450	(35)
For design asses can be used inste				construct	ion are no	t known pr	ecisely the	e indicative	e values of	TMP in Ta	able 1f		
Thermal bridg	es : S (L	x Y) cal	culated (	using Ap	pendix l	<						24.4	(36)
if details of therm		are not kn	own (36) =	= 0.15 x (3	1)								
Total fabric he									(36) =			107.89	(37)
Ventilation he	i	1	·	<u> </u>			· .			(25)m x (5)	1	1	
Jan 46.07	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	-	(00)
(38)m= 46.07	45.44	45.44	44.29	43.6	43.28	42.98	42.98	43.77	44.29	44.85	45.44	J	(38)
Heat transfer			455 :-	454 15	45. :=	455			= (37) + (	1	1,55	1	
(39)m= 153.96 Stroma FSAP 200	153.33 9 Version	153.33 : 1.5.0.49 (	152.18 SAP 9.90	151.49 - http://w\	151.17 ww.stroma	150.87 .com	150.87	151.66	152.18	152.74	153.33	450 P	age 2 of 39)
•		\							Average =	Sum(39) <sub>1</sub>	12 / 1 Z=	152.26	(39)

leat lo	ss paraı	meter (H	ILP), W	m²K					(40)m	= (39)m ÷	(4)			
10)m=	1.58	1.57	1.57	1.56	1.55	1.55	1.55	1.55	1.55	1.56	1.57	1.57		_
lumbo	r of day	c in mor	oth (Tab	lo 1a\					,	Average =	Sum(40) <sub>1.</sub>	12 /12=	1.56	(40
iumbe T	Jan	Feb	nth (Tab Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
11)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41
_														`
4. Wat	ter heat	ng ener	gy requi	irement:								kWh/ye	ear:	
ssume	ed occu	pancy, N	N.								2.7	156		(42
if TF		, N = 1 ·		[1 - exp	(-0.0003	349 x (TF	FA -13.9)	)2)] + 0.0	0013 x (	ΓFA -13.		100		(
		•	iter usag	ge in litre	s per da	ay Vd,av	erage =	(25 x N)	+ 36		103.	8889		(43
		-		usage by a day (all w		•	designed t ld)	to achieve	a water us	se target o	f			
Γ	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ot wate				<u> </u>			Table 1c x							
l4)m=	114.28	110.12	105.97	101.81	97.66	93.5	93.5	97.66	101.81	105.97	110.12	114.28		
_	antant of	la a t v v a t a u			and labor 1	×100 ·· \/-/ ··		T / 2000			m(44) <sub>112</sub> =		1246.6668	(44
											ables 1b, 1		_	
5)m= [	169.88	148.57	153.32	133.66	128.25	110.67	102.56	117.68	119.09	138.79	151.5	164.52	1638.4874	(4
nstanta	aneous wa	ater heatir	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)		10tai = 5u	m(45) <sub>112</sub> =		1030.4074	(-
6)m=	25.48	22.29	23	20.05	19.24	16.6	15.38	17.65	17.86	20.82	22.72	24.68		(4
	storage													
				ss facto	r is knov	vn (kWh	/day):				0.0	)24		(4
•			m Table					(4-)			0.	54		(4
			-	, kWh/ye nder loss		s not kno		(47) x (48)	=		0.0	)13		(4
			•				in same					0		(5
If com	munity he	ating and	no tank in	dwelling,	enter 110	litres in bo	x (50)							
Otherv	wise if no	stored hot	t water (th	is includes	instantan	eous com!	oi boilers) e	enter '0' in	box (50)					
		Ū		om Tabl	e 2 (kW	h/litre/da	ıy)					0		(5
		rom Tal		0.1							(	0		(5
•			m Table									0		(5
•			_	, kWh/ye	ear			((50) x (51	) x (52) x (	(53) =		0		(5
•	,	64) in (5	,	طممم سما				(/EC) /	FF) (44).	_	0.0	)13		(5
г				for each		0.00		((56)m = (	, , ,		0.00	0.4		/5
6)m= cvlinder	0.4 r contains	0.36 dedicated	0.4 d solar sto	0.39 rage. (57)	0.4 m = (56)m	0.39 x [(50) – (	0.4 H11)] ÷ (50	0.4 0), else (5	0.39 7)m = (56)	0.4 m where (	0.39 H11) is fro	0.4 m Appendi	ix H	(5
7)m= [	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(5
, r				<u> </u>							<u> </u>	60		(5
-				om Table for each		59)m = (	(58) ÷ 36	35 × (41)	m		30	JO		(0
i ii i i ai y					,	•	er heatir	, ,		r thermo	stat)			
-	<u> </u>					29.59	30.58	30.58	29.59	30.58	29.59	20.50		(5
-	30.58	27.62	30.58	29.59	30.58	29.59	00.00	30.30	29.59	30.30	29.59	30.58		(5
(mod 9)m= [				l		l	65 × (41)		29.59	30.30	29.59	30.56		(-

Total heat re	quired for	water he	eating ca	alculated	l for e	each month	(62)	m =	0.85 × (	45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m= 200.8	<del>-</del>	184.29	163.64	159.23	140		148	_	149.07	169.76	181.47	195.49		(62)
Solar DHW inpu	ut calculated	using App	endix G oı	· Appendix	H (ne	gative quantit	y) (ent	er '0'	if no sola	r contribu	tion to wate	r heating)	ı	
(add addition	nal lines if	FGHRS	and/or \	vwhrs	арр	lies, see Ap	pend	dix G	3)					
(63)m= 0	0	0	0	0	0	0	0	)	0	0	0	0		(63)
Output from	water hea	ıter				•					•		•	
(64)m= 200.8	5 176.55	184.29	163.64	159.23	140	.65 133.53	148	.66	149.07	169.76	181.47	195.49		
	•	•				•		Outp	ut from wa	ater heate	er (annual) <sub>1</sub>	12	2003.2178	(64)
Heat gains f	om water	heating,	kWh/m	onth 0.2	5 ′ [0	.85 × (45)m	+ (6	1)m	] + 0.8 x	: [(46)m	+ (57)m	+ (59)m	]	
(65)m= 80.94	71.49	75.44	68.11	67.1	60.	47 58.56	63.	59	63.27	70.61	74.04	79.16		(65)
include (5	7)m in cal	culation (	of (65)m	only if c	ylind	er is in the	dwell	ing	or hot w	ater is f	rom com	munity h	eating	
5. Internal	gains (see	e Table 5	and 5a	):										
Metabolic ga	ins (Table	e 5), Wat	ts										_	
Jan	Feb	Mar	Apr	May	Jι	ın Jul	A	ug	Sep	Oct	Nov	Dec		
(66)m= 162.9	3 162.93	162.93	162.93	162.93	162	.93 162.93	162	.93	162.93	162.93	162.93	162.93		(66)
Lighting gair	ıs (calcula	ted in Ap	pendix	L, equat	ion L	9 or L9a), a	lso s	ee 7	Table 5		-	-		
(67)m= 56.43	50.12	40.76	30.86	23.07	19.	47 21.04	27.	35	36.71	46.62	54.41	58		(67)
Appliances of	gains (calc	ulated ir	Append	dix L, eq	uatio	n L13 or L1	3a), a	also	see Tal	ole 5				
(68)m= 376.5	5 380.46	370.61	349.65	323.19	298	.32 281.7	277	7.8	287.64	308.6	335.07	359.94		(68)
Cooking gair	ns (calcula	ated in A	ppendix	L, equat	ion L	.15 or L15a	), als	o se	e Table	5				
(69)m= 54.01	54.01	54.01	54.01	54.01	54.	01 54.01	54.	01	54.01	54.01	54.01	54.01		(69)
Pumps and f	ans gains	(Table 5	5a)											
(70)m= 0	0	0	0	0	0	0	0	)	0	0	0	0		(70)
Losses e.g.	evaporatio	on (nega	tive valu	es) (Tab	le 5)									
(71)m= -108.6	2 -108.62	-108.62	-108.62	-108.62	-108	.62 -108.62	-108	.62	-108.62	-108.62	-108.62	-108.62		(71)
Water heating	ıg gains (⅂	Table 5)										-		
(72)m= 108.8	3 106.39	101.39	94.6	90.19	83.	99 78.71	85.	47	87.87	94.9	102.84	106.4		(72)
Total intern	al gains =	•	-			(66)m + (67)n	า + (68	3)m +	- (69)m + (	70)m + (7	71)m + (72)	m		
(73)m= 650.1	645.29	621.09	583.43	544.77	510	0.1 489.78	498	.94	520.55	558.44	600.63	632.66		(73)
6. Solar gai	ns:													
Solar gains ar		•	r flux from	Table 6a	and as	ssociated equa	tions	to co	nvert to th	e applica		ion.		
Orientation:	Access F Table 6d		Area m²			Flux Table 6a		т.	g_ able 6b	т	FF able 6c		Gains (W)	
Cauth					_		1 1							1
South 0.9			10.		× L	47.32	X		0.76	_  ×	0.7	_ =	353.3	(78)
South 0.93		_	10.		× L	77.18	X	<u> </u>	0.76	_  ×	0.7	_ =	576.23	<u> </u> (78)
South 0.93			10.	==	× L	94.25	X		0.76	_  ×	0.7	_  =	703.61	(78)
South 0.9			10.		× L	105.11	X		0.76	x	0.7	_  =	784.75	[(78)
South 0.93			10.		× L	108.55	X		0.76	×	0.7	_  =	810.4	<u> </u> (78)
South 0.93		X	10.	12	x L	108.9	X	<u> </u>	0.76	_  ×	0.7	=	813	(78)
South 0.93			10.	12	× L	107.14	X		0.76	×	0.7	=	799.85	(78)
South 0.93	0.77	X	10.	12	x	103.88	X		0.76	x	0.7	=	775.56	(78)

South	0.9x	0.77	х	10.	12	x	9	9.99	x		0.76	х	0.7	=	746.5	(78)
South	0.9x	0.77	x	10.	12	x	8	5.29	х		0.76	_ x _	0.7		636.76	(78)
South	0.9x	0.77	X	10.	12	x	5	6.07	х		0.76	_ x _	0.7	=	418.6	(78)
South	0.9x	0.77	х	10.	12	x	4	0.89	x		0.76	x	0.7		305.28	(78)
	_					,										_
Solar o	ains in	watts, ca	alculated	I for eacl	h month				(83)m	= St	um(74)m .	(82)m				
(83)m=	353.3	576.23	703.61	784.75	810.4	-	813	799.85	775.	56	746.5	636.76	418.6	305.28		(83)
Total g	ains – i	nternal a	nd solar	(84)m =	= (73)m ·	+ (8	33)m	, watts					•		•	
(84)m=	1003.4	1221.52	1324.7	1368.18	1355.17	1:	323.1	1289.63	1274	4.5	1267.05	1195.2	1019.23	937.93		(84)
7. Me	an inter	nal temp	erature	(heating	season	)				•						
		during h					area f	from Tab	ole 9.	Th	1 (°C)				21	(85)
-		tor for g	•			-			,		. ( -)					┛`′
	Jan	Feb	Mar	Apr	May	È	Jun	Jul	Αι	ıa	Sep	Oct	Nov	Dec		
(86)m=	1	0.99	0.98	0.96	0.88	⊢	0.7	0.48	0.4	Ť	0.75	0.95	1	1		(86)
` '									l	!						` '
ĺ		l temper				_				$\neg$		00.70	00.07	00.44	1	(07)
(87)m=	20.13	20.3	20.51	20.68	20.88		0.98	21	21		20.97	20.76	20.37	20.14		(87)
Temp	erature	during h	eating p	eriods ir	rest of	dw	elling	from Ta	ble 9	), Th	n2 (°C)				1	
(88)m=	19.63	19.64	19.64	19.65	19.65	1	9.65	19.66	19.6	66	19.65	19.65	19.64	19.64		(88)
Utilisa	ation fac	tor for ga	ains for I	rest of d	welling,	h2,	m (se	e Table	9a)							
(89)m=	1	0.99	0.97	0.93	0.81	(	).57	0.32	0.3	3	0.63	0.91	0.99	1		(89)
Mean	interna	l temper	ature in	the rest	of dwelli	na	T2 (fc	ollow ste	ns 3	to 7	in Table	e 9c)				
(90)m=	18.54	18.78	19.08	19.32	19.56	Ť	9.65	19.66	19.6	$\neg$	19.64	19.43	18.88	18.55		(90)
			7								f	LA = Livin	g area ÷ (4	1) =	0.38	(91)
Mass	intorno	l taranar	otuus /fo	مارين ۾ ماڻ ي	مبيراء ماء	11:	~ L	ΛΤ4	. /4	£I	Λ) Το					
(92)m=	19.14	temper	19.62	19.84	20.06		97 = n 0.15	20.17	20.1	$\neg$	20.14	19.94	19.45	19.15		(92)
` ′		nent to the						ļ -					19.40	19.10		(02)
(93)m=	19.14	19.36	19.62	19.84	20.06	_	0.15	20.17	20.1		20.14	19.94	19.45	19.15		(93)
		ting requ				<u> </u>					•…					. ,
		mean int			re obtair	ned	at ste	ep 11 of	Table	e 9b	o, so that	t Ti.m=(	76)m an	d re-calo	culate	
		factor fo		•								, (				
	Jan	Feb	Mar	Apr	May		Jun	Jul	Αι	Jg	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm	:											•	
(94)m=	1	0.99	0.97	0.94	0.83	(	0.62	0.38	0.3	9	0.68	0.92	0.99	1		(94)
1	ıl gains,	hmGm ,		<u> </u>		_									1	
(95)m=	999.94			1282.67			21.75	492	491.	94	856.25	1099.37	1009.94	935.33		(95)
		age exte			from Ta				1						1	
(96)m=	4.5	5	6.8	8.7	11.7		14.6	16.9	16.		14.3	10.8	7	4.9		(96)
1		e for mea				_			<del>- `</del>	<del>_</del> т	<u> </u>		ı		1	(0-1)
	2254.44			1695.36			39.19	492.65	492.		885.7	1390.54		2184.87		(97)
		g require				/Vh			<del>-</del>	Ì	<u> </u>		r e	000.00	1	
(98)m=	933.35	667.8	505.07	297.14	102.15		0	0	0		0	216.63	641.49	929.66		7(00)
										ıotal	per year (	(kvvh/year	r) = Sum(9	<b>∀)</b> <sub>15,912</sub> =	4293.28	(98)
Space	e heatin	g require	ement in	kWh/m²	/year										44.02	(99)

9a. Energy requirements – Indi	vidual heati	ng systems	includinç	g micro-C	CHP)					
Space heating:					,					
Fraction of space heat from se	•		/ system						0	(201)
Fraction of space heat from m	nain system(	(s)		(202) = 1	- (201) =				1	(202)
Fraction of total heating from I	main systen	n 1		(204) = (2	02) × [1 –	(203)] =			1	(204)
Efficiency of main space heati	•								92.8	(206)
Efficiency of secondary/supple	ementary he	eating syster	n, %						0	(208)
Jan Feb Mar		∕lay Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/y	ear
Space heating requirement (c	· · · · · · · · · · · · · · · · · · ·	oove) 2.15 0	0	0	0	216.63	641.49	020.66	1	
	l				U	210.03	041.49	929.66		(044)
$(211)m = \{[(98)m \times (204)] + (211)m = \{[(98)m \times (204)] + (211)m = (211)m + (211)m =	· · · · · · · · · · · · · · · · · · ·	0.07 0	0	0	0	233.44	691.26	1001.78		(211)
1000.77 710.01 044.20	020.10	0.07			I (kWh/yea				4626.37	(211)
Space heating fuel (secondary	v). kWh/moi	nth								` ′
$= \{[(98)\text{m x } (201)] + (214) \text{ m }\} \text{ x}$	•		_							
(215)m= 0 0 0	0	0 0	0	0	0	0	0	0		
				Tota	I (kWh/yea	ar) =Sum(2	215) <sub>15,1012</sub>	2=	0	(215)
Water heating	Late Labor									
Output from water heater (calc		9.23 140.65	133.53	148.66	149.07	169.76	181.47	195.49		
Efficiency of water heater									79.1	(216)
(217)m= 87.7 87.33 86.67	85.68 82	2.96 79.1	79.1	79.1	79.1	84.76	87.2	87.74		(217)
Fuel for water heating, kWh/mo										
$(219)$ m = $(64)$ m x $100 \div (217)$ (219)m = $229.03$ $202.17$ $212.65$		1.93 177.81	168.81	187.94	188.45	200.28	208.12	222.81		
(210)111 220.00   202.11   212.00	100.00	1.00	100.01		I = Sum(2:		200.12	222.01	2380.99	(219)
Annual totals							Wh/year	, ,	kWh/ye	
Space heating fuel used, main	system 1						-		4626.37	
Water heating fuel used									2380.99	
Electricity for pumps, fans and	electric kee	p-hot						'		
central heating pump:								130		(230c)
boiler with a fan-assisted flue								45		(230e)
Total electricity for the above, k	(Wh/vear			sum	of (230a).	(230g) =			175	(231)
Electricity for lighting	(VVIII) y Gai				, ,	( 0/			398.64	(232)
10a. Fuel costs - individual he	ating avatar	<b>~</b> 0!							390.04	(232)
Toa. Fuel Costs - Illulvidual fle	aling syster	115.								
		<b>F</b> ι kV	i <b>el</b> Vh/year			Fuel P (Table			Fuel Cos £/year	t
Space heating - main system 1		(21	1) x			3.	1	x 0.01 =	143.4176	(240)
Space heating - main system 2	2	(21	3) x			0		x 0.01 =	0	(241)
Space heating - secondary		(21	5) x			0		x 0.01 =	0	(242)
Water heating cost (other fuel)		(21	9)					x 0.01 =		(247)
Water ricating cost (other ruch		(21	٠,			3.			73.81	[(247)

Pumps, fans and electric keep-hot	(231)	11.46 × 0.01 =	20.06 (249)
(if off-peak tariff, list each of (230a) to (230g) se			
Energy for lighting	(232)	11.46 X 0.01 =	45.00 (200)
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254)			
	247) + (250)(254) =		388.9675 (255)
11a. SAP rating - individual heating systems			
Energy cost deflator (Table 12)			0.47 (256)
3,	$(256)] \div [(4) + 45.0] =$		1.2826 (257)
SAP rating (Section 12)			82.1084 (258)
12a. CO2 emissions – Individual heating syste	ms including micro-CHP		
	Energy	Emission factor	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating (main system 1)	(211) x	0.198 =	916.02 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Water heating	(219) x	0.198	471.44 (264)
Space and water heating	(261) + (262) + (263) + (2	(64) = 	1387.46 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517 =	90.48 (267)
Electricity for lighting	(232) x	0.517 =	206.1 (268)
Total CO2, kg/year		sum of (265)(271) =	1684.03 (272)
CO2 emissions per m²		(272) ÷ (4) =	17.27 (273)
El rating (section 14)			84 (274)
13a. Primary Energy			
	Energy	Primary	P. Energy
	kWh/year	factor	kWh/year
Space heating (main system 1)	(211) x	1.02	4718.9 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Energy for water heating	(219) x	1.02 =	2428.61 (264)
Space and water heating	(261) + (262) + (263) + (2	(64) =	7147.52 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92 =	511 (267)
Electricity for lighting	(232) x	0 =	1164.03 (268)
'Total Primary Energy		sum of (265)(271) =	8822.54 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	90.45 (273)

				User D	etails:						
Assessor Name:					Strom	a Num	ber:				
Software Name:	Stroma FS	SAP 200	9		Softwa	are Ve	rsion:		Versio	n: 1.5.0.49	
			Pi	roperty A	Address	: House	1				
Address :											
1. Overall dwelling dime	ensions:			_	4 - 5						
Ground floor					1(m²)	(1a) x		eight(m)	(2a) =	Volume(m³	')     (
								2.5	J -	103.75	= '
First floor					1.5	(1b) x	2	2.5	(2b) =	103.75	(;
Total floor area TFA = (1	a)+(1b)+(1c)+	·(1d)+(1e	e)+(1n	)	83	(4)					
Dwelling volume						(3a)+(3b	)+(3c)+(3d	)+(3e)+	.(3n) =	207.5	( !
2. Ventilation rate:					- 41 ··		4-4-1				
	main heating		econdar eating	у 	other	_	total			m³ per hou	ır —
Number of chimneys	0	+	0	] + [	0	] = [	0	X 4	40 =	0	(6
Number of open flues	0	+	0	] + [	0	_ = [	0	x 2	20 =	0	(6
Number of intermittent fa	ans						0	X '	10 =	0	(7
Number of passive vents	3						0	X .	10 =	0	(7
Number of flueless gas f	ires					Ī	0	x	40 =	0	<u> </u>
						_					
						_			Air cr	nanges per ho	our —
Infiltration due to chimne  If a pressurisation test has be	7					continuo fr	0 (0) to (		÷ (5) =	0	(8
Number of storeys in t			ей, ргосеес	7 to (17), c	unerwise (	continue II	OIII (9) 10 (	10)		0	<u> </u>
Additional infiltration		,						[(9)	-1]x0.1 =	0	<del>-</del> (
Structural infiltration: 0	).25 for steel o	r timber f	frame or	0.35 for	masoni	ry consti	ruction			0	( <i>'</i>
if both types of wall are p deducting areas of openi			ponding to	the greate	er wall are	a (after					
If suspended wooden			ed) or 0.	1 (seale	d), else	enter 0				0	<u> </u>
If no draught lobby, er	nter 0.05, else	enter 0								0	(
Percentage of window	s and doors d	raught st	ripped							0	(
Window infiltration					0.25 - [0.2	2 x (14) ÷ 1	100] =			0	(
Infiltration rate							12) + (13) +			0	(*
Air permeability value,				•	•	•	etre of e	nvelope	area	6.1	<b>-</b>  (*
If based on air permeabi  Air permeability value applie	-						is beina us	sed		0.3	(*
Number of sides on which		uut nac		409	po					2	(
Shelter factor					(20) = 1 -	[0.075 x (	19)] =			0.85	(2
Infiltration rate incorpora	ting shelter fa	ctor			(21) = (18	) x (20) =				0.26	(2
Infiltration rate modified		nd speed	<del>     </del>	-						1	
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	J	
Monthly average wind sp		1	<del></del>	-						1	
(22)m= 5.4 5.1	5.1 4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1		

Wind Factor (2	22a)m =	(22)m ÷	4										
(22a)m= 1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27		
A divisted infiltr	otion rot	م (مااميين	na for oh	oltor on	طيينامط م		(210) v	(220)m	<u>.</u>	!	!	•	
Adjusted infiltr	0.33	0.33	0.29	0.27	0.25	0.24	0.24	0.27	0.29	0.31	0.33	1	
Calculate effec				-			0.24	0.27	0.20	0.01	0.00	l	
If mechanica	al ventila	ition:										0	(23a)
If exhaust air h		•		, ,	,			•	) = (23a)			0	(23b)
If balanced with		•	-	_								0	(23c)
a) If balance					·	<del>- ` `                                 </del>	<del>-                                    </del>	<del>``</del>	<del> </del>	<del>,                                    </del>	<u> </u>	÷ 100]	(0.4.)
(24a)m= 0		0	0	0	. 0	0	0	0	0	0	0		(24a)
b) If balance		ı			i	<u> </u>	r ``	<del>``</del>	<del>- ` `</del>	<del></del>		Ī	(0.41-)
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If whole h	ouse ex n < 0.5 ×			•					5 v (23h	<b>.</b> )			
(24c)m = 0	0.5 7	0	0	0	0	0	0	0	0	0	0		(24c)
d) If natural													,
,	n = 1, the				•				0.5]				
(24d)m= 0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55		(24d)
Effective air	change	rate - er	iter (24a	) or (24b	o) or (24	c) or (24	d) in box	(25)					_
(25)m= 0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55		(25)
3. Heat losse	s and he	eat loss r	paramete	er:								_	
ELEMENT	Gros		Openin		Net Ar	ea	U-val	ue	AXU		k-value	)	ΑΧk
_	area	(m²)	m	l <sup>2</sup>	A ,r	m²	W/m2	K	(W/I	K)	kJ/m²-l	<	kJ/K
Doors					2	X	1.4	=	2.8	╚			(26)
Windows					6.125	x1,	/[1/( 1.5 )+ 	0.04] =	8.67	╝.			(27)
Floor Type 1					41.5	Х	0.24	=	9.96				(28)
Floor Type 2					41.5	Х	0.24	=	9.96				(28)
Walls	83.1	8	14.2	5	68.93	3 X	0.25	=	17.23				(29)
Roof	41.	5	0		41.5	Х	0.2	=	8.3				(30)
Total area of e	lements	, m²			207.6	8							(31)
* for windows and						ated using	formula 1	/[(1/U-valu	ie)+0.04] a	as given in	paragraph	3.2	
** include the area Fabric heat los				is and pan	llioris		(26)(30)	) + (32) =				65.50	(33)
Heat capacity	·	`	0)				(==)(==)		.(30) + (3)	2) + (32a).	(32e) =	65.59 15904.	<del></del>  : :
Thermal mass	,	,	P = Cm -	- TFA) ir	n k.J/m²K				tive Value	, , ,	(020)	450	(35)
For design assess	•	`		,			ecisely the			· ·	able 1f	430	(00)
		tailed calci	ılation				-						
can be used inste	ad of a dea	anoa oalot	alation.										(0.0)
Thermal bridge	es : S (L	x Y) cal	culated (		•	<						16.61	(36)
Thermal bridge	es : S (L al bridging	x Y) cal	culated (		•	<		(33) +	(36) -				
Thermal bridge if details of therma Total fabric he	es : S (L al bridging at loss	x Y) cal	culated ( own (36) =	= 0.15 x (3	•	<			(36) = - 0.33 × (	(25)m v (F)		16.6 <sup>2</sup> 82.2	(36)
Thermal bridge if details of therma Total fabric he Ventilation hea	es : S (L al bridging at loss at loss ca	x Y) calcare not kn	culated ( own (36) =	= 0.15 x (3	1)		Δυσ	(38)m	= 0.33 × (	(25)m x (5)	_		
Thermal bridge if details of thermal Total fabric he Ventilation head	es : S (L al bridging at loss at loss ca Feb	x Y) cale are not kn alculated Mar	culated ( own (36) =	= 0.15 x (3	•	Jul 36.21	Aug 36.21		= 0.33 × (	Nov	Dec 37.98		
Thermal bridge if details of thermal Total fabric her Ventilation head Summer (38)m= 38.43	es : S (L al bridging at loss at loss ca Feb 37.98	x Y) calc are not kn alculated Mar 37.98	culated ( own (36) = I monthly Apr	9 0.15 x (3) May	Jun	Jul	Ť	(38)m Sep 36.77	= 0.33 × ( Oct 37.15	Nov 37.55	Dec		(37)
Thermal bridge if details of thermal Total fabric her Ventilation head Ventilation head (38)m= 38.43  Heat transfer of	es: S (L al bridging at loss at loss ca Feb 37.98	x Y) calc are not kn alculated Mar 37.98	culated ( own (36) = I monthly Apr 37.15	= 0.15 x (3 / May 36.66	Jun 36.42	Jul 36.21	36.21	(38)m Sep 36.77 (39)m	$= 0.33 \times ($ Oct $= 37.15$ $= (37) +$	Nov 37.55	Dec 37.98		(37)
Thermal bridge if details of thermal Total fabric her Ventilation head Summer (38)m= 38.43	es : S (L al bridging at loss at loss ca Feb 37.98 coefficier 120.18	x Y) calculated Mar 37.98 att, W/K	culated (100m (36) = 1 monthly Apr 37.15	May 36.66	Jun 36.42	Jul 36.21	Ť	(38)m Sep 36.77 (39)m 118.98	= 0.33 × ( Oct 37.15 = (37) + (37)	Nov 37.55	Dec 37.98	82.2	(37)

leat lo	ss para	meter (F	HLP), W	m²K					(40)m	= (39)m ÷	(4)			
10)m=	1.45	1.45	1.45	1.44	1.43	1.43	1.43	1.43	1.43	1.44	1.44	1.45		_
lumbo	r of day	c in moi	nth (Tab	lo 1a)					,	Average =	Sum(40) <sub>1</sub> .	12 /12=	1.44	(4
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
l1)m=	31	28	31	30	31	30	31	31	30	31	30	31		(4
L														
4. Wat	ter heat	ing ener	gy requi	rement:								kWh/ye	ar:	
eeuma	ed occu	nancy I	NI.								2.5	173		(4
if TF		, N = 1		[1 - exp	(-0.0003	349 x (TF	A -13.9	)2)] + 0.0	0013 x (	ΓFA -13.		173		(4
		•	ater usag	ge in litre	s per da	ay Vd,av	erage =	(25 x N)	+ 36		98.9	9331		(4
educe t	the annua	l average	hot water	usage by	5% if the a	lwelling is hot and co	designed t			se target o				·
Γ	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
t wate						ctor from 7			СОР		1101			
4)m=	108.83	104.87	100.91	96.95	93	89.04	89.04	93	96.95	100.91	104.87	108.83		
	, , ,				41			T (000			m(44) <sub>112</sub> =		1187.197	(4
_						190 x Vd,r							-	
5)m= [	161.77	141.49	146	127.29	122.14	105.39	97.66	112.07	113.41	132.17	144.27	156.67		٦,
nstanta	aneous w	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)		Total = Su	m(45) <sub>112</sub> =		1560.3265	(
	24.27	21.22	21.9	19.09	18.32	15.81	14.65	16.81	17.01	19.82	21.64	23.5		(4
	storage					10.01								•
If ma	anufactu	rer's de	clared lo	ss facto	r is knov	vn (kWh	/day):				0.0	024		(4
empe	rature fa	actor fro	m Table	2b							0.	54		(4
0,			storage					(47) x (48)	=		0.0	013		(4
			-			s not kno age with								(!
		,		•		litres in bo						0		(-
	•	•		•		eous comb	. ,	enter '0' in	box (50)					
ot wat	ter stora	age loss	factor fr	om Tabl	e 2 (kW	h/litre/da	y)					0		(!
olume	e factor t	from Tal	ble 2a									0		(!
empe	rature fa	actor fro	m Table	2b								0		(
nergy	lost fro	m water	storage	, kWh/ye	ear			((50) x (51	) x (52) x	(53) =		0		(!
nter (4	49) or (5	54) in (5	5)								0.0	013		(!
ater s	storage	loss cal	culated f	or each	month			((56)m = (	55) × (41)ı	m				
6)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(!
cylinde	r contains	dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (57	7)m = (56)	m where (	H11) is fro	m Appendi	кН	
7)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(!
imary	circuit	loss (an	nual) fro	m Table	3						30	60		(!
-		•	•			59)m = (	58) ÷ 36	55 × (41)	m					
(mod	lified by	factor fi	om Tab	le H5 if t	here is s	olar wat	er heatir	ng and a	cylinde	r thermo	stat)			
` _	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		( !
9)m= [	00.00					•								
9)m=				month (	(61)m =	(60) ÷ 36	65 × (41)	)m						

Total boot so wise different booting a calculate different booting (CO) as 0.05 c. (45) as 1.46 as 1.46 as 1.46 as	(04)
Total heat required for water heating calculated for each month $(62)m = 0.85 \times (45)m + (46)m + (57)m + (59)m + (59)m + (50)m	` '
(62)m= 192.75 169.47 176.98 157.27 153.11 135.37 128.64 143.05 143.39 163.14 174.25 187.65	(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)	
(add additional lines in 1 Gritts and/or vvvi its applies, see Appendix G)  (63)m= 0 0 0 0 0 0 0 0 0 0 0	(63)
	(55)
Output from water heater (64)m= 192.75 169.47 176.98 157.27 153.11 135.37 128.64 143.05 143.39 163.14 174.25 187.65	
	925.0569 (64)
Heat gains from water heating, kWh/month 0.25 $^{\prime}$ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]	(5.7)
(65)m= 78.25 69.14 73.01 65.99 65.07 58.71 56.93 61.72 61.38 68.41 71.64 76.55	(65)
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating	` '
	ig
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)
	(00)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	(67)
(67)m= 53.33 47.37 38.52 29.16 21.8 18.41 19.89 25.85 34.7 44.06 51.42 54.81	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	(60)
(68)m= 336.71 340.2 331.4 312.66 288.99 266.76 251.9 248.41 257.21 275.95 299.62 321.85	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	(00)
(69)m= 52.62 52.62 52.62 52.62 52.62 52.62 52.62 52.62 52.62 52.62 52.62	(69)
Pumps and fans gains (Table 5a)	
(70) m =	(70)
Losses e.g. evaporation (negative values) (Table 5)	
(71)m= -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69	(71)
Water heating gains (Table 5)	
(72)m= 105.17 102.88 98.13 91.66 87.46 81.55 76.52 82.96 85.25 91.94 99.5 102.89	(72)
Total internal gains = $(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$	
(73)m= 598.19 593.43 571.02 536.45 501.22 469.68 451.28 460.19 480.12 514.92 553.5 582.53	(73)
6. Solar gains:	
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.	
<b>0–</b>	ains (W)
South 0.9x 0.77 x 6.12 x 47.32 x 0.76 x 0.7 =	213.73 (78)
South 0.9x 0.77 x 6.12 x 77.18 x 0.76 x 0.7	348.58 (78)
South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 =	425.64 (78)
South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 =	474.73 (78)
South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 =	490.24 (78)
South 0.9x 0.77 x 6.12 x 108.9 x 0.76 x 0.7 =	491.81 (78)
South 0.9x 0.77 x 6.12 x 107.14 x 0.76 x 0.7 =	483.86 (78)
South 0.9x 0.77 x 6.12 x 103.88 x 0.76 x 0.7 =	469.16 (78)

South	0.9x	0.77	X	6.1	2	x	9	9.99	x		0.76	x	0.7	=	451.59	(78)
South	0.9x	0.77	X	6.1	2	X	8	5.29	х		0.76	_ x _	0.7		385.2	(78)
South	0.9x	0.77	X	6.1	2	x	5	6.07	х		0.76	_ x _	0.7	=	253.22	(78)
South	0.9x	0.77	X	6.1	2	x	4	0.89	x		0.76	x	0.7	=	184.67	(78)
	_								•							
Solar o	ains in	watts, ca	alculated	I for eacl	h month				(83)m	ı = Sı	um(74)m .	(82)m				
(83)m=	213.73	348.58	425.64	474.73	490.24		91.81	483.86	469	.16	451.59	385.2	253.22	184.67		(83)
Total g	ains – i	nternal a	nd solar	(84)m =	= (73)m	+ (8	83)m	, watts					•		•	
(84)m=	811.91	942.01	996.66	1011.17	991.47	9	61.49	935.14	929	.35	931.71	900.12	806.73	767.2		(84)
7. Me	an inter	nal temp	erature	(heating	season	)										
		during h		·			area f	from Tab	ole 9	. Th	1 (°C)				21	(85)
-		tor for g	٠.			_				,	. ( -)					` ′
	Jan	Feb	Mar	Apr	May	È	Jun	Jul	ΙΑ	ug	Sep	Oct	Nov	Dec	]	
(86)m=	1	1	0.99	0.97	0.91	⊢	0.75	0.52	0.5	<del>-  </del>	0.8	0.96	1	1		(86)
` '								<u> </u>		!				· ·		, ,
ĺ		l temper				_			T			20.70	00.44	00.00	1	(07)
(87)m=	20.21	20.34	20.52	20.68	20.87		0.97	21	2	1	20.96	20.76	20.41	20.22		(87)
Temp	erature	during h	eating p	eriods ir	rest of	dw	elling	from Ta	able 9	9, Tł	n2 (°C)				,	
(88)m=	19.73	19.73	19.73	19.74	19.74	1	9.74	19.75	19.	75	19.74	19.74	19.73	19.73		(88)
Utilisa	ation fac	tor for g	ains for	rest of d	welling,	h2,	m (se	e Table	9a)						_	
(89)m=	1	0.99	0.98	0.96	0.86		0.62	0.36	0.3	36	0.68	0.93	0.99	1		(89)
Mean	interna	l temper	ature in	the rest	of dwell	ina	T2 (f	ollow ste	ns 3	to 7	in Tahl	e 9c)				
(90)m=	18.72	18.91	19.16	19.39	19.64	Ť	9.73	19.75	19.		19.72	19.51	19.02	18.73	1	(90)
` ′											f	LA = Livin	g area ÷ (4	<del>1</del> ) =	0.36	(91)
			-1 (6	a tha - I		ne .		A T4	. /4		A) TO					
(92)m=	19.26	temper	19.65	19.86	20.08	$\overline{}$	g) = 11 20.18	20.2	+ (1		A) × 12 20.17	19.97	19.53	19.27	1 —	(92)
` ′		nent to the				_		!					19.55	19.21		(32)
(93)m=	19.26	19.43	19.65	19.86	20.08	т —	20.18	20.2	20		20.17	19.97	19.53	19.27	1	(93)
		ting requ			20.00		.0.10	20.2		· <u>-</u>	20.17	10.07	10.00	10.27		()
		mean int			re ohtair	ned	at st	≥n 11 of	Tahl	e Gh	so tha	t Ti m-/	76)m an	d re-cald	rulate	
		factor fo		•			at ott	5p 11 01	i abi		, 00 1110	( 11,111–(	7 0)111 011	a ro oare	Jaiato	
	Jan	Feb	Mar	Apr	May		Jun	Jul	Α	ug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm												_	
(94)m=	1	0.99	0.98	0.96	0.87	(	0.67	0.42	0.4	12	0.72	0.94	0.99	1		(94)
Usefu	l gains,	hmGm ,	W = (94	4)m x (84	4)m											
(95)m=	809.67	934.96	977.7	968.71	866.69	6	45.18	390.02	389	.99	671.1	845.89	801.11	765.42		(95)
Month	nly aver	age exte	rnal tem	perature	from T	abl	e 8	-							•	
(96)m=	4.5	5	6.8	8.7	11.7	<u> </u>	14.6	16.9	16	.9	14.3	10.8	7	4.9		(96)
1		e for mea			erature,	Lm	, W =	=[(39)m	x [(9	3)m-	- (96)m	]			,	
(97)m=	1780.17	1733.82	1544.7	1331.53	996.14	6	62.24	390.6	390	.59	698.56	1094.01	1500.01	1726.75		(97)
		g require				Wh	/mont	th = 0.02	24 x	(97)	m – (95	<u>`</u>	ŕ		1	
(98)m=	722.05	536.83	421.84	261.23	96.31		0	0	C	)	0	184.6	503.21	715.23		_
										Total	per year	(kWh/yeaı	r) = Sum(9	8) <sub>15,912</sub> =	3441.3	(98)
Space	e heatin	g require	ement in	kWh/m²	/year										41.46	(99)

9a. Energy requirements – Individu	al heating s	ystems i	ncluding	micro-C	CHP)					
Space heating:	. ,							1		<b>—</b> , ,
Fraction of space heat from secon		mentary	•		(004)				0	(201)
Fraction of space heat from main	. ,			(202) = 1		(000)1			1	(202)
Fraction of total heating from mair	•			(204) = (2	02) <b>x</b> [1 –	(203)] =			1	(204)
Efficiency of main space heating s	•		0.4						92.8	(206)
Efficiency of secondary/suppleme	<u> </u>	g systen	·	i	i		i	i	0	(208)
<u> </u>	pr May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/y	ear ear
Space heating requirement (calcu 722.05 536.83 421.84 261		0	0	0	0	184.6	503.21	715.23		
$(211)$ m = {[(98)m x (204)] + (210)m		<u> </u>	<u> </u>							(211)
778.07 578.48 454.57 281		0	0	0	0	198.93	542.25	770.72		(211)
	l .	<u> </u>	<u> </u>	Tota	l (kWh/yea	ar) =Sum(2	1 211) <sub>15,1012</sub>	<u>-</u> =	3708.3	(211)
Space heating fuel (secondary), k	Wh/month							!		
= {[(98)m x (201)] + (214) m } x 100		ı	ı	1	ı		1	ı	I	
(215)m= 0 0 0 0	0	0	0	O Tota	0	0	0	0		(045)
Mataulaatina				Tota	l (kWh/yea	ar) =Surri(2	213) <sub>15,1012</sub>	·=	0	(215)
Water heating Output from water heater (calculate	ed above)									
192.75 169.47 176.98 157		135.37	128.64	143.05	143.39	163.14	174.25	187.65		
Efficiency of water heater									79.1	(216)
(217)m= 87.31 86.98 86.35 85.	46 82.91	79.1	79.1	79.1	79.1	84.44	86.78	87.34		(217)
Fuel for water heating, kWh/month $(219)m = (64)m \times 100 \div (217)m$										
(219)m= $220.76$ $194.84$ $204.96$ $184$	.03 184.66	171.14	162.63	180.84	181.27	193.2	200.79	214.83		
				Tota	I = Sum(2	19a) <sub>112</sub> =		•	2293.97	(219)
Annual totals	4					k'	Wh/year	•	kWh/ye	ar
Space heating fuel used, main syst	em 1								3708.3	_
Water heating fuel used									2293.97	
Electricity for pumps, fans and elec	tric keep-ho	t								
central heating pump:								130		(230c)
boiler with a fan-assisted flue								45		(230e)
Total electricity for the above, kWh	/year			sum	of (230a).	(230g) =			175	(231)
Electricity for lighting									376.75	(232)
10a. Fuel costs - individual heating	g systems:									
		Fu				Fuel P			Fuel Cos	t
Space heating, main system 4			/h/year			(Table		x 0.01 =	£/year	(0.10)
Space heating - main system 1						3.			114.9572	(240)
Space heating - main system 2			3) x			0		x 0.01 =	0	(241)
Space heating - secondary			5) x			0		x 0.01 =	0	(242)
Water heating cost (other fuel)		(219	9)			3.	1	x 0.01 =	71.11	(247)

Pumps, fans and electric keep-hot	(231)	11.46 x 0.01 =	20.06 (249)
(if off-peak tariff, list each of (230a) to (230g) se			
Energy for lighting	(232)	11.46 X 0.01 =	45.10 (200)
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254)			
3,	247) + (250)(254) =		355.3007 (255)
11a. SAP rating - individual heating systems			
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF) [(255) x	(256)] ÷ $[(4) + 45.0]$ =		1.3046 (257)
SAP rating (Section 12)			81.8006 (258)
12a. CO2 emissions – Individual heating syste	ems including micro-CHP		
	Energy	<b>Emission factor</b>	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating (main system 1)	(211) x	0.198	734.24 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Water heating	(219) x	0.198	454.21 (264)
Space and water heating	(261) + (262) + (263) + (2	64) =	1188.45 (265)
Electricity for pumps, fans and electric keep-ho-	t (231) x	0.517 =	90.48 (267)
Electricity for lighting	(232) x	0.517 =	194.78 (268)
Total CO2, kg/year		sum of (265)(271) =	1473.7 (272)
CO2 emissions per m²		(272) ÷ (4) =	17.76 (273)
El rating (section 14)			85 (274)
13a. Primary Energy			
	Energy	Primary	P. Energy
	kWh/year	factor	kWh/year
Space heating (main system 1)	(211) x	1.02	3782.46 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Energy for water heating	(219) x	1.02	2339.85 (264)
Space and water heating	(261) + (262) + (263) + (2	64) =	6122.31 (265)
Electricity for pumps, fans and electric keep-ho	t (231) x	2.92	511 (267)
Electricity for lighting	(232) x	0 =	1100.11 (268)
'Total Primary Energy		sum of (265)(271) =	7733.42 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	93.17 (273)

				User D	Details:						
Assessor Name: Software Name:	Stroma	FSAP 200	)9		Strom Softwa				Versio	on: 1.5.0.49	
			Р	roperty	Address	House	1				
Address :											
Overall dwelling dime	ensions:			A	a ( 2 )		A 1 l .	. !   . ( / )		Value of ma	·\
Ground floor					<b>a(m²)</b> 62.66	(1a) x		eight(m) 39	(2a) =	Volume(m³	(3a
Total floor area TFA = (1	a)+(1b)+(1d	c)+(1d)+(1e	e)+(1ı	ገ) 🥻	62.66	(4)					
Dwelling volume						(3a)+(3b	)+(3c)+(3c	d)+(3e)+	(3n) =	149.7574	(5)
2. Ventilation rate:											
	main heatir		econda neating	ry	other		total			m³ per hou	ır
Number of chimneys	0	<del></del>	0	7 + [	0	= [	0	X e	40 =	0	(6a
Number of open flues	0	- +	0	<b></b>	0	Ī = Ē	0	x	20 =	0	(6b
Number of intermittent fa	ans					<b>-</b>	0	x	10 =	0	 (7a
Number of passive vents	6					F	0	x	10 =	0	(7b
Number of flueless gas f						F	0	x	40 =	0	(70
variber of fluciess gas i	1103					L	0			0	(//
									Air ch	anges per ho	our
Infiltration due to chimne	ys, flues an	d fans = (6	a)+(6b)+(7	7a)+(7b)+(	(7c) =	Г	0		÷ (5) =	0	(8)
If a pressurisation test has l	been carried o	ut or is intende	ed, procee	d to (17),	otherwise o	continue fr	rom (9) to (				
Number of storeys in t	he dwelling	(ns)								0	(9)
Additional infiltration	OF for oto o	l av timbar	frame of	0 25 fa				[(9)	-1]x0.1 =	0	= (10 -
Structural infiltration: 0  if both types of wall are p						•	ruction			0	(11
deducting areas of openi	ings); if equal ເ	ıser 0.35							,		_
If suspended wooden		,	led) or 0	.1 (seale	ed), else	enter 0				0	(12
If no draught lobby, er										0	(13
Percentage of window Window infiltration	's and doors	araught s	прреа		0.25 - [0.2	x (14) ÷ 1	1001 =			0	(14 (15
Infiltration rate					(8) + (10)		_	+ (15) =		0	(16
Air permeability value,	, q50, expre	ssed in cub	oic metre	es per ho	our per s	quare m	etre of e	envelope	area	6.1	(17
If based on air permeabi					•	•				0.3	(18
Air permeability value applie	es if a pressuri	sation test ha	s been doi	ne or a de	gree air pe	rmeability	is being u	sed			_
Number of sides on which	ch sheltered				(20) – 1	10 075 v (r	10\1			2	(19
Shelter factor	برمدام مام مرشد	factor			(20) = 1 -		19)] =			0.85	(20
Infiltration rate incorpora	_		<b>.</b>		(21) = (18	) X (20) =				0.26	(21
Infiltration rate modified	Mar Ap	<del>- i</del>	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	<u> </u>		I Juli	<u> Jui</u>	_ Aug	l 2eh	1 001	INOV	l nec	I	
Monthly average wind sp (22)m= 5.4 5.1	5.1 4.5	_	3.9	3.7	3.7	4.2	4.5	4.8	5.1	]	
3.4 3.1	3.1 4.3	1 7.1	1 3.3	L 3.7	J	7.2	1 7.5		J 0.1		
Wind Factor (22a)m = (2	22)m ÷ 4									_	
(22a)m= 1.35 1.27	1.27 1.12	2 1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27		

Adjusted infiltra	ation rate	e (allowi	ng for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m					
0.35	0.33	0.33	0.29	0.27	0.25	0.24	0.24	0.27	0.29	0.31	0.33		
Calculate effec		_	rate for t	he appli	cable ca	se	-	-	-	-	-		/00
If mechanica			endix N (2	3h) = (23a	a) × Fmv (e	equation (1	N5)) othe	rwise (23h	) = (23a)			0	(23
If balanced with									) — ( <b>20</b> 0)			0	(23
		•	•	ŭ		`		,	26\m . /	22h) v [	1 (220)	0	(23
a) If balance	0		0	0	0	o (IVIVI	1K) (24a	0	0	230) <b>x</b> [	0	] <del>-</del> 100]	(24
	-								<u> </u>				(-
b) If balance	o mecha 0	o o	0	without 0	neat rec	overy (r	0	0	0	230)	0	1	(24
					<u> </u>				0			J	(2
c) If whole he if (22b)m				•	•				5 × (23h	n)			
24c)m= 0	0	0	0	0	0	0	0	0	0	0	0	1	(24
d) If natural	/entilatio	n or wh	ole hous	e nositiv	/e innut	L ventilatio	n from l	L	<u> </u>	<u> </u>	<u> </u>	J	
if (22b)m									0.5]				
24d)m= 0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	]	(24
Effective air	change	rate - er	nter (24a	) or (24b	o) or (24	c) or (24	d) in box	x (25)	•	•	•	•	
25)m= 0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55		(2
2 Hoot laces	م ما له م	t loss						•					_
3. Heat losses	Gros		Openin		Net Ar	00	U-valı	110	AXU		k-value		AXk
LEMENT	area		operiiri		A,r		W/m2		(W/	K)	kJ/m <sup>2</sup> -	-	kJ/K
Doors					2	x	1.4	_ [	2.8			-	(26
Vindows					6.125	x1	/[1/( 1.5 )+	0.04] =	8.67	Ħ		-	(27
loor					62.66	X	0.24	<del> </del>	15.038				(28
Valls	62.8	· · · · · · · · · · · · · · · · · · ·	14.2		48.59		0.25		12.15	片 ;		╡ ⊨	(29
Roof	62.6		0		62.66	_	0.2	<del>-</del>	12.53	룩 ;		-	(30
otal area of e						_	0.2		12.55				
for windows and		•	offoctivo wi	ndow I I ve	188.1		ı formula 1	/[/1/    val	(0) 1 0 041 4	ne aivon in	naraaranl		(3
include the area						ateu using	i ioiiiiuia i	/[( 1/ <b>O</b> -vaic	0-7+0.0 <del>4</del> ] 6	is given in	paragrapi	1 3.2	
abric heat los	s, W/K =	= S (A x	U)				(26)(30)	) + (32) =				59.85	(3:
leat capacity	Cm = S(	(Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	11823.0	)9 (34
hermal mass	parame	ter (TMF	c = Cm -	- TFA) ir	n kJ/m²K			Indica	tive Value	: High		450	(3
or design assess	ments wh	ere the de	tails of the	construct	ion are no	t known pr	ecisely the	e indicative	values of	TMP in Ta	able 1f		
an be used instea													
hermal bridge	,	,		٠.	•	<						18.82	(30
details of thermatotal fabric hea		are not kn	own (36) =	= 0.15 x (3	11)			(22) 1	(26) -				. 700
		مامان مام	را طاعم مصل						(36) =	'OE\ ·· (E)		78.67	(37
entilation hea		i	· ·		1	11	Λ	<u> </u>		(25)m x (5)		1	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	-	(38
38)m= 27.74	27.41	27.41	26.81	26.45	26.29	26.13	26.13	26.54	26.81	27.1	27.41	J	(30
leat transfer c					ı	ī	ı	<del>- ` ´</del>	= (37) + (	<del></del>		1	
39)m= 106.41	106.08	106.08	105.48	105.12	104.96	104.8	104.8	105.21	105.48	105.77	106.08		
									Average =	Sum(39) <sub>1</sub>	12 /12=	105.52	2 (39

eat los	ss para	meter (H	ILP), W	m²K					(40)m	= (39)m ÷	(4)			
-0)m=	1.7	1.69	1.69	1.68	1.68	1.68	1.67	1.67	1.68	1.68	1.69	1.69		
			-41- / <b>T</b> -1-	I- 4-\					/	Average =	Sum(40) <sub>1</sub> .	12 /12=	1.68	(40
umbei T			nth (Tab	· ·	Max	1	11	A	Can	0-4	Nov	Daa		
1)m-	Jan 31	Feb 28	Mar 31	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31	Nov 30	Dec 31		(4 <sup>-</sup>
1)m=	31	20	31	30	31	30	31	31	30	31	30	31		(4
1 \N/ot	or booti	na onor	gy requi	iromont:								kWh/ye	or:	
+. VVal	ei neau	ng ener	gy requi	nement.								Kvvii/ye	aı.	
if TFA				[1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.0	0013 x (	ΓFA -13.		558		(42
nnual	average	e hot wa			es per da							3939		(43
		_			5% if the c ater use, l	_	_	o acnieve	a water us	se target o	ī			
Γ	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ot water		litres per			Vd,m = fa		Table 1c x							
4)m=	96.13	92.64	89.14	85.65	82.15	78.65	78.65	82.15	85.65	89.14	92.64	96.13		
								- (2)			m(44) <sub>112</sub> =		1048.7273	(4
											ables 1b, 1		_	
5)m= [	142.9	124.98	128.97	112.44	107.89	93.1	86.27	99	100.18	116.75	127.44	138.39		٦,,
instanta	aneous wa	ater heatir	ng at point	of use (no	o hot water	storage),	enter 0 in	boxes (46		Total = Su	m(45) <sub>112</sub> =	_ L	1378.3365	(4
6)m= [	21.44	18.75	19.35	16.87	16.18	13.97	12.94	14.85	15.03	17.51	19.12	20.76		(4
	torage	loss:												
) If ma	nufactu	rer's de	clared lo	oss facto	r is knov	vn (kWh	/day):				0.0	)24		(4
emper	ature fa	ctor fro	m Table	2b							0.	54		(4
0,			storage			( )		(47) x (48)	) =		0.0	)13		(4
			,		s factor is olar stor							0		(5
•		` '		0 ,	enter 110	Ü						<u> </u>		(0
	-	_		_	instantan			enter '0' in	box (50)					
ot wat	er stora	ige loss	factor fr	om Tab	le 2 (kW	h/litre/da	ıy)					0		(5
olume	factor f	rom Tal	ble 2a									0		(5
emper	ature fa	ctor fro	m Table	2b								0		(5
nergy	lost from	m water	storage	, kWh/ye	ear			((50) x (51	) x (52) x (	(53) =		0		(5
nter (4	19) or (5	64) in (5	5)								0.0	013		(5
/ater s	torage	loss cal	culated f	for each	month			((56)m = (	55) × (41)r	m				
6)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(5
cylinder _	contains	dedicated	d solar sto	rage, (57)	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Appendi:	хH	
7)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(5
rimary	circuit	loss (an	nual) fro	m Table	e 3						36	60		(5
rimary	circuit	loss cal	culated 1	for each	month (	•	` '	, ,						
· _	<del></del>				here is s			<del></del>			<del></del>			
9)m=	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		(5
					(0.4)	(00) . 0(	SE (44)	۱m						
ombi l	oss cal	culated	for each	month (	(61)m =	(60) ÷ 30	00 X (41)	)111						

Г			ı —	<del></del>		_		-	Ò		i		<del>`</del>	<del>`</del>	- (59)m + (61) ¬	
` ' L		152.96	159.95	142.42	138.87			117.25	129.		130.16	147.7		169.37		(62)
							_					contrib	ution to wate	er heating	)	
` г			ı —	and/or \	ı —	ap I	<del>.                                     </del>				<del></del>		1 .	Ι ,	7	(62)
(63)m=	0	0	0	0	0		0	0	0		0	0	0	0		(63)
· r		ater hea		1,40,40	400.07	T 46		447.05	400	<u> </u>	400.40	4 47 7	1.57.40	100.07	7	
(64)m=	173.88	152.96	159.95	142.42	138.87	12	23.08	117.25	129.		130.16	147.7		169.37	4740,0000	(64)
				1.14/1./		- / 1		(45)					ter (annual) <sub>1</sub>		1743.0669	(04)
Ĭ					ı —	_		<u> </u>	·			- ,	n + (57)m	<del>- `                                   </del>	ון 1	(GE)
(65)m=	71.98	63.65	67.34	61.06	60.33		4.63	53.15	57.3		56.98	63.28		70.48	]	(65)
				, ,	-	ylin	ider is	in the c	dwelli	ing d	or hot wa	ater is	from com	munity l	neating	
5. Inte	ernal ga	ins (see	Table 5	5 and 5a	):											
Metabo		s (Table				_					_ 1		1		7	
	Jan	Feb	Mar	Apr	May	⊢	Jun	Jul	Αι	-	Sep	Oct	+	Dec	_	(22)
(66)m=	123.35	123.35	123.35	123.35	123.35			123.35	123.		123.35	123.3	123.35	123.35		(66)
ŗ	<del></del>	<u>`</u>		ppendix	<del></del>	_								·	7	
(67)m=	40.03	35.55	28.91	21.89	16.36	1:	3.81	14.93	19.	4	26.04	33.06	38.59	41.14		(67)
		-		Append		_				$\rightarrow$			_			
(68)m=	268.06	270.84	263.83	248.91	230.07	21	2.37	200.54	197.	.76	204.77	219.69	238.53	256.24		(68)
Cookin	g gains	(calcula	ited in A	ppendix	L, equa	ion	L15 c	or L15a)	, also	o se	e Table	5				
(69)m=	49.39	49.39	49.39	49.39	49.39	49	9.39	49.39	49.3	39	49.39	49.39	49.39	49.39		(69)
Pumps	and far	ns gains	(Table	5a)											_	
(70)m=	0	0	0	0	0		0	0	0		0	0	0	0		(70)
Losses	e.g. ev	aporatio	n (nega	tive valu	es) (Tab	le 5	5)								_	
(71)m=	-82.23	-82.23	-82.23	-82.23	-82.23	-8	2.23	-82.23	-82.	23	-82.23	-82.23	-82.23	-82.23		(71)
Water I	neating	gains (T	able 5)												_	
(72)m=	96.74	94.72	90.52	84.8	81.09	7:	5.87	71.43	77.1	12	79.14	85.05	91.73	94.73		(72)
Total i	nternal	gains =					(66)n	n + (67)m	+ (68	)m +	(69)m + (	70)m +	(71)m + (72)	m		
(73)m=	495.34	491.62	473.77	446.11	418.04	39	2.56	377.41	384.	.79	400.46	428.3	2 459.36	482.61		(73)
6. Sol	ar gains	);														
Solar g	ains are c	alculated	using sola	r flux from	Table 6a	and	associa	ited equa	tions t	o cor	overt to the	e applic	able orienta	ion.		
Orienta		ccess Fable 6d		Area m²			Flux Tab	t le 6a			g_ able 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	6.1	2	x [	47	7.32	×		0.76	X	0.8	=	244.26	(78)
South	0.9x	0.77	х	6.1	2	x	77	'.18	х		0.76	x	0.8		398.38	(78)
South	0.9x	0.77	x	6.1	2	x [	94	.25	х		0.76	×	0.8	<u> </u>	486.45	(78)
South	0.9x	0.77	x	6.1	2	x	10	5.11	х		0.76	×	0.8	<del>-</del>	542.54	(78)
South	0.9x	0.77	x			x [		8.55	X		0.76	×	0.8		560.28	(78)
South	0.9x	0.77	x			x [		08.9	x		0.76	×	0.8		562.07	(78)
South	0.9x	0.77	x			x [		7.14	x		0.76	×	0.8		552.99	(78)
South	0.9x	0.77	x			x [		3.88	X		0.76	×	0.8	= =	536.19	(78)
	L					L		-	L		-					` ′

South	0.9x	0.77	Х	6.1	2	x	9	9.99	x		0.76	х	0.8	=	516.1	(78)
South	0.9x	0.77	x	6.1	2	x	8	5.29	x		0.76	_ x _	0.8		440.23	(78)
South	0.9x	0.77	X	6.1	2	x	5	6.07	X		0.76	= x =	0.8	=	289.4	(78)
South	0.9x	0.77	X	6.1	2	x	4	0.89	x		0.76	x	0.8	_	211.05	(78)
Solar gair	ns in w	atts. ca	lculated	I for eac	h month				(83)m	ı = Sı	um(74)m .	(82)m				
<b>—</b>		398.38	486.45	542.54	560.28	г	62.07	552.99	536	.19	516.1	440.23	289.4	211.05		(83)
Total gair	ns – int	ernal a	nd solar	(84)m =	= (73)m ·	+ (8	83)m	, watts							ı	
(84)m= 7	39.6	890	960.22	988.65	978.31	9:	54.63	930.39	920	.97	916.56	868.55	748.76	693.66		(84)
7. Mean	intern	al temp	erature	(heating	season	)									•	
Tempera				·			area f	from Tak	nle 9	Th	1 (°C)				21	(85)
Utilisatio		•	•			•			JIC 0,	,	. ( 0)				21	
	Jan	Feb	Mar	Apr	May	È	Jun	Jul	Ι	ug	Sep	Oct	Nov	Dec	]	
(86)m=	1	0.99	0.97	0.94	0.86	⊢	0.68	0.46	0.4	Ť	0.72	0.93	0.99	1		(86)
` '								<u> </u>		!		0.55	0.00	'		(00)
Mean in						_									1	(0-)
(87)m= 2	0.12	20.29	20.51	20.68	20.88	2	20.98	21	2	1	20.96	20.77	20.36	20.12		(87)
Tempera	ature d	uring h	eating p	eriods ir	rest of	dw	elling	from Ta	able 9	9, Th	n2 (°C)				_	
(88)m= 1	9.55	19.55	19.55	19.56	19.56	1	9.56	19.57	19.	57	19.56	19.56	19.55	19.55		(88)
Utilisatio	n facto	or for ga	ains for	rest of d	welling.	h2.	m (se	e Table	9a)						_	
	0.99	0.98	0.96	0.91	0.78		0.54	0.3	0.	3	0.59	0.88	0.99	1	]	(89)
ـــ Mean in	tornal t	ompor	aturo in	the rest	of dwalli	na	T2 (f	ollow etc	nc 3	to 7	in Tabl	0.00)				
	8.45	18.7	19	19.25	19.48	Ť	9.56	19.57	19.		19.55	19.36	18.81	18.46	1	(90)
(00)	00	10		10.20			0.00						g area ÷ (4		0.64	(91)
													Ĭ `	,	0.04	(-,
Mean in								l e	r È	$\neg$					, —	(00)
` '	9.52	19.72	19.96	20.16	20.37	_	20.46	20.48	20.		20.45	20.26	19.8	19.52		(92)
Apply ac					· ·	_		1	1			•	40.0	40.50	1	(93)
` '	9.52	19.72	19.96	20.16	20.37		20.46	20.48	20.	40	20.45	20.26	19.8	19.52		(90)
8. Space					ro obtoir	. o d	l ot ot	on 11 of	Tobl	0 Ob	oo tha	+ Ti m_/	76\m on	d ro ool	nulata	
Set Ti to the utilis				•		ieu	al Sie	ғр п о	ıabı	e ar	), 50 illa	ι 11,111=(	<i>i</i> ojili ali	u re-carc	Julate	
	Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec	]	
Utilisatio	on facto	or for ga	ains, hm	<u> </u>	,						•		ı	I.	J	
	0.99	0.98	0.96	0.93	0.82	(	0.63	0.4	0.4	11	0.68	0.91	0.99	1		(94)
Useful g	ains, h	mGm ,	W = (94	4)m x (84	4)m										ı	
(95)m= 73	35.38	876	924.91	916.45	806.63	5	98.7	374.18	374	.12	621.03	788.84	738.64	690.38		(95)
Monthly	avera	ge exte	rnal tem	perature	from Ta	abl	e 8								<u>.</u>	
(96)m=	4.5	5	6.8	8.7	11.7	·	14.6	16.9	16.	.9	14.3	10.8	7	4.9		(96)
Heat los	s rate	for mea	an intern	al tempe	erature,	Lm	ı , W =	=[(39)m	x [(93	3)m-	- (96)m	]			- •	
(97)m= 15	597.7	1561.28	1396.17	1209.32	911.54	6	15.34	375.16	375	.16	647.24	997.58	1353.65	1550.68		(97)
Space h	eating	require	ment fo	r each n	nonth, k	Νh	/mont	th = 0.02	24 x [	(97)	m – (95	)m] x (4 <sup>-</sup>	1)m		-	
(98)m= $64$	41.57	460.51	350.62	210.86	78.06		0	0	0		0	155.3	442.81	640.07		
										Total	per year	(kWh/year	) = Sum(9	8) <sub>15,912</sub> =	2979.79	(98)
Space h	eating	require	ement in	kWh/m²	/year										47.55	(99)
	,															

9a. Energy requirements – Ind	ividual h	eating sy	ystems i	ncluding	micro-C	CHP)					
Space heating:											
Fraction of space heat from s	_		mentary	•						0	(201)
Fraction of space heat from m	•	. ,			(202) = 1	` '				1	(202)
Fraction of total heating from	•				(204) = (2	02) × [1 –	(203)] =			1	(204)
Efficiency of main space heat	•									92.8	(206)
Efficiency of secondary/supple	ementar	y heating	g systen	n, %		•	•			0	(208)
Jan Feb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/y	ear
Space heating requirement (c	alculated	d above)	0	0	0	0	155.3	442.81	640.07		
						0	100.0	442.01	040.07		(244)
$(211)m = \{[(98)m \times (204)] + (216)m \times (204)\} + (216)m \times (204)\} + (216)m \times (204) + (216)m \times (204)\} + (216)m \times (204)$	227.22	84.11	00)	0	0	0	167.35	477.16	689.73		(211)
					Tota	l I (kWh/yea	ar) =Sum(2		 =	3210.98	(211)
Space heating fuel (secondar	y), kWh/	month									
= {[(98)m x (201)] + (214) m} $\times$	100 ÷ (2	208)				•	•				
(215)m= 0 0 0	0	0	0	0	0	0	0	0	0		_
					Tota	l (kWh/yea	ar) =Sum(2	215) <sub>15,101</sub>	<u>=</u>	0	(215)
Water heating Output from water heater (calc	ulated al	nove)									
173.88 152.96 159.95	142.42	138.87	123.08	117.25	129.98	130.16	147.73	157.42	169.37		
Efficiency of water heater										79.1	(216)
(217)m= 87.28 86.87 86.15	85.16	82.64	79.1	79.1	79.1	79.1	84.24	86.72	87.33		(217)
Fuel for water heating, kWh/mo $(219)$ m = $(64)$ m x $100 \div (217)$											
(219)m= $199.22$ $176.08$ $185.67$	167.25	168.03	155.6	148.23	164.32	164.55	175.36	181.52	193.95		
					Tota	I = Sum(2	19a) <sub>112</sub> =			2079.77	(219)
Annual totals							k'	Wh/yeaı	•	kWh/yea	ar _
Space heating fuel used, main	system	1								3210.98	
Water heating fuel used										2079.77	
Electricity for pumps, fans and	electric l	keep-ho	t								
central heating pump:									130		(230c)
boiler with a fan-assisted flue									45		(230e)
Total electricity for the above, I	kWh/yea	r			sum	of (230a).	(230g) =			175	(231)
Electricity for lighting										282.76	(232)
10a. Fuel costs - individual he	eating sy	stems:									
	<u> </u>		<b>-</b>				Fal D			Fred Cook	
			Fu k₩	h/year			Fuel P (Table			Fuel Cost £/year	
Space heating - main system 1			(21	1) x			3.	1	x 0.01 =	99.5403	(240)
Space heating - main system 2	2		(21	3) x			0		x 0.01 =	0	(241)
Space heating - secondary			(21	5) x					x 0.01 =	0	(242)
Water heating cost (other fuel)			(21	9)			3.		x 0.01 =	64.47	(247)
			•				<u></u>	<u>.                                    </u>		1	()

Pumps, fans and electric keep-hot
Energy for lighting (232)
Additional standing charges (Table 12)  Appendix Q items: repeat lines (253) and (254) as needed  Total energy cost (245)(247) + (250)(254) = 322.4723 (255)  11a. SAP rating - individual heating systems  Energy cost deflator (Table 12)  Energy cost factor (ECF) [(255) × (256)] ÷ [(4) + 45.0] = 1.4078 (257)  SAP rating (Section 12)  Energy Energy Energy Energy Energy Energy KWh/year  Space heating (main system 1) (211) × 0.198 = 635.77 (261)  Space heating (secondary) (215) × 0 = 0 (263)  Water heating Space and water heating  (219) × 0.198 = 411.79 (264)  Space and water heating  (261) + (262) + (263) + (264) = 1047.57 (265)  Electricity for pumps, fans and electric keep-hot  (231) × 0.517 = 90.48 (267)
Appendix Q items: repeat lines (253) and (254) as needed  Total energy cost (245)(247) + (250)(254) = 322.4723 (255)  11a. SAP rating - individual heating systems  Energy cost deflator (Table 12)  Energy cost factor (ECF) [(255) x (256)] ÷ [(4) + 45.0] = 1.4078 (257)  SAP rating (Section 12)  Energy kWh/year  Energy kWh/year  Space heating (main system 1) (211) x 0.198 = 635.77 (261)  Space heating (secondary) (215) x 0 = 0 (263)  Water heating (219) x 0.198 = 411.79 (284)  Space and water heating (261) + (262) + (263) + (264) = 1047.57 (265)  Electricity for pumps, fans and electric keep-hot (231) x 0.517 = 90.48 (267)
Total energy cost (245)(247) + (250)(254) = 322.4723 (255)  11a. SAP rating - individual heating systems  Energy cost deflator (Table 12)  Energy cost factor (ECF) [(255) × (256)] ÷ [(4) + 45.0] = 1.4078 (257)  SAP rating (Section 12)  12a. CO2 emissions - Individual heating systems including micro-CHP  Energy kWh/year kg CO2/kWh kg CO2/kWh kg CO2/year  Space heating (main system 1) (211) × 0.198 = 635.77 (261)  Space heating (secondary) (215) × 0 = 0 (263)  Water heating (219) × 0.198 = 411.79 (264)  Space and water heating (261) + (262) + (263) + (264) = 1047.57 (265)  Electricity for pumps, fans and electric keep-hot (231) × 0.517 = 90.48 (267)
11a. SAP rating - individual heating systems   Energy cost deflator (Table 12)
Energy cost deflator (Table 12)  Energy cost factor (ECF)  SAP rating (Section 12)  Energy  kWh/year  Energy  kWh/year  Space heating (main system 1)  Space heating (secondary)  Water heating  (219) x  (219) x  (219) x  (211) x  (219) x  (219) x  (210) x  (210) x  (211) x  (211) x  (211) x  (212) x  (213) x  (214) x  (215) x  (215) x  (216) x  (216) x  (217) x  (218) x  (219) x
Energy cost factor (ECF) [(255) x (256)] ÷ [(4) + 45.0] =
SAP rating (Section 12)    Energy   Emission factor   kg CO2/kWh   kg CO2/year
Energy   Emission factor   kWh/year   kg CO2/kWh   kg CO2/year
Energy kWh/year kg CO2/kWh kg CO2/year  Space heating (main system 1) (211) x 0.198 = 635.77 (261)  Space heating (secondary) (215) x 0 = 0 (263)  Water heating (219) x 0.198 = 411.79 (264)  Space and water heating (261) + (262) + (263) + (264) = (261) + (262) + (263) + (264) = (265)  Electricity for pumps, fans and electric keep-hot (231) x 0.517 = 90.48 (267)
kWh/year       kg CO2/kWh       kg CO2/year         Space heating (main system 1)       (211) x       0.198       =       635.77 (261)         Space heating (secondary)       (215) x       0       =       0 (263)         Water heating       (219) x       0.198       =       411.79 (264)         Space and water heating       (261) + (262) + (263) + (264) =       1047.57 (265)         Electricity for pumps, fans and electric keep-hot       (231) x       0.517       =       90.48 (267)
Space heating (main system 1)       (211) x       0.198       =       635.77       (261)         Space heating (secondary)       (215) x       0       =       0       (263)         Water heating       (219) x       0.198       =       411.79       (264)         Space and water heating       (261) + (262) + (263) + (264) =       1047.57       (265)         Electricity for pumps, fans and electric keep-hot       (231) x       0.517       =       90.48       (267)
Space heating (secondary)  Water heating  (215) x  0 = 0 (263)  Water heating  Space and water heating  (219) x  (261) + (262) + (263) + (264) = (265)  Electricity for pumps, fans and electric keep-hot  (231) x  (215) x  0 = 0 (263)  (264)  (264)  (265)
Water heating (219) x (264)  Space and water heating (261) + (262) + (263) + (264) = (265)  Electricity for pumps, fans and electric keep-hot (231) x (267)
Space and water heating (261) + (262) + (263) + (264) = 1047.57 (265)  Electricity for pumps, fans and electric keep-hot (231) x 90.48 (267)
Electricity for pumps, fans and electric keep-hot (231) x 0.517 = 90.48 (267)
Electricity for lighting $ (232) \times 0.517 = 146.19  (268) $
Total CO2, kg/year sum of (265)(271) = 1284.23 (272)
CO2 emissions per $m^2$ (272) ÷ (4) = 20.5 (273)
EI rating (section 14)
13a. Primary Energy
Energy Primary P. Energy
kWh/year factor kWh/year
Space heating (main system 1) (211) x 1.02 = 3275.2 (261)
Space heating (secondary) $ (215) \times 0 $ = 0 (263)
Energy for water heating (219) x 1.02 = 2121.36 (264)
Space and water heating $(261) + (262) + (263) + (264) = 5396.56$ (265)
Electricity for pumps, fans and electric keep-hot (231) x 2.92 = 511 (267)
Electricity for lighting $(232) \times 0 = 825.66  (268)$
'Total Primary Energy sum of (265)(271) = 6733.22 (272)
Primary energy kWh/m²/year $(272) \div (4) = 107.46$ (273)

# CSH Level 4 SAP 2009 Worksheets for 1 to 5 Bedroom

				User D	etails:						
Assessor Name: Software Name:	Stroma FS	SAP 200	9		Strom Softwa				Versic	n: 1.5.0.49	
			Р	roperty	Address	: House	1				
Address :											
1. Overall dwelling dime	ensions:			<b>A</b>	- ( 2)		A 11	· ' l. ( / \		Walana day	o).
Ground floor				Area	<b>a(m²)</b> 75	(1a) x		eight(m) 2.5	(2a) =	Volume(m <sup>3</sup>	<b>°)</b>   (3a
First floor						(1b) x			](2b) =		(3b
	a) . (4 b) . (4 a) .	(4 -1) . (4 -)	\ .	\	75			2.5	(20) =	187.5	(30
Total floor area TFA = (1	a)+(1b)+(1c)+	(1a)+(1e	)+(1r	1)	150	(4)					_
Dwelling volume						(3a)+(3b	)+(3c)+(3c	d)+(3e)+	.(3n) =	375	(5)
2. Ventilation rate:	main	9,	econda	*\/	other		total			m³ per hou	ır
	heating	<u>h</u>	eating	· - –	Other		ioiai			m per noc	_
Number of chimneys	0	_] +	0	<u></u>	0	_	0		40 =	0	(6a
Number of open flues	0	+	0	_] +	0	_ = _	0	x 2	20 =	0	(6b
Number of intermittent fa	ins						0	X '	10 =	0	(7a
Number of passive vents							0	X '	10 =	0	(7b
Number of flueless gas f	ires						0	X 4	40 =	0	(7c
_									A in a la		
L.Ch., C L		(0	-) . (Ch) . (T	(74) . (	7-)			_		anges per h	
Infiltration due to chimne  If a pressurisation test has be	7					continue fu	0 rom (9) to		÷ (5) =	0	(8)
Number of storeys in t			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				(0)	)		0	(9)
Additional infiltration								[(9)	-1]x0.1 =	0	(10
Structural infiltration: 0						•	ruction			0	(11
if both types of wall are p deducting areas of openi			onding to	the great	er wall are	a (atter					
If suspended wooden		,	ed) or 0	1 (seale	ed), else	enter 0				0	(12
If no draught lobby, en										0	(13
Percentage of window	s and doors d	raught sti	ripped		0.25 [0.2	) v (1.4) · .	1001 -			0	(14
Window infiltration Infiltration rate					0.25 - [0.2]		100] = 12) + (13) ·	+ (15) =		0	(15 (16
Air permeability value,	a50. express	ed in cub	ic metre	s per ho					area	0 4.8	(10
If based on air permeabi				•	•	•				0.24	(18
Air permeability value applie	es if a pressurisati	on test has	been dor	e or a de	gree air pe	rmeability	is being u	sed			
Number of sides on which Shelter factor	h sheltered				(20) = 1 -	[0 075 v (*	10\1 –			0	(19
Infiltration rate incorpora	ting shelter fac	etor			$(20) = 1^{-2}$ (21) = (18)		. 5/1 –			1 0.24	(20)
Infiltration rate modified f	-				,= -/ (10	, (==) =				0.24	(∠1
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp					1 3	11.	1		1	I	
(22)m= 5.4 5.1	5.1 4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1		

Wind Factor (2	22a)m =	(22)m ÷	4										
(22a)m= 1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27	]	
Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m					
0.32	0.31	0.31	0.27	0.25	0.23	0.22	0.22	0.25	0.27	0.29	0.31		
Calculate effecture of the Calculate of		•	rate for t	he appli	cable ca	se						0	(23
If exhaust air h			endix N. (2	3b) = (23a	a) × Fmv (e	eguation (N	N5)) . othe	rwise (23b	) = (23a)			0	(23
If balanced with		0 11	, (	, (	, ,	• •	,, .	`	, (200)			0	
a) If balance		•	•	J		,		,	2b)m + (	23b) × [	1 – (23c)		(23
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
b) If balance	ed mecha	anical ve	ntilation	without	heat red	covery (N	лV) (24b	)m = (22	2b)m + (	23b)	•	•	
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
c) If whole h					•				- (00)				
		(23b), t	· `	ŕ	í –		ŕ	<del></del>	<u> </u>	<del>i                                      </del>	Ι ,	1	(24
(24c)m= 0	0	0		0	0	0	0	0	0	0	0	J	(24
d) If natural if (22b)n		on or wh en (24d)							0.51				
(24d)m= 0.55	0.55	0.55	0.54	0.53	0.53	0.52	0.52	0.53	0.54	0.54	0.55		(24
Effective air	change	rate - er	iter (24a	) or (24b	o) or (24	c) or (24	d) in bo	k (25)					_
(25)m= 0.55	0.55	0.55	0.54	0.53	0.53	0.52	0.52	0.53	0.54	0.54	0.55		(25
3. Heat losse	s and he	eat loss r	paramete	er:								_	
ELEMENT	Gros		Openin		Net Ar	ea	U-val	ue	ΑXU		k-value	e	ΑΧk
	area	(m²)	m	-	A ,r	m²	W/m2	2K	(W/	K)	kJ/m²-l	K	kJ/K
Doors					2	X	1.2	=	2.4				(26
Windows					6.25	х1.	/[1/( 1.2 )+	0.04] =	7.16				(27
Floor Type 1					75	Х	0.2	=	15				(28
Floor Type 2					75	X	0.2	=	15				(28
Walls	150.	18	14.5		135.6	8 x	0.18	=	24.42				(29
Roof	75		0		75	X	0.18	=	13.5				(30
Total area of e	lements	, m²			375.1	8							(31
* for windows and						ated using	formula 1	/[(1/U-valu	ie)+0.04] a	as given in	paragraph	3.2	
** include the area				ls and pan	titions		(26) (20	\					
Fabric heat los		•	U)				(26)(30	, ,	(00) . (0	0) - (00-)	(00-)	84.64	====
Heat capacity	,	,		TEA):	. 1. 1/217					2) + (32a).	(32e) =	40329.19	====
Thermal mass	•	`		,			raciaal : th		tive Value	· ·	abla 1f	450	(35
For design assess can be used inste				construct	ion are noi	t known pr	ecisely the	e inaicative	values of	TIMPINI	able 11		
Thermal bridge	es : S (L	x Y) cal	culated ı	using Ap	pendix l	<						13.88	(36
if details of therma		are not kn	own (36) =	= 0.15 x (3	1)								
Total fabric he								(33) +	(36) =			98.52	(37
Ventilation hea		1	l monthly		1	1	1	<del>- ` ` ` </del>	<del></del>	(25)m x (5)	_	1	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m= 68.37	67.67	67.67	66.39	65.62	65.26	64.92	64.92	65.8	66.39	67.01	67.67		(38
Heat transfer of	coefficier	nt, W/K						(39)m	= (37) + (	38)m		,	
(39)m= 166.89 Stroma FSAP 200	166.19	166.19	164.9	164.14	163.78	163.44	163.44	164.32	164.9	165.52	166.19		000
	.⊸ version.	1:00491	3AP 9.90	ı - muo://W\	ww.ธแตฑล	LCUIII			Avorago -	Sum(39) <sub>1</sub>	/12_	I 16/100	age 2 <b>🍕 3</b> 9

eat lo	ss para	meter (H	ILP), W	m²K					(40)m	= (39)m ÷	(4)			
0)m=	1.11	1.11	1.11	1.1	1.09	1.09	1.09	1.09	1.1	1.1	1.1	1.11		_
umbo	r of day	c in mor	nth (Tab	lo 1a)					,	Average =	Sum(40) <sub>1.</sub>	12 /12=	1.1	(40
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1)m=	31	28	31	30	31	30	31	31	30	31	30	31		(4
L		!				<u> </u>	<u> </u>	<u> </u>						
I. Wat	ter heat	ing ener	gy requi	rement:								kWh/ye	ear:	
eeuma	ad occu	pancy, N	d									240		(4)
if TF		, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.0	0013 x (¯	ΓFA -13.		342		(4:
								(25 x N)				3547		(43
		_		• •		hot and co	-	to achieve	a water us	se target o	ſ			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ot wate	r usage in	litres per	day for ea		Vd,m = fa	ctor from 7	Table 1c x							
4)m=	120.29	115.92	111.54	107.17	102.79	98.42	98.42	102.79	107.17	111.54	115.92	120.29		
neray o	ontent of	hot water	used - cal	culated ma	anthly = 1	100 v Vd r	n v nm v [	Tm / 3600			m(44) <sub>112</sub> = ables 1b, 1		1312.2566	(4
	178.81	156.39	161.38	140.7	135	116.5	107.95	123.88	125.35	146.09	159.47	173.17	_	
	170.01	130.55	101.30	140.7	133	110.5	107.93	125.00			m(45) <sub>112</sub> =		1724.6917	(4
instanta	aneous w	ater heatir	ng at point	of use (no	hot water	r storage),	enter 0 in	boxes (46			() 112	·		`
	26.82	23.46	24.21	21.1	20.25	17.47	16.19	18.58	18.8	21.91	23.92	25.98		(4
	storage		olored le	on footo	r io kno	vo (k\/h	(dov):							
			m Table		1 15 KITOV	vn (kWh	luay).					54		(4
•				, kWh/ye	ear			(47) x (48)	. =			54 013		(4
•			-	-		s not kno		( 11 ) 11 ( 10 )			0.0	713		(
		, ,		•		age with						0		(!
	-	-		_		litres in bo		enter '0' in	hov (50)					
						h/litre/da		ornor o m	DOX (00)					(!
		from Tal		om rabi	C 2 (KVV)	11/11110/00	·y <i>)</i>					0		(!
			m Table	2b							-	0		( <u>!</u>
•				, kWh/ye	ear			((50) x (51	) x (52) x	(53) =		0		` (!
		64) in (5	_	,				(()	, (= ,	()		013		(!
ater s	storage	loss cal	culated f	or each	month			((56)m = (	55) × (41)ı	m				
6)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(!
ylinde	r contains	dedicated	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	x H	
7)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		( !
imary	/ circuit	loss (an	nual) fro	m Table	3	-	-	-			36	60		( !
-						59)m = (	(58) ÷ 36	65 × (41)	m					
·	<u>-</u>							ng and a			<del></del>			
9)m=	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		(5
	loss cal	culated t	for each	month (	(61)m =	(60) ÷ 36	65 × (41	)m						
i damo -	1000 001				,	` '								

Total heat required for water he	eating calculated	I for each month	$(62)$ m = $0.85 \times (4)$	45)m + (46)m +	(57)m +	(59)m + (61)m
(62)m= 209.79 184.37 192.36	170.67 165.98	146.47 138.93	154.85 155.33	177.07 189.45	204.15	(62)
Solar DHW input calculated using App	endix G or Appendix	H (negative quantit	y) (enter '0' if no solar	contribution to wate	er heating)	
(add additional lines if FGHRS					-	
(63)m= 0 0 0	0 0	0 0	0 0	0 0	0	(63)
Output from water heater				,	!	
(64)m= 209.79 184.37 192.36	170.67 165.98	146.47 138.93	154.85 155.33	177.07 189.45	204.15	
	l l	l l	Output from wat	ter heater (annual) <sub>1</sub>	I12	2089.4221 (64)
Heat gains from water heating,	kWh/month 0.25	5 ´ [0.85 × (45)m	n + (61)m] + 0.8 x	[(46)m + (57)m	+ (59)m	]
(65)m= 84.24 74.38 78.44	70.76 69.67	62.72 60.68	65.97 65.66	73.36 77.01	82.36	(65)
include (57)m in calculation of	of (65)m only if c	ylinder is in the	dwelling or hot wa	ater is from com	munity h	leating
5. Internal gains (see Table 5	5 and 5a):					
Metabolic gains (Table 5), Wat	ts					
Jan Feb Mar	Apr May	Jun Jul	Aug Sep	Oct Nov	Dec	
(66)m= 176.05 176.05 176.05	176.05 176.05	176.05 176.05	176.05 176.05	176.05 176.05	176.05	(66)
Lighting gains (calculated in Ap	ppendix L, equati	ion L9 or L9a), a	ilso see Table 5	-		•
(67)m= 85.57 76 61.81	46.79 34.98	29.53 31.91	41.48 55.67	70.69 82.5	87.95	(67)
Appliances gains (calculated in	Appendix L, eq	uation L13 or L1	3a), also see Tab	le 5		
(68)m= 478.39 483.36 470.85	444.22 410.6	379 357.89	352.93 365.44	392.07 425.69	457.28	(68)
Cooking gains (calculated in A	ppendix L, equat	ion L15 or L15a	), also see Table !	5		
(69)m= 55.54 55.54 55.54	55.54 55.54	55.54 55.54	55.54 55.54	55.54 55.54	55.54	(69)
Pumps and fans gains (Table 5	ōa)				•	
(70)m= 10 10 10	10 10	10 10	10 10	10 10	10	(70)
Losses e.g. evaporation (negative	tive values) (Tab	le 5)				
(71)m= -117.37 -117.37 -117.37	-117.37 -117.37	-117.37 -117.37	-117.37 -117.37	-117.37 -117.37	-117.37	(71)
Water heating gains (Table 5)						
(72)m= 113.22 110.69 105.43	98.28 93.64	87.11 81.55	88.67 91.2	98.6 106.95	110.7	(72)
Total internal gains =		(66)m + (67)n	n + (68)m + (69)m + (7	70)m + (71)m + (72)	)m	
(73)m= 801.41 794.27 762.31	713.52 663.44	619.86 595.58	607.3 636.53	685.58 739.36	780.16	(73)
6. Solar gains:						
Solar gains are calculated using solar	r flux from Table 6a	and associated equa	ations to convert to the	applicable orientat	tion.	
Orientation: Access Factor	Area	Flux	g_ Table Ch	FF Table Ca		Gains
Table 6d	m²	Table 6a	Table 6b	Table 6c		(W)
South 0.9x 0.77 x		x 47.32	x 0.76	X 0.7	=	218.09 (78)
South 0.9x 0.77 x	6.25	× 77.18	× 0.76	X 0.7	_ =	355.69 (78)
South 0.9x 0.77 x	6.25	x 94.25	x 0.76	X 0.7	_ =	434.33 (78)
South 0.9x 0.77 x		× 105.11	× 0.76	X 0.7	=	484.41 (78)
South 0.9x 0.77 x	6.25	x 108.55	× 0.76	X 0.7	=	500.25 (78)
South 0.9x 0.77 x	6.25	x 108.9	× 0.76	X 0.7	=	501.85 (78)
South 0.9x 0.77 x	6.25	x 107.14	× 0.76	X 0.7	=	493.74 (78)
South 0.9x 0.77 x	6.25	x 103.88	x 0.76	X 0.7	=	478.74 (78)

South	0.9x	0.77	X	6.2	25	x	9	9.99	x		0.76	х	0.7	=	460.8	(78)
South	0.9x	0.77	X	6.2	25	x	8	5.29	x		0.76	_ x _	0.7		393.06	(78)
South	0.9x	0.77	X	6.2	25	x	5	6.07	х		0.76	x	0.7	=	258.39	(78)
South	0.9x	0.77	X	6.2	25	x	4	0.89	х		0.76	x	0.7		188.44	(78)
	_									•						_
Solar o	ains in	watts, ca	alculated	for eac	h month				(83)m	ı = Sı	um(74)m .	(82)m				
(83)m=	218.09	355.69	434.33	484.41	500.25	5	01.85	493.74	478	.74	460.8	393.06	258.39	188.44		(83)
Total g	ains – i	nternal a	nd solar	(84)m =	= (73)m ·	+ (8	83)m	, watts							•	
(84)m=	1019.49	1149.97	1196.64	1197.93	1163.69	11	21.71	1089.32	1086	5.04	1097.33	1078.64	997.76	968.6		(84)
7. Me	an inter	nal temp	erature	(heating	season	)										
		during h		·			area 1	from Tab	ole 9.	. Th	1 (°C)				21	(85)
•		tor for g	٠.			·				,	. ( -)					┛`′
	Jan	Feb	Mar	Apr	May	È	Jun	Jul	A	ug	Sep	Oct	Nov	Dec		
(86)m=	1	1	1	1	0.98	⊢	0.86	0.61	0.6	<del>  </del>	0.9	0.99	1	1		(86)
` ′				<u> </u>		<u> </u>										` '
ı		l temper		<u>_</u>	· ·	_		<del> </del>		$\neg$	<del></del>	00.70	00.40		1	(07)
(87)m=	20.33	20.42	20.55	20.68	20.85		0.97	21	2	1	20.96	20.76	20.49	20.34		(87)
Temp	erature	during h	eating p	eriods ir	rest of	dw	elling	from Ta	ble 9	9, Tr	n2 (°C)			•	1	
(88)m=	19.99	20	20	20	20.01	2	20.01	20.01	20.	01	20.01	20	20	20		(88)
Utilisa	ation fac	tor for g	ains for	rest of d	welling,	h2,	m (se	e Table	9a)					_		
(89)m=	1	1	1	0.99	0.95		).77	0.47	0.4	17	0.81	0.98	1	1		(89)
Mean	interna	l temper	ature in	the rest	of dwelli	na	T2 (fc	ollow ste	ns 3	to 7	in Tabl	e 9c)				
(90)m=	19.11	19.24	19.43	19.62	19.86	Ť	9.99	20.01	20.		19.98	19.75	19.35	19.13		(90)
											f	LA = Livin	g area ÷ (4	4) =	0.42	(91)
Mass	intorno	l taranar	atuwa /fa	مارين و ماغيس	مبيراء ماء	11:		ΛΤ4	. /4	£I	Λ) Το					
(92)m=	19.62	temper	19.9	20.07	20.28		<del>9) = п</del> 20.4	20.43	+ (1 20.	$\neg$	20.39	20.17	19.83	19.64	]	(92)
` ′		nent to the				L							19.00	13.04		(02)
(93)m=	19.47	19.58	19.75	19.92	20.13	_	20.25	20.28	20.		20.24	20.02	19.68	19.49		(93)
		ting requ			20110		.0.20				20:2	20.02	10.00	10110		
		mean int			re obtair	ned	at ste	ep 11 of	Tabl	e 9b	o, so tha	t Ti.m=(	76)m an	d re-calo	culate	
		factor fo									.,	, (			-	
	Jan	Feb	Mar	Apr	May		Jun	Jul	Αı	ug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm	1:											•	
(94)m=	1	1	1	0.99	0.96	Ľ	0.79	0.51	0.5	51	0.84	0.98	1	1		(94)
1	l gains,	hmGm ,		4)m x (8	4)m	_								•	1	
(95)m=	1019.2				1112.25		89.32	550.99	550	.97	917.79	1061.56	996.85	968.36		(95)
		age exte		<del>.                                      </del>	from Ta	$\overline{}$								·	1	
(96)m=	4.5	5	6.8	8.7	11.7	<u> </u>	14.6	16.9	16.		14.3	10.8	7	4.9		(96)
1		e for mea				_					<u> </u>			i	1	(0-1)
` ′		2423.65		<u> </u>	1383.2		25.96	551.75	551		976.09	1520.94	2098.52	2424.22		(97)
· ·		g require		r		/Vh				Ť			<u> </u>	4000 15	1	
(98)m=	1100.8	856.62	713.8	476.5	201.58		0	0	0		0	341.78	793.21	1083.15		7(00)
										ıotal	per year	(kvvh/year	) = Sum(9	<b>∀)</b> ₁5,912 =	5567.43	(98)
Space	e heatin	g require	ement in	kWh/m²	/year										37.12	(99)

9a. Energy requirements -	- Individual h	eating sy	ystems i	ncluding	micro-C	CHP)					
Space heating:	_								ı		_
Fraction of space heat from			mentary	•		(204)				0	(201)
Fraction of space heat from	•	, ,			(202) = 1 - (204)	` '	(202)]			1	(202)
Fraction of total heating f	•				(204) = (204)	02) <b>x</b> [1 –	(203)] =			1	(204)
Efficiency of main space				<b>.</b> 0/						92.9	(206)
Efficiency of secondary/s	<del>''</del>									0	(208)
Jan Feb Space heating requirement	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/y	ear
·	13.8 476.5	201.58	0	0	0	0	341.78	793.21	1083.15		
$(211)m = \{[(98)m \times (204)]\}$	+ (210)m } x	100 ÷ (2	 106)	<u> </u>	ļ		<u>I</u>	<u> </u>			(211)
	88.35 512.91	216.99	0	0	0	0	367.9	853.83	1165.94		, ,
	'	•		•	Tota	l (kWh/yea	ar) =Sum(2	211),15,101	2=	5992.93	(211)
Space heating fuel (seco	• 7 .								·		
$= \{[(98)m \times (201)] + (214)\}$	<u> </u>									1	
(215)m= 0 0	0 0	0	0	0	0 Tota	0 L(kWh/vea	0 ar) =Sum(3	0 215) <sub>15,1012</sub>	0	0	(215)
Water heating						(	,	715,1012	2	0	(210)
Output from water heater	(calculated a	bove)									
	2.36 170.67	165.98	146.47	138.93	154.85	155.33	177.07	189.45	204.15		
Efficiency of water heater										82.8	(216)
` ' -	0.56 90	88.05	82.8	82.8	82.8	82.8	89.19	90.77	91.14		(217)
Fuel for water heating, kW $(219)$ m = $(64)$ m x $100 \div (64)$ m											
	2.42 189.63	188.51	176.9	167.79	187.02	187.6	198.53	208.72	224		
					Tota	I = Sum(2	19a) <sub>112</sub> =			2374.1	(219)
Annual totals	main avatam	1					k'	Wh/yeaı	r I	kWh/ye	ar
Space heating fuel used, i	main system	ı								5992.93	_
Water heating fuel used										2374.1	
Electricity for pumps, fans	and electric	keep-ho	t							i	
central heating pump:									130		(230c)
boiler with a fan-assisted	l flue								45		(230e)
Total electricity for the abo	ove, kWh/yea	ar			sum	of (230a).	(230g) =	:		175	(231)
Electricity for lighting										604.48	(232)
10a. Fuel costs - individu	ıal heating sy	stems:									
			Fu kW	<b>el</b> /h/year			Fuel P (Table			Fuel Cos £/year	t
Space heating - main syst	tem 1		(21	1) x			3.	1	x 0.01 =	185.7809	(240)
Space heating - main syst			(21:	3) x			0		x 0.01 =	0	(241)
Space heating - secondar				5) x					x 0.01 =	0	(242)
Water heating cost (other	•		(21						x 0.01 =		(247)
vvator ricating cost (otile)	1401)		(=1)	- /			3.	1		73.6	(247)

Pumps, fans and electric keep-hot	(231)	11.46 × 0.01 =	20.06 (249)
(if off-peak tariff, list each of (230a) to (230	Og) separately as applicable and ap		
Energy for lighting	(232)	11.46 X 0.01 =	69.27 (250)
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (	` '		
	245)(247) + (250)(254) =		454.7062 (255)
11a. SAP rating - individual heating syste	ems		
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF)	255) x (256)] ÷ [(4) + 45.0] =		1.096 (257)
SAP rating (Section 12)			84.7114 (258)
12a. CO2 emissions – Individual heating	systems including micro-CHP		
	Energy	<b>Emission factor</b>	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating (main system 1)	(211) x	0.198 =	1186.6 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Water heating	(219) x	0.198	470.07 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1656.67 (265)
Electricity for pumps, fans and electric kee	ep-hot (231) x	0.517 =	90.48 (267)
Electricity for lighting	(232) x	0.517 =	312.52 (268)
Total CO2, kg/year	su	m of (265)(271) =	2059.66 (272)
CO2 emissions per m <sup>2</sup>	(27	72) ÷ (4) =	13.73 (273)
EI rating (section 14)			86 (274)
13a. Primary Energy			
	Energy	Primary	P. Energy
	kWh/year	factor	kWh/year
Space heating (main system 1)	(211) x	1.02 =	6112.79 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Energy for water heating	(219) x	1.02 =	2421.58 (264)
Space and water heating	(261) + (262) + (263) + (264) =		8534.37 (265)
Electricity for pumps, fans and electric kee	ep-hot (231) x	2.92 =	511 (267)
Electricity for lighting	(232) x	0 =	1765.08 (268)
'Total Primary Energy	Sui	m of (265)(271) =	10810.45 (272)
Primary energy kWh/m²/year	(27	72) ÷ (4) =	72.07 (273)
, ,,			. =

			User D	etails: _						
Assessor Name:	Stroma ESAP 3	2009		Strom				Versio	nn: 1 5 0 49	
Software Name.	Stroma FSAP 2009   Software Version:   Version: 1.5.0.49									
Address :	Stroma Number:   Stroma FSAP 2009   Software Version:   Version: 1.5.0.49									
1. Overall dwelling dimens	ions:									
			Area	a(m²)	-	Ave He	eight(m)	_	Volume(m³)	_
Ground floor			5	6.67	(1a) x	2	2.5	(2a) =	141.675	(3a)
First floor			5	6.67	(1b) x	2	2.5	(2b) =	141.675	(3b)
Total floor area TFA = (1a)+	·(1b)+(1c)+(1d)+	(1e)+(1n	) 1	13.34	(4)			_		_
Dwelling volume					(3a)+(3b	)+(3c)+(3d	d)+(3e)+	.(3n) =	283.35	(5)
2. Ventilation rate:										
			у	other		total			m³ per hour	
Number of chimneys			+ [	0	= [	0	X 4	40 =	0	(6a)
Number of open flues	0 +	0	Ī + 🗀	0	Ī = Ī	0	x	20 =	0	(6b)
Number of intermittent fans						0	x .	10 =	0	[7a)
Number of passive vents					F	0	x ·	10 =	0	(7b)
Number of flueless gas fires					\	0	x 4	40 =	0	] <sub>(7c)</sub>
								Air ch	nanges per ho	<b>」</b>
					continue fr			÷ (5) =	0	(8)
•	dwelling (ns)								0	-  ` `
	for stool or timb	or frame or	0.25 for	macani	ny concti	ruction	[(9)	-1]x0.1 =		╡`′
if both types of wall are prese	ent, use the value co				•	uction			0	J(11)
If suspended wooden floo	or, enter 0.2 (uns	ealed) or 0.	1 (seale	d), else	enter 0				0	(12)
• ,									0	(13)
<u>=</u>	nd doors draugh	t stripped		0.05 [0.0	) (4.4)4	1001			0	╡゛゛
							ı (15) —			╡゛゛
	n everessed in	cubic metre		. , . ,	, , , ,	, , ,	, ,	area		╡゛゛
	•		•	•	•	ione oi e	uvelope	aica		╡゛゛
						is being us	sed		U.L.	۱٬۰۳/
	heltered			(00)	ro o== :	40)1			1	(19)
Shelter factor	al alter to t					19)] =				╡
		!		(21) = (18	) x (20) =				0.22	(21)
	<del></del>	1 1	11	Λ			NI:		1	
		ay   Jun	Jul	Aug	Sep	l Oct	I NOV	Dec		
Monthly average wind spee			2.7	2.7	1 42	T		<u> </u>	1	

4.5

3.9

3.7

3.7

4.2

4.8

5.1

Wind Factor (2	22a)m =	(22)m ÷	4										
(22a)m= 1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27		
Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m					
0.3	0.28	0.28	0.25	0.23	0.22	0.21	0.21	0.23	0.25	0.27	0.28	]	
		•	rate for t	he appli	cable ca	se		•	•		•		(222
			endix N. (2	3b) = (23a	a) × Fmv (e	eguation (N	N5)) . othe	rwise (23b	) = (23a)				
		0 11		, ,	, ,	. ,	,, .	,	, (===,				
		•	•	_					2b)m + (	23b) <b>x</b> [′	1 – (23c)		(200
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0	]	(24a
b) If balance	ed mech	anical ve	ntilation	without	heat red	covery (N	ЛV) (24b	m = (22)	2b)m + (	23b)			
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0	]	(24b
c) If whole h	ouse ex	tract ven	tilation o	or positiv	e input v	ventilatio	n from o	outside	•		•		
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m													
( )									0	0	0	]	(240
,									0.51				
		<u> </u>		,	· `	<del></del>		<del></del>		0.54	0.54		(240
` '	change	rate - er										,	
				` `	<u> </u>	· `		· /	0.53	0.54	0.54	1	(25)
Majusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m													
22a)m 1.35 1.27 1.27 1.12 1.12 1.02 0.98 0.92 0.92 1.05 1.10 1.12 1.2 1.27  Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m  0.3 0.28 0.28 0.25 0.23 0.22 0.21 0.21 0.21 0.23 0.25 0.27 0.28  Calculate affective air change rate for the applicable case  If mechanical ventilation:  If exhaust air heat pump using Appendix N, (23b) = (23a) x Frw (equation (N5)), otherwise (23b) = (23a)  If exhaust air heat pump using Appendix N, (23b) = (23a) x Frw (equation (N5)), otherwise (23b) = (23a)  If exhaust air heat pump using Appendix N, (23b) = (23a) x Frw (equation (N5)), otherwise (23b) = (23a)  If exhaust air heat pump using Appendix N, (23b) = (23a) x Frw (equation (N5)), otherwise (23b) = (23a)  If exhaust air heat pump using Appendix N, (23b) = (23a) x Frw (equation (N5)), otherwise (23b) = (23a)  If exhaust air heat pump using Appendix N, (23b) = (23a) x Frw (equation (N5)), otherwise (23b) = (23a)  If exhaust air heat pump using Appendix N, (23b) = (23a) x Frw (equation (N5)), otherwise (23b) = (23a)  If exhaust air heat pump using Appendix N, (23b) = (23b) x Hord (12b) x Hor													
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m   0.3													
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a) m  0.3 0.28 0.28 0.28 0.25 0.23 0.22 0.21 0.21 0.23 0.25 0.27 0.26  Calculate effective air change rate for the applicable case If exhaust air heat pump using Appendix N, (22b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) = (23a) If balanced with heat recovery; efficiency in % allowing for in-use factor (from Table 4b) = 0 (23a) 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 0 0 0 0 0 0 0													
C2ajm   1.35   1.27   1.27   1.12   1.02   0.98   0.92   0.92   1.05   1.05   1.12   1.2   1.27													
	113	52	12 1	2		=		=		<b>=                                    </b>		룩 누	
						_		=		룩 ¦		룩 늗	
						= '	0.10		10.2				
	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,				=	0		0	— r			`
-	l roof wind	ows, use e	ffective wi	ndow U-va						L as given in	paragrapl		(32)
** include the area	as on both	sides of in	ternal wal	ls and par	titions								
		•	U)				(26)(30)	) + (32) =				67.3	4 (33)
								((28)	(30) + (32	2) + (32a).	(32e) =	27842.	1791 (34)
	•	`		,								450	(35)
J				construct	ion are noi	t known pr	ecisely the	e indicative	values of	TMP in Ta	able 1f		
	/	v V) cal	culated i	using Ap	pendix l	<						12.4	8 (36)
Thermal bridge	es:5(L	x 1) can											
if details of therma	al bridging	,		= 0.15 x (3	1)			(33) +	(36) =			70.8	2 (37)
if details of therma Total fabric he	al bridging at loss	are not kn	own (36) =		1)					(25)m x (5)	)	79.8	2 (37)

Copyright   Substantial   Su	(20) - 50.05   50.5   40.07   40.47   40.04   40.70   40.70   40.07   50.07   50.07	(20)
Signature   130.77   130.32   130.32   129.49   128.99   128.76   128.54   128.54   128.54   129.11   129.49   129.89   130.32   129.54   139.89   130.32   129.54   139.89   130.32   129.54   139.89   130.32   129.54   139.89   130.32   129.54   139.89   130.32   129.54   139.89   130.32   129.54   139.89   130.32   139.89   1.15   1.15   1.15   1.15   1.15   1.15   1.15   1.15   1.14   1.14   1.14   1.13   1.13   1.14   1.14   1.15   1.15   1.15   1.14   1.14   1.14   1.15   1.15   1.15   1.15   1.15   1.14   1.14   1.14   1.13   1.13   1.14   1.14   1.15   1.15   1.15   1.14   1.14   1.14   1.15   1.15   1.15   1.14   1.14   1.15   1.15   1.15   1.14   1.14   1.15   1.14   1.14   1.14   1.13   1.13   1.14   1.14   1.15   1.15   1.15   1.15   1.14   1.14   1.15   1.15   1.15   1.14   1.14   1.15   1.15   1.15   1.14   1.14   1.15   1.15   1.15   1.14   1.15   1.15   1.14   1.15   1.15   1.15   1.14   1.15   1.15   1.15   1.14   1.15   1.15   1.14   1.15   1.15   1.14   1.15   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.15   1.14   1.15   1.14   1.15   1.15   1.14   1.15   1.15   1.15   1.14   1.15   1.15   1.14   1.15   1.14   1.15   1.14   1.15   1.15   1.14   1.15   1.	(38)m= 50.95 50.5 50.5 49.67 49.17 48.94 48.72 48.72 49.29 49.67 50.07 50.5	(38)
Heat loss parameter (HLP), W/m²K		
Heat loss parameter (HLP), W/m²K  (40)m = (1.15   1.15   1.15   1.15   1.15   1.14   1.14   1.14   1.13   1.13   1.13   1.14   1.14   1.15   1.15    Number of days in month (Table 1a)    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec		(30)
Average   Sum(40]   1.14   1		(39)
Number of days in month (Table 1a)	(40)m= 1.15 1.15 1.15 1.14 1.14 1.13 1.13 1.14 1.14 1.15 1.15	_
4. Water heating energy requirement:  **Notice of the string energy requirement**  **Assumed occupancy, N   17		(40)
### Assumed occupancy, N  If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)  If TFA £ 13.9, N = 1  Annual average hot water usage in litres per day Vd, average = (25 x N) + 36  Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target or not more that 125 litres per person per day (all water use, hot and cold)    Jan	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	
Assumed occupancy, N  if TFA > 13.9, N = 1 + 1.76 × [1 - exp(-0.000349 × (TFA -13.9/2)] + 0.0013 × (TFA -13.9)  if TFA £ 13.9, N = 1  Annual average hot water usage in litres per day Vd, average = (25 × N) + 36  Annual average hot water usage in litres per day Vd, average = (25 × N) + 36  Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, not 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 to x (43)  (44)m= 117.52 113.25 108.97 104.7 400.43 46.15 96.15 100.43 104.7 108.97 113.25 117.52  Energy content of hot water used - calculated monthly = 4,190 × Vd, m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)  (45)m 17.4.7 152.79 157.67 137.46 131.89 113.81 105.47 121.02 122.47 142.72 155.8 168.18  Total = Sum(45) = 1684.9743 (45)  If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)  Water storage loss:  a) If manufacturer's declared loss factor is known (kWh/day): 0.024 (47)  Temperature factor from Table 2b 0.54 (48)  Energy lost from water storage, kWh/year (47) × (48) = 0.013 (49)  If manufacturer's declared cylinder loss factor is not known:  Cylinder volume (litres) including any solar storage within same 0 (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Otherwise if no stored hot water storage, kWh/year ((50	(41)m= 31 28 31 30 31 30 31 30 31 30 31	(41)
Assumed occupancy, N  if TFA > 13.9, N = 1 + 1.76 × [1 - exp(-0.000349 × (TFA -13.9/2)] + 0.0013 × (TFA -13.9)  if TFA £ 13.9, N = 1  Annual average hot water usage in litres per day Vd, average = (25 × N) + 36  Annual average hot water usage in litres per day Vd, average = (25 × N) + 36  Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, not 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 to x (43)  (44)m= 117.52 113.25 108.97 104.7 400.43 46.15 96.15 100.43 104.7 108.97 113.25 117.52  Energy content of hot water used - calculated monthly = 4,190 × Vd, m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)  (45)m 17.4.7 152.79 157.67 137.46 131.89 113.81 105.47 121.02 122.47 142.72 155.8 168.18  Total = Sum(45) = 1684.9743 (45)  If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)  Water storage loss:  a) If manufacturer's declared loss factor is known (kWh/day): 0.024 (47)  Temperature factor from Table 2b 0.54 (48)  Energy lost from water storage, kWh/year (47) × (48) = 0.013 (49)  If manufacturer's declared cylinder loss factor is not known:  Cylinder volume (litres) including any solar storage within same 0 (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Otherwise if no stored hot water storage, kWh/year ((50		
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  Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target or not more that 125 litres per person per day (all water use, hot and cold)  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  Hot water usage in litres per day for each month Vd, m = factor from Table 1c x (43)  (44)m = 117.52 113.25 108.97 104.7 100.43 96.15 96.15 96.15 100.43 104.7 108.97 113.25 117.52  Total = Sum(44):= 128.037 (44)  Energy content of hot water used - calculated monthly = 1.90 x Vd, m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)  (45)m = 174.7 152.79 157.67 137.46 131.88 131.81 / 105.47 121.02 122.47 142.72 155.8 169.18  If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)  Water storage loss:  a) If manufacturer's declared loss factor is known (kWh/day):  Cylinder volume (litres) including any solar storage within same 0 (50)  If manufacturer's declared cylinder loss factor is not known:  Cylinder volume (litres) including any solar storage within same 0 (50)  If community heating and no tank in dwelling, enter 110 litres in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter 0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter 0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter 0' in box (50)  Otherwise if no stored hot water storage, kWh/year ((50) x (51) x (52) x (53) = 0 (54)  Energy lost from water storage, kWh/year ((50) x (51) x (52) x (53) = 0 (54)  Energy lost from water storage (sc) and no tank in dwelling, enter 110 litres in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter 0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi	4. Water heating energy requirement: kWh/year:	
if TFA £ 13.9, N = 1  Annual average hot water usage in litres per day Vd, average = (25 x N) + 36  Annual average hot water usage by 5% if the dwelling is designed to achieve a water use target or not more that 125 litres per person per day (all water use, hot and cold)    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec		(42)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec		
Sep   Oct   Nov   Dec   Nov   Dec   Nov   Dec   Nov   Dec   Nov   Dec   Nov   Nov   Dec   Nov		(43)
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 = 117.52   113.25   108.97   104.7   100.43   96.15   96.15   100.43   104.7   108.97   113.25   117.52    Total = Sum(44) = 17.52   113.25   108.97   104.7   100.43   96.15   96.15   100.43   104.7   108.97   113.25   117.52    Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)  (45)m = 174.7   152.79   157.67   137.46   131.89   113.81   105.47   121.02   122.47   142.72   155.8   169.18    If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)  (46)m = 26.2   22.92   23.65   20.62   19.78   17.07   15.82   18.15   18.37   21.41   23.37   25.38   (46)  Water storage loss:  a) If manufacturer's declared closs factor is known (kWh/day):		
Total = Sum(44)   Total = Sum(45)   Total = Su		
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x mx x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)  (45)m= 174.7	(44)m= 117.52 113.25 108.97 104.7 100.43 96.15 96.15 100.43 104.7 108.97 113.25 117.52	
174.7		(44)
Total = Sum(45)p =   1684.9743   (45)		
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)  (46)m= 26.2 22.92 23.65 20.62 19.78 17.07 15.82 18.15 18.37 21.41 23.37 25.38 (46)  Water storage loss:  a) If manufacturer's declared loss factor is known (kWh/day): 0.024 (47)  Temperature factor from Table 2b 0.54 (48)  Energy lost from water storage, kWh/year (47) × (48) = 0.013 (49)  If manufacturer's declared cylinder loss factor is not known:  Cylinder volume (litres) including any solar storage within same 0 (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Volume factor from Table 2a 0 (52)  Temperature factor from Table 2b 0 (53)  Energy lost from water storage, kWh/year ((50) × (51) × (52) × (53) = 0 (54)  Enter (49) or (54) in (55) (55)  Water storage loss calculated for each month ((56)m = (55) × (41)m)  (56)m= 0.4 0.36 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4		(45)
Water storage loss:       a) If manufacturer's declared loss factor is known (kWh/day):       0.024       (47)         Temperature factor from Table 2b       0.54       (48)         Energy lost from water storage, kWh/year       (47) x (48) =       0.013       (49)         If manufacturer's declared cylinder loss factor is not known:       Cylinder volume (litres) including any solar storage within same       0       (50)         If community heating and no tank in dwelling, enter 110 litres in box (50)       0       (50)         Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)       0       (51)         Hot water storage loss factor from Table 2 (kWh/litre/day)       0       (51)         Volume factor from Table 2a       0       (52)         Temperature factor from Table 2b       0       (53)         Energy lost from water storage, kWh/year       ((50) x (51) x (52) x (53) =       0       (54)         Enter (49) or (54) in (55)       0.013       (55)         Water storage loss calculated for each month       ((56)m = (55) x (41)m       (56)         (56)m=       0.4       0.36       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0		(40)
a) If manufacturer's declared loss factor is known (kWh/day):  Temperature factor from Table 2b  Energy lost from water storage, kWh/year  (47) x (48) = 0.013  (49)  If manufacturer's declared cylinder loss factor is not known:  Cylinder volume (litres) including any solar storage within same  0  (50)  If community heating and no tank in dwelling, enter 110 litres in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Hot water storage loss factor from Table 2 (kWh/litre/day)  Volume factor from Table 2a  Temperature factor from Table 2b  Energy lost from water storage, kWh/year  ((50) x (51) x (52) x (53) = 0  Enter (49) or (54) in (55)  Water storage loss calculated for each month  ((56)m = (55) x (41)m)  (56)m = 0.4 0.36 0.4 0.39 0.4 0.39 0.4 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4		(46)
Temperature factor from Table 2b       0.54       (48)         Energy lost from water storage, kWh/year       (47) x (48) =       0.013       (49)         If manufacturer's declared cylinder loss factor is not known:       0       (50)         Cylinder volume (litres) including any solar storage within same       0       (50)         If community heating and no tank in dwelling, enter 110 litres in box (50)       0       (51)         Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)       0       (51)         Hot water storage loss factor from Table 2 (kWh/litre/day)       0       (51)         Volume factor from Table 2a       0       (52)         Temperature factor from Table 2b       0       (53)         Energy lost from water storage, kWh/year       ((50) x (51) x (52) x (53) =       0       (54)         Enter (49) or (54) in (55)       0.013       (55)         Water storage loss calculated for each month       ((56)m = (55) x (41)m       (56)         (56)m = 0.4 0.36 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.4 0.39 0.4 0.39 0.4 0.39 0.4       0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4		(47)
Energy lost from water storage, kWh/year (47) x (48) = 0.013 (49)  If manufacturer's declared cylinder loss factor is not known:  Cylinder volume (litres) including any solar storage within same 0 (50)  If community heating and no tank in dwelling, enter 110 litres in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Volume factor from Table 2a 0 (52)  Temperature factor from Table 2b 0 (53)  Energy lost from water storage, kWh/year ((50) x (51) x (52) x (53) = 0 (54)  Enter (49) or (54) in (55) 0.013 (55)  Water storage loss calculated for each month ((56)m = (55) x (41)m)  (56)m = 0.4 0.36 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4 (56)	· · · · · · · · · · · · · · · · · · ·	
If manufacturer's declared cylinder loss factor is not known:         Cylinder volume (litres) including any solar storage within same       0       (50)         If community heating and no tank in dwelling, enter 110 litres in box (50)         Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)         Hot water storage loss factor from Table 2 (kWh/litre/day)       0       (51)         Volume factor from Table 2a       0       (52)         Temperature factor from Table 2b       0       (53)         Energy lost from water storage, kWh/year       ((50) x (51) x (52) x (53) =       0       (54)         Enter (49) or (54) in (55)       0.013       (55)         Water storage loss calculated for each month       ((56)m = (55) x (41)m         (56)m=       0.4       0.36       0.4       0.39       0.4       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39 <t< td=""><td></td><td>, ,</td></t<>		, ,
If community heating and no tank in dwelling, enter 110 litres in box (50)  Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)  Hot water storage loss factor from Table 2 (kWh/litre/day)  Volume factor from Table 2a  Temperature factor from Table 2b  Energy lost from water storage, kWh/year  ((50) × (51) × (52) × (53) = 0  (54)  Enter (49) or (54) in (55)  Water storage loss calculated for each month  ((56)m= $0.4$ $0.36$ $0.4$ $0.39$ $0.4$	· · · · · · · · · · · · · · · · · · ·	(10)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)         Hot water storage loss factor from Table 2 (kWh/litre/day)       0       (51)         Volume factor from Table 2a       0       (52)         Temperature factor from Table 2b       0       (53)         Energy lost from water storage, kWh/year       ((50) x (51) x (52) x (53) =       0       (54)         Enter (49) or (54) in (55)       0.013       (55)         Water storage loss calculated for each month       ((56)m = (55) x (41)m       (56)         (56)m = 0.4 0.36 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4       0.4 0.39 0.4 0.39 0.4 0.39 0.4       0.56)		(50)
Hot water storage loss factor from Table 2 (kWh/litre/day)  Volume factor from Table 2a  Temperature factor from Table 2b  Energy lost from water storage, kWh/year  Enter (49) or (54) in (55)  Water storage loss calculated for each month  ((56)m= 0.4 0.36 0.4 0.39 0.4 0.39 0.4 0.4 0.39 0.4 0.39 0.4 0.39 0.4 (56)		
Volume factor from Table 2a       0       (52)         Temperature factor from Table 2b       0       (53)         Energy lost from water storage, kWh/year       ((50) x (51) x (52) x (53) =       0       (54)         Enter (49) or (54) in (55)       0.013       (55)         Water storage loss calculated for each month       ((56)m = (55) x (41)m         (56)m=       0.4       0.36       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.39       0.4       0.56)	· · · · · · · · · · · · · · · · · · ·	
Temperature factor from Table 2b	Notice to the form Table On	
Energy lost from water storage, kWh/year $((50) \times (51) \times (52) \times (53) = 0$ (54) Enter (49) or (54) in (55) $0.013$ (55) Water storage loss calculated for each month $((56)m = (55) \times (41)m$ (56) $0.4 \times 0.36 \times 0.4 \times 0.39 \times 0.4 \times$		` '
Enter (49) or (54) in (55) $0.013$ (55)  Water storage loss calculated for each month $((56)m = (55) \times (41)m$ (56)m= $0.4$ $0.36$ $0.4$ $0.39$ $0.4$ $0.39$ $0.4$ $0.4$ $0.39$ $0.4$ $0.39$ $0.4$ (56)		, ,
Water storage loss calculated for each month $((56)m = (55) \times (41)m$ (56)m = 0.4  0.36  0.4  0.39  0.4  0.39  0.4  0.39  0.4  0.39  0.4 (56)	5 + (40) (54) · (55)	•
(56)m= 0.4 0.36 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 (56)		, ,
	(56)m= 0.4 0.36 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4	(56)
(57)m= 0.4 0.36 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4 (57)	(57)m= 0.4 0.36 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4 0.39 0.4	(57)

Primary circuit loss calculated for each month (59)m = (58) + 365 x (41)m (modified by factor from Table 5 ls of them the size of water heating and a cylinder thermostat)  (59)m= (0.58)   77.62   0.058   29.59   0.058   29.59   0.058   29.59   0.058   28.59   0.058   0.		
Primary circuit  loss calculated for each month (59)m = (68) + 365 x (41) m	Primary circuit loss (annual) from Table 3	360 (58)
Combi   Cost		
Combi loss calculated for each month (61)m = (60) + 365 x (41)m  (61)m = 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(modified by factor from Table H5 if there is solar water heating and a cylinder thermo	ostat)
Column   D	(59)m= 30.58 27.62 30.58 29.59 30.58 29.59 30.58 29.59 30.58	29.59 30.58 (59)
Column   D	Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m	
(62)   (62)   (62)   (62)   (63)   (6		0 0 (61)
(62)   (62)   (62)   (62)   (63)   (6	Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m +	- (46)m + (57)m + (59)m + (61)m
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		
Compute   Comp	Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribu	ution to water heating)
Cosime 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		3,
Compute   Comp		0 0 (63)
Compute   Comp	Output from water heater	
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= 82.55		185.77 200.16
(65)ma	Output from water heate	er (annual) <sub>112</sub> 2049.7047 (64)
(65)m= 82.55   72.9   76.88   69.38   68.31   61.51   59.53   64.7   64.39   71.92   75.77   80.71   (65)	Heat gains from water heating, kWh/month 0.25 $^{\prime}$ [0.85 $\times$ (45)m + (61)m] + 0.8 $\times$ [(46)m	n + (57)m + (59)m l
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating  5. Internal gains (See Table 5 and 5a):  Metabolic gains (Table 5). Watts  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (66)m= 170.01 170		<del>, ` ´ , ` ´ , </del>
Metabolic gains (Table 5). Wats   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec		from community heating
Metabolic gains (Table 5). Watts    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec		nom commany nearing
Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec		
(66)   170.01   170.0		Nov Doc
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5  (67)m= 72.76		
(67) m= 72.76 64.63 52.56 39.79 29.74 25.11 27.13 35.27 47.34 60.11 70.15 74.79  Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5  (68) m= 412.34 416.62 405.84 382.88 353.91 326.68 308.48 304.2 314.99 337.94 366.92 394.15  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69) m= 54.83 (69)  Pumps and fans gains (Table 5a)  (70) m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		170.01
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5  (68)m= 412.34		70 15 74 79 (67)
(68)m= 412.34 416.62 405.84 382.88 353.91 326.68 308.48 304.2 314.99 337.94 366.92 394.15 (68)  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m= 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 (69)  Pumps and fans gains (Table 5a) (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		70.13
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69)m= 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 (69)  Pumps and fans gains (Table 5a)  (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		720000 20445 (68)
(69)   54.83		366.92 394.15
Pumps and fans gains (Table 5a)  (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		T (00)
(70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		54.83 54.83 (69)
Losses e.g. evaporation (negative values) (Table 5) (71)m= -113.34 -11		
(71)m= -113.34	(70)m= 0 0 0 0 0 0 0 0 0	0 0 (70)
Water heating gains (Table 5) (72)m= 110.95		
(72)m= 110.95	(71)m= -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34	-113.34 -113.34 (71)
Total internal gains =	Water heating gains (Table 5)	
(73)m=       707.56       701.23       673.24       630.53       586.98       548.73       527.13       537.94       563.26       606.21       653.4       688.92       (73)         6. Solar gains:         Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.         Orientation: Access Factor Area Table 6d       Flux g_ FF       Gains Table 6c       (W)         South 0.9x 0.77       x 10.12       x 47.32       x 0.76       x 0.7       = 176.65       (78)	(72)m= 110.95 108.48 103.34 96.36 91.82 85.44 80.01 86.96 89.43 96.66	104.82 108.49 (72)
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 Area Flux g_ FF Gains Table 6d m² Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x 0.7 = 176.65 (78)	<b>Total internal gains =</b> $(66)m + (67)m + (68)m + (69)m + (70)m + (70)m + (68)m + (69)m + (69$	71)m + (72)m
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Area Flux g_ FF Gains Table 6d m² Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x 0.7 = 176.65 (78)	(73)m= 707.56 701.23 673.24 630.53 586.98 548.73 527.13 537.94 563.26 606.21	653.4 688.92 (73)
Orientation: Access Factor Area Flux $g_{-}$ FF Gains Table 6d $m^2$ Table 6a Table 6b Table 6c (W)  South $0.9 \times 0.77$ × $10.12$ × $47.32$ × $0.76$ × $0.7$ = $176.65$ (78)	6. Solar gains:	
Table 6d $m^2$ Table 6a Table 6b Table 6c (W)  South $0.9x$ $0.77$ $\times$ $10.12$ $\times$ $47.32$ $\times$ $0.76$ $\times$ $0.7$ = 176.65 (78)	Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applica	able orientation.
South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x 0.7 = 176.65 (78)	<b>0</b>	
0.11	l able 6d m² l able 6a l able 6b l	i able 6C (W)
South 0.9x 0.77 x 10.12 x 77.18 x 0.76 x 0.7 = 288.11 (78)	South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x	0.7 = 176.65 (78)
	South 0.9x 0.77 x 10.12 x 77.18 x 0.76 x	0.7 = 288.11 (78)

South	0.9x	0.77		< [	10.12		X	9	4.25	X		0.76	X	0.7	=	351.81	(78)
South	0.9x	0.77		<b>κ</b>	10.12		X	10	05.11	X		0.76	X	0.7	=	392.38	(78)
South	0.9x	0.77		κ	10.12		X	10	08.55	X		0.76	X	0.7	=	405.2	(78)
South	0.9x	0.77		<b>κ</b>	10.12		X	1	08.9	X		0.76	X	0.7	=	406.5	(78)
South	0.9x	0.77		<b>K</b>	10.12		X	10	07.14	x		0.76	X	0.7	-	399.93	(78)
South	0.9x	0.77		<b>κ</b> [	10.12		x	10	03.88	x		0.76	x	0.7	-	387.78	(78)
South	0.9x	0.77		< [	10.12		x	9	9.99	x		0.76	x	0.7	=	373.25	(78)
South	0.9x	0.77		<b>κ</b> [	10.12		X	8	5.29	X		0.76	×	0.7	=	318.38	(78)
South	0.9x	0.77		<b>κ</b>	10.12		X	5	6.07	x		0.76	x	0.7	=	209.3	(78)
South	0.9x	0.77		ĸ 🗀	10.12		X	4	0.89	x		0.76	x	0.7	=	152.64	. (78)
	_																
Solar g	ains in	watts, ca	lculate	d fo	r each r	month	1			(83)m	ı = Sı	um(74)m .	(82)m				
(83)m=	176.65	288.11	351.81	39	2.38	405.2	4	06.5	399.93	387	.78	373.25	318.3	8 209.3	152.64	1	(83)
Total ga	ains – i	nternal a	nd sol	ar (84	4)m = (7	73)m	+ (8	33)m	, watts	•				!	-!		
(84)m=	884.21	989.34	1025.0	10	22.91 9	92.18	9	55.22	927.06	925	.72	936.51	924.5	9 862.69	841.56	3	(84)
7 Mea	an inter	nal temp	eratur	he (he	ating se	easor	וו								•		
		during h						area f	from Tal	ole 9	Th	1 (°C)				21	(85)
•		ctor for ga	_	•			_				,	. ( •)	-				
	Jan	Feb	Mar		Apr	May		Jun	Jul	A	ug	Sep	Oc	Nov	Dec	,	
(86)m=	1	1	1	+	_	0.96		0.82	0.57	0.5		0.85	0.98	1	1	4	(86)
` '	in to me o	l tomorous	-t	lis size		T4 /5			no 240 -	7 in T	able	200)				_	
(87)m=	20.35	l tempera	20.58			20.87	т —	w ste	ps 3 to 7	2 in 1	$\overline{}$	20.97	20.79	20.51	20.36	7	(87)
						$\overline{}$							20.7	20.51	20.30	_	(01)
i r		during h		_		$\overline{}$	т —			ı			40.00	1 10 07	T 40.00	- III	(00)
(88)m=	19.96	19.96	19.96	19	9.97	19.97	1	9.97	19.98	19.	98	19.97	19.9	19.97	19.96		(88)
		tor for ga				elling,	h2,	m (se	e Table	9a)						_	
(89)m=	1	1	0.99	0	.98	0.92	(	0.71	0.43	0.4	13	0.76	0.97	1	1		(89)
Mean	interna	l tempera	ature ii	the	rest of	dwell	ing	T2 (fc	ollow ste	eps 3	to 7	in Tabl	e 9c)				
(90)m=	19.11	19.25	19.44	19	9.63 1	19.86	1	9.96	19.98	19.	98	19.95	19.7	19.35	19.13		(90)
_				•	•					•		f	LA = Li	ving area ÷	(4) =	0.4	(91)
Mean	interna	l tempera	ature (	or th	e whole	e dwe	llin	a) – fl	Δ <b>ν</b> Τ1	<b>±</b> (1	_ fl	Δ) <b>v</b> T2					
(92)m=	19.61	19.72	19.9	$\overline{}$		20.26	_	20.37	20.38	20.	$\overline{}$	20.36	20.10	19.81	19.62		(92)
L		nent to th								L					1		, ,
(93)m=	19.61	19.72	19.9	_		20.26	_	0.37	20.38	20.		20.36	20.10		19.62		(93)
_		iting requ					<u> </u>								1 1 1 1 1		
					erature	obtai	ned	at ste	en 11 of	Tabl	e 9h	so tha	t Ti m	=(76)m a	nd re-ca	lculate	
		factor fo						at ott	ор о.	, ab		, 00 tila	,	(10) a		around to	
	Jan	Feb	Mar		Apr	May		Jun	Jul	A	ug	Sep	Ос	Nov	Dec	;	
Utilisa	tion fac	tor for ga	ains, h	n:	•									•		_	
(94)m=	1	1	0.99	0	.98	0.93	(	0.75	0.48	0.4	18	0.8	0.97	1	1		(94)
Useful	gains,	hmGm ,	W = (	94)m	x (84)r	n										_	
(95)m=	883.55	987.3	1018.8	3 10	07.04 9	26.74	72	20.08	447	446	.99	746.53	899.4	860.88	841.03	3	(95)
Month	ly aver	age exte	rnal te	mper	ature fr	rom T	abl	e 8									
(96)m=	4.5	5	6.8	8	3.7	11.7		14.6	16.9	16.	.9	14.3	10.8	7	4.9		(96)
_																	

Heat loss rate for many internal temperature I m. W = I(20) m. v. I(02) m. (06) m. I	
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m- (96)m] (97)m= 1975.42 1918.52 1706.54 1470.72 1104.36 742.45 447.53 447.53 781.92 1212.58 1664.44 1918.04	97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m	,
(98)m= 812.35 625.78 511.62 333.85 132.15 0 0 0 233.01 578.56 801.29	
Total per year (kWh/year) = Sum(98) <sub>15,912</sub> = 4028.61 (§	98)
Space heating requirement in kWh/m²/year 35.54	99)
9a. Energy requirements – Individual heating systems including micro-CHP)	
Space heating: Fraction of space heat from secondary/supplementary system 0 (2	201)
	202)
	204)
	206)
Efficiency of secondary/supplementary heating system, %	208)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec kWh/year	
Space heating requirement (calculated above)	
812.35 625.78 511.62 333.85 132.15 0 0 0 0 233.01 578.56 801.29	
	211)
875.38 674.33 551.31 359.75 142.4 0 0 0 0 251.09 623.45 863.46  Total (kWh/year) = Sum(211) <sub>15,1012</sub> 4341.17 (2	211)
	211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } x 100 ÷ (208)	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	
Total (kWh/year) = Sum(215) <sub>15,1012</sub> = 0 (2	215)
Water heating	
Output from water heater (calculated above)  205.67   180.77   188.64   167.43   162.87   143.79   136.44   152   152.45   173.7   185.77   200.16	
	216)
	217)
Fuel for water heating, kWh/month	,
$(219)m = (64)m \times 100 \div (217)m$	
(219)m= 235.29   207.41   217.72   194.88   194.91   181.78   172.49   192.16   192.73   204.61   213.68   228.92   Total = Sum(219a) <sub>112</sub> = 2436.59   (2	>
	219)
Annual totals kWh/year kWh/year Space heating fuel used, main system 1 4341.17	
Water heating fuel used 2436.59	
Electricity for pumps, fans and electric keep-hot	
central heating pump:	230c)
boiler with a fan-assisted flue	230e)
Total electricity for the above, kWh/year sum of (230a)(230g) = 175	231)
Electricity for lighting 514.01 (2	232)
10a. Fuel costs - individual heating systems:	

	<b>Fuel</b> kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	3.1 × 0.01	134.5763 (240)
Space heating - main system 2	(213) x	0 x 0.01 :	0 (241)
Space heating - secondary	(215) x	0 x 0.01 :	0 (242)
Water heating cost (other fuel)	(219)	3.1 × 0.01 :	75.53 (247)
Pumps, fans and electric keep-hot	(231)	11.46 × 0.01	20.06 (249)
(if off-peak tariff, list each of (230a) to (230g) s Energy for lighting	eparately as applicable and ap	ply fuel price according to	
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254	) as needed		
	(247) + (250)(254) =		395.0706 (255)
11a. SAP rating - individual heating systems			
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF) [(255):	x (256)] ÷ [(4) + 45.0] =		1.1727 (257)
SAP rating (Section 12)			83.641 (258)
12a. CO2 emissions - Individual heating syst	ems including micro-CHP		
	<b>Energy</b> kWh/year	<b>Emission factor</b> kg CO2/kWh	<b>Emissions</b> kg CO2/year
Space heating (main system 1)			
Space heating (main system 1) Space heating (secondary)	kWh/year	kg CO2/kWh	kg CO2/year
	kWh/year (211) x	kg CO2/kWh = 0.198 =	kg CO2/year 859.55 (261)
Space heating (secondary)	kWh/year (211) x (215) x	kg CO2/kWh  0.198 =	kg CO2/year 859.55 (261) 0 (263)
Space heating (secondary) Water heating	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) =	kg CO2/kWh  0.198 =	kg CO2/year  859.55 (261)  0 (263)  482.44 (264)
Space heating (secondary) Water heating Space and water heating	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) =	kg CO2/kWh  0.198 =  0 0.198 =	kg CO2/year  859.55 (261)  0 (263)  482.44 (264)  1342 (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-ho	kWh/year  (211) x  (215) x  (219) x  (261) + (262) + (263) + (264) =  ot (231) x  (232) x	kg CO2/kWh  0.198 =  0 =  0.198 =	kg CO2/year  859.55 (261)  0 (263)  482.44 (264)  1342 (265)  90.48 (267)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-ho Electricity for lighting	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) = ot (231) x (232) x sur	kg CO2/kWh  0.198 =  0.198 =  0.517 =  0.517 =	kg CO2/year  859.55 (261)  0 (263)  482.44 (264)  1342 (265)  90.48 (267)  265.74 (268)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-ho Electricity for lighting Total CO2, kg/year	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) = ot (231) x (232) x sur	kg CO2/kWh  0.198 =  0.198 =  0.517 =  0.517 =  0.517 =	kg CO2/year  859.55 (261)  0 (263)  482.44 (264)  1342 (265)  90.48 (267)  265.74 (268)  1698.21 (272)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-ho Electricity for lighting Total CO2, kg/year CO2 emissions per m²	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) = ot (231) x (232) x sur	kg CO2/kWh  0.198 =  0.198 =  0.517 =  0.517 =  0.517 =	kg CO2/year  859.55 (261)  0 (263)  482.44 (264)  1342 (265)  90.48 (267)  265.74 (268)  1698.21 (272)  14.98 (273)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-ho Electricity for lighting Total CO2, kg/year CO2 emissions per m² El rating (section 14)	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) = ot (231) x (232) x sur	kg CO2/kWh  0.198 =  0.198 =  0.517 =  0.517 =  0.517 =	kg CO2/year  859.55 (261)  0 (263)  482.44 (264)  1342 (265)  90.48 (267)  265.74 (268)  1698.21 (272)  14.98 (273)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-ho Electricity for lighting Total CO2, kg/year CO2 emissions per m² El rating (section 14)	kWh/year  (211) x  (215) x  (218) x  (261) + (262) + (263) + (264) =  ot (231) x  (232) x  sur  (27	kg CO2/kWh  0.198  0  0.198  0.517  0.517  m of (265)(271) =  72) ÷ (4) =	kg CO2/year  859.55 (261)  0 (263)  482.44 (264)  1342 (265)  90.48 (267)  265.74 (268)  1698.21 (272)  14.98 (273)  86 (274)  P. Energy
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-ho Electricity for lighting Total CO2, kg/year CO2 emissions per m² El rating (section 14)  13a. Primary Energy	kWh/year  (211) x  (215) x  (219) x  (261) + (262) + (263) + (264) =  ot (231) x  (232) x  sur  (27	kg CO2/kWh  0.198  0  0.198  0  0.517  0.517  m of (265)(271) =  (22) ÷ (4) =	kg CO2/year  859.55 (261)  0 (263)  482.44 (264)  1342 (265)  90.48 (267)  265.74 (268)  1698.21 (272)  14.98 (273)  86 (274)  P. Energy kWh/year
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-ho Electricity for lighting Total CO2, kg/year CO2 emissions per m² El rating (section 14)  13a. Primary Energy  Space heating (main system 1)	kWh/year (211) x (215) x (219) x (261) + (262) + (263) + (264) = ot (231) x (232) x  sur (27)  Energy kWh/year (211) x	kg CO2/kWh  0.198  0 0.198  0.517  0.517  m of (265)(271) =  (22) ÷ (4) =   Primary factor  1.02  =	kg CO2/year  859.55 (261)  0 (263)  482.44 (264)  1342 (265)  90.48 (267)  265.74 (268)  1698.21 (272)  14.98 (273)  86 (274)  P. Energy kWh/year  4428 (261)

(231) x

Electricity for pumps, fans and electric keep-hot

(267)

Electricity for lighting (232) x 0 = 1500.9 (268) (268) (Total Primary Energy sum of (265)...(271) = 8925.21 (272) (272) (272)  $\div$  (4) = 78.75 (273)

# DRAE

				User De							
Assessor Name:		=				a Num					
Software Name:	Stroma FS	SAP 2009				are Ve			Versio	n: 1.5.0.49	
A alabaga a			Pro	operty A	(daress	: House	1				
Address: 1. Overall dwelling dimer	nsions:										
T. Overall awelling alliner	1010110.			Area	(m²)		Ave He	eight(m)		Volume(m <sup>3</sup>	3)
Ground floor					<u> </u>	(1a) x		2.5	(2a) =	121.925	<b>,</b> (3
First floor				48	3.77	(1b) x	2	2.5	](2b) =	121.925	 (3
Гotal floor area TFA = (1а	)+(1b)+(1c)+	(1d)+(1e)	+(1n)	97	7.54	(4)			_		
) Owelling volume	, , , , , ,	(	,	,		l	)+(3c)+(3c	l)+(3e)+	.(3n) =	243.85	(5
-						(00)	., ( ) ) ( ) ( )	,, (,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	.()	243.65	(`
2. Ventilation rate:	main	Se	condary	y (	other		total			m³ per hou	r
Number of chimneys	heating		eating 0	, ] + [		7 = 6		x	40 =		
•	0	<b>-</b>		]	0	」	0		20 =	0	╡`
Number of open flues	0	_] '	0	] ' [_	0	┚╶┟	0			0	(6
Number of intermittent fan	ns ————————————————————————————————————					Ļ	0		10 =	0	(7
Number of passive vents		_				Ĺ	0		10 =	0	(7
Number of flueless gas fir	es					L	0	X 4	40 =	0	(7
									Air ch	nanges per ho	our
Infiltration due to chimney	s flues and f	ans - (6a	)+(6b)+(7a	a)+(7b)+(7	(c) =	Г	0	FT.	÷ (5) =	0	(8
If a pressurisation test has be	,					continue fi			- (0) =	0	
Number of storeys in the	e dw <mark>elling</mark> (n	s)								0	(9
Additional infiltration								[(9)	-1]x0.1 =	0	(1
Structural infiltration: 0.2						•	ruction			0	(1
if both types of wall are pre deducting areas of opening			ionaing to t	irie greate	r wall are	a (aner					
If suspended wooden flo	oor, enter 0.2	2 (unseale	ed) or 0.1	1 (sealed	d), else	enter 0				0	(1
If no draught lobby, ente										0	(1
Percentage of windows	and doors d	raught str	ipped							0	(1
Window infiltration						2 x (14) ÷ ′		()		0	(1
Infiltration rate						, , ,	12) + (13) -	, ,		0	(1
Air permeability value, of based on air permeabilit				•	•	•	ietre of e	nvelope	area	5.1	— (1 — ,,
Air permeability value applies	-						is beina u	sed		0.26	(1
Number of sides on which					60	<b>y</b>				1	(1
Shelter factor				(	(20) = 1 -	[0.075 x (	19)] =			0.92	(2
nfiltration rate incorporation	ng shelter fac	ctor		(	(21) = (18	) x (20) =				0.24	(2
nfiltration rate modified fo	r monthly wi	nd speed							•	1	
Jan Feb I	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spe	ed from Tab	le 7								_	
(22)m= 5.4 5.1 5	5.1 4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1		

Wind Factor (2	22a)m =	(22)m ÷	4										
(22a)m= 1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27		
Adjusted infiltr	ation rate	e (allowi	na for sh	nelter an	d wind s	peed) =	(21a) x	(22a)m				ı	
0.32	0.3	0.3	0.27	0.24	0.23	0.22	0.22	0.25	0.27	0.28	0.3		
Calculate effec		•	rate for t	he appli	cable ca	se							
If mechanica												0	(23a)
If exhaust air h		0 11	, ,	, (	,	. `	,, .	`	) = (23a)			0	(23b)
If balanced with		•	•	Ū		,		,				0	(23c)
a) If balance						<del>- ` ` </del>	<del>- ` ` - </del>	<del>í `</del>	<del> </del>	<del>-                                    </del>	<u>`</u>	÷ 100] I	(0.4-)
(24a)m= 0			0	0	0	0 (5	0	0	0	0	0		(24a)
b) If balance	ı							<del>í `</del>	<del> </del>	<del></del>		I	(24b)
(24b)m= 0	0	0	0	0		0	0	0	0	0	0		(24b)
c) If whole h		tract ven ‹ (23b), t		•	•				5 × (23h	o)			
(24c)m = 0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If natural	ventilatio	on or wh	ole hous	e positiv	re input '	ventilatio	n from I	oft	<u>Į</u>	<u>!</u>	<u>İ</u>		
		en (24d)							0.5]				
(24d)m= 0.55	0.55	0.55	0.54	0.53	0.53	0.52	0.52	0.53	0.54	0.54	0.55		(24d)
Effective air	change	rate - er	iter (24a	) or (24b	o) or (24	c) or (24	d) in box	(25)					
(25)m= 0.55	0.55	0.55	0.54	0.53	0.53	0.52	0.52	0.53	0.54	0.54	0.55		(25)
3. Heat losse	s and he	eat loss p	paramete	er:									
ELEMENT	Gros		Openin		Net Ar	ea	U-valı	ue	ΑXU		k-value	)	ΑΧk
-	area	(m²)	m	ĮŽ	A ,r	n²	W/m2	K .	(W/	K)	kJ/m²-ł	<	kJ/K
Doors					2	X	1.4	=	2.8	Ш			(26)
Windows					10.12	5 x1/	/[1/( 1.4 )+	0.04] =	13.42				(27)
Floor Type 1					48.77	X	0.2	=	9.75400	1			(28)
Floor Type 2					48.77	X	0.2	= [	9.75400	1 [			(28)
Walls	97.7	<b>7</b> 2	22.2	5	75.47	X	0.2	= [	15.09				(29)
Roof	48.7	77	0		48.77	, X	0.18	_ = [	8.78	$\overline{}$		$\neg \vdash$	(30)
Total area of e	lements	, m²			244.0	3							(31)
* for windows and						ated using	formula 1	/[(1/U-valu	ie)+0.04] a	as given in	paragraph	3.2	
** include the area				ls and part	titions		(26) (20)	\ (22\)			İ		
Fabric heat los		•	U)				(26)(30)		(00) - (0)	o) - (00-)	(00-)	73.03	
Heat capacity	,	,		TE 4 \ ' :						2) + (32a).	(32e) =	17942.8	
Thermal mass	•	`		,			o o io o lu tha		tive Value	· ·	abla 1f	450	(35)
For design assess can be used inste				CONSTRUCT	ion are not	r known pr	ecisely the	e indicative	values of	TIVIP IN T	able II		
Thermal bridge	es : S (L	x Y) cal	culated ı	using Ap	pendix ł	<						19.52	(36)
if details of therma		are not kn	own (36) =	= 0.15 x (3	1)								
Total fabric he								(33) +	(36) =			92.55	(37)
Ventilation hea			monthly	/			1	<del>- ` ´</del>		(25)m x (5)	) 	ı	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m= 44.32	43.87	43.87	43.07	42.59	42.36	42.15	42.15	42.7	43.07	43.46	43.87		(38)
Heat transfer of	coefficier	nt, W/K						(39)m	= (37) + (	38)m		•	
(39)m= 136.86 Stroma FSAP 200	136.42	136.42	135.62	135.14	134.91	134.7	134.7	135.25	135.62	136.01	136.42	-	200 2 1: 7
Judina FJAP 200	e version:	. 1.5.0.49 (	JAF 3.30)	- nap://w\	พพ.ธแบแล	.com			Average =	Sum(39) <sub>1</sub>	12 /12=	135.6	Page 2 of 39)

eat los	ss parai	meter (H	ILP), W	m²K					(40)m	= (39)m ÷	(4)			
0)m=	1.4	1.4	1.4	1.39	1.39	1.38	1.38	1.38	1.39	1.39	1.39	1.4		_
umbor	r of day	c in mor	nth (Tab	lo 1a)					,	Average =	Sum(40) <sub>1.</sub>	12 /12=	1.39	(40
Г	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41
Ĺ								l						
1. Wat	er heati	ing ener	gy requi	rement:								kWh/ye	ear:	
0011000	ad again	nanay N										1		(40
if TFA				[1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.0	0013 x (¯	ΓFA -13.		156		(42
								(25 x N)			103.	8889		(43
		•				iweiling is hot and co	-	to achieve	a water us	se target o	ī			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ot water							Table 1c x		•					
4)m=	114.28	110.12	105.97	101.81	97.66	93.5	93.5	97.66	101.81	105.97	110.12	114.28		
aoreu oe	ontont of	hat water	unad aal	aulated me	onthly — 1	400 v Vd r	n v nm v [	Tm / 2600			m(44) <sub>112</sub> =		1246.6668	(44
		148.57	153.32	133.66	128.25	110.67	102.56		119.09	138.79	151.5	164.52	_	
5)m= [	169.88	146.57	155.52	133.00	120.25	110.67	102.36	117.68			m(45) <sub>112</sub> =		1638.4874	(4
instanta	aneous wa	ater heatir	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)		Iotal – Ou	111(40)112 =		1030.4074	
6)m=	25.48	22.29	23	20.05	19.24	16.6	15.38	17.65	17.86	20.82	22.72	24.68		(4
	torage		Janes et J	64-		(1.) (1.)	(1-1-1)							
					r is knov	vn (kWh	/day):				_	)24		(4
•			m Table	∠b , kWh/ye	oor			(47) x (48)	_			54		(4
			-	-		s not kno		(47) X (40)	_		0.0	)13		(4
ylinde	r volum	e (litres)	) includir	ng any s	olar stor	age with	in same					0		(5
	-	-		_		litres in bo			(50)					
								enter '0' in	DOX (5U)					
		ige ioss from Tal		om rabi	e z (KVV	h/litre/da	iy)					0		(5
			oie ∠a m Table	2b							-	0		(5 (5
•				, kWh/ye	ear			((50) x (51	) x (52) x (	(53) =		0		(5
•		64) in (5	_	,y.	Jul			((00) // (0)	)	(00)		)13		(5
ater s	torage	loss cal	culated f	or each	month			((56)m = (	55) × (41)ı	m				
6)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(5
cylinder	contains	dedicated	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	ix H	
7)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(5
- rimary	circuit	loss (an	nual) fro	m Table	3			•			36	60		(5
-						59)m = (	(58) ÷ 36	65 × (41)	m					
(modi								ng and a			stat)			
9)m=	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		(5
ombi l	loss cal	culated	for each	month (	(61)m =	(60) ÷ 30	65 × (41)	)m						
<u> </u>														

Total heat re	quired for	water he	eating ca	alculated	l for e	each month	(62)	m =	0.85 × (	45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m= 200.8	<del>-</del>	184.29	163.64	159.23	140		148	_	149.07	169.76	181.47	195.49		(62)
Solar DHW inpu	ut calculated	using App	endix G oı	· Appendix	H (ne	gative quantit	y) (ent	er '0'	if no sola	r contribu	tion to wate	r heating)	ı	
(add addition	nal lines if	FGHRS	and/or \	vwhrs	арр	lies, see Ap	pend	dix G	3)					
(63)m= 0	0	0	0	0	0	0	0	)	0	0	0	0		(63)
Output from	water hea	ıter				•					•	•	•	
(64)m= 200.8	5 176.55	184.29	163.64	159.23	140	.65 133.53	148	.66	149.07	169.76	181.47	195.49		
	•	•				•		Outp	ut from wa	ater heate	er (annual) <sub>1</sub>	12	2003.2178	(64)
Heat gains f	om water	heating,	kWh/m	onth 0.2	5 ′ [0	.85 × (45)m	+ (6	1)m	] + 0.8 x	: [(46)m	+ (57)m	+ (59)m	]	
(65)m= 80.94	71.49	75.44	68.11	67.1	60.	47 58.56	63.	59	63.27	70.61	74.04	79.16		(65)
include (5	7)m in cal	culation (	of (65)m	only if c	ylind	er is in the	dwell	ing	or hot w	ater is f	rom com	munity h	eating	
5. Internal	gains (see	e Table 5	and 5a	):										
Metabolic ga	ins (Table	e 5), Wat	ts										_	
Jan	Feb	Mar	Apr	May	Jι	ın Jul	A	ug	Sep	Oct	Nov	Dec		
(66)m= 162.9	3 162.93	162.93	162.93	162.93	162	.93 162.93	162	.93	162.93	162.93	162.93	162.93		(66)
Lighting gair	ıs (calcula	ted in Ap	pendix	L, equat	ion L	9 or L9a), a	lso s	ee 7	Table 5		-	-		
(67)m= 56.43	50.12	40.76	30.86	23.07	19.	47 21.04	27.	35	36.71	46.62	54.41	58		(67)
Appliances of	gains (calc	ulated ir	Append	dix L, eq	uatio	n L13 or L1	3a), a	also	see Tal	ole 5				
(68)m= 376.5	5 380.46	370.61	349.65	323.19	298	.32 281.7	277	7.8	287.64	308.6	335.07	359.94		(68)
Cooking gair	ns (calcula	ated in A	ppendix	L, equat	ion L	.15 or L15a	), als	o se	e Table	5				
(69)m= 54.01	54.01	54.01	54.01	54.01	54.	01 54.01	54.	01	54.01	54.01	54.01	54.01		(69)
Pumps and f	ans gains	(Table 5	5a)											
(70)m= 0	0	0	0	0	0	0	0	)	0	0	0	0		(70)
Losses e.g.	evaporatio	on (nega	tive valu	es) (Tab	le 5)									
(71)m= -108.6	2 -108.62	-108.62	-108.62	-108.62	-108	.62 -108.62	-108	.62	-108.62	-108.62	-108.62	-108.62		(71)
Water heating	ıg gains (⅂	Table 5)										-		
(72)m= 108.8	3 106.39	101.39	94.6	90.19	83.	99 78.71	85.	47	87.87	94.9	102.84	106.4		(72)
Total intern	al gains =	•	-			(66)m + (67)n	า + (68	3)m +	- (69)m + (	70)m + (7	71)m + (72)	m		
(73)m= 650.1	645.29	621.09	583.43	544.77	510	.1 489.78	498	.94	520.55	558.44	600.63	632.66		(73)
6. Solar gai	ns:													
Solar gains ar		•	r flux from	Table 6a	and as	ssociated equa	tions	to co	nvert to th	e applica		ion.		
Orientation:	Access F Table 6d		Area m²			Flux Table 6a		т.	g_ able 6b	т	FF able 6c		Gains (W)	
Cauth					_		1 1							1
South 0.9			10.		× L	47.32	X		0.76	_  ×	0.7	_ =	353.3	(78)
South 0.93		_	10.		× L	77.18	X	<u> </u>	0.76	_  ×	0.7	_ =	576.23	<u> </u> (78)
South 0.93			10.	===	× L	94.25	X		0.76	_  ×	0.7	_  =	703.61	(78)
South 0.9			10.		× L	105.11	X		0.76	x	0.7	_  =	784.75	[(78)
South 0.93			10.		× L	108.55	X		0.76	×	0.7	_  =	810.4	<u> </u> (78)
South 0.93		X	10.	12	x L	108.9	X	<u> </u>	0.76	_  ×	0.7	=	813	(78)
South 0.93			10.	12	× L	107.14	X		0.76	×	0.7	=	799.85	(78)
South 0.93	0.77	X	10.	12	x	103.88	X		0.76	x	0.7	=	775.56	(78)

South on							, ,				_		7(70)
South 0.9x		X	10.		X	99.99	]	0.76	_	0.7	=	746.5	(78)
South 0.9x		X	10.		X	85.29	]	0.76	_	0.7	_ =	636.76	(78)
South 0.9x		X	10.	_	X	56.07	]	0.76	X	0.7	_ =	418.6	(78)
South 0.9x	0.77	X	10.	12	X	40.89	X	0.76	X	0.7	=	305.28	(78)
Oalan maina ir		-11-4-	l <b>f</b> an a a al				(00)	C (7.4)	(00)				
Solar gains ii (83)m= 353.3		703.61	784.75	810.4	813	799.85	775.5	Sum(74)m . 6 746.5	636.76	418.6	305.28		(83)
Total gains –							1 1 1 0.0	7 10.0	000.70	110.0	000.20		()
(84)m= 1003.4	-			1355.17	1323.1	<del></del>	1274.	5 1267.05	1195.2	1019.23	937.93		(84)
7. Mean inte	ernal temr	perature	(heating	season	)		l e			ļ.			
Temperatur						from Tal	ble 9. T	Γh1 (°C)				21	(85)
Utilisation fa	_				_		J.O O,	( 0)				21	(/
Jan	<del></del>	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(86)m= 1	0.99	0.98	0.94	0.84	0.64	0.43	0.43	•	0.93	0.99	1		(86)
	ol tompor	l .	living or		llow of		Tin To					I	
Mean intern	<del></del>	20.63	20.78	20.93	20.99	21	21	20.98	20.84	20.49	20.28		(87)
		l .				<u> </u>	ļ	<b>i</b>	20.04	20.40	20.20		(0.)
Temperatur						<del>`</del>	1	<del></del>	40.77	40.77	10.77		(00)
(88)m= 19.76	19.77	19.77	19.77	19.78	19.78	19.78	19.78	19.78	19.77	19.77	19.77		(88)
Utilisation fa					h2,m (s	ee Table	9a)						
(89)m= 1	0.99	0.96	0.91	0.76	0.53	0.3	0.3	0.58	0.88	0.99	1		(89)
Mean intern	al temper	ature in	the rest	of dwelli	ng T2 (	follow ste	eps 3 t	o 7 in Tabl	e 9c)				
(90)m= 18.85	19.09	19.35	19.56	19.73	19.78	19.78	19.78	19.77	19.64	19.16	18.85		(90)
_								f	LA = Livir	ng area ÷ (4	4) =	0.38	(91)
Mean intern	al temper	ature (fo	r the wh	ole dwe	lling) =	fLA × T1	+ (1 –	$fLA) \times T2$					
(92)m= 19.39	19.6	19.84	20.02	20.19	20.24	20.24	20.24	20.23	20.09	19.66	19.39		(92)
Apply adjus	tment to t	he mear	internal	temper	ature fr	om Table	4e, w	here appro	priate	•	•		
(93)m= 19.39	19.6	19.84	20.02	20.19	20.24	20.24	20.24	20.23	20.09	19.66	19.39		(93)
8. Space he													
Set Ti to the the utilisation					ed at s	tep 11 of	Table	9b, so tha	t Ti,m=(	76)m an	d re-cald	culate	
Jan		Mar	Apr	May	Jun	Jul	Aug	g Sep	Oct	Nov	Dec		
Utilisation fa	_!		•	iviay	Juli	Jul	I Yuí	g   Seb	OCI	1407	Dec		
(94)m= 1	0.99	0.96	0.92	0.79	0.57	0.35	0.35	0.62	0.9	0.99	1		(94)
Useful gains	s, hmGm	, W = (94	1)m x (84	4)m		_!		<u> </u>		!		l	
(95)m= 999.66	<del></del>	<u> </u>	1257.8	1072.67	753.83	450.16	450.1	4 789.95	1072	1008.35	935.17		(95)
Monthly ave	erage exte	rnal tem	perature	from Ta	able 8		•	<u> </u>				1	
(96)m= 4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9		(96)
Heat loss ra	ite for mea	an intern	al tempe	erature,	Lm , W	=[(39)m	x [(93)	m– (96)m	]			•	
(97)m= 2038.1	4 1992.08	1778.6	1535.73	1146.76	760.52	450.34	450.3	4 802.22	1260.56	1722.28	1976.88		(97)
Space heat	<del></del>	r			/Vh/moi	-10.02	24 x [(9	97)m – (95	<del>- `</del>	<del>r</del>		Ī	
(98)m= 772.63	3 528.6	373.51	200.11	55.13	0	0	0	0	140.29	514.03	775.03		<b>_</b>
							To	otal per year	(kWh/yea	r) = Sum(9	8) <sub>15,912</sub> =	3359.33	(98)
Space heat	ing require	ement in	kWh/m²	<sup>2</sup> /year								34.44	(99)

9a. Energy requirements – Inc	lividual h	eating sy	ystems i	ncluding	micro-C	CHP)					
Space heating:		, .							1		<b>_</b>
Fraction of space heat from s			mentary	•		(204)			i	0	(201)
Fraction of space heat from r	•	` ,			(202) = 1	` '	(202)1		i	1	(202)
Fraction of total heating from	•				(204) = (2	∪∠) <b>×</b> [1 –	(203)] =			1	(204)
Efficiency of main space hea				- 01						93.3	(206)
Efficiency of secondary/supp	1		-		T .		I -		<u> </u>	0	(208)
Jan Feb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/y	ear
Space heating requirement (control of the space of the sp	200.11	55.13	0	0	0	0	140.29	514.03	775.03		
$(211)m = \{[(98)m \times (204)] + (204)\}$	l			1	1	l	I	I	<u> </u>		(211)
828.12 566.56 400.33	214.48	59.08	0	0	0	0	150.36	550.94	830.69		` '
	•			•	Tota	l (kWh/yea	ar) =Sum(2	211)	<u>.</u>	3600.56	(211)
Space heating fuel (secondar	• , .								!		
$= \{[(98)m \times (201)] + (214) \text{ m}\}$	T									1	
(215)m= 0 0 0	0	0	0	0	0 Tota	0 I (kWh/vea	0 ar) =Sum(2	215)	0	0	(215)
Water heating						(		/15,101			(213)
Output from water heater (calc	ulated a	bove)									
200.85 176.55 184.29	163.64	159.23	140.65	133.53	148.66	149.07	169.76	181.47	195.49		
Efficiency of water heater										79.6	(216)
(217)m= 87.86 87.36 86.46	85.15	82.1	79.6	79.6	79.6	79.6	84.11	87.24	87.92		(217)
Fuel for water heating, kWh/m $(219)$ m = $(64)$ m × $100 \div (217)$								L			
(219)m= 228.6 202.1 213.15	192.18	193.94	176.7	167.75	186.76	187.27	201.84	208.02	222.35		
					Tota	I = Sum(2				2380.67	(219)
Annual totals Space heating fuel used, mair	svetam	1					k'	Wh/yeaı	<b>r</b>	kWh/yea	ar
,	ay Stell	1									=
Water heating fuel used	olootric	kaan ha								2380.67	
Electricity for pumps, fans and	electric	keep-no	ι							ı	(000)
central heating pump:									130		(230c)
boiler with a fan-assisted flue									45		(230e)
Total electricity for the above,	kWh/yea	r			sum	of (230a).	(230g) =			175	(231)
Electricity for lighting										398.64	(232)
10a. Fuel costs - individual h	eating sy	stems:									
			Fu kW	<b>el</b> /h/year			Fuel P (Table			Fuel Cos £/year	t
Space heating - main system	1		(21	1) x			3.	1	x 0.01 =	111.6175	(240)
Space heating - main system	2		(21:	3) x			0		x 0.01 =	0	(241)
Space heating - secondary			(21	5) x			0		x 0.01 =	0	(242)
Water heating cost (other fuel)			(21	9)			3.		x 0.01 =	73.8	(247)
and the state of t			•					·		10.0	()

Pumps, fans and electric keep-hot (231)				
Energy for lighting (232)	Pumps, fans and electric keep-hot	(231)	11.46 × 0.01 =	20.06 (249)
Additional standing charges (Table 12)  Appendix Q items: repeat lines (253) and (254) as needed  Total energy cost (245)(247) + (250)(254) = 367.1673 (255)  11a. SAP rating - individual heating systems  Energy cost deflator (Table 12)  Energy cost factor (ECP) ((255) x (256)) + ((4) + 45.0) = 1.1.777 (257)  SAP rating (Section 12)  12a. CO2 emissions – Individual heating systems including micro-CHP  Energy kWh/year Emission factor kg CO2/kWh kg CO2/kWh kg CO2/kw				
Appendix Q items: repeat lines (253) and (254) as needed  Total energy cost (245)(247) + (250)(254) = 357.1573 (255)  11a. SAP rating - individual heating systems  Energy cost deflator (Table 12)  Energy cost factor (ECF) ([255) × (256)] ÷ [(4) + 45.0] = 1.1777 (257)  SAP rating (Section 12)  12a. CO2 emissions – Individual heating systems including micro-CHP  Energy kWh/year Emission factor kg CO2/kWh kg CO2/kWh kg CO2/year  Space heating (main system 1) (211) x 0.198 = 712.91 (281)  Space heating (secondary) (215) x 0 = 0 (283)  Water heating  Space and water heating (219) x 0.196 (281) (281)  Space and water heating (221) x 0.517 = 90.48 (267)  Electricity for pumps, fans and electric keep-hot (231) x 0.517 = 90.48 (267)  Electricity for lighting (232) x 0.517 = 90.48 (267)  Electricity for lighting (232) x 0.517 = 90.48 (267)  Electricity for lighting (232) x 0.517 = 90.48 (272)  CO2 emissions per m² (272) + (4) = 1.5.18 (273)  El rating (section 14) 86 (272)  CO2 emissions per m² (272) + (4) = 1.5.18 (273)  El rating (section 14) 86 (274)  13a. Primary Energy  Energy kWh/year  Space heating (main system 1) (211) x 1.02 = 3672.58 (261)  Space heating (secondary) (215) x 0 = 0 (263)  Energy for water heating (219) x 1.02 = 0 (263)		(232)	11.46	45.00 (250)
Total energy cost   (245)(247) + (250)(254) =   357.1573   (255)     11a. SAP rating - individual heating systems     Energy cost deflator (Table 12)	Additional standing charges (Table 12)			106 (251)
Energy cost deflator (Table 12) Energy cost factor (ECF) [(255) x (256)] + [(4) + 45.0] =				
Energy cost deflator (Table 12)  Energy cost factor (ECF)  [(255) × (256)] ÷ [(4) + 45.0] =		247) + (250)(254) =		357.1573 (255)
Energy cost factor (ECF) {(255) x (256)} + [(4) + 45.0] =	11a. SAP rating - Individual heating systems			
SAP rating (Section 12)   83.5716   (258)	Energy cost deflator (Table 12)			0.47 (256)
Space heating (main system 1)   (211)   x   (215)   x   (219)   x   (219)   x   (211)	=1.0.g)	$(256)] \div [(4) + 45.0] =$		1.1777 (257)
Energy kWh/year         Emission factor kg CO2/kWh         Emissions kg CO2/year           Space heating (main system 1)         (211) x         0.198 = 712.91 (261)           Space heating (secondary)         (215) x         0 = 0 (263)           Water heating         (219) x         0.198 = 471.37 (264)           Space and water heating         (261) + (262) + (263) + (264) = (261)         1184.28 (265)           Electricity for pumps, fans and electric keep-hot         (231) x         0.517 = 40.48 (267)           Electricity for lighting         (232) x         0.517 = 206.1 (268)           Total CO2, kg/year         sum of (265)(271) = 1480.86 (272)           CO2 emissions per m²         (272) + (4) = 15.18 (273)           EI rating (section 14)         86 (274)           13a. Primary Energy           Primary factor         P. Energy kWh/year           Space heating (main system 1)         (211) x         1.02 = 3672.58 (261)           Space heating (secondary)         (215) x         0 = 0 (263)           Energy for water heating         (219) x         1.02 = 2428.28 (264)				83.5716 (258)
KWh/year   kg CO2/kWh   kg CO2/year	12a. CO2 emissions – Individual heating syste	ms including micro-CHP		
Space heating (main system 1)       (211) x       0.198       = 712.91 (261)         Space heating (secondary)       (215) x       0       = 0 (263)         Water heating       (219) x       0.198       = 471.37 (264)         Space and water heating       (261) + (262) + (263) + (264) =       1184.28 (265)         Electricity for pumps, fans and electric keep-hot       (231) x       0.517 = 90.48 (267)         Electricity for lighting       (232) x       0.517 = 206.1 (268)         Total CO2, kg/year       (272) ± (4) =       1480.86 (272)         CO2 emissions per m²       (272) ± (4) =       15.18 (273)         El rating (section 14)       86 (274)         13a. Primary Energy         Energy kWh/year       Primary factor       P. Energy kWh/year         Space heating (main system 1)       (211) x       1.02 = 3672.58 (261)         Space heating (secondary)       (215) x       0 = 0 (263)         Energy for water heating       (219) x       1.02 = 2428.28 (264)				
Space heating (secondary)  (215)		,		
Water heating  (219) x  (219) x  (219) x  (219) x  (219) x  (261) + (262) + (263) + (264) =  (261) + (262) + (263) + (264) + (263) + (264) =  (261) + (262) + (263) + (264) + (263) + (264)	,		0.198 =	712.91 (261)
Space and water heating    (261) + (262) + (263) + (264) =		,	0 =	0 (263)
Electricity for pumps, fans and electric keep-hot (231) x				471.37 (264)
Electricity for lighting  Total CO2, kg/year  CO2 emissions per m²  El rating (section 14)  Energy kWh/year  Space heating (main system 1)  Space heating (secondary)  Energy for water heating  (232) x   0.517  206.1 (268)  (272)  1480.86 (272)  15.18 (273)  86 (274)  Primary factor  P. Energy kWh/year  Space heating (secondary)  (211) x  1.02  3672.58 (261)  Co2 emissions per m²  (272)  15.18 (273)  P. Energy kWh/year  Space heating (secondary)  Space heating (secondary)  (215) x  0  1.02  2428.28 (264)			(4) =	1184.28 (265)
Total CO2, kg/year  CO2 emissions per m²  EI rating (section 14)  Energy kWh/year  Space heating (main system 1)  Space heating (secondary)  Energy for water heating  Sum of (265)(271) = 1480.86 (272)  15.18 (273)  15.18 (273)  P. Energy kWh/year  Factor  1.02 = 3672.58 (261)  1.02 = 0 (263)  1.02 = 2428.28 (264)	Electricity for pumps, fans and electric keep-hot		0.517 =	90.48 (267)
CO2 emissions per m²  El rating (section 14)  Energy kWh/year  Space heating (main system 1)  Space heating (secondary)  Energy kWh/year  (272) ÷ (4) =  15.18  (273)  Primary factor  Rwh/year  1.02  F. Energy kWh/year  Space heating (secondary)  (211) x  1.02  The state of the	Electricity for lighting	(232) x	0.517 =	206.1 (268)
El rating (section 14)    Bab   (274)	Total CO2, kg/year		sum of (265)(271) =	1480.86 (272)
Energy   RWh/year   Frimary   Factor   Factor   RWh/year   Space heating (main system 1)   (211)   x   1.02   = 3672.58   (261)	CO2 emissions per m²		(272) ÷ (4) =	15.18 (273)
Energy kWh/year         Primary factor         P. Energy kWh/year           Space heating (main system 1)         (211) x         1.02         = 3672.58 (261)           Space heating (secondary)         (215) x         0         = 0 (263)           Energy for water heating         (219) x         1.02         = 2428.28 (264)	EI rating (section 14)			86 (274)
kWh/year       factor       kWh/year         Space heating (main system 1)       (211) x       1.02       = 3672.58 (261)         Space heating (secondary)       (215) x       0       = 0 (263)         Energy for water heating       (219) x       1.02       = 2428.28 (264)	13a. Primary Energy			
kWh/year       factor       kWh/year         Space heating (main system 1)       (211) x       1.02       = 3672.58 (261)         Space heating (secondary)       (215) x       0       = 0 (263)         Energy for water heating       (219) x       1.02       = 2428.28 (264)		Energy	Primary	P. Energy
Space heating (secondary)       (215) x       0       =       0       (263)         Energy for water heating       (219) x       1.02       =       2428.28       (264)		•	factor	kWh/year
Energy for water heating (219) x 1.02 = 2428.28 (264)	Space heating (main system 1)	(211) x	1.02 =	3672.58 (261)
1102	Space heating (secondary)	(215) x	0 =	0 (263)
Space and water heating $(261) + (262) + (263) + (264) = 6100.86$ (265)	Energy for water heating	(219) x	1.02 =	2428.28 (264)
	Space and water heating	(261) + (262) + (263) + (26	(4) =	6100.86 (265)
Electricity for pumps, fans and electric keep-hot (231) x 2.92 = 511 (267)	Electricity for pumps, fans and electric keep-hot	(231) x	2.92 =	511 (267)
Electricity for lighting $(232) \times 0 = 1164.03 (268)$	Electricity for lighting	(232) x	0 =	1164.03 (268)
'Total Primary Energy sum of (265)(271) = 7775.88 (272)	'Total Primary Energy		sum of (265)(271) =	7775.88 (272)
Primary energy kWh/m²/year $(272) \div (4) = 79.72 \qquad (273)$	Primary energy kWh/m²/year		(272) ÷ (4) =	79.72 (273)

				User De			<u></u>				
Assessor Name:	0. 50					a Num			., .	4 5 0 40	
Software Name:	Stroma FS	SAP 2009				are Ve			Versio	on: 1.5.0.49	
Address :			Pr	operty A	\aaress	: House	1				
Address :  1. Overall dwelling dime	nsions:										
				Area	(m²)		Ave He	eight(m)		Volume(m	<sup>3</sup> )
Ground floor					• •	(1a) x		2.5	(2a) =	103.75	(3
First floor				4	1.5	(1b) x	2	2.5	(2b) =	103.75	(3
Total floor area TFA = (1a	a)+(1b)+(1c)+	(1d)+(1e)-	+(1n)	) :	83	(4)			J		
Dwelling volume	, , , , ,		` '			l	o)+(3c)+(3c	d)+(3e)+	(3n) =	207.5	(5
										201.5	(
2. Ventilation rate:	main		condary	y (	other		total			m³ per hou	ır
Number of chimneys	heating 0	he	eating 0	] + [	0	<b>7</b> = F	0	x	40 =	0	(6
Number of open flues	0	┪╻	0	] <u> </u> 	0	」	0		20 =	0	(6
Number of intermittent far			0	]	0	┙┟			10 =		╡`
						L	0		10 =	0	(7
Number of passive vents		$\overline{}$				Ĺ	0			0	(7
Number of flueless gas fil	res					L	0	x	40 =	0	(7
_									Air ch	nanges per h	our
Infiltration due to chimne	vs, flues and f	ans = (6a)	)+(6b)+(7a	a)+(7b)+(7	'c) =	Г	0	Н	÷ (5) =	0	(8
If a pressurisation test has b	′ ′					continue fi			- (-)		``
Number of storeys in the	ne dw <mark>elling</mark> (n	s)								0	(9
Additional infiltration	05 for stool o			0.05 for				[(9)	-1]x0.1 =	0	(1
Structural infiltration: 0. <i>if both types of wall are pr</i>						•	ruction			0	(1
deducting areas of opening	ngs); if equal use	0.35									
If suspended wooden f		`	d) or 0.′	1 (sealed	d), else	enter 0				0	(1
If no draught lobby, ent										0	(1
Percentage of windows Window infiltration	s and doors d	raugnt stri	ppea	(	n 25 - IN 2	2 x (14) ÷ 1	1001 -			0	
Infiltration rate							12) + (13) ·	+ (15) =		0	(1 (1
Air permeability value,	q50, expresse	ed in cubic	c metres	s per ho	ur per s	quare m	netre of e	envelope	area	4.8	<b>-</b>  (1
If based on air permeabili				•	•	•				0.24	(1
Air permeability value applies		on test has l	been done	e or a deg	ree air pe	rmeability	is being u	sed			_
Number of sides on whicl Shelter factor	h sheltered			,	(20) = 1 -	[0.075 x (	19)] =			2	(1
Infiltration rate incorporat	ing shelter fac	etor				) x (20) =	-/1			0.85	(2
Infiltration rate modified for	_			`	, (10	, ( ~)				U.Z	\^2
	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	]	
Monthly average wind sp						1 2-12		1		ı	
	5.1 4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1	1	

Wind Factor (2	22a)m =	(22)m ÷	4										
(22a)m= 1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27		
Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m			-		
0.28	0.26	0.26	0.23	0.21	0.2	0.19	0.19	0.21	0.23	0.24	0.26		
Calculate effec		•	rate for t	he appli	cable ca	se				!			<del></del> 1
If mechanica			on dia N. (O	OL) (OO-			1 <b>5</b> \\		) (00-)			0	(23a)
If exhaust air h		0		, ,	,	. ,	,, .	,	)) = (23a)			0	(23b)
If balanced with		-		_					Ol. ) /	(001)	4 (00 -)	0	(23c)
a) If balance (24a)m= 0	ea mech	anicai ve	ntilation	with nea	at recove	ery (MVI	$\frac{18}{0}$ (248	$\frac{1}{100} = \frac{1}{100}$	2b)m + (	$\frac{230) \times [}{0}$	1 – (23c)	i ÷ 100] I	(24a)
` '	<u> </u>				<u>l</u>	l			<u> </u>		0	J	(244
b) If balance (24b)m= 0	o mech	anicai ve	ntilation	without 0	neat rec		//V) (24k	$\int_{0}^{\infty} \int_{0}^{\infty} dx = (2x)^{2}$	2b)m + (	23b)   0	0	1	(24b
	<u> </u>				<u> </u>	ļ	<u> </u>					J	(= 1~)
c) If whole h		(23b), t		•	-				.5 × (23h	o)			
(24c)m = 0	0	0	0	0	0	0	0	0	0	0	0	]	(24c)
d) If natural	ventilatio	on or wh	ole hous	e positiv	/e input	ventilatio	on from I	oft	<u> </u>	<u> </u>	<u> </u>	J	
		en (24d)							0.5]			_	
(24d)m = 0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53		(24d)
Effective air	change	rate - er	iter (24a	) or (24k	o) or (24	c) or (24	d) in box	k (25)					
(25)m = 0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53		(25)
3. Heat losse	s and he	eat loss r	paramete	er:									
ELEMENT	Gros		Openin		Net Ar	ea	U-val	ue	ΑXU		k-value	e	ΑΧk
_	area	(m²)	m	l <sup>2</sup>	A ,r	m²	W/m2	2K	(W/	K)	kJ/m²-l	K	kJ/K
Doors					2	X	1.2	=	2.4	Ш			(26)
Windows					6.125	x1,	/[1/( 1.4 )+	0.04] =	8.12				(27)
Floor Type 1					41.5	Х	0.15	=	6.225				(28)
Floor Type 2					41.5	Х	0.15	=	6.225				(28)
Walls	83.1	18	14.2	5	68.93	3 X	0.18	=	12.41				(29)
Roof	41.	5	0		41.5	х	0.13	=	5.39				(30)
Total area of e	lements	, m²			207.6	8							(31)
* for windows and						ated using	formula 1	/[(1/U-valu	ue)+0.04] a	as given in	paragraph	1 3.2	
** include the area				ls and pari	titions		(26)(30)	) ± (32) =					
Fabric heat los		•	U)				(20)(30)		(20) + (2)	2) + (225)	(220) -	48.89	====
Heat capacity Thermal mass			) Cm	T [	. l. 1/m21/			., ,	(30) + (3. itive Value	2) + (32a).	(32e) =	15904.0	====
For design assess	•	`		,			ecisely the				ahle 1f	450	(35)
can be used inste				CONSTRUCT	ion are no	. KIIOWII PI	ecisely life	rindicative	values of	TIVII III T	abie II		
Thermal bridge	es : S (L	x Y) cal	culated (	using Ap	pendix l	<						11.42	(36)
if details of therma		are not kn	own (36) =	= 0.15 x (3	1)								
Total fabric he									(36) =			60.32	(37)
Ventilation hea	r					_	_		i _	(25)m x (5)	Ī _	1	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(00)
(38)m= 36.83	36.55	36.55	36.04	35.73	35.59	35.46	35.46	35.81	36.04	36.29	36.55		(38)
Heat transfer of	r	nt, W/K				T	T	(39)m	= (37) + (	38)m	1	1	
(39)m= 97.15 Stroma FSAP 200	96.87	96.87	96.36	96.05	95.91	95.77	95.77	96.12	96.36	96.6	96.87		206 2 df 7
Judina FBAF 200	,0 v CI SIU[]	. 1.3.0.48 (	JAI- 9.90)	, - mup.//w\	พพ.อเเบเเล	.00111			Average =	: Sum(39) <sub>1</sub>	12 /12=	96.35	age 2 $\phi(39)$

leat lo	ss paraı	meter (H	ILP), W	m²K		•			(40)m	= (39)m ÷	(4)			
10)m=	1.17	1.17	1.17	1.16	1.16	1.16	1.15	1.15	1.16	1.16	1.16	1.17		_
lumba	r of day	e in moi	nth (Tab	(د ۱ ما					,	Average =	Sum(40) <sub>1.</sub>	12 /12=	1.16	(40
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
l1)m=	31	28	31	30	31	30	31	31	30	31	30	31		(4
-	•													
4. Wat	ter heati	ing ener	gy requi	rement:								kWh/ye	ar:	
ssume	ed occu	pancy, I	N								2.5	173		(4:
			+ 1.76 x	[1 - exp	(-0.0003	849 x (TF	FA -13.9)	)2)] + 0.0	0013 x (	ΓFA -13.	9)			·
	A £ 13.9 average	•	ater usag	ge in litre	s per da	ay Vd,av	erage =	(25 x N)	+ 36		98.9	9331		(4:
Reduce t	the annua	l average	hot water	usage by	$5\%$ if the $\alpha$	lwelling is hot and co	designed t			se target o				•
οι <i>πι</i> οι ε Γ	Jan	Feb	Mar		May	Jun	Jul	Λιια	Sep	Oct	Nov	Dec		
ot wate				Apr ach month		ctor from 7		Aug (43)	Sep	Oct	INOV	Dec		
14)m=	108.83	104.87	100.91	96.95	93	89.04	89.04	93	96.95	100.91	104.87	108.83		
							_				m(44) <sub>112</sub> =		1187.197	(4
											ables 1b, 1			
l5)m= [	161.77	141.49	146	127.29	122.14	105.39	97.66	112.07	113.41	132.17	144.27	156.67	4500 0005	٦,,
instanta	aneous wa	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)		lotal = Su	m(45) <sub>112</sub> =		1560.3265	(4
6)m= [	24.27	21.22	21.9	19.09	18.32	15.81	14.65	16.81	17.01	19.82	21.64	23.5		(4
	storage		7											
					r is knov	vn (kWh	/day):				0.0	)24		(4
•			m Table					(47)				54		(4
٠.			storage red cylir			s not kno		(47) x (48)	=		0.0	013		(4
			-			age with						0		(5
	-	•		•		litres in bo	. ,							
						eous comb		enter '0' in	box (50)					
		Ū		om Tabl	e 2 (kW	h/litre/da	ıy)					0		(
	e factor f		ble 2a m Table	2h								0		(5
•					oor			((E0) v (E1	) v ( <b>5</b> 2) v (	(E2) —		0		(5
• • •	105t 1101 49) or (5		storage 5)	, KVVII/y	dai			((50) x (51	) X (32) X (	(55) =		0		(5 (5
,	,	, ,	culated f	or each	month			((56)m = (	55) × (41)ı	m	0.0	<i>3</i> 10		,
56)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(5
cylinde	r contains	dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (57	7)m = (56)	m where (	H11) is fro	m Appendi	кН	
57)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(5
rimary	/ circuit	loss (an	nual) fro	m Table	3						36	60		(5
-		•	•			59)m = (	(58) ÷ 36	55 × (41)	m					
(mod	lified by	factor fi	om Tab	le H5 if t	here is s	olar wat	er heatir	ng and a	cylinde	r thermo	stat)			
_	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		(5
9)m=														
9)m= [		culated	for each	month (	(61)m =	(60) ÷ 36	65 × (41)	)m						

Total boot so wise different booting a calculate different booting (CO) as 0.05 c. (45) as 1.46 as 1.46 as 1.46 as	(04)
Total heat required for water heating calculated for each month $(62)m = 0.85 \times (45)m + (46)m + (57)m + (59)m + (59)m + (50)m	` '
(62)m= 192.75 169.47 176.98 157.27 153.11 135.37 128.64 143.05 143.39 163.14 174.25 187.65	(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)	
(add additional lines in 1 Gritts and/or vvvi its applies, see Appendix G)  (63)m= 0 0 0 0 0 0 0 0 0 0 0	(63)
	(55)
Output from water heater (64)m= 192.75 169.47 176.98 157.27 153.11 135.37 128.64 143.05 143.39 163.14 174.25 187.65	
	925.0569 (64)
Heat gains from water heating, kWh/month 0.25 $^{\prime}$ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]	(5.7)
(65)m= 78.25 69.14 73.01 65.99 65.07 58.71 56.93 61.72 61.38 68.41 71.64 76.55	(65)
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating	` '
	ig
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)
	(00)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	(67)
(67)m= 53.33 47.37 38.52 29.16 21.8 18.41 19.89 25.85 34.7 44.06 51.42 54.81	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	(60)
(68)m= 336.71 340.2 331.4 312.66 288.99 266.76 251.9 248.41 257.21 275.95 299.62 321.85	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	(00)
(69)m= 52.62 52.62 52.62 52.62 52.62 52.62 52.62 52.62 52.62 52.62 52.62	(69)
Pumps and fans gains (Table 5a)	
(70) m =	(70)
Losses e.g. evaporation (negative values) (Table 5)	
(71)m= -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69	(71)
Water heating gains (Table 5)	
(72)m= 105.17 102.88 98.13 91.66 87.46 81.55 76.52 82.96 85.25 91.94 99.5 102.89	(72)
Total internal gains = $(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$	
(73)m= 598.19 593.43 571.02 536.45 501.22 469.68 451.28 460.19 480.12 514.92 553.5 582.53	(73)
6. Solar gains:	
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.	
<b>0–</b>	ains (W)
South 0.9x 0.77 x 6.12 x 47.32 x 0.76 x 0.7 =	213.73 (78)
South 0.9x 0.77 x 6.12 x 77.18 x 0.76 x 0.7	348.58 (78)
South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 =	425.64 (78)
South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 =	474.73 (78)
South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 =	490.24 (78)
South 0.9x 0.77 x 6.12 x 108.9 x 0.76 x 0.7 =	491.81 (78)
South 0.9x 0.77 x 6.12 x 107.14 x 0.76 x 0.7 =	483.86 (78)
South 0.9x 0.77 x 6.12 x 103.88 x 0.76 x 0.7 =	469.16 (78)

South 0.9x	0.77	x	6.1	2	x	99.99	x	0.76	x [	0.7		451.59	(78)
South 0.9x	0.77	x	6.1	2	x	85.29	x	0.76	x	0.7	=	385.2	(78)
South 0.9x	0.77	x	6.1	2	x	56.07	x	0.76	х	0.7	=	253.22	(78)
South 0.9x	0.77	x	6.1	2	х	40.89	x	0.76	_ x [	0.7		184.67	(78)
•							_						
Solar gains in	watts, ca	alculated	for eacl	n month			(83)m = 3	Sum(74)m .	(82)m				
(83)m= 213.73	348.58	425.64	474.73	490.24	491.8	1 483.86	469.16	451.59	385.2	253.22	184.67		(83)
Total gains –	internal a	nd solar	(84)m =	(73)m -	+ (83)r	n , watts	•	•	•	•	•	•	
(84)m= 811.91	942.01	996.66	1011.17	991.47	961.49	935.14	929.35	931.71	900.12	806.73	767.2		(84)
7. Mean inte	rnal temp	erature (	(heating	season	)	_			•				
Temperature	·		`			a from Tal	ble 9. Th	n1 (°C)				21	(85)
Utilisation fa	•	•			•		,	( - /					` ′
Jan	Feb	Mar	Apr	May	Jun	<del> </del>	Aug	Sep	Oct	Nov	Dec	1	
(86)m= 1	0.99	0.98	0.95	0.84	0.63	0.42	0.42	0.68	0.93	0.99	1		(86)
		<u> </u>					<u> </u>	<u> </u>					` '
Mean interna						<u> </u>		T				l	(07)
(87)m= 20.45	20.58	20.72	20.84	20.96	21	21	21	20.99	20.9	20.62	20.45		(87)
Temperature	during h	eating p	eriods ir	rest of	dwellir	ng from Ta	able 9, T	h2 (°C)					
(88)m= 19.95	19.95	19.95	19.95	19.96	19.96	19.96	19.96	19.96	19.95	19.95	19.95		(88)
Utilisation fa	ctor for g	ains for r	est of d	welling,	n2,m (	see Table	9a)					_	
(89)m= 1	0.99	0.97	0.92	0.77	0.53	0.31	0.32	0.58	0.88	0.99	1		(89)
Mean interna	al temper	ature in t	the rest	of dwalli	na T2	(follow ste	ens 3 to	7 in Tah	la 9c)				
(90)m= 19.25	19.43	19.63	19.8	19.93	19.96	`	19.96	19.95	19.86	19.49	19.25	1	(90)
										g area ÷ (4	L	0.36	(91)
											,	0.00	` ′
Mean interna	<del></del>	<del>`</del>				1	<del>'</del>	1		1 400	40.00	. —	(02)
(92)m= 19.68	19.84	20.03	20.18	20.3	20.33		20.34	20.33	20.24	19.9	19.68		(92)
Apply adjust	19.84	ne mean <sub>20.03</sub>	20.18	temper	20.33	1	20.34	ere appro	20.24	100	19.68	1	(93)
(93)m= 19.68			20.16	20.3	20.33	20.34	20.34	20.33	20.24	19.9	19.00		(90)
8. Space hea	•		oporotiu	o obtoin	od ot a	stop 11 of	Toble C	lb oo tha	ot Ti m_/	76)m on	d ro ool	nulata	
the utilisation					eu ai s	step i i oi	i abie s	D, SO 1116	ıı 11,111 <b>=</b> (	70)III ali	u re-carc	Julate	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	]	
Utilisation fa	ctor for g	ains, hm	•					·			I.	J	
(94)m= 1	0.99	0.97	0.93	0.79	0.57	0.35	0.35	0.62	0.9	0.99	1		(94)
Useful gains	, hmGm ,	, W = (94	l)m x (84	4)m		<u>.</u>		!	!	!		•	
(95)m= 809.03	931.38	964.82	936.8	788.09	547.37	7 328.98	328.97	575	806.09	798.39	764.98		(95)
Monthly ave	age exte	rnal tem	perature	from Ta	able 8	•	•	•	•	•	•	•	
(96)m= 4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9		(96)
Heat loss rat	e for mea	an intern	al tempe	erature,	Lm , W	/ =[(39)m	x [(93)m	n– (96)m	]			-	
(97)m= 1474.9	1437.64	1281.39	1105.69	825.99	549.77	7 329.01	329.01	579.53	909.34	1246.17	1431.93		(97)
Space heatir	ng require	ement for	r each n	nonth, k\	Vh/mo	nth = 0.02	24 x [(97	7)m – (95	5)m] x (4	1)m			
(98)m= 495.4	340.2	235.53	121.6	28.2	0	0	0	0	76.82	322.4	496.21		
							Tot	al per year	(kWh/yea	r) = Sum(9	8)15,912 =	2116.37	(98)
Space heatir	ng require	ement in	kWh/m²	/year								25.5	(99)
•	٠.			-									

9a. Energy requirements – Individua	heating syste	ms including	g micro-C	CHP)					
Space heating:	_ ·							_	(oo.t)
Fraction of space heat from second		itary system		(204)				0	(201)
Fraction of space heat from main sy			(202) = 1		(000)1			1	(202)
Fraction of total heating from main	•		(204) = (2	02) <b>x</b> [1 –	(203)] =			1	(204)
Efficiency of main space heating sy								93.3	(206)
Efficiency of secondary/supplement	ary heating sy	stem, %	,		,	,		0	(208)
Jan Feb Mar Ap	<del></del>	un Jul	Aug	Sep	Oct	Nov	Dec	kWh/y	/ear
Space heating requirement (calcula 495.4 340.2 235.53 121.6	<del>-                                    </del>	0 0	0	0	76.82	322.4	496.21		
			1 0	0	70.02	322.4	490.21		(0.4.4)
$(211)m = \{[(98)m \times (204)] + (210)m \}$ $530.98  364.63  252.44  130.3$		0 0	0	0	82.34	345.55	531.85		(211)
300.30 304.03 202.44 130.3	0 00.22			l (kWh/yea				2268.35	(211)
Space heating fuel (secondary), kW	h/month				(	715,101	2	2200.00	(211)
$= \{[(98) \text{m x } (201)] + (214) \text{ m } \} \text{ x } 100 - (201) \}$									
(215)m= 0 0 0 0	0	0 0	0	0	0	0	0		
			Tota	l (kWh/yea	ar) =Sum(2	215) <sub>15,101</sub>	2	0	(215)
Water heating									
Output from water heater (calculated 192.75   169.47   176.98   157.2		5.37 128.64	143.05	143.39	163.14	174.25	187.65		
Efficiency of water heater	7   155.11   150	0.37   120.04	143.03	143.39	103.14	174.23	107.03	79.6	(216)
(217)m= 87.02 86.44 85.38 83.94	81.09 79	9.6 79.6	79.6	79.6	82.74	86.23	87.09	7 0.0	(217)
Fuel for water heating, kWh/month									` '
$(219)$ m = $(64)$ m x $100 \div (217)$ m			_						
(219)m= 221.49 196.06 207.29 187.3	6 188.81 170	0.07 161.61	179.71	180.13	197.18	202.07	215.47		<u> </u>
Annual totale			1018	I = Sum(2				2307.24	(219)
<b>Annual totals</b> Space heating fuel used, main syste	m 1				K	Wh/yea	ſ	kWh/ye 2268.35	ar
Water heating fuel used								2307.24	$\dashv$
_	a kaon hat							2007.24	
Electricity for pumps, fans and electr	c keep-not							ı	(222
central heating pump:							130		(2300
boiler with a fan-assisted flue							45		(2306
Total electricity for the above, kWh/y	ear		sum	of (230a).	(230g) =	:		175	(231)
Electricity for lighting								376.75	(232)
10a. Fuel costs - individual heating	systems:								
		Fuel kWh/year			Fuel P (Table			Fuel Cos £/year	s <b>t</b>
Space heating - main system 1		(211) x			3.	1	x 0.01 =	70.3188	(240)
Space heating - main system 2		(213) x					x 0.01 =	0	(241)
Space heating - secondary		(215) x					x 0.01 =	0	(242)
Water heating cost (other fuel)		(219)					x 0.01 =		
vvater rieating COSt (Other ruer)		(210)			3.	1	X 0.01 =	71.52	(247)

Pumps, fans and electric keep-hot	(231)	11.46 × 0.01 =	20.06 (249)
(if off-peak tariff, list each of (230a) to (230g) se			
Energy for lighting	(232)	11.46 × 0.01 =	43.10
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254)	as needed		
	247) + (250)(254) =		311.0737 (255)
11a. SAP rating - individual heating systems			
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF) [(255) x (	256)] ÷ [(4) + 45.0] =		1.1422 (257)
SAP rating (Section 12)			84.066 (258)
12a. CO2 emissions – Individual heating system	ms including micro-CHP		
	Energy	<b>Emission factor</b>	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating (main system 1)	(211) x	0.198	449.13 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Water heating	(219) x	0.198	456.83 (264)
Space and water heating	(261) + (262) + (263) + (	264) =	905.97 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517 =	90.48 (267)
Electricity for lighting	(232) x	0.517 =	194.78 (268)
Total CO2, kg/year		sum of (265)(271) =	1191.22 (272)
CO2 emissions per m²		(272) ÷ (4) =	14.35 (273)
El rating (section 14)			88 (274)
13a. Primary Energy			
	Energy	Primary	P. Energy
	kWh/year	factor	kWh/year
Space heating (main system 1)	(211) x	1.02 =	2313.72 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Energy for water heating	(219) x	1.02	2353.39 (264)
Space and water heating	(261) + (262) + (263) + (	264) =	4667.1 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	511 (267)
Electricity for lighting	(232) x	0 =	1100.11 (268)
'Total Primary Energy		sum of (265)(271) =	6278.21 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	75.64 (273)

				User D	Details:						
Assessor Name: Software Name:	Stroma FS	SAP 200	19		Strom Softwa				Versio	n: 1.5.0.49	
			Р	roperty	Address	: House	1				
Address :											
1. Overall dwelling dime	ensions:										
Ground floor				_	<b>a(m²)</b> 62.66	(1a) x		eight(m) :.39	(2a) =	Volume(m³	<b>')</b> (3
otal floor area TFA = (1	a)+(1b)+(1c)+	(1d)+(1e	e)+(1r	1) 6	62.66	(4)					
welling volume						(3a)+(3b	o)+(3c)+(3c	d)+(3e)+	.(3n) =	149.7574	(5
2. Ventilation rate:											
	main heating		econdar eating	У	other		total			m³ per hou	ır
lumber of chimneys	0	_ + _	0	+ [	0	] = [	0	X 4	40 =	0	(6
lumber of open flues	0	_ + _	0	Ī + Ē	0	Ī = [	0	x	20 =	0	= (6
lumber of intermittent fa	ns						0	x -	10 =	0	
lumber of passive vents						Ť	0	x ·	10 =	0	= (7
lumber of flueless gas fi	res					_ 	0	X 4	40 =	0	
						L		_	Air ch	anges per ho	
nfiltration due to chimne	vs. flues and f	ans = (6	a)+(6b)+(7	′a)+(7b)+(	(7c) =	Г	0		÷ (5) =	0	(8
If a pressurisation test has b						continue f			. (0)	0	
Number of storeys in the	ne dwelling (n	s)								0	(9
Additional infiltration								[(9)	-1]x0.1 =	0	(1
Structural infiltration: 0 if both types of wall are pl						•	ruction			0	(1
deducting areas of opening			portaing to	ine great	er wan are	a (anter					
If suspended wooden f	loor, enter 0.2	2 (unseal	ed) or 0	.1 (seale	ed), else	enter 0				0	(
If no draught lobby, en	·									0	(
Percentage of windows	s and doors d	raught st	ripped		0.25 - [0.2	) v (4.4) · ·	1001 —		ļ	0	<b>—</b> (
Window infiltration Infiltration rate						` '	100] = 12) + (13) -	+ (15) =	<u> </u> 	0	
Air permeability value,	a50 express	ed in cub	oic metre	s per ho					area [	4.8	
based on air permeabil				•	•	•	10110 01 0	лиоюро	[	0.24	╡,
Air permeability value applie	-						is being u	sed	L	-	┛`
umber of sides on whic	h sheltered				(22)	/				2	(
helter factor					(20) = 1 -		19)] =			0.85	(:
filtration rate incorporat	-				(21) = (18	) X (20) =				0.2	(:
filtration rate modified f	<del></del>	<del>'</del>		1, .1	۸	000	0-4	Mari	Dan		
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
onthly average wind sp	eed from Tab	le 7 4.1	2.0	3.7	3.7	4.2	1 F	4.8	F 4		
2)m= 5.4 5.1	0.1 4.5	4.1	3.9	3./	J 3./	4.2	4.5	4.8	5.1		
/ind Factor (22a)m = (2	2)m ÷ 4										
A = (22a) = (22a)	<i>-)</i> ···· ·										

0.28	0.26	0.26	0.23	0.21	0.2	0.19	0.19	(22a)m 0.21	0.23	0.24	0.26	]	
Calculate effe		•	rate for t	he appli	cable ca	se	l					J ,	
If mechanica							.=					0	(2:
If exhaust air h		0 11		, ,	,	. `	,, .	•	) = (23a)			0	(2:
If balanced with		•	-	_								0	(2:
a) If balance	1						<del>- ` ` - </del>	<del>``</del>	<u> </u>	<del></del>	<del>' ' '</del>	) ÷ 100] ī	(0
24a)m= 0	0	0	0	0	0	0	0	0	0	0	0	]	(24
b) If balance		ı					<u> </u>	í È	<u> </u>	<del>-                                    </del>	T .	7	(2
24b)m= 0	0	0	0	0	0	0	0	0	0	0	0	]	(2
c) If whole h	iouse ext n < 0.5 ×			•	•				5 v (22h	.)			
$\frac{11 (220)1}{24c)m=0}$	0.5 x	0	0	0	0	0	C) = (221)	0	0	0	0	1	(2
d) If natural												J	(-
	n = 1, the								0.5]				
24d)m= 0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53	]	(2
Effective air	change	rate - er	ter (24a	or (24b	o) or (24	c) or (24	d) in box	· (25)			•	4	
25)m= 0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53		(2
									_				
3. Heat losse													
LEMENT	Gros area		Openin m		Net Ar A ,r		U-valu W/m2		A X U (W/I	K)	k-value kJ/m²-l		X X k J/K
oors					2	x	1.2	= [	2.4				(2
/indows					6.125	x1,	/[1/( 1.4 )+	0.04] =	8.12	Ħ			(2
loor					62.66		0.15	i	9.399	Ħ,			) (2
Valls	1 00 0	'	_		02:00				0.000				
	1 628	84	14 29	5 l	48 59	) x	0.15		7 29			$\neg$ $\overline{}$	<u>(2</u>
coof	62.8		14.25	5	48.59	=	0.15	= [ = _ [	7.29	<u> </u>		$\exists \vdash$	== `
	62.6	66	0	5	62.66	×	0.15	= [	7.29 8.15				(3
otal area of e	62.6	66		5	62.66	x 6	0.13	= [	8.15				(3
coof otal area of e arty wall	62.6 elements	66		5	62.66 188.10	×		=		] [ ] [ ] [			(2) (3) (3) (3) (3) (3)
otal area of e arty wall nternal wall **	62.6 elements	66 , m²	0		62.66 188.10 10	5 x 6 x	0.13	= [	8.15		poragraph		(3
otal area of e arty wall sternal wall ** for windows and	62.6 elements	ows, use e	0	ndow U-va	62.66  188.10  10  0	5 x 6 x	0.13	= [	8.15	as given in	paragraph	h 3.2	(3
otal area of earty wall ternal wall ** for windows and include the area	62.6 elements I roof winder	ows, use e	0  ffective will ternal wall	ndow U-va	62.66  188.10  10  0	6 x ated using	0.13	= [ = [ /[(1/U-valu	8.15	as given in	paragraph	h 3.2	(3
otal area of e arty wall iternal wall ** for windows and include the area abric heat los	62.6 Elements I roof winder as on both	ows, use e sides of int	0  ffective will ternal wall	ndow U-va	62.66  188.10  10  0	6 x ated using	0.13  0  formula 1	= [   = [  /[(1/U-valu   + (32) =	8.15				(3)
otal area of earty wall ternal wall ** for windows and include the area abric heat lose eat capacity	62.6 elements I roof winder as on both as, W/K = Cm = S(	ows, use e sides of in = S (A x (A x k)	0 ffective winternal wall	ndow U-va	62.66  188.10  10  0  alue calculations	6 x ated using	0.13  0  formula 1	= [   = [  /[(1/U-valu   + (32) =   ((28)	8.15 0 re)+0.04] a	2) + (32a).		43.47	(3)
otal area of e arty wall sternal wall ** for windows and include the area abric heat los eat capacity hermal mass or design assess	62.6  Plements  I roof winder as on both as, W/K = Cm = S( a parame	ows, use e sides of in = S (A x (A x k) ter (TMF ere the de	ffective winternal wall  U)  P = Cm ÷	ndow U-va ds and part	62.66 188.10 10 0 alue calculations	x 6 x ated using	0.13 0 1 formula 1. (26)(30)	= $=$ $=$ $=$ $=$ $=$ $=$ $=$ $=$ $=$	8.15 0 re)+0.04] a .(30) + (32 tive Value	2) + (32a). : Medium	(32e) =	43.47 12523.09	(3)
otal area of e arty wall sternal wall ** for windows and include the area abric heat los eat capacity hermal mass or design assess an be used inste	62.6  I roof windows on both  SS, W/K =  Cm = S(  parame  sments whe  ad of a det	ows, use e sides of interest the detailed calculations.	ffective winternal walk  U)  P = Cm ÷  tails of the ulation.	ndow U-va ls and part - TFA) in constructi	62.66  188.10  10  0 alue calculations  1 kJ/m²K	x 6  x ated using	0.13 0 1 formula 1. (26)(30)	= $=$ $=$ $=$ $=$ $=$ $=$ $=$ $=$ $=$	8.15 0 re)+0.04] a .(30) + (32 tive Value	2) + (32a). : Medium	(32e) =	43.47 12523.09 250	(3)
otal area of e arty wall ternal wall ** for windows and include the area abric heat los eat capacity hermal mass or design assess on be used inste	62.6 elements I roof winder as on both as, W/K = Cm = S( a parame aments whe ad of a det es : S (L	ows, use e sides of in = S (A x (A x k ) ter (TMF ere the de tailed calcu x Y) calcu	ffective winternal wall  U)  P = Cm ÷ tails of the ulation. culated to	ndow U-vals and part - TFA) in constructi	62.66  188.10  10  0  alue calculations  kJ/m²K  fon are not	x 6  x ated using	0.13 0 1 formula 1. (26)(30)	= $=$ $=$ $=$ $=$ $=$ $=$ $=$ $=$ $=$	8.15 0 re)+0.04] a .(30) + (32 tive Value	2) + (32a). : Medium	(32e) =	43.47 12523.09	(3)
otal area of earty wall ternal wall ** for windows and include the area abric heat los eat capacity hermal mass or design assess on be used inste	62.6  Plements  I roof winder as on both as, W/K = Cm = S( a parame aments whe ad of a det es : S (L al bridging	ows, use e sides of in = S (A x (A x k ) ter (TMF ere the de tailed calcu x Y) calcu	ffective winternal wall  U)  P = Cm ÷ tails of the ulation. culated to	ndow U-vals and part - TFA) in constructi	62.66  188.10  10  0  alue calculations  kJ/m²K  fon are not	x 6  x ated using	0.13 0 1 formula 1. (26)(30)	= [ 	8.15 0 (30) + (32) 0 (30) + (32) 100 tive Value	2) + (32a). : Medium	(32e) =	43.47 12523.09 250 7.53	(3) (3) (3) (3) (3) (3) (3) (3) (3) (3)
otal area of e arty wall aternal wall ** for windows and include the area abric heat los eat capacity hermal mass or design assess an be used inste hermal bridge details of thermal otal fabric he	62.6  Froof winder  Froof wind	ows, use e sides of in = S (A x k) ter (TMF ere the de tailed calculate x Y) calculare not kn	offective winternal wall U) $P = Cm \div tails of the ulation. culated to the culate$	ndow U-va ls and part - TFA) in constructi using Ap = 0.15 x (3	62.66  188.10  10  0  alue calculations  kJ/m²K  fon are not	x 6  x ated using	0.13 0 1 formula 1. (26)(30)	= [   = [  /[(1/U-valu   + (32) =   ((28)   Indica   indicative	8.15 0 (30) + (32) tive Value values of	2) + (32a). : Medium : TMP in Ta	(32e) = able 1f	43.47 12523.09 250	(3) (3) (3) (3) (3) (3) (3) (3) (3) (3)
otal area of earty wall aternal wall ** for windows and include the area abric heat los eat capacity hermal mass or design assess an be used inste hermal bridge details of therma otal fabric he entilation hea	62.6 elements I roof windows on both ess, W/K = Cm = S( exparame esments whe ad of a det es : S (L eal bridging eat loss at loss ca	ows, use e sides of interest (TMF) ere the detailed calculated are not kn	offective winternal wall U) $P = Cm \div tails of the ulation.$ culated to own (36) =	ndow U-vals and part - TFA) in constructionsing Ap	62.66  188.10  0  alue calculations  kJ/m²K  fon are not spendix k	x ated using	0.13  0  1 formula 1  (26)(30)	= [ 	8.15 0 (30) + (32) tive Value values of (36) = = 0.33 × (	2) + (32a). : Medium : <i>TMP in Ta</i> 25)m x (5)	(32e) = able 1f	43.47 12523.09 250 7.53	(3 (3 (3 (3 (3 (3 (3 (3 (3 (3 (3 (3 (3 (
otal area of earty wall sternal wall ** for windows and include the area abric heat los eat capacity hermal mass or design assess an be used inste hermal bridge details of therma otal fabric he entilation hea	62.6  Plements  I roof winder as on both as, W/K = Cm = S( a parame and of a det es : S (L al bridging at loss at loss ca Feb	ows, use e sides of interest the detailed calculated Mar	offective winternal wall ternal wall tails of the plation. culated to cown (36) =	ndow U-vals and part - TFA) in constructions April 12 (3) (4) (5) (6) (7) (7) (7) (8) (7) (7) (8) (7) (7) (8) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7	62.66  188.10  0  alue calculations  kJ/m²K  fon are not opendix k  1)  Jun	x x 6 x x atted using	0.13  of ormula 1.  (26)(30)  ecisely the	= [   = [  /[(1/U-valu   + (32) =   ((28)   Indica   indicative   (33) +   (38)m   Sep	8.15 0 (30) + (32 tive Value values of (36) = = 0.33 × (	2) + (32a). : Medium : <i>TMP in Ta</i> 25)m x (5) Nov	(32e) = able 1f  Dec	43.47 12523.09 250 7.53	(3 (3 (3 (3 (3 (3 (3 (3 (3 (3 (3 (3 (3 (
otal area of earty wall sternal wall ** for windows and include the area abric heat los eat capacity hermal mass or design assess an be used inste hermal bridge details of therma otal fabric he entilation hea  Jan 8)m= 26.58	62.6 elements I roof windo as on both as, W/K = Cm = S( parame sments whe ad of a det es : S (L al bridging at loss at loss ca Feb 26.38	ows, use e sides of in S (A x k) ter (TMF ere the de tailed calculare not kn alculated Mar 26.38	offective winternal wall U) $P = Cm \div tails of the ulation.$ culated to the culat	ndow U-vals and part - TFA) in constructionsing Ap	62.66  188.10  0  alue calculations  kJ/m²K  fon are not spendix k	x ated using	0.13  0  1 formula 1  (26)(30)	= [   = [  /[(1/U-valu   + (32) =   ((28)   Indica   indicative   (33) +   (38)m   Sep   25.84	8.15 0 (30) + (32) tive Value values of (36) = = 0.33 × ( Oct 26.01	2) + (32a). : Medium : TMP in Ta 25)m x (5) Nov 26.19	(32e) = able 1f	43.47 12523.09 250 7.53	(3) (3) (3) (3) (3) (3) (3) (3) (3)
otal area of earty wall aternal wall ** for windows and include the area abric heat los leat capacity hermal mass or design assess an be used inste hermal bridge details of therma otal fabric he fentilation hea	62.6 elements I roof windo as on both as, W/K = Cm = S( parame sments whe ad of a det es : S (L al bridging at loss at loss ca Feb 26.38	ows, use e sides of in S (A x k) ter (TMF ere the de tailed calculare not kn alculated Mar 26.38	offective winternal wall ternal wall tails of the plation. culated to cown (36) =	ndow U-vals and part - TFA) in constructions April 12 (3) (4) (5) (6) (7) (7) (7) (8) (7) (7) (8) (7) (7) (8) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7	62.66  188.10  0  alue calculations  kJ/m²K  fon are not opendix k  1)  Jun	x x 6 x x atted using	0.13  of ormula 1.  (26)(30)  ecisely the	= [   = [  /[(1/U-valu   + (32) =   ((28)   Indica   indicative   (33) +   (38)m   Sep   25.84	8.15 0 (30) + (32 tive Value values of (36) = = 0.33 × (	2) + (32a). : Medium : TMP in Ta 25)m x (5) Nov 26.19	(32e) = able 1f  Dec	43.47 12523.09 250 7.53	

leat lo	ss para	meter (H	ILP), W	m²K					(40)m	= (39)m ÷	· (4)			
10)m=	1.24	1.23	1.23	1.23	1.23	1.22	1.22	1.22	1.23	1.23	1.23	1.23		
		_ :	-41- / <b>T</b> -1-	I- 4-\					,	Average =	Sum(40) <sub>1</sub> .	12 /12=	1.23	(40
iumbe T			nth (Tab	· ·	Max	1	11	A	Con	O e t	Nov	Dag		
11)m-	Jan 31	Feb 28	Mar 31	Apr 30	May 31	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31	Nov 30	Dec 31		(41
l1)m=	31	20	31	30	31	30	31	31	30	31	30	31		(41
4 \Mot	tor boot	ing once	gy requi	iromont:								kWh/ye	vor:	
4. vvai	iei neai	ing ener	gy requi	nement.								KVVII/ye	:ai.	
if TF				[1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.0	0013 x (	ΓFA -13		558		(42
nnual	average	e hot wa						(25 x N) to achieve	+ 36 a water us	se target o		3939		(43
ot more	that 125	litres per p	person per	day (all w	ater use, l	hot and co	ld)							
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
lot wate	r usage in	litres per	day for ea	ach month	Vd,m = fa	ctor from T	Table 1c x	(43)		•				
14)m=	96.13	92.64	89.14	85.65	82.15	78.65	78.65	82.15	85.65	89.14	92.64	96.13		_
nerav c	ontent of	hot water	used - cal	culated me	onthly = $4$ .	190 x Vd.r	n x nm x E	Tm / 3600			m(44) <sub>112</sub> = ables 1b, 1		1048.7273	(44
15)m= [	142.9	124.98	128.97	112.44	107.89	93.1	86.27	99	100.18	116.75	127.44	138.39	_	
S)111= [	142.0	124.50	120.57	112.77	107.00	33.1	00.27	75			m(45) <sub>112</sub> =		1378.3365	(4
instanta	aneous w	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46		rotal – ou	111(10)112		1010.0000	`
6)m=	21.44	18.75	19.35	16.87	16.18	13.97	12.94	14.85	15.03	17.51	19.12	20.76		(4
	storage					(1.14.11	, , , , , , , , , , , , , , , , , , ,							
·			clared lo		r is knov	vn (kWh	/day):				0.0	)24		(4
•			m Table					(. <del></del> )			0.	54		(4
0,			storage red cylir			s not kno		(47) x (48)	) =		0.0	013		(4
			,				in same					0		(5
If com	munity he	ating and	no tank in	dwelling,	enter 110	litres in bo	x (50)							
Otherv	wise if no	stored ho	t water (th	is includes	instantan	eous coml	bi boilers)	enter '0' in	box (50)					
lot wat	ter stora	age loss	factor fr	om Tab	e 2 (kW	h/litre/da	ıy)					0		(5
		from Tal										0		(5
			m Table									0		(5:
			storage	, kWh/ye	ear			((50) x (51	l) x (52) x	(53) =		0		(5
•	, ,	54) in (5:	,	for ooob	manth			(/EG\m - /	EE) ~ (41)	~	0.0	013		(5
_	<del>_</del>		culated f				1	. , ,	55) × (41)ı	1				(5
66)m=	0.4	0.36	0.4	0.39	0.4 m = (56)m	0.39 × [(50) = (	0.4 H11)1 ÷ (5)	0.4 0) else (5)	0.39 7)m = (56)	0.4	0.39	0.4 m Appendi	v H	(5
				- · ·	· ·	I	1	1		1		1	<b>A11</b>	(5
57)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(5
-			inual) fro			>	·\				36	60		(5
•					`	•	` '	$65 \times (41)$		r tharma	octat)			
moa) 1 <sub>=59)m=</sub>	30.58	27.62	30.58	29.59	30.58	29.59	30.58	ng and a	cylinde 29.59	30.58	29.59	30.58		(5
, r				l	l	l	l	<u> </u>	20.00	1 00.00	20.00	55.56		(0)
Г				i	<u> </u>	ì í	65 × (41)			ı				(6
31)m=	0	0	0	0	0	0	0	0	0	0	0	0		

Total heat required for water heating calculated for each month (6	$2)m = 0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$
(62)m= 173.88 152.96 159.95 142.42 138.87 123.08 117.25 1	29.98   130.16   147.73   157.42   169.37   (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 Appe	ndix G)
(63)m= 0 0 0 0 0 0	0 0 0 0 0 (63)
Output from water heater	
(64)m= 173.88 152.96 159.95 142.42 138.87 123.08 117.25 1	29.98   130.16   147.73   157.42   169.37
	Output from water heater (annual) <sub>112</sub> 1743.0669 (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= 72.3 63.94 67.67 61.37 60.66 54.94 53.47	57.7 57.29 63.6 66.36 70.8 (65)
include (57)m in calculation of (65)m only if cylinder is in the dw	elling or hot water is from community heating
5. Internal gains (see Table 5 and 5a):	
Metabolic gains (Table 5), Watts	
Jan Feb Mar Apr May Jun Jul	Aug Sep Oct Nov Dec
(66)m= 123.35 123.35 123.35 123.35 123.35 123.35 1	23.35 123.35 123.35 123.35 123.35 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also	see Table 5
(67)m= 40.41 35.89 29.19 22.1 16.52 13.95 15.07	9.59 26.29 33.38 38.96 41.54 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a	), also see Table 5
	97,76 204.77 219.69 238.53 256.24 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), a	lso see Table 5
(69)m= 49.39 49.39 49.39 49.39 49.39 49.39	9.39 49.39 49.39 49.39 (69)
Pumps and fans gains (Table 5a)	
(70)m= 0 0 0 0 0 0	0 0 0 0 0 (70)
Losses e.g. evaporation (negative values) (Table 5)	
	32.23 -82.23 -82.23 -82.23 (71)
Water heating gains (Table 5)	<del></del>
	77.55 79.57 85.49 92.16 95.16 (72)
Total internal gains = (66)m + (67)m +	(68)m + (69)m + (70)m + (71)m + (72)m
	85.41 401.14 429.07 460.16 483.44 (73)
6. Solar gains:	
Solar gains are calculated using solar flux from Table 6a and associated equatio	ns to convert to the applicable orientation.
Orientation: Access Factor Area Flux	g_ FF Gains
Table 6d m <sup>2</sup> Table 6a	Table 6b Table 6c (W)
	$\times$ 0.76 $\times$ 0.7 = 213.73 (78)
South 0.9x 0.77 x 6.12 x 77.18	$\times$ 0.76 $\times$ 0.7 = 348.58 (78)
South 0.9x 0.77 x 6.12 x 94.25	$\times$ 0.76 $\times$ 0.7 = 425.64 (78)
South 0.9x 0.77 x 6.12 x 105.11	$\times$ 0.76 $\times$ 0.7 = 474.73 (78)
South 0.9x 0.77 x 6.12 x 108.55	$\times$ 0.76 $\times$ 0.7 = 490.24 (78)
South 0.9x 0.77 x 6.12 x 108.9	$\times$ 0.76 $\times$ 0.7 = 491.81 (78)
South 0.9x 0.77 x 6.12 x 107.14	$\times$ 0.76 $\times$ 0.7 = 483.86 (78)
South 0.9x 0.77 x 6.12 x 103.88	$\times$ 0.76 $\times$ 0.7 = 469.16 (78)

South	0.9x	0.77	X	6.1	2	x	9	9.99	x		0.76	х	0.7	=	451.59	(78)
South	0.9x	0.77	X	6.1	2	X	8	5.29	x		0.76	_ x _	0.7		385.2	(78)
South	0.9x	0.77	X	6.1	2	x	5	6.07	X		0.76	_ x _	0.7	=	253.22	(78)
South	0.9x	0.77	X	6.1	2	x	4	0.89	x		0.76	_ x _	0.7	_	184.67	(78)
	_															
Solar gai	ins in v	vatts. ca	alculated	for eac	h month				(83)m	ı = Sı	um(74)m .	(82)m				
<b>~</b>	213.73	348.58	425.64	474.73	490.24	Т .	91.81	483.86	469	.16	451.59	385.2	253.22	184.67		(83)
Total gai	ins – in	nternal a	nd solar	(84)m =	= (73)m	+ (	33)m	, watts					!		ı	
(84)m= 7	709.88	840.98	900.12	921.48	908.87	8	84.94	861.85	854	.57	852.73	814.27	713.39	668.11		(84)
7 Mear	n interr	nal temp	erature	(heating	season	)									•	
				·			area f	from Tab	nle 9	Th	1 (°C)				21	(85)
•		_		living are		-			JIC 0,	• • • • • • • • • • • • • • • • • • • •	. ( 0)				21	(00)
	Jan	Feb	Mar	Apr	May	È	Jun	Jul	Ι	ug	Sep	Oct	Nov	Dec	]	
-	0.97	0.94	0.9	0.84	0.72	⊢	0.54	0.36	0.3		0.58	0.81	0.95	0.98		(86)
` ′	!	ļ		<u> </u>		_		<u> </u>		!		0.01	0.55	0.50		(00)
								ps 3 to 7		-			ı		1	(0-)
(87)m=	20.13	20.34	20.57	20.74	20.9		0.98	21	2	1	20.97	20.82	20.4	20.12		(87)
Temper	rature	during h	eating p	eriods ir	rest of	dw	elling	from Ta	able 9	), Th	n2 (°C)				_	
(88)m=	19.89	19.89	19.89	19.9	19.9		19.9	19.9	19.	.9	19.9	19.9	19.9	19.89		(88)
Utilisatio	on fact	tor for a	ains for	rest of d	welling.	h2.	m (se	e Table	9a)						_	
	0.96	0.93	0.87	0.8	0.65	_	0.45	0.27	0.2	7	0.5	0.76	0.93	0.97	]	(89)
Moan ir	atornal	tompor	aturo in	the rest	of dwall	na	T2 (f	ollow ste	nc 3	to 7	in Tabl	0.90)				
	18.79	19.09	19.4	19.62	19.82	Ť	9.89	19.9	19.	$\neg$	19.88	19.72	19.18	18.78	1	(90)
(55)		10.00	, 51.1	70.02	.0.02		0.00	70.0					ig area ÷ (4	<u> </u>	0.64	(91)
													Ĭ `	,	0.04	(,
			,	i		_	<u> </u>	LA × T1	<u>`</u>						. —	(00)
` '	19.64	19.89	20.15	20.34	20.51	_	0.59	20.6	20.		20.58	20.42	19.96	19.64		(92)
· · · · · —	<u> </u>	1		ı	· ·	т —		m Table	1				1 40.00	40.04	1	(93)
` '	19.64	19.89	20.15	20.34	20.51		0.59	20.6	20.	۰۰	20.58	20.42	19.96	19.64		(90)
8. Spac					ro obtoir	200	ot ot	on 11 of	Tobl	0 Oh	oo tha	+ Ti m_/	76)m on	d ro ool	nulata	
				using Ta		ieu	al Si	ғр п о	ıabı	e ar	), 50 illa	ι 11,111=(	76)m an	u re-carc	Julate	
	Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	Dec	]	
Utilisatio	on fact	tor for ga		<u> </u>	,			ļ	<u> </u>	<u> </u>	<u>'</u>			<u>I</u>	ı	
	0.96	0.93	0.88	0.81	0.69		0.51	0.33	0.3	3	0.55	0.79	0.93	0.97		(94)
ـــ Useful و	gains,	hmGm ,	W = (94	4)m x (8	4)m	_							!		ı	
(95)m= 6	82.57	780.08	789.96	750.92	625.08	4	49.3	282.62	282	.58	468.09	639.5	665.63	645.22		(95)
Monthly	/ avera	ge exte	rnal tem	perature	from T	abl	e 8		•	•			•		•	
(96)m=	4.5	5	6.8	8.7	11.7		14.6	16.9	16.	.9	14.3	10.8	7	4.9		(96)
Heat los	ss rate	for mea	an intern	al tempe	erature,	Lm	, W =	=[(39)m :	x [(9	3)m-	- (96)m	]			_	
(97)m= 1	175.01	1152.18	1032.79	896.21	676.71	4	59.09	283.55	283	.54	482.42	740.83	1000.5	1140.51		(97)
Space h	heating	g require	ement fo	r each n	nonth, k	Wh	/mont	th = 0.02	24 x [	(97)	m – (95	)m] x (4	1)m		- •	
(98)m= 3	366.38	250.05	180.67	104.61	38.41	Ĺ	0	0	0		0	75.39	241.11	368.5		
										Total	per year	(kWh/yea	r) = Sum(9	8) <sub>15,912</sub> =	1625.11	(98)
Space h	heating	g require	ement in	kWh/m²	?/year										25.94	(99)
•		•			-											

9a. Energy requirements – Individual he	eating systems	s including	g micro-C	CHP)					
Space heating: Fraction of space heat from secondary	/cupplements	ry cyctom					ı	0	(201)
Fraction of space heat from main syste		iry system	(202) = 1 ·	- (201) =				0	(202)
Fraction of total heating from main syst	, ,		` '	02) × [1 –	(203)] =			1	(204)
Efficiency of main space heating system								93.3	(206)
Efficiency of secondary/supplementary		em, %						0	(208)
Jan Feb Mar Apr	May Jur	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	<b>-</b> ear
Space heating requirement (calculated	l above)	!			!				
366.38 250.05 180.67 104.61	38.41 0	0	0	0	75.39	241.11	368.5		
$(211)$ m = {[(98)m x (204)] + (210)m} x 1		_	Г		Ι	ı	ī	l	(211)
392.69 268.01 193.64 112.12	41.17 0	0	0 Tota	0 I (kWh/yea	80.8	258.42	394.96	4744.04	(244)
Space heating fuel (accordant) k/M/h/n	nanth		TOLA	ii (KVVII/yea	ar) =3um(2	211) <sub>15,1012</sub>	<i>-</i>	1741.81	(211)
Space heating fuel (secondary), kWh/n = $\{[(98)\text{m x}(201)] + (214)\text{ m}\} \text{ x } 100 \div (214)\text{ m}\}$									
(215)m= 0 0 0 0	0 0	0	0	0	0	0	0		
	•		Tota	l (kWh/yea	ar) =Sum(2	215) <sub>15,1012</sub>	<u>.</u> =	0	(215)
Water heating									
Output from water heater (calculated ab	ove) 138.87 123.0	8 117.25	129.98	130.16	147.73	157.42	169.37		
Efficiency of water heater								79.6	(216)
(217)m= 86.56 85.92 84.94 83.81	81.7 79.6	79.6	79.6	79.6	82.92	85.75	86.63		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m									
(219)m= 200.89 178.04 188.31 169.94	169.98 154.6	2 147.3	163.29	163.52	178.16	183.59	195.51		
			Tota	I = Sum(2	19a) <sub>112</sub> =		•	2093.13	(219)
Annual totals	i				k'	Wh/year	r	kWh/yea	ır
Space heating fuel used, main system 1								1741.81	_
Water heating fuel used								2093.13	
Electricity for pumps, fans and electric k	eep-hot								
central heating pump:							130		(230c)
boiler with a fan-assisted flue							45		(230e)
Total electricity for the above, kWh/year			sum	of (230a).	(230g) =			175	(231)
Electricity for lighting								285.49	(232)
10a. Fuel costs - individual heating sys	stems:								
		<b>uel</b> Wh/year			Fuel P (Table			Fuel Cost £/year	1
Space heating - main system 1	(2	211) x			3.	1	x 0.01 =	53.9962	(240)
Space heating - main system 2	(2	213) x			0		x 0.01 =	0	(241)
Space heating - secondary	(2	215) x			0		x 0.01 =	0	(242)
-					1 0			•	
Water heating cost (other fuel)		219)			3.		x 0.01 =	64.89	(247)

Pumps, fans and electric keep-hot	(231)	11.46 × 0.01 =	20.06 (249)
(if off-peak tariff, list each of (230a) to (230g) sep			
Energy for lighting	(232)	11.46 × 0.01 =	32.72
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254) a	as needed		
	47) + (250)(254) =		277.655 (255)
11a. SAP rating - individual heating systems			
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF) [(255) x (	256)] ÷ [(4) + 45.0] =		1.2121 (257)
SAP rating (Section 12)			83.0908 (258)
12a. CO2 emissions – Individual heating system	ns including micro-CHP		
	Energy	<b>Emission factor</b>	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating (main system 1)	(211) x	0.198 =	344.88 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Water heating	(219) x	0.198	414.44 (264)
Space and water heating	(261) + (262) + (263) + (26	64) =	759.32 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517 =	90.48 (267)
Electricity for lighting	(232) x	0.517 =	147.6 (268)
Total CO2, kg/year		sum of (265)(271) =	997.39 (272)
CO2 emissions per m²		(272) ÷ (4) =	15.92 (273)
El rating (section 14)			88 (274)
13a. Primary Energy			
	Energy	Primary	P. Energy
	kWh/year	factor	kWh/year
Space heating (main system 1)	(211) x	1.02	1776.65 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Energy for water heating	(219) x	1.02 =	2135 (264)
Space and water heating	(261) + (262) + (263) + (26	64) =	3911.65 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	511 (267)
Electricity for lighting	(232) x	0 =	833.62 (268)
'Total Primary Energy		sum of (265)(271) =	5256.26 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	83.89 (273)

CSH Level 5/6 SAP 2009 Worksheets for 1 to 5 Bedroom

				User D	etails:						
Assessor Name: Software Name:	Stroma FS	SAP 200	9		Strom Softwa				Versic	n: 1.5.0.49	
			Р	roperty	Address	: House	1				
Address :											
1. Overall dwelling dime	ensions:			<b>A</b>	- ( 2)		A 11	· ' l. ( / \		Walana day	o).
Ground floor				Area	<b>a(m²)</b> 75	(1a) x		eight(m) 2.5	(2a) =	Volume(m <sup>3</sup>	<b>°)</b>   (3a
First floor						(1b) x			](2b) =		(3b
	a) . (4 b) . (4 a) .	(4 -1) . (4 -)	\ .	\	75			2.5	(20) =	187.5	(30
Total floor area TFA = (1	a)+(1b)+(1c)+	(1a)+(1e	)+(1r	1)	150	(4)					_
Dwelling volume						(3a)+(3b	)+(3c)+(3c	d)+(3e)+	.(3n) =	375	(5)
2. Ventilation rate:	main	9,	econda	*\/	other		total			m³ per hou	ır
	heating	<u>h</u>	eating	· –	Other		lotai			m per noc	_
Number of chimneys	0	_] +	0	<u></u>	0	_	0		40 =	0	(6a
Number of open flues	0	+	0	_] +	0	_ = _	0	x 2	20 =	0	(6b
Number of intermittent fa	ins						0	X '	10 =	0	(7a
Number of passive vents							0	X '	10 =	0	(7b
Number of flueless gas f	ires						0	X 4	40 =	0	(7c
_									A in a la		
L.Ch., C L		(0	-) . (Ch) . (T	(74) . (	7-)			_		anges per h	
Infiltration due to chimne  If a pressurisation test has be	7					continue fu	0 rom (9) to		÷ (5) =	0	(8)
Number of storeys in t			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				(0)	)		0	(9)
Additional infiltration								[(9)	-1]x0.1 =	0	(10
Structural infiltration: 0						•	ruction			0	(11
if both types of wall are p deducting areas of openi			onding to	the great	er wall are	a (atter					
If suspended wooden		,	ed) or 0	1 (seale	ed), else	enter 0				0	(12
If no draught lobby, en										0	(13
Percentage of window	s and doors d	raught sti	ripped		0.25 [0.2	) v (1.4) · .	1001 -			0	(14
Window infiltration Infiltration rate					0.25 - [0.2]		100] = 12) + (13) ·	+ (15) =		0	(15 (16
Air permeability value,	a50. express	ed in cub	ic metre	s per ho					area	0 4.8	(10
If based on air permeabi				•	•	•				0.24	(18
Air permeability value applie	es if a pressurisati	on test has	been dor	e or a de	gree air pe	rmeability	is being u	sed			
Number of sides on which Shelter factor	h sheltered				(20) = 1 -	[0 075 v (*	10\1 –			0	(19
Infiltration rate incorpora	ting shelter fac	etor			$(20) = 1^{-2}$ (21) = (18)		. 5/1 –			1 0.24	(20)
Infiltration rate modified f	-				,= -/ (10	, (==) =				0.24	(∠1
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp					1 3	11.	1		1	I	
(22)m= 5.4 5.1	5.1 4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1		

Wind Footon (22a) - (22) - (22) -	4									
Wind Factor (22a)m = (22)m $\div$ (22a)m= 1.35 1.27 1.27	1.12 1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27	1	
` '	1 1	ļ	<u> </u>	ļ	ļ			1	J	
Adjusted infiltration rate (allow	<del> </del>	т —	<del>i ´</del>	<u>`                                    </u>	<del>` ´</del>	T	T	T	1	
0.32 0.31 0.31  Calculate effective air change	o.27 0.25	0.23 icable ca	0.22 Se	0.22	0.25	0.27	0.29	0.31		
If mechanical ventilation:									0	(23a)
If exhaust air heat pump using App	endix N, (23b) = (23	a) × Fmv (e	equation (I	N5)) , othe	rwise (23b	) = (23a)			0	(23b)
If balanced with heat recovery: effic	ciency in % allowing	for in-use f	actor (fron	n Table 4h	) =				0	(23c)
a) If balanced mechanical ve	entilation with he	1	ery (MVI	HR) (24a	a)m = (22)	2b)m + (	23b) × [	1 – (23c)	÷ 100]	
(24a)m = 0 0 0	0 0	0	0	0	0	0	0	0		(24a)
b) If balanced mechanical ve			<del>-                                    </del>	<del></del>	ŕ	<del> </del>	<del>- ´</del>	T _	1	(0.41)
(24b)m= 0 0 0	0 0	0	0	0	0	0	0	0		(24b)
c) If whole house extract verif $(22b)m < 0.5 \times (23b)$ ,	•	•				5 v (23h	2)			
$(24c)m = \begin{array}{c cccc} & & & & & & & & & & & & & & & & & $	0 0	0), 011161	0	0	0	0	0	0	1	(24c)
d) If natural ventilation or wh			<u> </u>						J	,
if (22b)m = 1, then (24d)	•					0.5]				
(24d)m= 0.55 0.55 0.55	0.54 0.53	0.53	0.52	0.52	0.53	0.54	0.54	0.55		(24d)
Effective air change rate - e	nter (24a) or (24	b) or (24	c) or (24	d) in box	k (25)					
(25)m= 0.55 0.55 0.55	0.54 0.53	0.53	0.52	0.52	0.53	0.54	0.54	0.55		(25)
3. Heat losses and heat loss	parameter:									
<b>ELEMENT</b> Gross	Openings	Net Ar		U-val		ΑXU		k-value		ΑΧk
area (m²)	m²	A ,r		W/m2	2K	(W/	K)	kJ/m²-l	K	kJ/K
Doors		2	X	1.2	=	2.4	<u> </u>			(26)
Windows		6.25	x1	/[1/( 1.2 )+	0.04] = [	7.16	ᆗ .			(27)
Floor Type 1		75	x	0.15	=	11.25	<u> </u>		╡	(28)
Floor Type 2		75	x	0.15	=	11.25	<u> </u>		╡	(28)
Walls 150.18	14.5	135.6	8 X	0.13	=	17.64	<u> </u>		╡	(29)
Roof 75	0	75	X	0.15	=	11.25				(30)
Total area of elements, m <sup>2</sup>		375.1								(31)
* for windows and roof windows, use of its include the areas on both sides of its			ated using	formula 1	/[(1/U-valu	ie)+0.04] a	as given in	paragraph	1 3.2	
Fabric heat loss, W/K = S (A x	: U)			(26)(30)	) + (32) =				68.1	(33)
Heat capacity $Cm = S(A \times k)$					((28)	.(30) + (32	2) + (32a).	(32e) =	40329.198	(34)
Thermal mass parameter (TM	P = Cm ÷ TFA) i	n kJ/m²K			Indica	tive Value	: High		450	(35)
For design assessments where the de		tion are no	t known pr	ecisely the	e indicative	values of	TMP in Ta	able 1f		
can be used instead of a detailed calc Thermal bridges : S (L x Y) ca		nandiy l							40.54	(26)
if details of thermal bridging are not ki		-	`						16.51	(36)
Total fabric heat loss	10 m (00) = 0.10 x (0	, , , , , , , , , , , , , , , , , , ,			(33) +	(36) =			84.61	(37)
Ventilation heat loss calculated	d monthly				(38)m	= 0.33 × (	(25)m x (5)	)		
Jan Feb Mar	Apr May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m= 68.37 67.67 67.67	66.39 65.62	65.26	64.92	64.92	65.8	66.39	67.01	67.67		(38)
Heat transfer coefficient, W/K					(39)m	= (37) + (	38)m		_	
(39)m= 152.98 152.28 152.28	151 150.23	149.87	149.53	149.53	150.41	151	151.62	152.28		
Stroma FSAP 2009 Version: 1.5.0.49	(SAP 9.90) - http://w	ww.stroma	i.com			Average =	Sum(39) <sub>1</sub>	12 /12=	151.08	ge 2 of 39)

eat lo	ss paraı	meter (H	ILP), W	m²K					(40)m	= (39)m ÷	(4)			
0)m=	1.02	1.02	1.02	1.01	1	1	1	1	1	1.01	1.01	1.02		_
umbo	r of dov	o in mor	oth (Tob	lo 1o\					,	Average =	Sum(40) <sub>1</sub> .	12 /12=	1.01	(4
Г	Jan	Feb	nth (Tab Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1)m=	31	28	31	30	31	30	31	31	30	31	30	31		(4
, r			-											·
4. Wat	ter heati	na ener	gy requi	irement:								kWh/ye	ar:	
if TF	ed occu A > 13.9 A £ 13.9	, N = 1		[1 - exp	(-0.0003	849 x (TF	FA -13.9	)2)] + 0.0	0013 x ( <sup>-</sup>	ΓFA -13.		342		(4
						ay Vd,av						3547		(4
		_				lwelling is hot and co	-	o acnieve	a water us	se target o	ſ			
Г	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ot wate		litres per		<u> </u>		ctor from T	Table 1c x		•					
4)m=	120.29	115.92	111.54	107.17	102.79	98.42	98.42	102.79	107.17	111.54	115.92	120.29		
				and to don	and the	×100 1/-/		T (200)			m(44) <sub>112</sub> =		1312.2566	(4
											bles 1b, 1		_	
5)m= [	178.81	156.39	161.38	140.7	135	116.5	107.95	123.88	125.35	146.09	159.47	173.17	4704.0047	٦,
nstanta	aneous wa	ater heatir	ng at point	of use (no	hot water	r storage),	enter 0 in	boxes (46		l otal = Sui	m(45) <sub>112</sub> =	L	1724.6917	(
6)m= [	26.82	23.46	24.21	21.1	20.25	17.47	16.19	18.58	18.8	21.91	23.92	25.98		(-
	storage	loss:												
If ma	anufactu	rer's de	clared lo	oss facto	r is knov	vn (kWh	/day):				0.0	024		(
empei	rature fa	ctor fro	m Table	2b							0.	54		(-
٠.			•	, kWh/ye				(47) x (48)	=		0.0	013		(•
			,			s not kno age with						0		(!
•		` '		0 ,		litres in bo						0		(-
	-	_		_		eous com		enter '0' in	box (50)					
ot wat	ter stora	ige loss	factor fr	om Tabl	e 2 (kW	h/litre/da	ıy)					0		(
olume	e factor f	rom Tal	ble 2a									0		(
empei	rature fa	actor fro	m Table	2b							(	0		(
nergy	lost from	m water	storage	, kWh/ye	ear			((50) x (51	) x (52) x	(53) =		0		(
nter (4	49) or (5	64) in (5	5)								0.0	013		(
ater s	storage	loss cal	culated f	for each	month			((56)m = (	55) × (41)ı	m				
6)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(
cylinde:	r contains	dedicated	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Appendi	хH	
7)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(
rimary	/ circuit	loss (an	nual) fro	m Table	3						36	60		(!
-						59)m = (	(58) ÷ 36	65 × (41)	m					
(mod	<del></del>					solar wat		<del></del>			stat)			
9)m=	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		(!
-														
ombi l	loss cal	culated	for each	month (	(61)m =	(60) ÷ 36	$65 \times (41)$	)m						

Total heat required for water he	eating calculated	I for each month	$(62)$ m = $0.85 \times (4)$	45)m + (46)m +	(57)m +	(59)m + (61)m
(62)m= 209.79 184.37 192.36	170.67 165.98	146.47 138.93	154.85 155.33	177.07 189.45	204.15	(62)
Solar DHW input calculated using App	endix G or Appendix	H (negative quantit	y) (enter '0' if no solar	contribution to wate	er heating)	
(add additional lines if FGHRS					-	
(63)m= 0 0 0	0 0	0 0	0 0	0 0	0	(63)
Output from water heater				,	!	
(64)m= 209.79 184.37 192.36	170.67 165.98	146.47 138.93	154.85 155.33	177.07 189.45	204.15	
	l l	l l	Output from wat	ter heater (annual) <sub>1</sub>	I12	2089.4221 (64)
Heat gains from water heating,	kWh/month 0.25	5 ´ [0.85 × (45)m	n + (61)m] + 0.8 x	[(46)m + (57)m	+ (59)m	]
(65)m= 84.24 74.38 78.44	70.76 69.67	62.72 60.68	65.97 65.66	73.36 77.01	82.36	(65)
include (57)m in calculation of	of (65)m only if c	ylinder is in the	dwelling or hot wa	ater is from com	munity h	leating
5. Internal gains (see Table 5	5 and 5a):					
Metabolic gains (Table 5), Wat	ts					
Jan Feb Mar	Apr May	Jun Jul	Aug Sep	Oct Nov	Dec	
(66)m= 176.05 176.05 176.05	176.05 176.05	176.05 176.05	176.05 176.05	176.05 176.05	176.05	(66)
Lighting gains (calculated in Ap	ppendix L, equati	ion L9 or L9a), a	ilso see Table 5	-		•
(67)m= 85.57 76 61.81	46.79 34.98	29.53 31.91	41.48 55.67	70.69 82.5	87.95	(67)
Appliances gains (calculated in	Appendix L, eq	uation L13 or L1	3a), also see Tab	le 5		
(68)m= 478.39 483.36 470.85	444.22 410.6	379 357.89	352.93 365.44	392.07 425.69	457.28	(68)
Cooking gains (calculated in A	ppendix L, equat	ion L15 or L15a	), also see Table !	5		
(69)m= 55.54 55.54 55.54	55.54 55.54	55.54 55.54	55.54 55.54	55.54 55.54	55.54	(69)
Pumps and fans gains (Table 5	ōa)				•	
(70)m= 10 10 10	10 10	10 10	10 10	10 10	10	(70)
Losses e.g. evaporation (negative	tive values) (Tab	le 5)				
(71)m= -117.37 -117.37 -117.37	-117.37 -117.37	-117.37 -117.37	-117.37 -117.37	-117.37 -117.37	-117.37	(71)
Water heating gains (Table 5)						
(72)m= 113.22 110.69 105.43	98.28 93.64	87.11 81.55	88.67 91.2	98.6 106.95	110.7	(72)
Total internal gains =		(66)m + (67)n	n + (68)m + (69)m + (7	70)m + (71)m + (72)	)m	
(73)m= 801.41 794.27 762.31	713.52 663.44	619.86 595.58	607.3 636.53	685.58 739.36	780.16	(73)
6. Solar gains:						
Solar gains are calculated using solar	r flux from Table 6a	and associated equa	ations to convert to the	applicable orientat	tion.	
Orientation: Access Factor	Area	Flux	g_ Table Ch	FF Table Ca		Gains
Table 6d	m²	Table 6a	Table 6b	Table 6c		(W)
South 0.9x 0.77 x		x 47.32	x 0.76	X 0.7	=	218.09 (78)
South 0.9x 0.77 x	6.25	× 77.18	× 0.76	X 0.7	_ =	355.69 (78)
South 0.9x 0.77 x	6.25	x 94.25	x 0.76	X 0.7	_ =	434.33 (78)
South 0.9x 0.77 x		× 105.11	× 0.76	X 0.7	=	484.41 (78)
South 0.9x 0.77 x	6.25	× 108.55	× 0.76	X 0.7	=	500.25 (78)
South 0.9x 0.77 x	6.25	x 108.9	× 0.76	X 0.7	=	501.85 (78)
South 0.9x 0.77 x	6.25	x 107.14	× 0.76	X 0.7	=	493.74 (78)
South 0.9x 0.77 x	6.25	x 103.88	x 0.76	X 0.7	=	478.74 (78)

South	0.9x	0.77	X	6.2	25	x	9	9.99	x		0.76	x	0.7	=	460.8	(78)
South	0.9x	0.77	X	6.2	25	x	8	35.29	X		0.76	x	0.7	=	393.06	(78)
South	0.9x	0.77	X	6.2	25	x	5	6.07	x		0.76	x	0.7		258.39	(78)
South	0.9x	0.77	X	6.2	25	x	4	10.89	X		0.76	x	0.7	=	188.44	(78)
	_															
Solar g	gains in	watts, ca	alculated	for eac	h month				(83)m	ı = Sı	um(74)m	(82)m				
(83)m=	218.09	355.69	434.33	484.41	500.25	50	01.85	493.74	478	.74	460.8	393.06	258.39	188.44		(83)
Total g	ains – ir	nternal a	nd solar	(84)m =	= (73)m	+ (8	33)m	, watts	•					•	•	
(84)m=	1019.49	1149.97	1196.64	1197.93	1163.69	11	21.71	1089.32	1086	6.04	1097.33	1078.64	997.76	968.6	]	(84)
7. Me	an inter	nal temp	erature	(heating	season	)									•	
		•		`		<i>'</i>	area 1	from Tab	ole 9.	. Th′	1 (°C)				21	(85)
•		Ū	٠.	living are		•			,	,	( - )					` ′
Otilloc	Jan	Feb	Mar	Apr	May	È	Jun	Jul	I Ai	ug	Sep	Oct	Nov	Dec	1	
(86)m=	1	1	1	0.99	0.96	┢	0.82	0.56	0.5	<del>-</del>	0.86	0.99	1	1		(86)
, ,								<u>l</u>								
						_		ps 3 to 7					00.50		1	(07)
(87)m=	20.41	20.5	20.62	20.74	20.89		0.98	21	2	1	20.98	20.82	20.56	20.42		(87)
Temp	erature	during h	eating p	eriods ir	rest of	dw	elling	from Ta	able 9	9, Th	n2 (°C)		•	•	1	
(88)m=	20.07	20.07	20.07	20.08	20.08	2	20.09	20.09	20.0	09	20.08	20.08	20.08	20.07		(88)
Utilisa	ation fac	tor for g	ains for	rest of d	welling,	h2,	m (se	ee Table	9a)							
(89)m=	1	1	1	0.99	0.93		0.72	0.44	0.4	4	0.77	0.98	1	1		(89)
Mean	interna	l temper	ature in	the rest	of dwell	ina	T2 (f	ollow ste	ns 3	to 7	in Table	e 9c)				
(90)m=	19.29	19.42	19.6	19.77	19.99	Ť	20.08	20.09	20.0	-	20.07	19.88	19.51	19.31	1	(90)
											f	LA = Livin	g area ÷ (4	<u>1</u> 4) =	0.42	(91)
			- 1 15	a tha - L		ne .			. /4		A) TO					
(92)m=	19.76	19.87	20.03	20.18	20.37	_	g) = 11 0.46	LA × T1	+ (1		A) × 12 20.45	20.27	19.95	19.78	1 —	(92)
` '								m Table					19.95	19.70		(32)
(93)m=	19.61	19.72	19.88	20.03	20.22	_	20.31	20.32	20.		20.3	20.12	19.8	19.63	1	(93)
. ,		ting requ			20.22		.0.51	20.32	20.,	<sup>32</sup>	20.5	20.12	19.0	19.03		(00)
					re ohtair	ned	at st	ep 11 of	Tahl	e Gh	so that	t Ti m-(	76)m an	d re-cal	rulate	
				using Ta		ica	at ott	CP 11 01	Tubi	0 00	, 50 1114	( 11,111–(	<i>r</i> 0)111 a11	a ro oak	diato	
	Jan	Feb	Mar	Apr	May		Jun	Jul	Αι	ug	Sep	Oct	Nov	Dec		
Utilisa	ation fac	tor for g	ains, hm	1:										•	_	
(94)m=	1	1	1	0.99	0.94	(	0.75	0.47	0.4	7	0.8	0.98	1	1		(94)
Usefu	ıl gains,	hmGm ,	W = (94	4)m x (8	4)m										-	
(95)m=	1019.18	1148.77	1192.23	1184.42	1094	83	38.39	511.26	511.	.25	872.53	1055.86	996.72	968.36		(95)
Month	nly avera	age exte	rnal tem	perature	from T	abl	e 8						-		-	
(96)m=	4.5	5	6.8	8.7	11.7		14.6	16.9	16.	.9	14.3	10.8	7	4.9		(96)
Heat	loss rate	for mea	an intern	al tempe	erature,	Lm	, W =	=[(39)m :	x [(93	3)m-	- (96)m	]			•	
(97)m=	2312.03	2241.89	1991.74	1710.83	1279.44	8	55.62	511.49	511.	.49	902.48	1407.88	1941.26	2242.37		(97)
Space				r	nonth, k	Wh	/mont	th = 0.02	24 x [	(97)	m – (95)	- `	1)m		1	
(98)m=	961.88	734.58	594.84	379.01	137.97		0	0	0		0	261.9	680.07	947.87		_
										Total	per year (	(kWh/year	r) = Sum(9	8)15,912 =	4698.1	(98)
Space	e heatin	g require	ement in	kWh/m²	<sup>2</sup> /year										31.32	(99)

9a. Energy requirements – I	ndividual h	eating sy	ystems i	ncluding	micro-C	CHP)					
Space heating:									I		_
Fraction of space heat from			mentary	•		(204)				0	(201)
Fraction of space heat from	-	, ,			(202) = 1 - (204) =	` '	(202)] _			1	(202)
Fraction of total heating fro	•				(204) = (204)	02) <b>x</b> [1 –	(203)] =			1	(204)
Efficiency of main space he				• 0/						92.9	(206)
Efficiency of secondary/sup	<del>`</del>	·								0	(208)
Jan Feb Ma		d above	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/y	ear
961.88 734.58 594.8	<del>`</del>	137.97	0	0	0	0	261.9	680.07	947.87		
$(211)$ m = {[(98)m x (204)] +	(210)m } x	100 ÷ (2	:06)	•			ı		1		(211)
1035.39 790.72 640.		148.51	0	0	0	0	281.91	732.04	1020.31		
			-		Tota	I (kWh/yea	ar) =Sum(2	211) <sub>15,1012</sub>	<u></u>	5057.16	(211)
Space heating fuel (second	• , .										
$= \{[(98)m \times (201)] + (214) m$ $(215)m = 0 0 0$	} x 100 ÷ (	208) 0	0	0	0	0	0	0	0		
(213)111- 0 0 0								215) <sub>15,1012</sub>		0	(215)
Water heating											
Output from water heater (c											
209.79 184.37 192.3	36 170.67	165.98	146.47	138.93	154.85	155.33	177.07	189.45	204.15		(040)
Efficiency of water heater (217)m= 90.91 90.68 90.2	1 89.51	87.1	82.8	82.8	82.8	82.8	88.54	90.5	90.93	82.8	(216)
Fuel for water heating, kWh		07.1	02.0	02.0	02.0	02.0	00.54	90.5	90.93		(217)
$(219)$ m = $(64)$ m x $100 \div (219)$ m = $(64)$ m = $($	17)m								1		
(219)m= 230.76 203.32 213.2	190.68	190.57	176.9	167.79	187.02	187.6 I = Sum(2	199.98	209.34	224.5		<b>—</b> ,
Annual totals					TUla	1 = Sum(2		Wh/yeaı		2381.68 kWh/yea	(219)
Space heating fuel used, ma	ain system	1					K	wii/yeai		5057.16	al
Water heating fuel used	-									2381.68	=
Electricity for pumps, fans a	nd electric	keep-ho	t								
central heating pump:									130		(230c)
boiler with a fan-assisted fl	110								45		(230e)
					eum	of (230a)	(230g) =		45	475	
Total electricity for the above	e, Kvvii/yea	l I			Sum	or (200a).	(200g) =	•		175	(231)
Electricity for lighting										604.48	(232)
10a. Fuel costs - individual	heating sy	stems:									
			Fu kV	ı <b>el</b> /h/year			Fuel P (Table			Fuel Cos £/year	t
Space heating - main syster	n 1		(21	1) x			3.	1	x 0.01 =	156.772	(240)
Space heating - main system	n 2		(21	3) x			0		x 0.01 =	0	(241)
Space heating - secondary			(21	5) x			0		x 0.01 =	0	(242)
Water heating cost (other fu	el)		(21	9)			3.	1	x 0.01 =	73.83	(247)
- ,	•										` ′

Pumps, fans and electric keep-hot	(231)	11.46 x 0.01 =	20.06 (249)
(if off-peak tariff, list each of (230a) to (230g) se			
Energy for lighting	(232)	11.46 x 0.01 =	09.27
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254)	as needed		
	247) + (250)(254) =		425.9323 (255)
11a. SAP rating - individual heating systems			
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF) [(255) x	$(256)] \div [(4) + 45.0] =$		1.0266 (257)
SAP rating (Section 12)			85.6788 (258)
12a. CO2 emissions – Individual heating syste	ms including micro-CHP		
	Energy	<b>Emission factor</b>	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating (main system 1)	(211) x	0.198 =	1001.32 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Water heating	(219) x	0.198	471.57 (264)
Space and water heating	(261) + (262) + (263) + (2	64) =	1472.89 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517 =	90.48 (267)
Electricity for lighting	(232) x	0.517 =	312.52 (268)
Total CO2, kg/year		sum of (265)(271) =	1875.88 (272)
CO2 emissions per m²		(272) ÷ (4) =	12.51 (273)
El rating (section 14)			87 (274)
13a. Primary Energy			
	Energy	Primary	P. Energy
	kWh/year	factor	kWh/year
Space heating (main system 1)	(211) x	1.02 =	5158.3 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Energy for water heating	(219) x	1.02 =	2429.31 (264)
Space and water heating	(261) + (262) + (263) + (2	64) =	7587.62 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92 =	511 (267)
Electricity for lighting	(232) x	0 =	1765.08 (268)
'Total Primary Energy		sum of (265)(271) =	9863.69 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	65.76 (273)

			User D	etails: _						
Assessor Name:	Stroma FSAP 2	2009		Strom Softwa				Versio	on: 1.5.0.49	
Software Name.	Stroma i OAi 2			Address				VCISIC	лт. т.о.о. <del>4</del> 0	
Address :										
1. Overall dwelling dimens	ions:									
			Area	a(m²)	-	Ave He	eight(m)	_	Volume(m³)	_
Ground floor			5	6.67	(1a) x	2	2.5	(2a) =	141.675	(3a)
First floor			5	6.67	(1b) x	2	2.5	(2b) =	141.675	(3b)
Total floor area TFA = (1a)+	·(1b)+(1c)+(1d)+	(1e)+(1n	) 1	13.34	(4)			_		_
Dwelling volume					(3a)+(3b	)+(3c)+(3d	d)+(3e)+	.(3n) =	283.35	(5)
2. Ventilation rate:										
	main heating	Secondar heating	у	other		total			m³ per hour	
Number of chimneys	0 +	0	+ [	0	= [	0	X 4	40 =	0	(6a)
Number of open flues	0 +	0	Ī + 🗀	0	Ī = Ī	0	x	20 =	0	(6b)
Number of intermittent fans						0	x ·	10 =	0	[7a)
Number of passive vents					F	0	x ·	10 =	0	(7b)
Number of flueless gas fires					\	0	x 4	40 =	0	] <sub>(7c)</sub>
								Air ch	nanges per ho	<b>」</b>
Infiltration due to chimneys, If a pressurisation test has been					continue fr	0 rom (9) to (		÷ (5) =	0	(8)
Number of storeys in the	dwelling (ns)								0	(9)
Additional infiltration Structural infiltration: 0.25	for stool or timb	or frame or	0.25 for	macani	ny concti	ruction	[(9)	-1]x0.1 =	0	(10)
if both types of wall are prese deducting areas of openings)	ent, use the value co				•	uction			0	(11)
If suspended wooden floo	or, enter 0.2 (uns	ealed) or 0.	1 (seale	d), else	enter 0				0	(12)
If no draught lobby, enter									0	(13)
Percentage of windows a	nd doors draugh	t stripped		0.05 [0.0	) (4.4)4	1001			0	(14)
Window infiltration				0.25 - [0.2]		100] = 12) + (13) -	ı (15) —		0	(15)
Infiltration rate  Air permeability value, q5	n everessed in	cubic metre		. , . ,	, , , ,	, , ,	, ,	area	0	(16)
If based on air permeability	•		•	•	•	ione oi e	uvelope	aica	0.24	(17)
Air permeability value applies if						is being us	sed		U.27	۱٬۰۳/
Number of sides on which s	heltered			(00)	ro o== :	40)1			1	(19)
Shelter factor	al alter to t			(20) = 1 -		19)] =			0.92	(20)
Infiltration rate incorporating		!		(21) = (18	) x (20) =				0.22	(21)
Infiltration rate modified for I	<del></del>	1 1	11	Λ			NI:		1	
Jan Feb Ma		ay Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spee			2.7	2.7	1 42	T		<u> </u>	1	

4.5

3.9

3.7

3.7

4.2

4.8

5.1

Wind Factor (2	22a)m =	(22)m ÷	4										
(22a)m= 1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27		
Adjusted infiltr	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m					
0.3	0.28	0.28	0.25	0.23	0.22	0.21	0.21	0.23	0.25	0.27	0.28		
Calculate effe		•	rate for t	he appli	cable ca	se		!	<u>I</u>	!	!		(22-
If exhaust air h			endix N. (2	3b) = (23a	a) × Fmv (e	equation (N	J5)) . othe	rwise (23b	) = (23a)			0	<del></del>
If balanced with		0 11		, ,	,	. ,	,, .	,	, (200)			0	<del></del>
a) If balance		•		_					2b)m + (	23b) <b>x</b> ['	1 – (23c)		(200
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0	]	(24a
b) If balance	ed mech	anical ve	ntilation	without	heat red	covery (N	IV) (24b	m = (22)	2b)m + (	23b)	1	_	
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24b
c) If whole h	ouse ex	tract ven	tilation o	or positiv	e input	ventilatio	n from o	outside		•	•	_	
if (22b)r	n < 0.5 ×	(23b), t	hen (24)	c) = (23b	); other	wise (24	c) = (22k	o) m + 0.	5 × (23b	) 	1	7	
(24c)m= 0	0	0	0	0	0	0	0	0	0	0	0		(240
d) If natural					•	ventilatio 4d)m = 0			0.51				
(24d)m= 0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.54	0.54		(240
Effective air									0.00	0.01	0.01	_	`
(25)m = 0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.54	0.54	1	(25)
3. Heat losse												_	_
<b>ELEMENT</b> Doors	Gros area		Openin m	_	Net Ar A ,r		U-valı W/m2		A X U (W/	K)	k-value kJ/m²-		A X k kJ/K (26)
Windows					10.12	5 x1/		0.04] =	13.42	Ħ			(27)
Floor Type 1					56.67	, x	0.15		8.5005			П Г	(28)
Floor Type 2					56.67	, x	0.15	<u> </u>	8.5005			<b>-</b>	(28)
Walls	113.	52	12.12	2	101.3	9 x	0.15	<u> </u>	15.21	<b>=</b>		<b>-</b>	(29)
Roof	56.6	57	0		56.67	, x	0.13	<u> </u>	7.37	<b>=</b>		<b>-</b>	(30)
Total area of e	elements	, m²			283.5	3							(31)
Party wall					10	X	0		0				(32)
* for windows and						ated using	formula 1	/[(1/U-valu	ie)+0.04] á	as given in	paragrapi	h 3.2	
** include the are				ls and par	titions		(26)(30)	\ (22)					
Fabric heat los		•	U)				(20)(30)	, , ,	(20) . (2)	n) . (22-)	(20-)	55.	
Heat capacity Thermal mass		,	2 – Cm :	TEA) ir	k I/m2k/					2) + (32a). · ⊌iab	(32e) =	27842.	
For design asses	•	`		,			ecisely the		tive Value values of		able 1f	45	0 (35)
· ·				30.100.000	GIO 1101	<i>51111</i> pr	- 5.55iy uit		01	111			
can be used inste						,						14.	(00)
Thermal bridg	es : S (L	x Y) cal	culated i	using Ap	pendix I	`						14.	18 (36)
	al bridging	,		О.	•	•		(33) +	(36) =				
Thermal bridg	al bridging at loss	are not kn	own (36) =	= 0.15 x (3	•	•				(25)m x (5)	)	69.9	

(20) = 50.05		50.5	40.07	40.47	40.04	40.70	10.70	40.00	40.07	50.07	50.5		(20)
(38)m= 50.95	50.5	50.5	49.67	49.17	48.94	48.72	48.72	49.29	49.67	50.07	50.5		(38)
Heat transfer (		<u> </u>	140.05	140.45	14000	140.7	1 440 7	· · ·	= (37) + (3	<del></del>	100.40		
(39)m= 120.93	120.48	120.48	119.65	119.15	118.92	118.7	118.7	119.27	119.65	120.05	120.48	440.7	7(20)
Heat loss para	ameter (I	HLP), W/	m²K	i		i			4verage = = (39)m ÷	Sum(39) <sub>1</sub> .	12 /12=	119.7	(39)
(40)m= 1.07	1.06	1.06	1.06	1.05	1.05	1.05	1.05	1.05	1.06	1.06	1.06		_
Number of day	ys in mo	nth (Tab	le 1a)					,	Average =	Sum(40) <sub>1</sub>	12 /12=	1.06	(40)
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 hea	ting ene	rgy requi	irement:								kWh/ye	ear:	
Assumed occu			[1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.0	0013 x ( <sup>-</sup>	ΓFA -13.		3335		(42)
if TFA £ 13.9	9, N = 1												
Annual averag									se target o		8364		(43)
not more that 125	-		• •		-	-		a water ac	o target e				_
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage i	in litres per					Table 1c x							
(44)m= 117.52	113.25	108.97	104.7	100.43	96.15	96.15	100.43	104.7	108.97	113.25	117.52		_
Energy content of	f hot water	used - cal	culated mo	onthly – 4	190 x Vd r	п х пт х Г	)Tm / 3600			m(44) <sub>112</sub> =		1282.037	(44)
(45)m= 174.7	152.79	157.67	137.46	131.89	113.81	105.47	121.02	122.47	142.72	155.8	169.18		
(43)11= 174.7	132.79	137.07	137.40	131.09	113.01	103.47	121.02			m(45) <sub>112</sub> =		1684.9743	(45)
If instantaneous w	vater heati	ng at point	of use (no	hot water	r storage),	enter 0 in	boxes (46		rotar – oa	11(10)112		1001.0110	
(46)m= 26.2 Water storage	22.92	23.65	20.62	19.78	17.07	15.82	18.15	18.37	21.41	23.37	25.38		(46)
a) If manufacti		clared lo	ss facto	r is knov	vn (kWh	/day):				0.0	024		(47)
Temperature f					`	,					54		(48)
Energy lost fro				ear			(47) x (48)	) =			013		(49)
If manufacture	r's decla	ared cylir	nder loss	factor is									` '
Cylinder volun	•	•	•		•		•				0		(50)
If community h	•		•			. ,	antar 'O' in	hov (50)					
		,				,	enter o m	DOX (30)				ı	<b></b>
Hot water stor	•		om rabi	e z (KVV	n/iitre/ua	iy)					0		(51)
Volume factor Temperature f			2h							-	0		(52) (53)
Energy lost fro				aar			((50) x (51	) v (52) v i	(53) –				
Enter (49) or (		_	, KVVII/ y (	Jai			((30) X (31)	) X (32) X (	(00) =		0 013		(54) (55)
Water storage	, ,	•	for each	month			((56)m = (	55) × (41)ı	m				,
(56)m= 0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(56)
If cylinder contains	l .		<u> </u>	<u> </u>		<u> </u>						ix H	` '
(57)m= 0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(57)
	•						•			•		ı	

Primary circuit loss calculated for each month (59)m = (58) + 365 x (41)m (modified by factor from Table 5 ls of them the size of water heating and a cylinder thermostat)  (59)m= (0.58)   77.62   0.058   29.59   0.058   29.59   0.058   29.59   0.058   28.59   0.058   0.		
Primary circuit  loss calculated for each month (59)m = (68) + 365 x (41) m	Primary circuit loss (annual) from Table 3	360 (58)
Combi   Cost		
Combi loss calculated for each month (61)m = (60) + 365 x (41)m  (61)m = 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(modified by factor from Table H5 if there is solar water heating and a cylinder thermo	ostat)
Column   D	(59)m= 30.58 27.62 30.58 29.59 30.58 29.59 30.58 29.59 30.58	29.59 30.58 (59)
Column   D	Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m	
(62)   (62)   (62)   (62)   (63)   (6		0 0 (61)
(62)   (62)   (62)   (62)   (63)   (6	Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m +	- (46)m + (57)m + (59)m + (61)m
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		
Compute   Comp	Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribu	ution to water heating)
Cosime 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		3,
Compute   Comp		0 0 (63)
Compute   Comp	Output from water heater	
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= 82.55		185.77 200.16
(65)ma	Output from water heate	er (annual) <sub>112</sub> 2049.7047 (64)
(65)m= 82.55   72.9   76.88   69.38   68.31   61.51   59.53   64.7   64.39   71.92   75.77   80.71   (65)	Heat gains from water heating, kWh/month 0.25 $^{\prime}$ [0.85 $\times$ (45)m + (61)m] + 0.8 $\times$ [(46)m	n + (57)m + (59)m l
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating  5. Internal gains (See Table 5 and 5a):  Metabolic gains (Table 5). Watts  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (66)m= 170.01 170		<del>, ` ´ , ` ´ ,</del>
Metabolic gains (Table 5). Wats   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec		from community heating
Metabolic gains (Table 5). Watts    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec		nom commany nearing
Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec		
(66)   170.01   170.0		Nov Doc
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5  (67)m= 72.76		
(67) m= 72.76 64.63 52.56 39.79 29.74 25.11 27.13 35.27 47.34 60.11 70.15 74.79  Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5  (68) m= 412.34 416.62 405.84 382.88 353.91 326.68 308.48 304.2 314.99 337.94 366.92 394.15  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69) m= 54.83 (69)  Pumps and fans gains (Table 5a)  (70) m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		170.01
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5  (68)m= 412.34		70 15 74 79 (67)
(68)m= 412.34 416.62 405.84 382.88 353.91 326.68 308.48 304.2 314.99 337.94 366.92 394.15 (68)  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m= 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 (69)  Pumps and fans gains (Table 5a) (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		70.13
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69)m= 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 (69)  Pumps and fans gains (Table 5a)  (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		720000 20445 (68)
(69)   54.83		366.92 394.15
Pumps and fans gains (Table 5a)  (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		T (00)
(70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		54.83 54.83 (69)
Losses e.g. evaporation (negative values) (Table 5) (71)m= -113.34 -11		
(71)m= -113.34	(70)m= 0 0 0 0 0 0 0 0 0	0 0 (70)
Water heating gains (Table 5) (72)m= 110.95		
(72)m= 110.95 108.48 103.34 96.36 91.82 85.44 80.01 86.96 89.43 96.66 104.82 108.49 (72)  Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m= 707.56 701.23 673.24 630.53 586.98 548.73 527.13 537.94 563.26 606.21 653.4 688.92 (73)  6. Solar gains:  Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Area Flux g_ FF Gains Table 6d Table 6d Table 6c (W)  South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x 0.7 = 176.65 (78)	(71)m= -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34 -113.34	-113.34 -113.34 (71)
Total internal gains =	Water heating gains (Table 5)	
(73)m=       707.56       701.23       673.24       630.53       586.98       548.73       527.13       537.94       563.26       606.21       653.4       688.92       (73)         6. Solar gains:         Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.         Orientation: Access Factor Area Table 6d       Flux g_ FF       Gains Table 6c       (W)         South 0.9x 0.77       x 10.12       x 47.32       x 0.76       x 0.7       = 176.65       (78)	(72)m= 110.95 108.48 103.34 96.36 91.82 85.44 80.01 86.96 89.43 96.66	104.82 108.49 (72)
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 Area Flux g_ FF Gains Table 6d m² Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x 0.7 = 176.65 (78)	<b>Total internal gains =</b> $(66)m + (67)m + (68)m + (69)m + (70)m + (70)m + (68)m + (69)m  71)m + (72)m	
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Area Flux g_ FF Gains Table 6d m² Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x 0.7 = 176.65 (78)	(73)m= 707.56 701.23 673.24 630.53 586.98 548.73 527.13 537.94 563.26 606.21	653.4 688.92 (73)
Orientation: Access Factor Area Flux $g_{-}$ FF Gains Table 6d $m^2$ Table 6a Table 6b Table 6c (W)  South $0.9 \times 0.77$ × $10.12$ × $47.32$ × $0.76$ × $0.7$ = $176.65$ (78)	6. Solar gains:	
Table 6d $m^2$ Table 6a Table 6b Table 6c (W)  South $0.9x$ $0.77$ $\times$ $10.12$ $\times$ $47.32$ $\times$ $0.76$ $\times$ $0.7$ = 176.65 (78)	Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applica	able orientation.
South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x 0.7 = 176.65 (78)	<b>0</b>	
0.11	l able 6d m² l able 6a l able 6b l	i able 6C (W)
South 0.9x 0.77 x 10.12 x 77.18 x 0.76 x 0.7 = 288.11 (78)	South 0.9x 0.77 x 10.12 x 47.32 x 0.76 x	0.7 = 176.65 (78)
	South 0.9x 0.77 x 10.12 x 77.18 x 0.76 x	0.7 = 288.11 (78)

South	0.9x	0.77	)		10.12	x	9	94.25	_ x [		0.76	x	0.7	=	351.81	(78)
South	0.9x	0.77	)		10.12	x	1	05.11	] x		0.76	x [	0.7	=	392.38	(78)
South	0.9x	0.77	)	(	10.12	x	1	08.55	x[		0.76	x	0.7	=	405.2	(78)
South	0.9x	0.77	)		10.12	x	1	08.9	] x [		0.76	x	0.7	=	406.5	(78)
South	0.9x	0.77	)		10.12	X	1	07.14	] x		0.76	x	0.7	=	399.93	(78)
South	0.9x	0.77	)	(	10.12	x	1	03.88	<b>x</b> [		0.76	x	0.7	=	387.78	(78)
South	0.9x	0.77	)		10.12	x	9	9.99	x[		0.76	x	0.7	=	373.25	(78)
South	0.9x	0.77	)	(	10.12	x	8	35.29	] x		0.76	x [	0.7	=	318.38	(78)
South	0.9x	0.77	)	(	10.12	x	5	6.07	<b>x</b> [		0.76	x	0.7	=	209.3	(78)
South	0.9x	0.77	)	(	10.12	x	4	10.89	x		0.76	x	0.7	=	152.64	(78)
Solar g	ains in	watts, ca	alculate	d for e	ach moi	nth			(83)m	= Su	m(74)m .	(82)m				
(83)m=	176.65	288.11	351.81	392.			406.5	399.93	387.	.78	373.25	318.38	209.3	152.64	]	(83)
Total g	ains – ir	nternal a	and sola	r (84)	n = (73)	m +	(83)m	, watts	!				1	1	J	
(84)m=	884.21	989.34	1025.05	1022	91 992.	18	955.22	927.06	925.	.72	936.51	924.59	862.69	841.56		(84)
7 Mea	an inter	nal temp	erature	(hea	ing seas	son)		•		<u>'</u>				•	•	
					- U		area ·	from Tal	ble 9.	Th1	(°C)				21	(85)
-		tor for g	_	-							( - )	-	_	_		
	Jan	Feb	Mar	A		$\overline{}$	Jun	Jul	Αι	Ja T	Sep	Oct	Nov	Dec		
(86)m=	1	1	1	0.9		_	0.77	0.52	0.5		0.81	0.98	1	1		(86)
Moan	intorna	Ltompor	oturo in	livino	area T1	L (fall	ow sto	nc 2 to 7	7 in T	ablo	00)					
(87)m=	20.43	20.52	20.65	20.	$\overline{}$		20.99	ps 3 to 7	21	_	20.98	20.84	20.58	20.44	1	(87)
												20.04	20.00	20.44		()
i r			20.03			$\overline{}$	welling 20.04	from Ta	able 9	_	2 (°C)	20.04	20.04	20.03	1	(88)
(88)m=	20.03	20.03	<u> </u>	20.0						J5	20.04	20.04	20.04	20.03		(00)
_								e Table	<del></del>				1		1	(22)
(89)m=	1	1	0.99	0.9	0.9	9	0.67	0.4	0.4	1	0.72	0.96	1	1		(89)
Mean	interna	l temper	ature in	the r	st of dw	/ellin	g T2 (f	ollow ste	eps 3	to 7	in Tabl	e 9c)		_	_	
(90)m=	19.28	19.41	19.6	19.7	7 19.9	97	20.04	20.05	20.0	05	20.03	19.88	19.51	19.3		(90)
											f	LA = Livir	ng area ÷ (	4) =	0.4	(91)
Mean	interna	l temper	ature (f	or the	whole d	welli	na) = f	LA × T1	+ (1 -	– fL <i>F</i>	4) x T2					
(92)m=	19.74	19.85	20.02	20.		$\overline{}$	20.42	20.42	20.4		20.41	20.26	19.93	19.75	]	(92)
ر Apply	adjustn	nent to t	he mea	n inte	nal temp	pera	ure fro	m Table	4e, ۱	wher	e appro	priate		1	ı	
(93)m=	19.74	19.85	20.02	20.	7 20.3	34	20.42	20.42	20.4	42	20.41	20.26	19.93	19.75		(93)
8. Spa	ace hea	ting requ	uiremer	nt									•			
Set Ti	to the r	mean int	ernal te	mper	ture obt	taine	d at st	ep 11 of	Table	e 9b	, so tha	t Ti,m=(	(76)m an	d re-cald	culate	
		factor fo														
	Jan	Feb	Mar	A	r Ma	ay	Jun	Jul	Αι	ug	Sep	Oct	Nov	Dec		
Utilisa	tion fac	tor for g	ains, hr	n:										_	_	
(94)m=	1	1	0.99	0.9	0.92	2	0.71	0.45	0.4	5	0.76	0.96	1	1		(94)
Usefu	I gains,	hmGm	, W = (9	94)m x	(84)m											
(95)m=	883.5	986.99	1017.5	1002	67 907.	94	680.58	418.18	418.	18	709.88	892.14	860.6	840.99		(95)
Month	nly avera	age exte	rnal ter	npera	ure from	n Tal	ole 8							_	,	
(96)m=	4.5	5	6.8	8.7	11.7	7	14.6	16.9	16.	9	14.3	10.8	7	4.9		(96)

Heat lose rate for many internal temperature I m. W = [(20)m v [(02)m (06)m]		
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m- (96)m] (97)m=   1842.84   1789.4   1592.14   1371.81   1029.64   691.66   418.37   418.37   728.69   1131.54   1552.6   1788.93		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m		` '
(98)m= 713.75 539.22 427.53 265.78 90.55 0 0 0 178.11 498.24 705.26		
Total per year (kWh/year) = Sum(98) <sub>15,912</sub> =	3418.45	(98)
Space heating requirement in kWh/m²/year	30.16	(99)
9a. Energy requirements – Individual heating systems including micro-CHP)		
Space heating: Fraction of space heat from secondary/supplementary system	0	(201)
Fraction of space heat from main system(s) (202) = 1 - (201) =	1	(202)
Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$	1	(204)
Efficiency of main space heating system 1	92.8	(206)
Efficiency of secondary/supplementary heating system, %	0	(208)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	kWh/ye	 ear
Space heating requirement (calculated above)		
713.75 539.22 427.53 265.78 90.55 0 0 0 0 178.11 498.24 705.26		
$(211)m = \{[(98)m \times (204)] + (210)m \} \times 100 \div (206)$		(211)
769.13 581.06 460.7 286.4 97.57 0 0 0 191.93 536.9 759.98 Total (kWh/year) = Sum(211) <sub>15,1012</sub> =		7(044)
	3683.67	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } x 100 ÷ (208)		
(215) m =		
Total (kWh/year) =Sum(215) <sub>15,1012</sub> =	0	(215)
Water heating		
Output from water heater (calculated above)  205.67   180.77   188.64   167.43   162.87   143.79   136.44   152   152.45   173.7   185.77   200.16		
205.67   180.77   188.64   167.43   162.87   143.79   136.44   152   152.45   173.7   185.77   200.16   Efficiency of water heater	79.1	(216)
(217)m= 87.16 86.85 86.23 85.34 82.62 79.1 79.1 79.1 79.1 84.18 86.62 87.19		(217)
Fuel for water heating, kWh/month		
$(219)$ m = $(64)$ m x $100 \div (217)$ m		
(219)m= 235.96   208.14   218.77   196.2   197.14   181.78   172.49   192.16   192.73   206.35   214.47   229.56   Total = Sum(219a) <sub>1.12</sub> =	0.145.70	7(242)
Annual totals kWh/year	2445.76 <b>kWh/yea</b>	(219)
Space heating fuel used, main system 1	3683.67	<u>'</u>
Water heating fuel used	2445.76	
Electricity for pumps, fans and electric keep-hot		_
central heating pump:		(230c)
boiler with a fan-assisted flue		(230e)
Total electricity for the above, kWh/year sum of (230a)(230g) =	175	(231)
Electricity for lighting	514.01	(232)
10a. Fuel costs - individual heating systems:		

	<b>Fuel</b> kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	3.1 x 0.01	= 114.1938 (240)
Space heating - main system 2	(213) x	0 x 0.01	= 0 (241)
Space heating - secondary	(215) x	0 x 0.01	= 0 (242)
Water heating cost (other fuel)	(219)	3.1 × 0.01	= 75.82 (247)
Pumps, fans and electric keep-hot	(231)	11.46 × 0.01	= 20.06 (249)
(if off-peak tariff, list each of (230a) to (230g) sepa Energy for lighting	rately as applicable and a	apply fuel price according t	
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254) as <b>Total energy cost</b> (245)(247)	needed () + (250)(254) =		374.9726 (255)
11a. SAP rating - individual heating systems			
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF) [(255) x (25	6)] ÷ [(4) + 45.0] =		1.113 (257)
SAP rating (Section 12)			84.4732 (258)
12a. CO2 emissions – Individual heating systems	including micro-CHP  Energy	Emission factor	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating (main system 1)	(211) X	0.198 =	kg CO2/year 729.37 (261)
Space heating (secondary)	(211) X (215) X	0.198 =	kg CO2/year  729.37 (261)  0 (263)
Space heating (secondary) Water heating	(211) X (215) X (219) X	0.198 =	kg CO2/year  729.37 (261)  0 (263)  484.26 (264)
Space heating (secondary) Water heating Space and water heating	(211) X (215) X (219) X (261) + (262) + (263) + (264)	0.198 = 0.198 =	kg CO2/year  729.37 (261)  0 (263)  484.26 (264)  1213.63 (265)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot	(211) X (215) X (219) X (261) + (262) + (263) + (264) (231) X	0.198 = 0.198 = 0.198 = 0.517 = 0.517	kg CO2/year  729.37 (261)  0 (263)  484.26 (264)  1213.63 (265)  90.48 (267)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot Electricity for lighting	(211) x (215) x (219) x (261) + (262) + (263) + (264) (231) x (232) x	0.198 = 0.198 = 0.198 = 0.517 = 0.517 = 0.517	kg CO2/year  729.37 (261)  0 (263)  484.26 (264)  1213.63 (265)  90.48 (267)  265.74 (268)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot Electricity for lighting Total CO2, kg/year	(211) x (215) x (219) x (261) + (262) + (263) + (264) (231) x (232) x	0.198 = 0 = 0.198 = 0.198 = 0.517 = 0.517 = sum of (265)(271) =	kg CO2/year  729.37 (261)  0 (263)  484.26 (264)  1213.63 (265)  90.48 (267)  265.74 (268)  1569.84 (272)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot Electricity for lighting Total CO2, kg/year CO2 emissions per m²	(211) x (215) x (219) x (261) + (262) + (263) + (264) (231) x (232) x	0.198 = 0.198 = 0.198 = 0.517 = 0.517 = 0.517	kg CO2/year  729.37 (261)  0 (263)  484.26 (264)  1213.63 (265)  90.48 (267)  265.74 (268)  1569.84 (272)  13.85 (273)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot Electricity for lighting Total CO2, kg/year CO2 emissions per m² El rating (section 14)	(211) x (215) x (219) x (261) + (262) + (263) + (264) (231) x (232) x	0.198 = 0 = 0.198 = 0.198 = 0.517 = 0.517 = sum of (265)(271) =	kg CO2/year  729.37 (261)  0 (263)  484.26 (264)  1213.63 (265)  90.48 (267)  265.74 (268)  1569.84 (272)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot Electricity for lighting Total CO2, kg/year CO2 emissions per m²	(211) x (215) x (219) x (261) + (262) + (263) + (264) (231) x (232) x	0.198 = 0 = 0.198 = 0.198 = 0.517 = 0.517 = sum of (265)(271) =	kg CO2/year  729.37 (261)  0 (263)  484.26 (264)  1213.63 (265)  90.48 (267)  265.74 (268)  1569.84 (272)  13.85 (273)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot Electricity for lighting Total CO2, kg/year CO2 emissions per m² El rating (section 14)	(211) x (215) x (219) x (261) + (262) + (263) + (264) (231) x (232) x	0.198 = 0 = 0.198 = 0.198 = 0.517 = 0.517 = sum of (265)(271) =	kg CO2/year  729.37 (261)  0 (263)  484.26 (264)  1213.63 (265)  90.48 (267)  265.74 (268)  1569.84 (272)  13.85 (273)
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot Electricity for lighting Total CO2, kg/year CO2 emissions per m² El rating (section 14)	(211) x (215) x (219) x (261) + (262) + (263) + (264) (231) x (232) x  Energy	0.198 = 0.198 = 0.198 = 0.517 = 0.517 = 0.517 = 0.272) ÷ (4) = Primary	kg CO2/year  729.37 (261)  0 (263)  484.26 (264)  1213.63 (265)  90.48 (267)  265.74 (268)  1569.84 (272)  13.85 (273)  87 (274)  P. Energy
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot Electricity for lighting Total CO2, kg/year CO2 emissions per m² El rating (section 14)  13a. Primary Energy	(211) x (215) x (219) x (261) + (262) + (263) + (264) (231) x (232) x Energy kWh/year	0.198 = 0.198 = 0.198 = 0.517 = 0.517 = 0.517 = 0.517 = 0.7272) ÷ (4) = 0.7272	kg CO2/year  729.37 (261)  0 (263)  484.26 (264)  1213.63 (265)  90.48 (267)  265.74 (268)  1569.84 (272)  13.85 (273)  87 (274)  P. Energy kWh/year
Space heating (secondary) Water heating Space and water heating Electricity for pumps, fans and electric keep-hot Electricity for lighting Total CO2, kg/year CO2 emissions per m² El rating (section 14)  13a. Primary Energy  Space heating (main system 1)	(211) x (215) x (219) x (261) + (262) + (263) + (264) (231) x (232) x Energy kWh/year (211) x	0.198 = 0.198 = 0.198 = 0.517 = 0.517 = 0.517 = 272) ÷ (4) =  Primary factor 1.02 =	kg CO2/year  729.37 (261)  0 (263)  484.26 (264)  1213.63 (265)  90.48 (267)  265.74 (268)  1569.84 (272)  13.85 (273)  87 (274)  P. Energy kWh/year  3757.34 (261)

(231) x

Electricity for pumps, fans and electric keep-hot

(267)

Electricity for lighting (232)  $\times$  0 = 1500.9 (268) (268) (272)  $\times$  Sum of (265)...(271) = 8263.92 (272) (273) (272)  $\times$  Primary energy kWh/m²/year (272)  $\div$  (4) = 72.91 (273)

			User D	etails: _						
Assessor Name:	Stroma FSAP:	2009	USEI D	Strom Softwa				Versio	on: 1.5.0.49	
			roperty <i>i</i>	Address						
Address :										
1. Overall dwelling dimensi	ons:									
			Area	a(m²)	•	Ave He	eight(m)	-	Volume(m³)	_
Ground floor			4	8.77	(1a) x	2	2.5	(2a) =	121.925	(3a)
First floor			4	8.77	(1b) x	2	2.5	(2b) =	121.925	(3b)
Total floor area TFA = (1a)+	(1b)+(1c)+(1d)+	+(1e)+(1n	n) g	7.54	(4)			_		_
Dwelling volume					(3a)+(3b	)+(3c)+(3d	l)+(3e)+	.(3n) =	243.85	(5)
2. Ventilation rate:										<b>」</b> ` ′
2. Verillation rate.	main	Secondar	у	other		total			m³ per hour	
Number of chimneys	heating +	heating 0	<b>1</b> + [	0	7 = [	0	x -	40 =	0	(6a)
Number of open flues	0 +		_	0	」	0	x	20 =	0	](6b)
Number of intermittent fans	0			0	J			10 =		┧`′
					Ļ	0		-	0	(7a)
Number of passive vents					Ĺ	0		10 =	0	(7b)
Number of flueless gas fires					L	0	X 4	40 =	0	(7c)
_								Air ch	nanges per ho	ıır
Infiltration due to chimneys,	flues and fans	- (6a)+(6b)+(7	a)+(7h)+(	7c) =			$\overline{}$			_
If a pressurisation test has been					continue fi	0 rom (9) to (		÷ (5) =	0	(8)
Number of storeys in the							ĺ .		0	(9)
Additional infiltration							[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0.25					•	ruction			0	(11)
if both types of wall are prese deducting areas of openings)		orresponding to	the great	er wall are	a (after					
If suspended wooden floo		sealed) or 0.	1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, enter	0.05, else enter	0							0	(13)
Percentage of windows ar	nd doors draugh	nt stripped							0	(14)
Window infiltration				0.25 - [0.2			<b>-</b> \		0	(15)
Infiltration rate	0			. , . ,	, , ,	12) + (13) -	, ,		0	(16)
Air permeability value, q50 If based on air permeability	•		•	•	•	etre of e	nvelope	area	4.8	(17)
Air permeability value applies if						is beina us	sed		0.24	(18)
Number of sides on which s				,					1	(19)
Shelter factor				(20) = 1 -	[0.075 x (	19)] =			0.92	(20)
Infiltration rate incorporating	shelter factor			(21) = (18	) x (20) =				0.22	(21)
Infiltration rate modified for r	<del></del>								7	
Jan Feb Ma	ar Apr M	lay Jun	Jul	Aug	Sep	Oct	Nov	Dec	]	
Monthly average wind speed	d from Table 7						_			

4.5

3.9

3.7

3.7

4.8

5.1

Wind Factor (2	22a)m =	(22)m ÷	4											
(22a)m= 1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27			
A 11 (11 (11)			, ,				(0.4.)	(00.)	ı	ı		ı		
Adjusted infiltr	ation rat	e (allowi	ng for sr 0.25	o.23	d wind s	0.21	(21a) x 0.21	(22a)m <sub>0.23</sub>	0.25	0.27	0.28	l		
Calculate effe					l -	l -	0.21	0.23	0.25	0.27	0.28	]		
If mechanica	al ventila	ition:											0	(23a)
If exhaust air h	eat pump ı	using Appe	endix N, (2	3b) = (23a	a) × Fmv (e	equation (N	N5)) , other	rwise (23b	) = (23a)				0	(23b)
If balanced with	n heat reco	overy: effic	iency in %	allowing f	or in-use f	actor (from	Table 4h	) =					0	(23c)
a) If balance	ed mecha	anical ve	ntilation	with hea	at recove	ery (MVI	HR) (24a	m = (22)	2b)m + (	23b) × [	1 – (23c)	÷ 100]		
(24a)m= 0	0	0	0	0	0	0	0	0	0	0	0			(24a)
b) If balance						<u> </u>	<del>- ` ` - </del>	<u> </u>	<del>r Ó - Ò</del>	<del>-                                    </del>	i	1		
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0			(24b)
c) If whole h				•					E v (22h	.)				
(24c)m = 0	0.5 x	(23b), t	0	0 = (23L	0	0	0 = (221)	0	0	0	0	l		(24c)
d) If natural			·									J		(= : -)
,		en (24d)		•	•				0.5]					
(24d)m= 0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.54	0.54			(24d)
Effective air	change	rate - er	iter (24a	) or (24b	o) or (24	c) or (24	d) in box	(25)						
(25)m= 0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.54	0.54			(25)
3. Heat losse	s and he	eat loss r	paramete	er:					_				-	
ELEMENT	Gros		Openin		Net Ar	ea	U-valı	ue	AXU		k-value	)	А	Χk
	area	(m²)	m	<sup>2</sup>	A ,r	m²	W/m2	K	(W/I	K)	kJ/m²-l	K	kJ	J/K
Doors					2	X	1	=	2	Ш				(26)
Windows					4040					_				
Floor Type 1					10.12	5 x1/	/[1/( 1.4 )+	0.04] =	13.42	<u> </u>				(27)
Floor Type 1					48.77		/[1/( 1.4 )+ 0.18	0.04] =	13.42 8.77860	1 [				(27)
Floor Type 2						<b>x</b>		— ;		=				<b></b> ` ´
Floor Type 2 Walls	97.7	72	22.25	5	48.77	x x	0.18	= [	8.77860	=				(28)
Floor Type 2	97.7		22.25	5	48.77	x x x x	0.18	=	8.77860 8.77860	=				(28)
Floor Type 2 Walls	48.7	77		5	48.77 48.77 75.47	x x x x x x	0.18 0.18 0.15	= [ = [ = [	8.77860 8.77860 11.32	=				(28) (28) (29)
Floor Type 2 Walls Roof Total area of e	48.7 elements	, m² ows, use e	0	ndow U-va	48.77 48.77 75.47 48.77 244.0	x x x x x x x x 3	0.18 0.18 0.15 0.13	= [	8.77860 8.77860 11.32 6.34	1 [	paragraph	13.2		(28) (28) (29) (30)
Floor Type 2 Walls Roof Total area of e * for windows and ** include the area	48.7 elements I roof windo	, m <sup>2</sup> ows, use e	0  ffective will ternal wall	ndow U-va	48.77 48.77 75.47 48.77 244.0	x x x x x x x x 3	0.18 0.18 0.15 0.13	= [ = [ = [ /[(1/U-value	8.77860 8.77860 11.32 6.34	1 [	paragraph		4.06	(28) (28) (29) (30) (31)
Floor Type 2 Walls Roof Total area of e * for windows and ** include the area Fabric heat los	48.7 elements I roof winder as on both ss, W/K =	, m² ows, use e sides of in = S (A x	0  ffective will ternal wall	ndow U-va	48.77 48.77 75.47 48.77 244.0	x x x x x x x x attention and attention attention and attention attention and attention	0.18 0.15 0.13 formula 1	=	8.77860 8.77860 11.32 6.34	1 [		6	4.06	(28) (28) (29) (30)
Floor Type 2 Walls Roof Total area of e * for windows and ** include the area	48.7 elements I roof winder as on both ss, W/K = Cm = S(	, m <sup>2</sup> ows, use e sides of int = S (A x (A x k)	0  ffective winternal wall  U)	ndow U-va	48.77 48.77 75.47 48.77 244.0: alue calculatitions	x x x x x x 3 ated using	0.18 0.15 0.13 formula 1	= = = = = = = = = = = = = = = = = = =	8.77860 8.77860 11.32 6.34 (e)+0.04] a	1 [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [		1794	4.06	(28) (28) (29) (30) (31)
Floor Type 2 Walls Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass For design assess	48.7 Elements I roof windden as on both SS, W/K = Cm = S( Deparaments when	, m² ows, use e sides of in = S (A x k) eter (TMF)	ffective winternal wall  U)  P = Cm ÷	ndow U-vals and part	48.77 48.77 75.47 48.77 244.0: alue calculatitions	x x x x x x x 3	0.18 0.15 0.13 0.13 0.13 0.13	= [ = [ = [ - [(1/U-valu + (32) = ((28)	8.77860 8.77860 11.32 6.34 (e)+0.04] a (30) + (32) tive Value	1	(32e) =	1794	12.8802	(28) (28) (29) (30) (31) (33) (34)
Floor Type 2 Walls Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass	48.7 elements froof winder as on both as, W/K = Cm = S( a parame aments wh ad of a dec	, m²  ows, use e sides of in = S (A x K)  tter (TMF) ere the de tailed calcular	offective winternal wall U) $P = Cm \div tails of the ulation.$	ndow U-ve ls and part - TFA) ir constructi	48.77 48.77 75.47 48.77 244.0 alue calculatitions  n kJ/m²K ion are not	x x x x x x x x x x x x x x x x x x x	0.18 0.15 0.13 0.13 0.13 0.13	= [ = [ = [ - [(1/U-valu + (32) = ((28)	8.77860 8.77860 11.32 6.34 (e)+0.04] a (30) + (32) tive Value	1	(32e) =	6 1794	12.8802	(28) (28) (29) (30) (31) (33) (34)
Floor Type 2 Walls Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used inste	48.7 Elements I roof winddens on both SS, W/K = Cm = S( Description parameter Descriptio	, m² cows, use e sides of in = S (A x (A x k) eter (TMF) ere the de tailed calcu x Y) calc	offective winternal wall U) $P = Cm \div tails of the ulation.$ culated to	ndow U-vals and part - TFA) ir constructi	48.77 48.77 75.47 48.77 244.0: alue calculatitions  h kJ/m²K ion are not	x x x x x x x x x x x x x x x x x x x	0.18 0.15 0.13 0.13 0.13 0.13	= [ = [ = [ - [(1/U-valu + (32) = ((28)	8.77860 8.77860 11.32 6.34 (e)+0.04] a (30) + (32) tive Value	1	(32e) =	6 1794	42.8802 450	(28) (28) (29) (30) (31) (33) (34) (35)
Floor Type 2 Walls Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used inste Thermal bridge if details of therma Total fabric he	48.7 elements I roof winder as on both ss, W/K = Cm = S( a parame sments wh ad of a dec es : S (L al bridging at loss	, m² ows, use e sides of in = S (A x k) eter (TMF) ere the de tailed calculare not kn	offective winternal wall U)  P = Cm ÷ tails of the plation. culated to cown (36) =	ndow U-vals and part - TFA) ir construction using Ap	48.77 48.77 75.47 48.77 244.0: alue calculatitions  h kJ/m²K ion are not	x x x x x x x x x x x x x x x x x x x	0.18 0.15 0.13 0.13 0.13 0.13	=   =   =   =   /[(1/U-valu + (32) = ((28) Indicative	8.77860 8.77860 11.32 6.34 (e)+0.04] a (30) + (32) tive Value	1	(32e) =	1794	42.8802 450	(28) (28) (29) (30) (31) (33) (34) (35)
Floor Type 2 Walls Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used inste Thermal bridge if details of therma Total fabric heat Ventilation hea	48.7 elements I roof winder as on both as, W/K = Cm = S( a parame and of a december is S (L al bridging at loss at loss ca	, m² ows, use e sides of in = S (A x k) eter (TMF) ere the de tailed calculated are not kn	offective winternal walk ternal walk U)  P = Cm ÷ tails of the ulation. culated u own (36) =	ndow U-vels and part - TFA) ir construction using Ap	48.77 48.77 75.47 48.77 244.0 alue calculatitions  h kJ/m²K ion are not opendix h	x x x x x x x x x x x x x x x x x x x	0.18 0.15 0.13 0.13 0.13 0.13	= = = = = = = = = = = = = = = = = = =	8.77860 8.77860 11.32 6.34 (a) + 0.04] a tive Value of values of (36) = = 0.33 × (	1	(32e) = able 1f	1794	42.8802 450 9.52	(28) (28) (29) (30) (31) (33) (34) (35)
Floor Type 2 Walls Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used inste Thermal bridge if details of therma Total fabric he Ventilation hea	48.7 elements I roof winder as on both as, W/K = Cm = S( a parame aments wh ad of a der es : S (L al bridging at loss at loss ca Feb	, m² ows, use e sides of in = S (A x k) ter (TMF) ere the de tailed calculated Mar	offective winternal wall U)  P = Cm ÷ tails of the ulation. culated to own (36) =	ndow U-vals and part  - TFA) ir  construction using Ap = 0.15 x (3)	48.77 48.77 75.47 48.77 244.0: alue calculations  h kJ/m²K ion are not opendix h 1)  Jun	x x x x x x x x x x x x x x x x x x x	0.18 0.15 0.13 formula 1 (26)(30)	=   =   =   =   	8.77860 8.77860 11.32 6.34  10.04] a  11.32 11.3	1	(32e) = able 1f  Dec	1794	42.8802 450 9.52	(28) (28) (29) (30) (31) (33) (34) (35) (36) (37)
Floor Type 2 Walls Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used inste Thermal bridge if details of therma Total fabric he Ventilation hea  Jan (38)m= 43.85	48.7 elements I roof winder as on both es, W/K = Cm = S( parame esments wh ad of a der es : S (L al bridging at loss at loss ca Feb 43.46	, m² ows, use e sides of in = S (A x k) eter (TMF) ere the de tailed calculated are not kn alculated Mar 43.46	offective winternal walk ternal walk U)  P = Cm ÷ tails of the ulation. culated u own (36) =	ndow U-vels and part - TFA) ir construction using Ap	48.77 48.77 75.47 48.77 244.0 alue calculatitions  h kJ/m²K ion are not opendix h	x x x x x x x x x x x x x x x x x x x	0.18 0.15 0.13 0.13 0.19 0.19 0.19 0.19 0.19 0.19 0.19 0.19	= [ = [ = [ - = [	8.77860  8.77860  11.32  6.34  10.04] a  11.32  11.	1	(32e) = able 1f	1794	42.8802 450 9.52	(28) (28) (29) (30) (31) (33) (34) (35)
Floor Type 2 Walls Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used inste Thermal bridge if details of therma Total fabric he Ventilation hea  [38]m= [43.85]	48.7 elements I roof winder as on both es, W/K = Cm = S( experiments where ad of a decrease : S (L earlier loss at loss car Feb 43.46 coefficier	, m² ows, use e sides of in = S (A x k) eter (TMF) ere the de tailed calculated are not kn alculated Mar 43.46	offective winternal walk ternal walk U)  P = Cm ÷ tails of the ulation. culated united to the culated to the cu	ndow U-vels and part - TFA) in construction using Ap = 0.15 x (3) May 42.32	48.77 48.77 75.47 48.77 244.0 244.0 alue calculatitions  h kJ/m²K ion are not opendix h 1)  Jun 42.12	x x x x x x x x x x x x x x x x x x x	0.18 0.15 0.13 formula 1. (26)(30) ecisely the	= = = = = = = = = = = = = = = = = = =	8.77860 8.77860 11.32 6.34 (e)+0.04] a tive Value of (36) = = 0.33 × ( Oct 42.74 = (37) + (36)	1	(32e) = able 1f  Dec 43.46	1794	42.8802 450 9.52	(28) (28) (29) (30) (31) (33) (34) (35) (36) (37)
Floor Type 2 Walls Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used inste Thermal bridge if details of therma Total fabric he Ventilation hea  Jan (38)m= 43.85	48.7 elements I roof winder as on both ess, W/K = Cm = S( a parame esments wh ad of a der es : S (L al bridging at loss at loss ca Feb 43.46 coefficier 127.05	, m² ows, use e sides of in = S (A x k) eter (TMF) ere the de tailed calculated are not kn alculated Mar 43.46 ht, W/K	offective winternal wall U)  P = Cm ÷ tails of the plation. culated to cown (36) = I monthly Apr 42.74	ndow U-vals and part - TFA) in construction using Ap = 0.15 x (3) / May 42.32	48.77 48.77 75.47 48.77 244.0 244.0 alue calculatitions  h kJ/m²K ion are not pendix k 1)  Jun 42.12	x x x x x x x x x x x x x x x x x x x	0.18 0.15 0.13 formula 1 (26)(30)	= [ = [ = [ ] = [	8.77860  8.77860  11.32  6.34  10.04] a  11.32  11.	1	(32e) = able 1f  Dec 43.46	1794	42.8802 450 9.52	(28) (28) (29) (30) (31) (33) (34) (35) (36) (37)

leat lo	ss paraı	meter (H	ILP), W	m²K					(40)m	= (39)m ÷	(4)			
10)m=	1.31	1.3	1.3	1.3	1.29	1.29	1.29	1.29	1.29	1.3	1.3	1.3		_
lumbo	r of day	s in mor	nth (Tab	lo 1a\					,	Average =	Sum(40) <sub>1</sub>	.12 /12=	1.3	(40
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
11)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41
Ĺ														
4. Wat	ter heat	ng ener	gy requi	irement:								kWh/ye	ear:	
ssiima	ed occu	pancy, N	N.								0.7	150		(42
if TF		, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)	)2)] + 0.0	0013 x (1	ΓFA -13.		156		(42
				ge in litre							103.	8889		(43
		•		usage by a day (all w		•	•	o acnieve	a water us	se target o	I			
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
lot water	r usage in	litres per	day for ea	ach month	Vd,m = fa	ctor from 7	Table 1c x							
14)m=	114.28	110.12	105.97	101.81	97.66	93.5	93.5	97.66	101.81	105.97	110.12	114.28		
neray o	content of	hot water	used - cal	culated m	anthly = 1	100 v Vd r	n v nm v F	Tm / 3600			m(44) <sub>112</sub> = ables 1b, 1		1246.6668	(4
		148.57	153.32	133.66	128.25	110.67	102.56		119.09	138.79	151.5	164.52	_	
5)m= [	169.88	146.57	155.52	133.00	120.25	110.67	102.56	117.68			m(45) <sub>112</sub> =		1638.4874	(4
instanta	aneous wa	ater heatir	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46)		i Otal = Sui	III(43)112 =		1030.4074	(-
6)m=	25.48	22.29	23	20.05	19.24	16.6	15.38	17.65	17.86	20.82	22.72	24.68		(4
	storage					(1) 10								
				ss facto	r is knov	vn (kWh	/day):				0.0	)24		(4
•			m Table		_			(47) (40)				54		(4
			-	, kWh/ye nder loss		s not kno		(47) x (48)	=		0.0	)13		(4
			•	ng any s							(	0		(5
If com	munity he	ating and	no tank in	dwelling,	enter 110	litres in bo	x (50)							
				is includes				enter '0' in	box (50)					
		Ū		om Tabl	e 2 (kW	h/litre/da	ıy)					)		(5
		rom Tal		Ol-							-	)		(5
•			m Table					//==> /= <i>-</i>	\	(=o)		)		(5
•		m water 54) in (59	_	, kWh/ye	ear			((50) x (51	) x (52) x (	(53) =		013		(5 (5
,	,	,	,	for each	month			((56)m = (	55) × (41)r	m	0.0	713		(3
66)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(5
Ĺ				ļ		ļ					H11) is fro		ix H	(-
7)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(5
rimary	, circuit	loss (an	nual) fro	om Table	. 3						36	50		(5
-				for each		59)m = (	(58) ÷ 36	55 × (41)	m					(-
-				le H5 if t	,	•	,	, ,		r thermo	stat)			
(	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		(5
9)m= [	30.30		00.00											
9)m=				month (		(60) ÷ 36	65 × (41)	)m						

Total heat re	quired for	water he	eating ca	alculated	l for e	each month	(62)	m =	0.85 × (	45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m= 200.8	<del>-</del>	184.29	163.64	159.23	140		148	_	149.07	169.76	181.47	195.49		(62)
Solar DHW inpu	ut calculated	using App	endix G oı	· Appendix	H (ne	gative quantit	y) (ent	er '0'	if no sola	r contribu	tion to wate	r heating)	ı	
(add addition	nal lines if	FGHRS	and/or \	vwhrs	арр	lies, see Ap	pend	dix G	3)					
(63)m= 0	0	0	0	0	0	0	0	)	0	0	0	0		(63)
Output from	water hea	ıter				•					•		•	
(64)m= 200.8	5 176.55	184.29	163.64	159.23	140	.65 133.53	148	.66	149.07	169.76	181.47	195.49		
	•	•				•		Outp	ut from wa	ater heate	er (annual) <sub>1</sub>	12	2003.2178	(64)
Heat gains f	om water	heating,	kWh/m	onth 0.2	5 ′ [0	.85 × (45)m	+ (6	1)m	] + 0.8 x	: [(46)m	+ (57)m	+ (59)m	]	
(65)m= 80.94	71.49	75.44	68.11	67.1	60.	47 58.56	63.	59	63.27	70.61	74.04	79.16		(65)
include (5	7)m in cal	culation (	of (65)m	only if c	ylind	er is in the	dwell	ing	or hot w	ater is f	rom com	munity h	eating	
5. Internal	gains (see	e Table 5	and 5a	):										
Metabolic ga	ins (Table	e 5), Wat	ts										_	
Jan	Feb	Mar	Apr	May	Jι	ın Jul	A	ug	Sep	Oct	Nov	Dec		
(66)m= 162.9	3 162.93	162.93	162.93	162.93	162	.93 162.93	162	.93	162.93	162.93	162.93	162.93		(66)
Lighting gair	ıs (calcula	ted in Ap	pendix	L, equat	ion L	9 or L9a), a	lso s	ee 7	Table 5		-	-		
(67)m= 56.43	50.12	40.76	30.86	23.07	19.	47 21.04	27.	35	36.71	46.62	54.41	58		(67)
Appliances of	gains (calc	ulated ir	Append	dix L, eq	uatio	n L13 or L1	3a), a	also	see Tal	ole 5				
(68)m= 376.5	5 380.46	370.61	349.65	323.19	298	.32 281.7	277	7.8	287.64	308.6	335.07	359.94		(68)
Cooking gair	ns (calcula	ated in A	ppendix	L, equat	ion L	.15 or L15a	), als	o se	e Table	5				
(69)m= 54.01	54.01	54.01	54.01	54.01	54.	01 54.01	54.	01	54.01	54.01	54.01	54.01		(69)
Pumps and f	ans gains	(Table 5	5a)											
(70)m= 0	0	0	0	0	0	0	0	)	0	0	0	0		(70)
Losses e.g.	evaporatio	on (nega	tive valu	es) (Tab	le 5)									
(71)m= -108.6	2 -108.62	-108.62	-108.62	-108.62	-108	.62 -108.62	-108	.62	-108.62	-108.62	-108.62	-108.62		(71)
Water heating	ıg gains (⅂	Table 5)										-		
(72)m= 108.8	3 106.39	101.39	94.6	90.19	83.	99 78.71	85.	47	87.87	94.9	102.84	106.4		(72)
Total intern	al gains =	•	-			(66)m + (67)n	า + (68	3)m +	- (69)m + (	70)m + (7	71)m + (72)	m		
(73)m= 650.1	645.29	621.09	583.43	544.77	510	.1 489.78	498	.94	520.55	558.44	600.63	632.66		(73)
6. Solar gai	ns:													
Solar gains ar		•	r flux from	Table 6a	and as	ssociated equa	tions	to co	nvert to th	e applica		ion.		
Orientation:	Access F Table 6d		Area m²			Flux Table 6a		т.	g_ able 6b	т	FF able 6c		Gains (W)	
Cauth					_		1 1							1
South 0.9			10.		× L	47.32	X		0.76	_  ×	0.7	_ =	353.3	(78)
South 0.93		_	10.		× L	77.18	X	<u> </u>	0.76	_  ×	0.7	_ =	576.23	<u> </u> (78)
South 0.93			10.	===	× L	94.25	X		0.76	_  ×	0.7	_  =	703.61	(78)
South 0.9			10.		× L	105.11	X		0.76	x	0.7	_  =	784.75	[(78)
South 0.93			10.		× L	108.55	X		0.76	×	0.7	_  =	810.4	<u> </u> (78)
South 0.93		X	10.	12	x L	108.9	X	<u> </u>	0.76	_  ×	0.7	=	813	(78)
South 0.93			10.	12	× L	107.14	X		0.76	×	0.7	=	799.85	(78)
South 0.93	0.77	X	10.	12	x	103.88	X		0.76	x	0.7	=	775.56	(78)

South	0.9x	0.77	Х	10.	12	x	9	9.99	X		0.76	x	0.7	=	746.5	(78)
South	0.9x	0.77	x	10.	12	x	8	5.29	x		0.76	_ x _	0.7	_ =	636.76	(78)
South	0.9x	0.77	X	10.	12	x	5	6.07	х		0.76	_ x _	0.7	=	418.6	(78)
South	0.9x	0.77	х	10.	12	x	4	0.89	х		0.76	x	0.7	=	305.28	(78)
	_								'							_
Solar ga	ains in	watts, ca	alculated	for eacl	n month				(83)m	= St	um(74)m	(82)m				
(83)m=	353.3	576.23	703.61	784.75	810.4	8	813	799.85	775.	.56	746.5	636.76	418.6	305.28		(83)
Total ga	ains – ii	nternal a	nd solar	(84)m =	(73)m -	+ (8	33)m	, watts			•				•	
(84)m=	1003.4	1221.52	1324.7	1368.18	1355.17	13	323.1	1289.63	127	4.5	1267.05	1195.2	1019.23	937.93		(84)
7. Mea	an inter	nal temp	erature	(heating	season	)										
		during h					area 1	from Tab	ole 9.	Th	1 (°C)				21	(85)
•		tor for g	٠.			·			,		( - )					┛`′
Γ	Jan	Feb	Mar	Apr	May	Ò	Jun	Jul	Αι	ug	Sep	Oct	Nov	Dec		
(86)m=	1	0.99	0.97	0.93	0.81	$\vdash$	0.6	0.4	0.4	Ť	0.66	0.91	0.99	1		(86)
` '														-		` '
		l temper				ollo						00.00	00.50	00.00	1	(07)
(87)m=	20.36	20.52	20.7	20.84	20.96		21	21	21	1	20.99	20.88	20.56	20.36		(87)
Tempe	erature	during h	eating p	eriods ir	rest of	dw	elling	from Ta	ble 9	), Th	n2 (°C)				1	
(88)m=	19.84	19.84	19.84	19.85	19.85	1	9.85	19.85	19.8	85	19.85	19.85	19.84	19.84		(88)
Utilisat	tion fac	tor for ga	ains for	est of d	welling,	h2,	m (se	e Table	9a)							
(89)m=	1	0.99	0.95	0.89	0.73		0.5	0.29	0.2	9	0.55	0.86	0.99	1		(89)
Mean i	interna	l temper	ature in	the rest	of dwelli	na	T2 (fc	ollow ste	ns 3	to 7	in Table	e 9c)				
(90)m=	19.03	19.26	19.51	19.69	19.82	Ť	9.85	19.85	19.8	$\neg$	19.85	19.75	19.32	19.02		(90)
_											f	LA = Livin	g area ÷ (4	l) =	0.38	(91)
Maggi	:	l taranar	otuus /fo	مارين و ماه س	مبياء ماء	II:	~ E	ΛΤ1	. /4	£I	A) TO					
(92)m=	19.53	temper	19.96	20.12	20.25	_	97 = n 0.28	20.29	20.2	$\neg$	20.28	20.18	19.79	19.53	]	(92)
` ′		nent to th											13.73	10.00		(02)
(93)m=	19.53	19.74	19.96	20.12	20.25		0.28	20.29	20.2		20.28	20.18	19.79	19.53		(93)
		ting requ			20:20		0.20				20.20	20110				
		mean int			e obtain	ed	at ste	ep 11 of	Tabl	e 9h	o, so that	t Ti.m=(	76)m an	d re-cald	culate	
		factor fo		•								, (			-	
	Jan	Feb	Mar	Apr	May		Jun	Jul	Αι	ug	Sep	Oct	Nov	Dec		
Utilisat	tion fac	tor for g	ains, hm	:											•	
(94)m=	1	0.98	0.96	0.9	0.76	(	0.54	0.33	0.3	3	0.59	0.88	0.99	1		(94)
	gains,	hmGm ,	<u>`</u>	<u> </u>											1	
` ′	999.34	1203		1236.29			11.32	425.26	425.	.25	747.23	1048.97	1006.82	934.97		(95)
		age exte			from Ta	$\overline{}$									1	
(96)m=	4.5	5	6.8	8.7	11.7		14.6	16.9	16.		14.3	10.8	7	4.9		(96)
		e for mea				_				_	<u> </u>				1	(0-1)
` ' L		1872.73			1076.72		14.65	425.33	425.		753.67	1185.07	1619.99	1858.6		(97)
· -		g require				/Vh				Ì	<u> </u>			007.40	1	
(98)m=	681.88	450.06	300.97	149.04	34.57		0	0	0		0	101.26	441.49	687.18		7(00)
										ıotal	per year (	ĸvvh/year	) = Sum(9	S) <sub>15,912</sub> =	2846.44	(98)
Space	heatin	g require	ement in	kWh/m²	/year										29.18	(99)

9a. Energy requirements – Individual heatir	ıg systems i	ncluding	micro-C	HP)											
Space heating:	ſ		7(204)												
Fraction of space heat from secondary/sup Fraction of space heat from main system(s		system	(202) = 1 -	- (201) =				1	(201)						
Fraction of total heating from main systems	•		(204) = (2	` '	(203)] =			1	(204)						
Efficiency of main space heating system 1			( - ) (	- / [	( /1			93.3	(206)						
Efficiency of secondary/supplementary he	ating systen	ղ. %						0	(208)						
	lay Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye							
Space heating requirement (calculated ab			710.9					, 0	<b>~</b> .						
681.88 450.06 300.97 149.04 34.	57 0	0	0	0	101.26	441.49	687.18								
(211)m = {[(98)m x (204)] + (210)m} x 100	÷ (206)	1	ı			1		ı	(211)						
730.84 482.38 322.58 159.74 37.	05 0	0	0	0	108.53	473.19	736.53		<b>¬</b>						
Occasional and the first form of the control of the	d.		rota	i (kwn/yea	ar) =Sum(2	211) <sub>15,1012</sub>	<u></u>	3050.85	(211)						
Space heating fuel (secondary), kWh/mon = $\{[(98)m \times (201)] + (214) \text{ m}\} \times 100 \div (208)$															
(215)m =		0	0	0	0	0	0								
	Total (kWh/year) =Sum(215) <sub>15,1012</sub> =														
Water heating															
	tput from water heater (calculated above)														
Efficiency of water heater		100.00	7,0.00	1 10101			1 1001.10	79.6	(216)						
(217)m= 87.62 87 85.91 84.36 81.	32 79.6	79.6	79.6	79.6	83.29	86.9	87.69		(217)						
Fuel for water heating, kWh/month															
$(219)$ m = $(64)$ m x $100 \div (217)$ m (219)m = $229.23$ $202.92$ $214.51$ $193.97$ $195$	.81 176.7	167.75	186.76	187.27	203.83	208.84	222.94								
			<u> </u>	I = Sum(2				2390.53	(219)						
Annual totals					k\	Wh/year	. '	kWh/yeaı	<b>-</b> - -						
Space heating fuel used, main system 1								3050.85	╛						
Water heating fuel used								2390.53							
Electricity for pumps, fans and electric keep	-hot														
central heating pump:							130		(230c)						
boiler with a fan-assisted flue							45		(230e)						
Total electricity for the above, kWh/year			sum	of (230a).	(230g) =			175	(231)						
Electricity for lighting								398.64	(232)						
10a. Fuel costs - individual heating system	ns:														
	Fu				Fuel P			Fuel Cost							
Space heating main quaters 4		/h/year			(Table		v 0.01 – I	£/year	7(0.45)						
Space heating - main system 1					3.	·	x 0.01 =	94.5763	(240)						
Space heating - main system 2		3) x			0		x 0.01 =	0	(241)						
Space heating - secondary		5) x			0		x 0.01 =	0	(242)						
Water heating cost (other fuel)	(21)	9)			3.′	1	x 0.01 =	74.11	(247)						

(231)	11.46 × 0.01 =	20.06 (249)
(232)	11.46 X 0.01 =	45.68 (250)
		106 (251)
needed		
7) + (250)(254) =		340.422 (255)
		0.47 (256)
[66]] ÷ [(4) + 45.0] =		1.1225 (257)
		84.3414 (258)
s including micro-CHP		
Energy	<b>Emission factor</b>	Emissions
•	kg CO2/kWh	kg CO2/year
	0.198	604.07 (261)
	0 =	0 (263)
	0.198	473.33 (264)
(261) + (262) + (263) + (264) =		1077.39 (265)
(231) x	0.517	90.48 (267)
(232) x	0.517	206.1 (268)
sun	n of (265)(271) =	1373.97 (272)
(27	2) ÷ (4) =	14.09 (273)
		87 (274)
Energy	Primary	P. Energy
kWh/year	factor	kWh/year
(211) x	1.02	3111.86 (261)
(215) x	0 =	0 (263)
(219) x	1.02 =	2438.35 (264)
	•	
(261) + (262) + (263) + (264) =		5550.21 (265)
(261) + (262) + (263) + (264) = (231) x	2.92	5550.21 (265) 511 (267)
	2.92 =	
(231) x (232) x	2.02	511 (267)
	arately as applicable and applicable	arately as applicable and apply fuel price according to (232)  sineeded (2) + (250)(254) =  sincluding micro-CHP  Energy kWh/year kg CO2/kWh (211) x 0.198 = (215) x 0 = (219) x 0.198 = (261) + (262) + (263) + (264) = (231) x 0.517 = sum of (265)(271) = (272) ÷ (4) =  Energy kWh/year (211) x 1.02 = (215) x 0 = (215) x 0 = (216) + (262) + (263) + (264) = (2172) ÷ (4) =

				User De			<u></u>				
Assessor Name:	0. 50					a Num			., .	4 5 0 40	
Software Name:	Stroma FS	SAP 2009				are Ve			Versio	on: 1.5.0.49	
Address :			Pr	operty A	\aaress	: House	1				
Address :  1. Overall dwelling dime	nsions:										
				Area	(m²)		Ave He	eight(m)		Volume(m	<sup>3</sup> )
Ground floor					• •	(1a) x		2.5	(2a) =	103.75	(3
First floor				4	1.5	(1b) x	2	2.5	(2b) =	103.75	(3
Total floor area TFA = (1a	a)+(1b)+(1c)+	(1d)+(1e)-	+(1n)	) :	83	(4)			J		
Dwelling volume	, , , , ,		` '			l	o)+(3c)+(3c	d)+(3e)+	(3n) =	207.5	(5
										201.5	(
2. Ventilation rate:	main		condary	y (	other		total			m³ per hou	ır
Number of chimneys	heating 0	he	eating 0	] + [	0	<b>7</b> = F	0	x	40 =	0	(6
Number of open flues	0	┪╻	0	] <u> </u> 	0	」	0		20 =	0	(6
Number of intermittent far			0	]	0	┙┟			10 =		╡`
						L	0		10 =	0	(7
Number of passive vents		$\overline{}$				Ĺ	0			0	(7
Number of flueless gas fil	res					L	0	x	40 =	0	(7
_									Air ch	nanges per h	our
Infiltration due to chimne	vs, flues and f	ans = (6a)	)+(6b)+(7a	a)+(7b)+(7	'c) =	Г	0	Н	÷ (5) =	0	(8
If a pressurisation test has b	′ ′					continue fi			- (-)		``
Number of storeys in the	ne dw <mark>elling</mark> (n	s)								0	(9
Additional infiltration	05 for stool o			0.05 for				[(9)	-1]x0.1 =	0	(1
Structural infiltration: 0. <i>if both types of wall are pr</i>						•	ruction			0	(1
deducting areas of opening	ngs); if equal use	0.35									
If suspended wooden f		`	d) or 0.′	1 (sealed	d), else	enter 0				0	(1
If no draught lobby, ent										0	(1
Percentage of windows Window infiltration	s and doors d	raugnt stri	ppea	(	n 25 - IN 2	2 x (14) ÷ 1	1001 -			0	
Infiltration rate							12) + (13) ·	+ (15) =		0	(1 (1
Air permeability value,	q50, expresse	ed in cubic	c metres	s per ho	ur per s	quare m	netre of e	envelope	area	4.8	<b>-</b>  (1
If based on air permeabili				•	•	•				0.24	(1
Air permeability value applies		on test has l	been done	e or a deg	ree air pe	rmeability	is being u	sed			_
Number of sides on whicl Shelter factor	h sheltered			,	(20) = 1 -	[0.075 x (	19)] =			2	(1
Infiltration rate incorporat	ing shelter fac	etor				) x (20) =	-/1			0.85	(2
Infiltration rate modified for	_			`	, (10	, ( ~)				U.Z	\^2
	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	]	
Monthly average wind sp						1 2-12		1		ı	
	5.1 4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1	1	

Wind Factor (2	22a)m =	(22)m ÷	4										
(22a)m= 1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27		
Adjusted infiltra	ation rat	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m			-		
0.28	0.26	0.26	0.23	0.21	0.2	0.19	0.19	0.21	0.23	0.24	0.26		
Calculate effec		_	rate for t	he appli	cable ca	se	l	l				Г	
If mechanica			andiv NL (O	ah) (aa	s) Em. /a	accetion (N	JEV otho	muiaa (22h	\ (225\			0	(23
If exhaust air he									) = (23a)			0	(23
		•	•	J		,		,	2h\ /	00h) [/	(00.5)	0 . 4001	(23
a) If balance	0	o 0	0	0	0	0	1K) (24a	$\frac{1}{0} = \frac{2}{2}$	0	23D) X [	0	+ 100j	(24
b) If balance					<u> </u>	<u> </u>	<u> </u>	<u> </u>				l	`
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0	]	(24
c) If whole h		tract ver	tilation o	or positiv	<u> </u>	ventilatio	n from o	L outside				J	
if (22b)n				•	•				5 × (23b	)			
(24c)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24
d) If natural					•				•	•	•	•	
if (22b)n		<u>`</u>	·	_	<u> </u>	<del></del>		<del></del>	_				10.
(24d)m= 0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53		(24
Effective air				1	<u> </u>	· `		<u>`                                    </u>	0.50	0.50	0.50	1	(0.5
(25)m= 0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53		(25
3. Heat losse	s and he	eat loss	oaramete	er:									
ELEMENT	Gros		Openin	-	Net Ar		U-val		AXU		k-value		A X k
Doors	area	(M²)	m	) <sup>2</sup>	A ,r	X	W/m2	<del></del>	(W/I	<u>()</u>	kJ/m²-l	^	kJ/K
Windows					2		1.2 /[1/( 1.2 )+	0.041 -	2.4	븍			(26
Floor Type 1					6.125				7.01	ᆗ ,			(27
Floor Type 2					41.5	_	0.15	=	6.225	႕ ¦		╡	(28
* *					41.5	=	0.15	=	6.225	닠 ¦		╡┝	(28
Walls	83.1		14.2	5	68.93	_	0.15	=	10.34	닠 ¦		╡┝	(29
Roof	41.		0		41.5	_	0.13	=	5.39				(30
Total area of e			effootivo vi	ndou II v	207.6		formula 1	/[/1/	·a) · 0 041 a	a siran in	naraarank	. 2.2	(31
* for windows and ** include the area						ateu using	i iorriiula T	/[( 1/ <b>U-</b> vait	ie)+0.04j a	is giveri iri	parayrapi	1 3.2	
Fabric heat los	s, W/K	= S (A x	U)				(26)(30)	) + (32) =				44.61	(33
Heat capacity	Cm = S(	Axk)						((28).	(30) + (32	2) + (32a).	(32e) =	15904.0	5 (34
Thermal mass	parame	ter (TMF	P = Cm ÷	- TFA) ir	n kJ/m²K			Indica	tive Value:	: High		450	(35
For design assess can be used instea				construct	ion are no	t known pr	ecisely the	e indicative	values of	TMP in Ta	able 1f		
Thermal bridge	es : S (L	x Y) cal	culated ı	using Ap	pendix l	<						10.38	(36
if details of therma		are not kn	own (36) =	= 0.15 x (3	1)								
Total fabric he									(36) =			55	(37
Ventilation hea									= 0.33 × (			1	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(00
(38)m= 36.83	36.55	36.55	36.04	35.73	35.59	35.46	35.46	35.81	36.04	36.29	36.55		(38
Heat transfer of					1	ı	ı		= (37) + (3		Г	1	
(39)m= 91.83 Stroma FSAP 200	91.55 9 Version	91.55	91.04 SAP 9.90	90.73	90.59	90.45	90.45	90.8	91.04	91.28	91.55	P	age 2 Mf.7
2	0.0001.		(3 0.00)						Average =	Sum(39) <sub>1</sub>	12 /12=	91.07	age 2 <b>∮{<del>3</del></b> 9

leat lo	ss para	meter (H	HLP), W	m²K					(40)m	= (39)m ÷	(4)			
10)m=	1.11	1.1	1.1	1.1	1.09	1.09	1.09	1.09	1.09	1.1	1.1	1.1		_
ماصدا	r of dow	a in ma	oth /Tob	lo 1o\					1	Average =	Sum(40) <sub>1</sub>	12 /12=	1.1	(4
admue ]	i i	Feb	nth (Tab Mar	· ·	Mov	lup	Jul	Λιια	Son	Oct	Nov	Dec		
11)m=	Jan 31	28	31	Apr 30	May 31	Jun 30	31	Aug 31	Sep 30	31	30	31		(4
	01	20	01						00	01		01		( .
4 Wa	ter heati	ing ener	rgy requi	irement:								kWh/ye	ar.	
				irement.								RVVIII y C	ar.	
if TF	ed occu A > 13.9 A £ 13.9	), N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.0	0013 x (	ΓFA -13.		173		(4
nnual	average	e hot wa						(25 x N)				9331		(4
		_	hot water person per			-	-	to achieve	a water us	se target o	f			
[	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ot wate			day for ea	<u> </u>					Зер	Oct	INOV	Dec		
4)m=	108.83	104.87	100.91	96.95	93	89.04	89.04	93	96.95	100.91	104.87	108.83		
						ļ	<u> </u>		-	Γotal = Su	m(44) <sub>112</sub> =		1187.197	(4
nergy c	content of I	hot water	used - cal	culated mo	onthly $= 4$ .	190 x Vd,r	n x nm x E	Tm / 3600	kWh/mor	th (see Ta	ables 1b, 1	c, 1d)		
5)m= [	161.77	141.49	146	127.29	122.14	105.39	97.66	112.07	113.41	132.17	144.27	156.67		_
netant	anoous w	ator hoatii	na at paint	of uso (no	hot water	r etorago)	ontor () in	boxes (46)		Total = Su	m(45) <sub>112</sub> =	_ [	1560.3265	(•
										40.00	04.04	00.5		,
	24.27 storage	21.22 OSS:	21.9	19.09	18.32	15.81	14.65	16.81	17.01	19.82	21.64	23.5		(4
	_		clared lo	ss facto	r is knov	vn (kWh	/day):				0.0	)24		(4
empe	rature fa	actor fro	m Table	2b							0.	54		(-
nergy	lost from	m water	storage	, kWh/ye	ear			(47) x (48)	=		0.0	)13		(-
			red cylir											
•			) includir	0 ,		Ü					(	0		(
	-	_	l no tank in t water (th	_				enter '0' in	hox (50)					
			factor fr					011101 0 111	БОЛ (ОО)					(!
	e factor f	•		om rabi	C 2 (KVV)	11/11110/00	·y <i>)</i>					0		(+
			m Table	2b								0		(!
•			storage		ear			((50) x (51	) x (52) x	(53) =				(!
	49) or (5		-	,				· · · · ·	, , ,	,		013		(
ater s	storage	loss cal	culated f	for each	month			((56)m = (	55) × (41)ı	m				
6)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(
cylinde	er contains	dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Appendi	хH	
7)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(!
imar.	v circuit	loce (an	nual) fro	m Table	. 3	!	!				36	60		(
-						59)m = (	(58) ÷ 36	65 × (41)	m					•
ııııaıv					,	•	` '	ng and a		r thermo	stat)			
-								<del></del>			<del></del>			- //
-	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		(;
(mod 9)m=	I		30.58 for each	l	l	l	l	l .	29.59	30.58	29.59	30.58		(;

Total boot so wise different booting a calculate different booting (CO) as 0.05 c. (45) as 1.46 as 1.46 as 1.46 as	(04)
Total heat required for water heating calculated for each month $(62)m = 0.85 \times (45)m + (46)m + (57)m + (59)m + (59)m + (50)m	` '
(62)m= 192.75 169.47 176.98 157.27 153.11 135.37 128.64 143.05 143.39 163.14 174.25 187.65	(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)	
(add additional lines in 1 Gritts and/or vvvi its applies, see Appendix G)  (63)m= 0 0 0 0 0 0 0 0 0 0 0	(63)
	(55)
Output from water heater (64)m= 192.75 169.47 176.98 157.27 153.11 135.37 128.64 143.05 143.39 163.14 174.25 187.65	
	925.0569 (64)
Heat gains from water heating, kWh/month 0.25 $^{\prime}$ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]	(5.7)
(65)m= 78.25 69.14 73.01 65.99 65.07 58.71 56.93 61.72 61.38 68.41 71.64 76.55	(65)
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating	` '
	ig
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)
	(00)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	(67)
(67)m= 53.33 47.37 38.52 29.16 21.8 18.41 19.89 25.85 34.7 44.06 51.42 54.81	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	(60)
(68)m= 336.71 340.2 331.4 312.66 288.99 266.76 251.9 248.41 257.21 275.95 299.62 321.85	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	(00)
(69)m= 52.62 52.62 52.62 52.62 52.62 52.62 52.62 52.62 52.62 52.62 52.62	(69)
Pumps and fans gains (Table 5a)	
(70) m =	(70)
Losses e.g. evaporation (negative values) (Table 5)	
(71)m= -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69 -100.69	(71)
Water heating gains (Table 5)	
(72)m= 105.17 102.88 98.13 91.66 87.46 81.55 76.52 82.96 85.25 91.94 99.5 102.89	(72)
Total internal gains = $(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$	
(73)m= 598.19 593.43 571.02 536.45 501.22 469.68 451.28 460.19 480.12 514.92 553.5 582.53	(73)
6. Solar gains:	
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.	
<b>0–</b>	ains (W)
South 0.9x 0.77 x 6.12 x 47.32 x 0.76 x 0.7 =	213.73 (78)
South 0.9x 0.77 x 6.12 x 77.18 x 0.76 x 0.7	348.58 (78)
South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 =	425.64 (78)
South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 =	474.73 (78)
South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 =	490.24 (78)
South 0.9x 0.77 x 6.12 x 108.9 x 0.76 x 0.7 =	491.81 (78)
South 0.9x 0.77 x 6.12 x 107.14 x 0.76 x 0.7 =	483.86 (78)
South 0.9x 0.77 x 6.12 x 103.88 x 0.76 x 0.7 =	469.16 (78)

South	0.9x	0.77	х	6.1	2	x	9	9.99	x		0.76	X	0.7	=	451.59	(78)
South	0.9x	0.77	x	6.1	2	x	8	5.29	X		0.76	_ x _	0.7		385.2	(78)
South	0.9x	0.77	X	6.1	2	X	5	6.07	X		0.76	x	0.7	=	253.22	(78)
South	0.9x	0.77	х	6.1	2	X	4	0.89	x		0.76	x	0.7	=	184.67	(78)
	_								•							_
Solar g	ains in	watts, ca	alculated	I for eac	h month				(83)m	ı = Sı	um(74)m .	(82)m				
(83)m=	213.73	348.58	425.64	474.73	490.24	т —	91.81	483.86	469	.16	451.59	385.2	253.22	184.67		(83)
Total g	ains – i	nternal a	nd solar	(84)m =	= (73)m	+ (	83)m	, watts							•	
(84)m=	811.91	942.01	996.66	1011.17	991.47	9	61.49	935.14	929	.35	931.71	900.12	806.73	767.2		(84)
7. Mea	an inter	nal temp	erature	(heating	season	)										
		during h					area 1	from Tab	ole 9.	. Th	1 (°C)				21	(85)
•		tor for g	•			-				,	. ( -)					` ′
	Jan	Feb	Mar	Apr	May	È	Jun	Jul	Α	ug	Sep	Oct	Nov	Dec	]	
(86)m=	1	0.99	0.97	0.94	0.81	-	0.6	0.4	0.4	<del>  </del>	0.65	0.91	0.99	1		(86)
` ′ [						_			l	!						` '
Г		l temper				OIIC T			T			00.00	00.07	00.54	1	(07)
(87)m=	20.51	20.63	20.77	20.88	20.97		21	21	2	1	21	20.92	20.67	20.51		(87)
Temp	erature	during h	eating p	eriods ir	rest of	dw	elling	from Ta	ble 9	9, Tr	n2 (°C)				1	
(88)m=	20	20	20	20.01	20.01	2	20.01	20.01	20.	01	20.01	20.01	20	20		(88)
Utilisa	ition fac	tor for g	ains for I	rest of d	welling,	h2	m (se	e Table	9a)							
(89)m=	1	0.99	0.96	0.9	0.74		0.51	0.3	0.	3	0.55	0.86	0.99	1		(89)
Mean	interna	l temper	ature in	the rest	of dwell	ina	T2 (fc	ollow ste	ns 3	to 7	in Tabl	e 9c)				
(90)m=	19.37	19.55	19.74	19.89	19.99	Ť	20.01	20.01	20.	$\neg$	20.01	19.94	19.6	19.37		(90)
											f	LA = Livin	g area ÷ (4	4) =	0.36	(91)
N4000	intown	l taranar	otuus /fo	مارين م مائد بير	ميناه مام	11:		ΛΤ4	. /4	£I	A) TO					
(92)m=	19.78	temper	20.11	20.25	20.34	$\overline{}$	97 = n 20.37	20.37	+ (1 20.		20.36	20.3	19.99	19.78	]	(92)
` <i>′</i> L		nent to the											19.99	19.70		(02)
(93)m=	19.78	19.94	20.11	20.25	20.34	_	20.37	20.37	20.		20.36	20.3	19.99	19.78	]	(93)
		ting requ			20.0			20.0.			20.00	20.0	10.00	10.10		,
		mean int			re obtair	ned	l at ste	en 11 of	Tabl	e 9h	o, so tha	t Ti.m=(	76)m an	d re-cald	culate	
		factor fo		•							, 00	, (			-	
	Jan	Feb	Mar	Apr	May		Jun	Jul	Α	ug	Sep	Oct	Nov	Dec		
Utilisa	ition fac	tor for g	ains, hm	:											•	
(94)m=	1	0.99	0.96	0.91	0.77		0.54	0.34	0.3	34	0.59	0.88	0.99	1		(94)
г	I gains,	hmGm ,	W = (94)	4)m x (8	4)m	_									1	
(95)m=	808.68	929.58	958.64	922.47	760.08	_	21.14	313.72	313	.72	548.2	789.24	797	764.73		(95)
г		age exte		·	from T				1				-	·	1	
(96)m=	4.5	5	6.8	8.7	11.7	<u> </u>	14.6	16.9	16		14.3	10.8	7	4.9		(96)
		e for mea				_			<del>-</del> -	<del>-</del> -	<u> </u>		i	i	1	(0-)
` ′ L		1367.66		1051.08	784.35	_	22.37	313.74	313		550.64	864.48	1185.69	1362.34		(97)
. г		g require				Wh T				Ť		<u> </u>	<u> </u>	444.00	1	
(98)m=	442.45	294.39	193.67	92.6	18.05	_	0	0	0		0	55.98	279.86	444.62		(OC)
										ıotal	per year	(KVVh/yeai	r) = Sum(9	<b>∀)</b> ₁5,912 =	1821.62	(98)
Space	e heatin	g require	ement in	kWh/m²	/year										21.95	(99)

9a. Energy requirements – Indiv	vidual heating	systems i	including	micro-C	CHP)					
Space heating:								ı		_
Fraction of space heat from se		lementary	-		(204)				0	(201)
Fraction of space heat from ma	, ,			(202) = 1	` '	(202)]			1	(202)
Fraction of total heating from m	•			(204) = (2	02) <b>x</b> [1 –	(203)] =			1	(204)
Efficiency of main space heatin	• ,	:	<b>.</b> 0/						93.3	(206)
Efficiency of secondary/supple	<del>i</del>	<del></del>	1		_				0	(208)
Jan Feb Mar Space heating requirement (ca	Apr Ma		Jul	Aug	Sep	Oct	Nov	Dec	kWh/y	ear
442.45 294.39 193.67	92.6 18.05	<del>- i</del>	0	0	0	55.98	279.86	444.62		
$(211)$ m = {[(98)m x (204)] + (210	D)m } x 100 ÷	(206)	1							(211)
474.22 315.53 207.58	99.24 19.35	<del> </del>	0	0	0	60	299.95	476.55		
	•	•	•	Tota	l (kWh/yea	ar) =Sum(2	211) <sub>15,1012</sub>		1952.43	(211)
Space heating fuel (secondary)	•									
$= \{[(98)m \times (201)] + (214) m \} \times (215)m = 0 0 0$	$\frac{100 \div (208)}{0}$	T 0	0	0	0	0	0	0		
(213)111- 0 0 0	0   0				l (kWh/yea		_		0	(215)
Water heating						_		'		
Output from water heater (calcu										
	157.27 153.1	1 135.37	128.64	143.05	143.39	163.14	174.25	187.65		(040)
Efficiency of water heater (217)m= 86.76 86.07 84.85	83.26 80.61	79.6	79.6	79.6	79.6	82.08	85.87	86.84	79.6	(216)
Fuel for water heating, kWh/mor		79.0	79.0	79.0	79.0	02.00	65.67	00.04		(217)
$(219)$ m = $(64)$ m x $100 \div (217)$ n	n									
(219)m= 222.16 196.89 208.57	188.89 189.9	5 170.07	161.61	179.71	180.13 I = Sum(2	198.75	202.92	216.09		<b>—</b> ,
Annual totals				TOLA	ii = Suiii(2		Wh/yeaı		2315.74 kWh/yea	(219)
Space heating fuel used, main s	system 1					K	wii/yeai	·	1952.43	ai 
Water heating fuel used									2315.74	=
Electricity for pumps, fans and e	electric keep-l	not						l		
central heating pump:								130		(230c)
boiler with a fan-assisted flue								45		(230e)
	Mhhaor			sum	of (230a).	(230a) -		45	475	
Total electricity for the above, k	vvii/yeai			Sum	OI (200a).	(2009) =			175	(231)
Electricity for lighting									376.75	(232)
10a. Fuel costs - individual hea	ating systems	:								
		Fu kV	i <b>el</b> Vh/year			Fuel P (Table			Fuel Cos £/year	t
Space heating - main system 1		(21	1) x			3.	1	x 0.01 =	60.5253	(240)
Space heating - main system 2		(21	3) x			0		x 0.01 =	0	(241)
Space heating - secondary		(21	5) x			0		x 0.01 =	0	(242)
Water heating cost (other fuel)		(21	9)			3.	1	x 0.01 =	71.79	(247)
<b>U</b> ( - 7						<u>_</u>		I		` ′

Pumps, fans and electric keep-hot	(231)	11.46 x 0.01 =	20.06 (249)
(if off-peak tariff, list each of (230a) to (230g	g) separately as applicable and ap		
Energy for lighting	(232)	11.46 X 0.01 =	43.18 (250)
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (2	254) as needed		
	45)(247) + (250)(254) =		301.5435 (255)
11a. SAP rating - individual heating syster	ms		
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF) [(25	55) x (256)] ÷ [(4) + 45.0] =		1.1072 (257)
SAP rating (Section 12)			84.5541 (258)
12a. CO2 emissions – Individual heating s	systems including micro-CHP		
	Energy	<b>Emission factor</b>	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating (main system 1)	(211) x	0.198 =	386.58 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Water heating	(219) x	0.198	458.52 (264)
Space and water heating	(261) + (262) + (263) + (264) =		845.1 (265)
Electricity for pumps, fans and electric keep	o-hot (231) x	0.517 =	90.48 (267)
Electricity for lighting	(232) x	0.517 =	194.78 (268)
Total CO2, kg/year	su	ım of (265)(271) =	1130.35 (272)
CO2 emissions per m²	(2	72) ÷ (4) =	13.62 (273)
EI rating (section 14)			88 (274)
13a. Primary Energy			
Toda i ilindiy Energy	_		
	<b>Energy</b> kWh/year	Primary factor	<b>P. Energy</b> kWh/year
Space heating (main system 1)	(211) x	1.02 =	1991.48 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Energy for water heating	(219) x	1.02 =	2362.05 (264)
Space and water heating	(261) + (262) + (263) + (264) =	=	4353.53 (265)
Electricity for pumps, fans and electric keep	o-hot (231) x	2.92	511 (267)
Electricity for lighting	(232) x	0 =	1100.11 (268)
'Total Primary Energy		ım of (265)(271) =	5964.64 (272)
Primary energy kWh/m²/year		72) ÷ (4) =	
Filmary energy Kwillingear	(2	· <del>-</del>	71.86 (273)

				User D	Details:						
Assessor Name: Software Name:	Stroma FS	SAP 200	19		Strom Softwa				Versio	n: 1.5.0.49	
			Р	roperty	Address	: House	1				
Address :											
1. Overall dwelling dime	ensions:										
Ground floor				_	<b>a(m²)</b> 62.66	(1a) x		eight(m) 39	(2a) =	Volume(m³	<b>')</b> (3
otal floor area TFA = (1	a)+(1b)+(1c)+	(1d)+(1e	e)+(1r	1) 6	62.66	(4)					
welling volume						(3a)+(3b	o)+(3c)+(3c	d)+(3e)+	.(3n) =	149.7574	(5
2. Ventilation rate:											
	main heating		econdar eating	У	other		total			m³ per hou	ır
lumber of chimneys	0	_ + _	0	+ [	0	] = [	0	X 4	40 =	0	(6
lumber of open flues	0	_ + _	0	Ī + Ē	0	Ī = [	0	x	20 =	0	= (6
lumber of intermittent fa	ns						0	x -	10 =	0	
lumber of passive vents						Ť	0	x ·	10 =	0	= (7
lumber of flueless gas fi	res					_ 	0	X 4	40 =	0	
						L		_	Air ch	anges per ho	
nfiltration due to chimne	vs. flues and f	ans = (6	a)+(6b)+(7	′a)+(7b)+(	(7c) =	Г	0		÷ (5) =	0	(8
If a pressurisation test has b						continue f			. (0)	0	
Number of storeys in the	ne dwelling (n	s)								0	(9
Additional infiltration								[(9)	-1]x0.1 =	0	(1
Structural infiltration: 0 if both types of wall are pl						•	ruction			0	(1
deducting areas of opening			portaing to	ine great	er wan are	a (anter					
If suspended wooden f	loor, enter 0.2	2 (unseal	ed) or 0	.1 (seale	ed), else	enter 0				0	(
If no draught lobby, en	·									0	(
Percentage of windows	s and doors d	raught st	ripped		0.25 - [0.2	) v (4.4) · ·	1001 —		ļ	0	<b>—</b> (
Window infiltration Infiltration rate						` '	100] = 12) + (13) -	+ (15) =	<u> </u> 	0	
Air permeability value,	a50 express	ed in cub	oic metre	s per ho					area [	4.8	
based on air permeabil				•	•	•	10110 01 0	лиоюро	[	0.24	╡,
Air permeability value applie	-						is being u	sed	L	-	┛`
umber of sides on whic	h sheltered				(22)	/				2	(
helter factor					(20) = 1 -		19)] =			0.85	(:
filtration rate incorporat	-				(21) = (18	) X (20) =				0.2	(:
filtration rate modified f	<del></del>	<del>'</del>		1, .1	۸	000	0-4	Mari	Dan		
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
onthly average wind sp	eed from Tab	le 7 4.1	2.0	3.7	3.7	4.2	1 F	4.8	F 4		
2)m= 5.4 5.1	0.1 4.5	4.1	3.9	3./	J 3./	4.2	4.5	4.8	5.1		
/ind Factor (22a)m = (2	2)m ÷ 4										
A = (22a) = (22a)	<i>-)</i> ···· ·										

0.28	0.26	0.26	0.23	0.21	d wind s	0.19	0.19	0.21	0.23	0.24	0.26		
Calculate effe		-	rate for t	he appli	cable ca	se	<u> </u>	ļ					
If mechanica							.=					0	(2:
If exhaust air h		0		, ,	,	. `	,, .	,	) = (23a)			0	(2:
If balanced with		-	-	_								0	(2:
a) If balance						<del></del>	<del>- ^ `-</del>	ŕ	<del> </del>	<del></del>	<del>- ` ´</del>	) ÷ 100] 1	(0
24a)m= 0		0	0	0	0	0	0	0	0	0	0	]	(2
b) If balance	ı						<u> </u>	<del>i `</del>	<u> </u>		Ι ,	1	(2
24b)m= 0	0	0	0	0	0	0	0	0	0	0	0	J	(2
c) If whole h	ouse ext			•	•				5 v (23h	<b>.</b> )			
$\frac{11(220)11}{24c)m} = 0$	0.5 7	0	0	0	0	0	0	0	0	0	0	1	(2
d) If natural												J	•
	0 = 1, the								0.5]				
24d)m= 0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53	]	(2
Effective air	change	rate - en	iter (24a	or (24b	o) or (24	c) or (24	d) in box	x (25)		•	•	•	
25)m= 0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53		(2
/indows			Г		6.125		1.2	= [ 0.04] = [	2.4 5.89 9.399		kJ/m²-	,	(2
/indows oor /alls oof otal area of earty wall ternal wall **		66 , m²	0		6.125 62.66 48.59 62.66 188.10	x x x x 66 x	0.15 0.15 0.13	= [ 0.04] = [ = [ = = [ = = [	2.4 5.89 9.399 7.29 8.15				(2) (2) (3) (3) (3)
findows oor falls oof otal area of earty wall ternal wall **	62.6	, m²	0	ndow U-va	6.125 62.66 48.59 62.66 188.10 0 alue calcula	x x x x 66 x	0.15 0.15 0.13	= [ 0.04] = [ = [ = = [ = = [	2.4 5.89 9.399 7.29 8.15				(2) (3) (3) (3)
/indows /oor /alls oof otal area of earty wall ternal wall ** for windows and include the area	62.6 elements froof winders on both	ows, use e	0  Iffective wi	ndow U-va	6.125 62.66 48.59 62.66 188.10 0 alue calcula	x x x x x 66 x x atted using	0.15 0.15 0.13	= [ 0.04] = [ = [ = [ ] = [ ] = [	2.4 5.89 9.399 7.29 8.15				(2) (2) (3) (3) (3) (3)
/indows loor /alls oof otal area of e arty wall aternal wall ** for windows and include the area abric heat los	62.6 I roof winder as on both ss, W/K =	ows, use e sides of in	0  Iffective wi	ndow U-va	6.125 62.66 48.59 62.66 188.10 0 alue calcula	x x x x x 66 x x atted using	0.15 0.15 0.13 0 on formula 1		2.4 5.89 9.399 7.29 8.15	[]	paragraph	] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [	(3) (3) (3) (3)
/indows loor /alls oof otal area of earty wall sternal wall ** for windows and include the area abric heat los eat capacity	62.6  Froof winders on both  as, W/K =  Cm = S(	ows, use e sides of in = S (A x A x k)	0 Iffective winternal walk	ndow U-va	6.125 62.66 48.59 62.66 188.10 0 alue calculations	x x x x x x attention of the control	0.15 0.15 0.13 0 on formula 1	= [ 0.04] = [ = [ ] = [ ] = [ ] = [ ] (1/U-value) + (32) = ((28)	2.4 5.89 9.399 7.29 8.15 0		paragraph	n 3.2	(3) (3) (3) (3) (3) (3) (3) (3) (4) (5) (5) (5) (6) (6) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7
/indows /oor /alls oof otal area of earty wall sternal wall ** for windows and include the area abric heat los eat capacity hermal mass or design assess an be used inste	62.6 I roof winder as on both Ss, W/K = Cm = S( parame sments what ad of a details and of a details are sments what of a detail are sments what of a details are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments what of a detail are sments when a d	ows, use e sides of in = S (A x A x k ) ter (TMF ere the detailed calculation)	offective winternal walk U)  P = Cm ÷ tails of the ulation.	ndow U-va ls and part - TFA) in constructi	6.125 62.66 48.59 62.66 188.10 0 alue calculations	x x x x x x x x x x x x x x x x x x x	0.15 0.15 0.13 0 on formula 1	$= \begin{bmatrix} \\ 0.04 \end{bmatrix} = \begin{bmatrix} \\ \\ \end{bmatrix} = \begin{bmatrix} \\ \\ \end{bmatrix} = \begin{bmatrix} \\ \end{bmatrix} = \begin{bmatrix} \\ \end{bmatrix} = \begin{bmatrix} \\ \end{bmatrix} = \begin{bmatrix} \\ \end{bmatrix} + (32) = ((28) \\ \end{bmatrix}$	2.4 5.89 9.399 7.29 8.15 0 e)+0.04] a	as given in (2) + (32a).	paragraph(32e) =	39.01 12523.0 250	(3) (3) (3) (3) (3) (3) (4) (5) (5) (5) (5) (5) (5) (6) (6) (6) (6) (6) (6) (6) (6) (6) (6
/indows /loor /alls oof otal area of earty wall sternal wall ** for windows and include the area abric heat lose eat capacity hermal mass or design assess an be used instelle	62.6 I roof winder as on both as, W/K = Cm = S( parame and of a detection and of a detect	ows, use e sides of in = S (A x A x k) ter (TMF ere the detailed calcular X Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) x X Y	offective winternal walk U)  P = Cm ÷ tails of the ulation. culated to	ndow U-vals and part - TFA) in constructi	6.125 62.66 48.59 62.66 188.10 0 alue calculations kJ/m²K ion are not	x x x x x x x x x x x x x x x x x x x	0.15 0.15 0.13 0 on formula 1	$= \begin{bmatrix} \\ 0.04 \end{bmatrix} = \begin{bmatrix} \\ \\ \end{bmatrix} = \begin{bmatrix} \\ \\ \end{bmatrix} = \begin{bmatrix} \\ \end{bmatrix} = \begin{bmatrix} \\ \end{bmatrix} = \begin{bmatrix} \\ \end{bmatrix} = \begin{bmatrix} \\ \end{bmatrix} + (32) = ((28) \\ \end{bmatrix}$	2.4 5.89 9.399 7.29 8.15 0 e)+0.04] a	as given in (2) + (32a).	paragraph(32e) =	39.01	(3) (3) (3) (3) (3) (3) (3) (3) (3) (3)
/indows /loor /alls oof otal area of earty wall sternal wall ** for windows and include the area abric heat los eat capacity hermal mass or design assess an be used inste hermal bridge details of thermal	62.6 I roof winder as on both ss, W/K = Cm = S( parame and of a dealers: S (Leal bridging	ows, use e sides of in = S (A x A x k) ter (TMF ere the detailed calcular X Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) calcular x Y) x X Y	offective winternal walk U)  P = Cm ÷ tails of the ulation. culated to	ndow U-vals and part - TFA) in constructi	6.125 62.66 48.59 62.66 188.10 0 alue calculations kJ/m²K ion are not	x x x x x x x x x x x x x x x x x x x	0.15 0.15 0.13 0 on formula 1	= [ 0.04] = [ = [ ] = [ ] = [ ] = [ ] = [ (1/U-value) + (32) = ((28) Indicative	2.4 5.89 9.399 7.29 8.15 0 e)+0.04] a	as given in (2) + (32a).	paragraph(32e) =	39.01 12523.0 250	(3) (3) (3) (3) (3) (3) (3) (3) (3) (3)
loor  loof  loof  lalls  oof  otal area of earty wall  aternal wall **  for windows and  include the area  abric heat los  leat capacity  hermal mass  or design assess  an be used inste  hermal bridge  details of therma  otal fabric he	62.6 I roof windows on both as, W/K = Cm = S( parame and of a determinents who add of a determinent of a det	ows, use e sides of in = S (A x k) ter (TMF ere the detailed calculation x Y) calculare not known	offective winternal walk U) $P = Cm \div tails of the culation. culated to the culation own (36) = 0.0000000000000000000000000000000000$	ndow U-va ls and part - TFA) in constructi using Ap = 0.15 x (3	6.125 62.66 48.59 62.66 188.10 0 alue calculations kJ/m²K ion are not	x x x x x x x x x x x x x x x x x x x	0.15 0.15 0.13 0 on formula 1	= [ 0.04] = [ = [ ] = [ ] = [ ] = [ ] = [ (1/U-value) + (32) = ((28) Indicative indic	2.4 5.89 9.399 7.29 8.15 0 (30) + (32) tive Value values of	as given in  2) + (32a).  Medium  TMP in Ta	paragraph(32e) =	39.01 12523.0 250	(3) (3) (3) (3) (3) (3) (3) (3) (3) (3)
loor Valls loof otal area of elearty wall aternal wall ** for windows and include the area abric heat los leat capacity hermal mass or design assess an be used inste hermal bridge details of therma total fabric he	62.6  I roof windows on both ss, W/K = Cm = S( parame sments whe ad of a det es : S (L al bridging at loss at loss ca	ows, use e sides of in S (A x k) ter (TMF ere the detailed calculated are not known alculated	offective winternal walk U)  P = Cm ÷ tails of the ulation. culated to own (36) =	ndow U-vals and part - TFA) in constructionsing Ap	6.125 62.66 48.59 62.66 188.10 0 alue calculations kJ/m²K fon are not	x x x x x x x x x x x x x x x x x x x	0.15 0.15 0.15 0.17 0.17 0.18 0.19 0.19 0.19 0.19 0.19 0.19 0.19 0.19	= [ 0.04] = [ = [ ] = [ ] = [ ] = [ ] = [ ] = [ ] = [ ] (1/U-value) + (32) = ((28) Indicative indicative (33) + (38)m	2.4 5.89 9.399 7.29 8.15 0 (30) + (32) tive Value values of	25)m x (5)	paragraph(32e) =	39.01 12523.0 250	(3) (3) (3) (3) (3) (3) (3) (3) (3) (3)
Vindows Vindows Vindows Vindows Vindows Vindows Vindows Vindos Vi	62.6 I roof windows on both as, W/K = Cm = S( parame and of a determinent	ows, use e sides of in = S (A x k) ter (TMF ere the detailed calculation x Y) calculare not known	offective winternal walk U) $P = Cm \div tails of the culation. culated to the culation own (36) = 0.0000000000000000000000000000000000$	ndow U-va ls and part - TFA) in constructi using Ap = 0.15 x (3	6.125 62.66 48.59 62.66 188.10 0 alue calculations kJ/m²K ion are not	x x x x x x x x x x x x x x x x x x x	0.15 0.15 0.13 0 on formula 1	= [ 0.04] = [ = [ ] = [ ] = [ ] = [ ] = [ (1/U-value) + (32) = ((28) Indicative indic	2.4 5.89 9.399 7.29 8.15 0 (30) + (32) tive Value values of	as given in  2) + (32a).  Medium  TMP in Ta	paragraph(32e) =	39.01 12523.0 250	(2) (2) (2) (3) (3) (3) (3) (3) (3) (3) (3) (3) (3
loor  /alls oof otal area of earty wall aternal wall ** for windows and include the area abric heat lost eat capacity hermal mass or design assess an be used insteend the details of thermal otal fabric heartilation heartilation heartilation heartilation heartilation heartilation in the design assess and the used insteend the used instead the used th	62.6 roof winders on both as, W/K = Cm = S( parame and of a determination of a determinat	ows, use e sides of in = S (A x A x k) ter (TMF ere the detailed calculated are not known alculated Mar 26.38	offective winternal walk U)  P = Cm ÷ tails of the culation. culated u own (36) =	ndow U-vals and part - TFA) in constructions April 12 (3) (4) (5) (6) (7) (7) (7) (8) (7) (7) (8) (7) (8) (7) (8) (7) (8) (7) (8) (7) (8) (7) (8) (7) (8) (7) (8) (8) (7) (8) (8) (8) (8) (8) (8) (8) (8) (8) (8	6.125 62.66 48.59 62.66 188.10 0 alue calculations kJ/m²K fon are not spendix h 1) Jun	x x x x x x x x x x x x x x x x x x x	0.15 0.15 0.15 0.13 0 formula 1. (26)(30)	= [ 0.04] = [ = [ ] = [ ] = [ ] = [ ] = [ ] (1/U-value) ) + (32) = ((28) Indicative) (33) + (38)m Sep 25.84	2.4 5.89 9.399 7.29 8.15 0 (30) + (32) tive Value values of (36) = = 0.33 × ( Oct	25)m x (5) Nov 26.19	paragraph(32e) = able 1f	39.01 12523.0 250	(3) (3) (3) (3) (3) (3) (3) (3) (3)

leat lo	ss para	meter (H	HLP), W/	m²K				•	(40)m	= (39)m ÷	(4)			
10)m=	1.17	1.16	1.16	1.16	1.15	1.15	1.15	1.15	1.16	1.16	1.16	1.16		_
lumbo	r of day	c in moi	nth (Tab	lo 1a)					,	Average =	Sum(40) <sub>1</sub> .	12 /12=	1.16	(4
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
l1)m=	31	28	31	30	31	30	31	31	30	31	30	31		(4
L														
4. Wat	ter heat	ing ener	gy requi	rement:								kWh/ye	ar:	
ssume	ed occu	nancy I	N								2.0	558		(4
if TF	A > 13.9	N = 1		[1 - exp	(-0.0003	349 x (TF	A -13.9	)2)] + 0.0	0013 x (	ΓFA -13.		330		(-
	A £ 13.9	•	ater usac	na in litra	s nar da	ny Vd,avo	arage –	(25 v NI)	<b>+</b> 36		07.6	2020		(4
educe t	the annua	l average	hot water	usage by	5% if the a	lwelling is	designed t			se target o		3939		(4
ot more ¬						not and co	,							
ot wate	Jan J	Feb	Mar day for ea	Apr	May	Jun ctor from 7	Jul	Aug	Sep	Oct	Nov	Dec		
Г	96.13	92.64	89.14	85.65	82.15	78.65	78.65	82.15	85.65	89.14	92.64	96.13		
4)m=	90.13	92.04	69.14	65.65	62.15	76.00	76.00	62.13			m(44) <sub>112</sub> =	l	1048.7273	\( <u>4</u>
nergy c	content of	hot water	used - cal	culated mo	onthly $= 4$ .	190 x Vd,n	n x nm x D	Tm / 3600			ables 1b, 1		1040.7273	
5)m=	142.9	124.98	128.97	112.44	107.89	93.1	86.27	99	100.18	116.75	127.44	138.39	_	
										Γotal = Su	m(45) <sub>112</sub> =		1378.3365	(4
						storage),								
	21.44 storage	18.75	19.35	16.87	16.18	13.97	12.94	14.85	15.03	17.51	19.12	20.76		(4
	_		clared lo	ss facto	r is knov	vn (kWh	/day):				0.0	024		(4
			m Table								_	54		(4
			storage		ear			(47) x (48)	=			013		(4
			-			s not kno								
•		,		•		age with						0		(
	•	•		•		litres in bo eous comb	. ,	enter '0' in	box (50)					
						h/litre/da			(00)			0		(!
	e factor	Ū		om rabi	0 2 (1111)	1711110700	· <b>y</b> /					0		(!
			m Table	2b								0		(!
nergy	lost fro	m water	storage	, kWh/ye	ear			((50) x (51	) x (52) x (	(53) =		0		(!
• • •	49) or (5		_	,								013		(
ater s	storage	loss cal	culated f	or each	month			((56)m = (	55) × (41)r	m				
6)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(!
cylinde	r contains	dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Appendi	хH	
7)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(
rimary	v circuit	loss (an	nual) fro	m Table	3						3(	60		(!
-		•	•			59)m = (	58) ÷ 36	65 × (41)	m					
	lified by	factor fi	om Tab	le H5 if t	here is s	olar wat	er heatir	ng and a	cylinde	thermo	stat)			
(mod	T	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		(!
· -	30.58	27.62	30.56	20.00										
9)m=						(60) ÷ 36	65 × (41)	)m						

(62)   (62)   (62)   (62)   (62)   (62)   (62)   (62)   (63)   (64)	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 0 0 0 0 0 0 0
Company   Comp	(63)ms 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
(63)me	Coutput from water heater  (64)me
Output from water heater  ((64)m= 173.86   152.96   159.95   142.42   138.87   123.08   117.25   128.96   130.16   147.73   157.42   169.37      Heat gains from water heating, kWh/month 0.25 * [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (57)m + (59)m]     (65)m= 172.3   63.94   67.67   61.37   60.66   54.94   53.47   57.7   57.29   63.6   66.36   70.8     (65)m include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating    S. Internal gains (see Table 5 and 5a):    Metabolic qains (Table 5), Watts	Output from water heater  (64)m= 173.88   152.96   159.96   142.42   138.87   123.08   117.25   129.98   130.16   147.73   157.42   169.37    Output from water heater (annual):2   1743.0669   (64)  Heat gains from water heating, kWh/month 0.25 ' [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]    (65)m= 72.3   63.94   67.67   61.37   60.66   54.94   53.47   57.7   57.29   63.6   66.36   70.8   (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). Watts  Metabolic gains (Table 5), Watts  Metabolic gains (123.35   123.35
Resign   173.88   152.96   159.95   142.42   138.87   123.08   117.25   129.98   130.16   147.73   157.42   169.37	Company   173.88   152.96   159.95   142.42   138.87   123.08   117.25   129.98   130.16   147.73   157.42   169.37
Compute from water heater   Compute from water heater   Computer    Couput from water heater (annual)  2	
Heat gains from water heating, kWh/morth 0.25 ' [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (65)m 72.3 63.94 67.67 61.37 60.86 54.94 53.47 57.7 57.29 63.6 66.36 70.8 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating    Summary   Heat gains from water heating, kWh/month 0.25 ′ [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (65)m=	
(65)m    72.3   63.94   67.67   61.37   60.66   54.94   53.47   57.7   57.29   63.6   66.36   70.8   (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):	(65)m= 72.3 63.94 67.67 61.37 60.66 54.94 53.47 57.7 57.29 63.6 66.36 70.8 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating  5. Internal gains (see Table 5 and 5a):  Metabolic gains (Table 5), Watts  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (66)m= 123.35
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    Same	include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating  5. Internal gains (see Table 5 and 5a):  Metabolic gains (Table 5), Watts  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (66)m= 123.35 123
Metabolic gains (Table 5), Watts	Metabolic gains (Table 5), Watts   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
Metabolic gains (Table 5), Watts    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec	Metabolic gains (Table 5), Watts    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec     123.35	Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
Cooling pains (calculated in Appendix L, equation L9 or L9a), also see Table 5	Cooking gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5  (67)	Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5  (67)m= 41.24  36.63  29.79  22.55  16.86  14.23  15.38  19.99  26.83  34.07  39.76  42.38  (67)  Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5  (68)m= 268.06  270.84  263.83  248.91  230.07  212.37  200.54  197.76  204.77  219.69  238.53  256.24  (68)  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69)m= 49.39  49.
(67) m=	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5  (68)mi= 268.06 270.84 263.83 248.91 230.07 212.37 200.54 197.76 204.77 219.69 238.53 256.24 (68)  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69)mi= 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 (69)  Pumps and fans gains (Table 5a)  (70)mi= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68)m= 268.06 270.84 263.83 248.91 230.07 212.37 200.54 197.76 204.77 219.69 238.53 256.24  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m= 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 (69)  Pumps and fans gains (Table 5a) (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
(68)m= 268.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69)m= 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 (69)  Pumps and fans gains (Table 5a)  (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69)m= 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 (69)  Pumps and fans gains (Table 5a)  (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
(69)m= 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 (69)  Pumps and fans gains (Table 5a)  (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(69)m = 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 (69)  Pumps and fans gains (Table 5a)  (70)m = 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Pumps and fans gains (Table 5a) (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Pumps and fans gains (Table 5a)  (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Common	(70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Losses e.g. evaporation (negative values) (Table 5) (71)m=	Losses e.g. evaporation (negative values) (Table 5)  (71)m=
Water heating gains (Table 5)  (72)m= 97.17 95.15 90.95 85.24 81.53 76.3 71.86 77.55 79.57 85.49 92.16 95.16 (72)  Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m= 496.98 493.13 475.08 447.2 418.96 393.41 378.29 385.81 401.68 429.75 460.96 484.28 (73)  6. Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Table 6d m2 Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 6.12 x 47.32 x 0.76 x 0.7 = 213.73 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 348.58 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 474.73 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 4474.73 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)	(71)m=
Water heating gains (Table 5)  (72)m= 97.17 95.15 90.95 85.24 81.53 76.3 71.86 77.55 79.57 85.49 92.16 95.16 (72)  Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m  (73)m= 496.98 493.13 475.08 447.2 418.96 393.41 378.29 385.81 401.68 429.75 460.96 484.28 (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 Table 6b Table 6c (W)  South 0.9x 0.77 x 6.12 x 47.32 x 0.76 x 0.7 = 213.73 (78)  South 0.9x 0.77 x 6.12 x 77.18 x 0.76 x 0.7 = 348.58 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 4425.64 (78)  South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 4490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 491.81 (78)	Water heating gains (Table 5)  (72)m= 97.17 95.15 90.95 85.24 81.53 76.3 71.86 77.55 79.57 85.49 92.16 95.16 (72)  Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m  (73)m= 496.98 493.13 475.08 447.2 418.96 393.41 378.29 385.81 401.68 429.75 460.96 484.28 (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 Area Flux g_ FF Gains
Total internal gains =   G66)m + (67)m + (68)m + (70)m + (71)m + (72)m	(72)m= 97.17 95.15 90.95 85.24 81.53 76.3 71.86 77.55 79.57 85.49 92.16 95.16         Total internal gains =
Total internal gains =	Total internal gains =
(73)m= 496.98 493.13 475.08 447.2 418.96 393.41 378.29 385.81 401.68 429.75 460.96 484.28 (73)  6. Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Table 6d m² Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 6.12 x 47.32 x 0.76 x 0.7 = 213.73 (78)  South 0.9x 0.77 x 6.12 x 77.18 x 0.76 x 0.7 = 348.58 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 474.73 (78)  South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)	(73)m= 496.98 493.13 475.08 447.2 418.96 393.41 378.29 385.81 401.68 429.75 460.96 484.28 (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 Area Flux g_ FF Gains
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         Table 6b         Table 6c         (W)           South 0.9x 0.77	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 Area Flux g_ FF 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	Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Area Flux g_ FF Gains
Orientation:         Access Factor Table 6d         Area m²         Flux Table 6a         g_ Table 6b         FF Table 6c         Gains (W)           South 0.9x 0.77	Orientation: Access Factor Area Flux g_ FF Gains
Table 6d m <sup>2</sup> Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 6.12 x 47.32 x 0.76 x 0.7 = 213.73 (78)  South 0.9x 0.77 x 6.12 x 77.18 x 0.76 x 0.7 = 348.58 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 474.73 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.9 x 0.76 x 0.7 = 491.81 (78)	<b>5</b>
South       0.9x       0.77       x       6.12       x       47.32       x       0.76       x       0.7       =       213.73       (78)         South       0.9x       0.77       x       6.12       x       77.18       x       0.76       x       0.7       =       348.58       (78)         South       0.9x       0.77       x       6.12       x       94.25       x       0.76       x       0.7       =       425.64       (78)         South       0.9x       0.77       x       6.12       x       105.11       x       0.76       x       0.7       =       474.73       (78)         South       0.9x       0.77       x       6.12       x       108.55       x       0.76       x       0.7       =       490.24       (78)         South       0.9x       0.77       x       6.12       x       108.9       x       0.76       x       0.7       =       491.81       (78)	Table 6d m <sup>2</sup> Table 6a Table 6b Table 6c (W)
South       0.9x       0.77       x       6.12       x       77.18       x       0.76       x       0.7       =       348.58       (78)         South       0.9x       0.77       x       6.12       x       94.25       x       0.76       x       0.7       =       425.64       (78)         South       0.9x       0.77       x       6.12       x       105.11       x       0.76       x       0.7       =       474.73       (78)         South       0.9x       0.77       x       6.12       x       108.55       x       0.76       x       0.7       =       490.24       (78)         South       0.9x       0.77       x       6.12       x       108.9       x       0.76       x       0.7       =       491.81       (78)	
South       0.9x       0.77       x       6.12       x       94.25       x       0.76       x       0.7       =       425.64       (78)         South       0.9x       0.77       x       6.12       x       105.11       x       0.76       x       0.7       =       474.73       (78)         South       0.9x       0.77       x       6.12       x       108.55       x       0.76       x       0.7       =       490.24       (78)         South       0.9x       0.77       x       6.12       x       108.9       x       0.76       x       0.7       =       491.81       (78)	South $0.9x$ 0.77 x 6.12 x 47.32 x 0.76 x 0.7 = 213.73 (78)
South       0.9x       0.77       x       6.12       x       105.11       x       0.76       x       0.7       =       474.73       (78)         South       0.9x       0.77       x       6.12       x       108.55       x       0.76       x       0.7       =       490.24       (78)         South       0.9x       0.77       x       6.12       x       108.9       x       0.76       x       0.7       =       491.81       (78)	South $0.9x$ $0.77$ $\times$ $6.12$ $\times$ $77.18$ $\times$ $0.76$ $\times$ $0.7$ = $348.58$ $(78)$
South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78) South 0.9x 0.77 x 6.12 x 108.9 x 0.76 x 0.7 = 491.81 (78)	South $0.9x$ 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)
South 0.9x 0.77 x 6.12 x 108.9 x 0.76 x 0.7 = 491.81 (78)	South $0.9x$ 0.77 $\times$ 6.12 $\times$ 105.11 $\times$ 0.76 $\times$ 0.7 = 474.73 (78)
	South $0.9x$ $0.77$ $\times$ $6.12$ $\times$ $108.55$ $\times$ $0.76$ $\times$ $0.7$ $=$ $490.24$ $(78)$
South 0.9x 0.77 x 6.12 x 107.14 x 0.76 x 0.7 = 483.86 (78)	South 0.9x 0.77 x 6.12 x 108.9 x 0.76 x 0.7 = 491.81 (78)
0.17 X 0.12 X 107.14 X 0.70 X 0.71	South 0.9x 0.77 x 6.12 x 107.14 x 0.76 x 0.7 = 483.86 (78)
South 0.9x 0.77 x 6.12 x 103.88 x 0.76 x 0.7 = 469.16 (78)	

South	0.9x	0.77	Х	6.1	2	x	9	9.99	x		0.76	х	0.7	=	451.59	(78)
South	0.9x	0.77	x	6.1	2	X	8	5.29	х		0.76	_ x _	0.7		385.2	(78)
South	0.9x	0.77	X	6.1	2	x	5	6.07	х		0.76	_ x _	0.7	=	253.22	(78)
South	0.9x	0.77	x	6.1	2	x	4	0.89	x		0.76	_ x _	0.7		184.67	(78)
	_								•							
Solar g	ains in	watts, ca	alculated	for eacl	h month				(83)m	ı = Sı	um(74)m .	(82)m				
<b>~</b>	213.73	348.58	425.64	474.73	490.24		91.81	483.86	469	.16	451.59	385.2	253.22	184.67		(83)
Total ga	ains – ii	nternal a	nd sola	(84)m =	= (73)m	+ (8	83)m	, watts					•		•	
(84)m=	710.71	841.71	900.72	921.93	909.21	8	85.22	862.15	854	.97	853.27	814.95	714.18	668.96		(84)
7. Mea	an inter	nal temp	erature	(heating	season	)										
				eriods ir			area f	from Tab	ole 9.	. Th	1 (°C)				21	(85)
•		_	•	living are		_				,	( )					` ′
Γ	Jan	Feb	Mar	Apr	May	È	Jun	Jul	Α	ug	Sep	Oct	Nov	Dec	]	
(86)m=	0.97	0.94	0.88	0.82	0.69	⊢	0.51	0.34	0.3	Ť	0.55	0.79	0.94	0.97		(86)
` ′ L				<u> </u>				<u> </u>		!			1			, ,
Г				living are		_			T			00.00	L 00 40		1	(07)
(87)m=	20.23	20.43	20.64	20.8	20.93		0.99	21	2	1	20.98	20.86	20.48	20.22		(87)
Tempe	erature	during h	eating p	eriods ir	rest of	dw	elling	from Ta	able 9	9, Tł	n2 (°C)			•	1	
(88)m=	19.95	19.95	19.95	19.96	19.96	1	9.96	19.96	19.	96	19.96	19.96	19.95	19.95		(88)
Utilisa	tion fac	tor for g	ains for	rest of d	welling,	h2,	m (se	ee Table	9a)					_		
(89)m=	0.96	0.92	0.86	0.78	0.63	(	0.43	0.26	0.2	26	0.47	0.74	0.92	0.96		(89)
Mean	interna	l temper	ature in	the rest	of dwell	ina	T2 (f	ollow ste	ns 3	to 7	in Tabl	e 9c)				
(90)m=	18.97	19.26	19.54	19.74	19.9	Ť	9.95	19.96	19.		19.95	19.82	19.34	18.96	1	(90)
` '   L											f	LA = Livin	g area ÷ (4	<u>1</u> 4) =	0.64	(91)
			-1 (5			ne .		A T4	. /4		A) TO					
(92)m=	19.77	20.01	20.25	or the wh	20.56	$\overline{}$	g) = 11 20.61	20.62	+ (1 20.		A) × 12 20.61	20.48	20.07	19.76	1 —	(92)
` ′				internal		_							20.07	19.70		(32)
(93)m=	19.77	20.01	20.25	20.41	20.56	т —	0.61	20.62	20.		20.61	20.48	20.07	19.76	1	(93)
		ting requ			20.00		.0.01	20.02			20.01	20.40	20.07	10.70		()
				mperatui	e obtair	ned	at ste	en 11 of	Tabl	e 9h	so tha	t Ti m=(	76)m an	d re-calc	culate	
				using Ta			ai oi	op o.	1 00	0 0.	, 00 1110	, (	. 0, a	a ro oare	Jaiato	
	Jan	Feb	Mar	Apr	May		Jun	Jul	Α	ug	Sep	Oct	Nov	Dec		
Utilisa	tion fac	tor for g	ains, hm	1:											-	
(94)m=	0.96	0.92	0.87	0.8	0.66	(	0.48	0.31	0.3	31	0.52	0.77	0.93	0.96		(94)
Useful	gains,	hmGm ,	W = (9	4)m x (84	4)m										,	
(95)m=	681.35	775.3	779.99	735.35	603.38	4:	27.99	268.04	268	.01	447.01	624.17	662.12	644.41		(95)
	ly aver	age exte		perature	from T	abl	e 8								1	
(96)m=	4.5	5	6.8	8.7	11.7	Ľ	14.6	16.9	16	.9	14.3	10.8	7	4.9		(96)
				al tempe		_			<del>- ` `</del>	_	· <i>′</i>		,	ı	1	
` ' L		1094.47	980.46	849.83	640.68		34.29	268.57	268		456.49	702.4	950.49	1083.85		(97)
. г				r each n		Wh			_	Ť	<u> </u>	<u> </u>	<del></del>		1	
(98)m=	323.93	214.49	149.15	82.42	27.75	L	0	0	0		0	58.2	207.63	326.94		_
										Total	l per year	(kWh/yea	r) = Sum(9	8) <sub>15,912</sub> =	1390.5	(98)
Space	heatin	g require	ement in	kWh/m²	?/year										22.19	(99)

9a. Energy requirements – Individual h	eating systems	including	micro-C	CHP)					
Space heating:	<u> </u>	J		,					7(004)
Fraction of space heat from secondar		•	(202) = 1 -	(201) -				0	(201)
Fraction of space heat from main sys	, ,		` /	` '	(202)]			1	(202)
Fraction of total heating from main sy			(204) = (204)	02) <b>x</b> [1 –	(203)] =			1	(204)
Efficiency of main space heating system		··· 0/						93.3	(206)
Efficiency of secondary/supplementar				_		1		0	(208)
Jan Feb Mar Apr Space heating requirement (calculate	May Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/y	ear
323.93 214.49 149.15 82.42	27.75 0	0	0	0	58.2	207.63	326.94		
(211)m = {[(98)m x (204)] + (210)m } x	100 ÷ (206)	1				<u> </u>			(211)
347.19 229.89 159.86 88.34	29.74 0	0	0	0	62.37	222.54	350.42		(= · · )
	!!		Tota	I (kWh/yea	ar) =Sum(2	211) <sub>15,1012</sub>	=	1490.36	(211)
Space heating fuel (secondary), kWh	/month						!		
= {[(98)m x (201)] + (214) m } x 100 ÷ (	<del>'                                    </del>	1			1	i	1	I	
(215)m= 0 0 0 0	0 0	0	0 Tota	0	0	0	0	_	
Matau haatin a			Tota	i (Kvvii/yea	ar) =Surri(2	215) <sub>15,1012</sub>	.=	0	(215)
Water heating Output from water heater (calculated a	hove)								
173.88 152.96 159.95 142.42	138.87 123.08	117.25	129.98	130.16	147.73	157.42	169.37		
Efficiency of water heater								79.6	(216)
(217)m= 86.25 85.51 84.43 83.21	81.2 79.6	79.6	79.6	79.6	82.36	85.35	86.34		(217)
Fuel for water heating, kWh/month									
$(219)$ m = $(64)$ m x $(100 \div (217)$ m $(219)$ m = $(219)$	171.01 154.62	147.3	163.29	163.52	179.37	184.44	196.17		
			Tota	I = Sum(2:	19a) <sub>112</sub> =		ļ.	2100.79	(219)
Annual totals					k'	Wh/year	r	kWh/yea	ar_
Space heating fuel used, main system	1							1490.36	
Water heating fuel used								2100.79	
Electricity for pumps, fans and electric	keep-hot								
central heating pump:							130		(230
boiler with a fan-assisted flue							45		(230
Total electricity for the above, kWh/yea	ar		sum	of (230a).	(230g) =	:		175	(231)
Electricity for lighting								291.31	(232)
10a. Fuel costs - individual heating sy	rstems:								
		<b>uel</b> Wh/year			Fuel P (Table			Fuel Cos £/year	t
Space heating - main system 1	(2	11) x			3.	1	x 0.01 =	46.2011	(240)
Space heating - main system 2	(2	13) x			0		x 0.01 =	0	(241)
Space heating - secondary	(2	15) x			0		x 0.01 =	0	(242)
Water heating cost (other fuel)	(2	19)			3.	1	x 0.01 =	65.12	(247)
								<u> </u>	

Pumps, fans and electric keep-hot	(231)	11.46 × 0.01 =	20.06 (249)
(if off-peak tariff, list each of (230a) to (230g) sep			
Energy for lighting	(232)	11.46 × 0.01 =	33.30 (200)
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254) a	as needed		
	47) + (250)(254) =		270.7652 (255)
11a. SAP rating - individual heating systems			
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF) [(255) x (	256)] ÷ [(4) + 45.0] =		1.1821 (257)
SAP rating (Section 12)			83.5104 (258)
12a. CO2 emissions – Individual heating syster	ms including micro-CHP		
	Energy	<b>Emission factor</b>	<b>Emissions</b>
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating (main system 1)	(211) x	0.198 =	295.09 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Water heating	(219) x	0.198	415.96 (264)
Space and water heating	(261) + (262) + (263) + (263)	64) =	711.05 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517 =	90.48 (267)
Electricity for lighting	(232) x	0.517 =	150.61 (268)
Total CO2, kg/year		sum of (265)(271) =	952.13 (272)
CO2 emissions per m²		(272) ÷ (4) =	15.2 (273)
El rating (section 14)			88 (274)
13a. Primary Energy			
	Energy	Primary	P. Energy
	kWh/year	factor	kWh/year
Space heating (main system 1)	(211) x	1.02 =	1520.16 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Energy for water heating	(219) x	1.02 =	2142.81 (264)
Space and water heating	(261) + (262) + (263) + (263)	64) =	3662.97 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92 =	511 (267)
Electricity for lighting	(232) x	0 =	850.64 (268)
'Total Primary Energy		sum of (265)(271) =	5024.61 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	80.19 (273)

Passivhaus SAP 2009 Worksheets for 1 to 5 Bedroom

				5							
_				User D							
Assessor Name:	0. 50		_		Strom						
Software Name:	Stroma FS	AP 200			Softwa				Versio	n: 1.5.0.49	
A dalace c			Р	roperty.	Address	: House	1				
Address: 1. Overall dwelling dime	ensions:										
1. Overall awelling airlie	71310113.			Area	a(m²)		Ave He	eight(m)		Volume(m³	*)
Ground floor						(1a) x		2.5	(2a) =	187.5	(3a)
First floor					75	(1b) x	2	2.5	(2b) =	187.5	(3b)
Total floor area TFA = (1a	a)+(1b)+(1c)+	(1d)+(1e)	)+(1r	n)	150	(4)			J .		
Dwelling volume						(3a)+(3b	)+(3c)+(3d	l)+(3e)+	.(3n) =	375	(5)
2. Ventilation rate:											
	main heating		econdar eating	ry	other		total			m³ per hou	r
Number of chimneys	0	] + [	0	+	0	= [	0	X 4	40 =	0	(6a)
Number of open flues	0	+	0	+	0	] = [	0	x 2	20 =	0	(6b)
Number of intermittent fa	ns						0	<b>x</b>	10 =	0	(7a)
Number of passive vents							0	x	10 =	0	(7b)
Number of flueless gas fi	res					Ī	0	x 4	40 =	0	(7c)
_									Air ob	anges nor he	
Infiltration due to object on	(a. fl., a. a. a. d. f.	(6)	s) . (6b) . (7	70) ( (7b) ( (	70) -			_		anges per ho	_
Infiltration due to chimne	7					continue fr	0 om (9) to (		÷ (5) =	0	(8)
Number of storeys in the								ĺ .		0	(9)
Additional infiltration								[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or	timber f	rame or	0.35 fo	r masoni	ry constr	ruction			0	(11)
if both types of wall are pa deducting areas of openir			oonding to	the great	er wall are	a (after					
If suspended wooden f			ed) or 0	.1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, en	ter 0.05, else	enter 0								0	(13)
Percentage of windows	s and doors dr	aught sti	ripped							0	(14)
Window infiltration					0.25 - [0.2	2 x (14) ÷ 1	00] =			0	(15)
Infiltration rate					(8) + (10)	+ (11) + (1	12) + (13) -	+ (15) =		0	(16)
Air permeability value,	q50, expresse	ed in cub	ic metre	s per ho	our per s	quare m	etre of e	nvelope	area	0.6	(17)
If based on air permeabil	ity value, then	(18) = [(17	7) ÷ 20]+(8	8), otherwi	ise (18) = (	(16)				0.03	(18)
Air permeability value applie		on test has	been dor	ne or a deg	gree air pe	rmeability	is being us	sed			_
Number of sides on which Shelter factor	h sheltered				(20) = 1 -	[0 075 x (1	19)1 =			0	(19)
Infiltration rate incorporat	ing shelter fac	tor			(20) = 1 (21) = (18)	•	*/1			0.03	(20)
Infiltration rate modified for	-					•				3.00	
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	eed from Tabl	e 7		-	•	-	•	-	•	•	
(22)m= 5.4 5.1	5.1 4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1		

Wind Factor (2 (22a)m= 1.35	2a)m =	(22)m ÷	4	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27	1	
(224)111- 1.55	1.21	1.27	1.12	1.02	0.50	0.02	0.02	1.00	1.12	1.2	1.27	l	
Adjusted infiltra		<u> </u>	<del></del>			<u> </u>	<u> </u>	<u> </u>	T			1	
0.04 Calculate effec	0.04	0.04 Change i	0.03	0.03 he appli	0.03 cable ca	0.03	0.03	0.03	0.03	0.04	0.04	]	
If mechanica		_	ate for ti	пс арріп	babic ca	30						0.5	(23a)
If exhaust air he	at pump ι	using Appe	endix N, (2	3b) = (23a	ı) × Fmv (e	equation (N	√5)) , othe	wise (23b	) = (23a)			0.5	(23b)
If balanced with	heat reco	very: effic	iency in %	allowing f	or in-use f	actor (from	n Table 4h	) =				77.35	(23c)
a) If balance	d mecha	anical ve	ntilation	with hea	at recove	ery (MVI	-IR) (24ε	m = (22)	2b)m + (	23b) × [	1 – (23c)	÷ 100]	
(24a)m= 0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15		(24a)
b) If balance	d mecha	anical ve	ntilation	without	heat red	covery (N	ЛV) (24b	)m = (22	2b)m + (	23b)			
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If whole ho				•									
if (22b)m		<u> </u>	<u> </u>	, ,	<u> </u>	<u> </u>	<u> </u>	<u> </u>	· ` `	<del></del>		1	(240)
(24c)m= 0	0	0	0	0	0	0	0	0	0	0	0	j	(24c)
d) If natural v if (22b)m									0.5]				
(24d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effective air	change	rate - er	iter (24a	or (24b	o) or (24	c) or (24	d) in box	(25)					
(25)m= 0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15		(25)
3. Heat losses	s and he	eat loss	paramete	er:									
ELEMENT	Gros	ss	Openin	_	Net Ar		U-valu		AXU		k-value		ΑΧk
	area	(m²)	m	2	A ,r		W/m2	K	(W/I	K)	kJ/m²-l	K	kJ/K
Doors					2	X	1.2	= \	2.4	닉			(26)
Windows					6.25	=	/[1/( 0.8 )+	0.04] = [	4.84	ᆗ ,			(27)
Floor Type 1					75	X	0.15	=	11.25	닠 !		⊣	(28)
Floor Type 2					75	X	0.15	=	11.25	<u> </u>		⊣	(28)
Walls	150.	18	14.5	_	135.6	8 X	0.15	=	20.35				(29)
Roof	. 75		0		75			=		_ ;		┥	
Total area of el						X	0.15	= [	11.25				(30)
			<i>.</i>		375.1	8						j	(30)
* for windows and ** include the area	roof windo	ows, use e			375.1	8				as given in	paragraph	13.2	
	roof windo	ows, use e sides of in	nternal wall		375.1	8 ated using		I		as given in	paragraph	66.19	
** include the area	roof windo s on both s, W/K =	ows, use e sides of in = S (A x	nternal wall		375.1	8 ated using	formula 1.	/[(1/U-valu + (32) =					(31)
** include the area Fabric heat los	roof windons on both s, W/K = Cm = S(	ows, use e sides of in = S (A x (A x k )	iternal wall U)	ls and part	375.1 alue calcul titions	8 lated using	formula 1.	/[(1/U-valu + (32) = ((28)	ie)+0.04] a	2) + (32a).		66.19	(31)
** include the area Fabric heat los Heat capacity (	roof windons on both s, W/K = Cm = S( parame	ows, use e sides of in = S (A x (A x k ) ter (TMF ere the de	oternal wall U) $P = Cm \div tails of the$	's and part - TFA) ir	375.1 alue calcul titions	8 lated using	g formula 1.	/[(1/U-valu + (32) = ((28) Indica	.(30) + (32) tive Value	2) + (32a). : High	(32e) =	66.19	(31)
** include the area Fabric heat los Heat capacity ( Thermal mass For design assess.	roof windons on both s, W/K = Cm = S( parame ments who	ows, use e sides of in = S (A x (A x k ) ter (TMF ere the de tailed calcu	oternal wall U) P = Cm ÷ tails of the	s and part	375.1 alue calcul ititions  n kJ/m²K ion are not	8 lated using	g formula 1.	/[(1/U-valu + (32) = ((28) Indica	.(30) + (32) tive Value	2) + (32a). : High	(32e) =	66.19	(31)
** include the area Fabric heat los Heat capacity ( Thermal mass For design assess can be used instea Thermal bridge if details of therma	roof windows on both s, W/K = Cm = S( parame ments whe ad of a det es : S (L	ows, use e sides of in = S (A x (A x k ) ter (TMF ere the de tailed calcu x Y) calc	eternal wall U) $P = Cm \div tails of the ulation.$ culated t	s and part - TFA) ir constructi	375.1 alue calcul titions  kJ/m²K tion are not	8 lated using	g formula 1.	/[(1/U-valu + (32) = ((28) Indica	.(30) + (32) tive Value	2) + (32a). : High	(32e) =	66.19 40329.198 450 16.51	(31) (33) (6 (34) (35) (36)
** include the area Fabric heat los Heat capacity ( Thermal mass For design assess can be used instea Thermal bridge if details of therma Total fabric hea	roof windons on both s, W/K = Cm = S( parame ments who ad of a det es : S (L al bridging at loss	ows, use e sides of in = S (A x (A x k ) ter (TMF ere the de tailed calcu x Y) calcu are not kn	oternal wall U) $P = Cm \div tails of the ulation.$ $culated to cown (36) = 0$	- TFA) ir constructi using Ap	375.1 alue calcul titions  kJ/m²K tion are not	8 lated using	g formula 1.	/[(1/U-value) + (32) = ((28) Indicate indicative) (33) +	.(30) + (32) tive Value e values of	2) + (32a). : High : TMP in Ta	(32e) =	66.19 40329.198 450	(31) (33) (6 (34) (35)
** include the area Fabric heat los Heat capacity ( Thermal mass For design assess can be used instea Thermal bridge if details of therma	roof windons on both s, W/K = Cm = S( parame ments who ad of a det es : S (L al bridging at loss	ows, use e sides of in = S (A x (A x k ) ter (TMF ere the de tailed calcu x Y) calcu are not kn	ternal wall U) $P = Cm \div tails of the valuation. culated unit own (36) =$	s and part - TFA) ir constructi using Ap = 0.15 x (3	375.1 alue calcul titions  kJ/m²K tion are not	8 lated using	(26)(30)	/[(1/U-valu + (32) = ((28) Indica e indicative (33) + (38)m	.(30) + (32) tive Value	2) + (32a). : High : TMP in Ta	(32e) =	66.19 40329.198 450 16.51	(31) (33) (6 (34) (35) (36)
** include the area Fabric heat los Heat capacity ( Thermal mass For design assess can be used instea Thermal bridge if details of therma Total fabric hea Ventilation hea	roof windons on both s, W/K = Cm = S( parame ments whe ad of a det es : S (L of bridging at loss at loss ca	ows, use e sides of in S (A x A x k ) ter (TMF ere the de tailed calcu x Y) calcu are not kn	oternal wall U) $P = Cm \div tails of the ulation.$ $culated to cown (36) = 0$	- TFA) ir constructi using Ap	375.1 alue calcul titions  n kJ/m²K fon are not spendix l	8 ated using	g formula 1.	/[(1/U-value) + (32) = ((28) Indicate indicative) (33) +	.(30) + (32) tive Value e values of (36) = = 0.33 × (	2) + (32a). : High : <i>TMP in Ta</i> (25)m x (5)	(32e) =	66.19 40329.198 450 16.51	(31) (33) (6 (34) (35) (36)
** include the area Fabric heat los Heat capacity ( Thermal mass For design assess can be used instea Thermal bridge if details of therma Total fabric hea Ventilation hea	roof windows on both s, W/K = Cm = S( parame ments whe ad of a det es : S (L al bridging at loss tt loss ca Feb 18.75	ows, use e sides of interest in the detailed calculated Mar 18.75	ternal wall U) P = Cm ÷ tails of the ulation. culated to own (36) =	- TFA) ir constructi using Ap = 0.15 x (3	375.1 alue calcul titions  kJ/m²K fon are not spendix I	8 ated using t known pro	(26)(30) recisely the	/[(1/U-value) + (32) = ((28) Indicate indicative) (33) + (38)m Sep 17.91	.(30) + (32) tive Value e values of  (36) = = 0.33 × (  Oct	2) + (32a). : High : TMP in Ta 25)m x (5) Nov 18.47	(32e) = able 1f	66.19 40329.198 450 16.51	(31) (33) (6) (34) (35) (36) (37)
** include the area Fabric heat los Heat capacity ( Thermal mass For design assess can be used instea Thermal bridge if details of therma Total fabric hea Ventilation hea  [38]m= [19.03]	roof windows on both s, W/K = Cm = S( parame ments whe ad of a det es : S (L al bridging at loss tt loss ca Feb 18.75	ows, use e sides of interest in the detailed calculated Mar 18.75	ternal wall U) P = Cm ÷ tails of the ulation. culated to own (36) =	- TFA) ir constructi using Ap = 0.15 x (3	375.1 alue calcul titions  kJ/m²K fon are not spendix I	8 ated using t known pro	(26)(30) recisely the	/[(1/U-value) + (32) = ((28) Indicate indicative) (33) + (38)m Sep 17.91	.(30) + (32) tive Value e values of  (36) = = 0.33 × ( Oct 18.19	2) + (32a). : High : TMP in Ta 25)m x (5) Nov 18.47	(32e) = able 1f	66.19 40329.198 450 16.51	(31) (33) (6) (34) (35) (36) (37)

eat lo	ss para	meter (F	ILP), W/	/m²K		•			(40)m	= (39)m ÷	(4)			
0)m=	0.68	0.68	0.68	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.68		_
ımha	r of day	e in mor	nth (Tabl	(د1 ما					/	Average =	Sum(40) <sub>1</sub> .	12 /12=	0.67	(4
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1)m=	31	28	31	30	31	30	31	31	30	31	30	31		(4
L														
. Wa	ter heat	ing ener	gy requi	irement:								kWh/ye	ear:	
sume	ed occu	pancy. I	N								2.0	342		(-
if TF	A > 13.9	, N = 1		[1 - exp	(-0.0003	849 x (TF	A -13.9	)2)] + 0.0	0013 x (	ΓFA -13.		012		`
	A £ 13.9	•	iter usad	ne in litre	s per da	av Vd av	erage =	(25 x N)	+ 36		100	3547		(-
duce t	the annua	l average	hot water	usage by	5% if the a	lwelling is	designed t	o achieve		se target o		3347		
· more				r day (all w				A	0	0-4	Nierr	Date		
t wate	Jan er usage in	Feb litres per	Mar day for ea	Apr ach month	May Vd,m = fa	Jun ctor from 7	Jul Fable 1c x	Aug (43)	Sep	Oct	Nov	Dec		
)m= [	120.29	115.92	111.54	107.17	102.79	98.42	98.42	102.79	107.17	111.54	115.92	120.29		
· L				I						Γotal = Su	l m(44) <sub>112</sub> =		1312.2566	
ergy c	content of	hot water	used - cal	culated mo	onthly = 4.	190 x Vd,r	n x nm x E	Tm / 3600	kWh/mon	th (see Ta	ables 1b, 1	c, 1d)		
)m= [	178.81	156.39	161.38	140.7	135	116.5	107.95	123.88	125.35	146.09	159.47	173.17		_
nstanta	aneous w	ater heatii	ng at point	of use (no	hot water	storage).	enter 0 in	boxes (46)		Total = Su	m(45) <sub>112</sub> =		1724.6917	
	26.82	23.46	24.21	21.1	20.25	17.47	16.19	18.58	18.8	21.91	23.92	25.98		(
	storage													·
If ma	anufactu	rer's de	clared lo	oss facto	r is knov	vn (kWh	/day):				0.0	)24		(
			m Table								0.	54		(
•			_	e, kWh/ye nder loss		e not kna		(47) x (48)	=		0.0	013		(
			•	ng any s								0		(
If com	nmunity he	ating and	no tank in	dwelling,	enter 110	litres in bo	x (50)							
Other	wise if no	stored ho	t water (thi	is includes	instantan	eous comb	oi boilers)	enter '0' in	box (50)					
t wat	ter stora	age loss	factor fr	om Tabl	e 2 (kWl	h/litre/da	y)					0		(
	e factor f			Oh								0		(
			m Table					((50) (54	) (50) (	(EQ)		0		(
0,	10st froi 49) or (5		•	, kWh/ye	ear			((50) x (51	) x (52) x (	(53) =		0		(
,	, ,	, ,	,	for each	month			((56)m = (	55) × (41)r	m	0.0	713		(
s)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(
· L	r contains	dedicated	d solar sto	rage, (57)	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (57	7)m = (56)	m where (	I H11) is fro	m Append	x H	
)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(
mar\	v circuit	loss (an	nual) fro	om Table	9.3	•					3(	60		(
-		•	•			59)m = (	58) ÷ 36	55 × (41)	m					
(mod	lified by	factor fr	om Tabl	le H5 if t	here is s	solar wat	er heatii	ng and a	cylinde	r thermo	stat)			
	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		(
)m=				•										
L	loss cal	culated	for each	month (	(61)m =	(60) ÷ 36	65 × (41)	)m						

Total heat required for water I	heating calcul	lated for e	ach month	(62)m =	= 0.85 × (	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m= 209.79 184.37 192.36	<del></del>	5.98 146.4		154.85	155.33	177.07	189.45	204.15		(62)
Solar DHW input calculated using Ap	pendix G or App	endix H (neg	ative quantit	y) (enter 'C	' if no sola	r contribut	ion to wate	er heating)		
(add additional lines if FGHRS	S and/or WWI	HRS appli	es, see Ap	pendix (	G)					
(63)m= 0 0 0	0	0 0	0	0	0	0	0	0		(63)
Output from water heater			•			•			•	
(64)m= 209.79 184.37 192.36	170.67 165	5.98 146.4	7 138.93	154.85	155.33	177.07	189.45	204.15		
		•	•	Out	out from w	ater heate	r (annual)₁	12	2089.4221	(64)
Heat gains from water heating	g, kWh/month	0.25 ′ [0.	35 × (45)m	n + (61)n	n] + 0.8 x	k [(46)m	+ (57)m	+ (59)m	]	
(65)m= 84.24 74.38 78.44	70.76 69	.67 62.7	2 60.68	65.97	65.66	73.36	77.01	82.36		(65)
include (57)m in calculation	of (65)m only	y if cylinde	r is in the	dwelling	or hot w	ater is f	om com	munity h	leating	
5. Internal gains (see Table	5 and 5a):									
Metabolic gains (Table 5), Wa	atts									
Jan Feb Mar		/lay Jui	n Jul	Aug	Sep	Oct	Nov	Dec		
(66)m= 176.05 176.05 176.05	176.05 176	6.05 176.0	5 176.05	176.05	176.05	176.05	176.05	176.05		(66)
Lighting gains (calculated in A	Appendix L, e	quation L9	or L9a), a	also see	Table 5				•	
(67)m= 87.69 77.88 63.34	47.95 35	.84 30.2	32.7	42.5	57.05	72.43	84.54	90.12		(67)
Appliances gains (calculated	in Appendix L	, equation	L13 or L1	3a), also	see Ta	ble 5				
(68)m= 478.39 483.36 470.85	444.22 41	0.6 379	357.89	352.93	365.44	392.07	425.69	457.28		(68)
Cooking gains (calculated in /	Appendix L, e	quation L	5 or L15a	), also s	ee Table	5				
(69)m= 55.54 55.54 55.54	55.54 55	55.5	1 55.54	55.54	55.54	55.54	55.54	55.54		(69)
Pumps and fans gains (Table	5a)									
(70)m= 10 10 10	10 1	10 10	10	10	10	10	10	10		(70)
Losses e.g. evaporation (neg	ative values)	(Table 5)		•				•		
(71)m= -117.37 -117.37 -117.37	' -117.37 -11	7.37 -117.	7 -117.37	-117.37	-117.37	-117.37	-117.37	-117.37		(71)
Water heating gains (Table 5)	)	•	•		•	•	•		•	
(72)m= 113.22 110.69 105.43	98.28 93	.64 87.1	81.55	88.67	91.2	98.6	106.95	110.7		(72)
Total internal gains =		. (	66)m + (67)r	n + (68)m	+ (69)m +	(70)m + (7	'1)m + (72)	m	•	
(73)m= 803.52 796.15 763.84	714.67 664	4.31 620.5	9 596.37	608.32	637.91	687.32	741.4	782.33		(73)
6. Solar gains:										
Solar gains are calculated using so	lar flux from Tabl	e 6a and ass	ociated equa	ations to co	onvert to th	ne applicat	ole orientat	ion.		
Orientation: Access Factor	Area		Flux	-	g_ 	_	FF		Gains	
Table 6d	m²		able 6a		able 6b	_	able 6c		(W)	_
South 0.9x 0.77	x 6.25	x	47.32	x	0.76	x	0.7	=	218.09	(78)
South 0.9x 0.77	× 6.25	х	77.18	X	0.76	x	0.7	=	355.69	(78)
South 0.9x 0.77	x 6.25	x	94.25	x	0.76	x	0.7	=	434.33	(78)
	× 6.25	x	105.11	x	0.76	x [	0.7	=	484.41	(78)
South 0.9x 0.77	x 6.25	x	108.55	x	0.76	x	0.7	=	500.25	(78)
South 0.9x 0.77	x 6.25	x	108.9	x	0.76	x	0.7	=	501.85	(78)
South 0.9x 0.77	x 6.25	x	107.14	x	0.76	x	0.7	=	493.74	(78)
South 0.9x 0.77	x 6.25	х	103.88	x	0.76	x	0.7	=	478.74	(78)

South 0.9	0.77	X	6.2	25	x	99.99	X	0.76	x [	0.7	=	460.8	(78)
South 0.9	0.77	X	6.2	25	х	85.29	X	0.76	x	0.7	=	393.06	(78)
South 0.9	0.77	x	6.2	25	x	56.07	X	0.76	х	0.7	=	258.39	(78)
South 0.93	0.77	x	6.2	25	х	40.89	х	0.76	_ x [	0.7	=	188.44	(78)
Solar gains i	n watts, ca	alculated	for eacl	h month			(83)m = 9	Sum(74)m .	(82)m				
(83)m= 218.0	9 355.69	434.33	484.41	500.25	501.85	493.74	478.74	460.8	393.06	258.39	188.44		(83)
Total gains -	- internal a	nd solar	(84)m =	= (73)m -	+ (83)m	, watts	•	•	•	•	•		
(84)m= 1021.6	31 1151.85	1198.17	1199.09	1164.55	1122.44	1090.11	1087.06	1098.71	1080.39	999.8	970.77		(84)
7. Mean int	ernal temp	perature (	(heating	season	)		•	•					
Temperatui	·					from Tal	ble 9 Th	11 (°C)				21	(85)
Utilisation fa	•	•			•		0.0 0, 11	( 0)				21	(00)
Jan	<del></del>	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(86)m= 1	1	0.98	0.95	0.79	0.57	0.38	0.38	0.61	0.91	1	1		(86)
` '		<u> </u>				<u> </u>	ļ		0.01	<u> </u>	<u> </u>		()
Mean interr						<u> </u>	1	1				Ī	(07)
(87)m= 20.73	20.81	20.89	20.96	21	21	21	21	21	20.98	20.83	20.73		(87)
Temperatu	e during h	eating p	eriods ir	rest of	dwellin	g from Ta	able 9, T	h2 (°C)					
(88)m= 20.36	20.36	20.36	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.36	20.36		(88)
Utilisation fa	actor for g	ains for r	est of d	welling, l	n2,m (s	ee Table	9a)						
(89)m= 1	1	0.98	0.92	0.74	0.52	0.32	0.32	0.56	0.87	1	1		(89)
Mean interr	al temper	ature in t	the rest	of dwelli	ng T2 (	follow etc	one 3 to	7 in Tab	lo (9c)				
(90)m= 20.01		20.24	20.32	20.37	20.37	20.37	20.37	20.37	20.35	20.15	20.01		(90)
(00)	1 -0	7	20.02		20.01	1 -0.0.				g area ÷ (4		0.42	(91)
										Ĭ `	,	0.42	(,
Mean interr	<del></del>	<del>`</del>		1		1	<del>'</del>	1			<del></del>		(20)
(92)m= 20.31	ļ.	20.52	20.59	20.63	20.63	20.63	20.63	20.63	20.61	20.44	20.31		(92)
Apply adjus	1	r r				1	1	<del></del>	r e	I aa aa	T 00.40	[	(02)
(93)m= 20.16		20.36	20.44	20.48	20.48	20.48	20.48	20.48	20.46	20.29	20.16		(93)
8. Space he						44 6	Table 0	l	1 T' /	70)	.1	la (a	
Set Ti to the the utilisation					ed at s	tep 11 of	rable 9	b, so tha	it 11,m=(	76)m an	d re-caid	culate	
Jan		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation fa			•			1	1 7.09	1 004		1.101			
(94)m= 1	0.99	0.98	0.92	0.75	0.53	0.33	0.33	0.57	0.87	1	1		(94)
Useful gain	s, hmGm	. W = (94	I)m x (84	ւ 4)m				ļ		!	!		
(95)m= 1020.6	1146.01	1169.77	1108.7	877.33	590.32	359.01	359.01	621.96	943.81	994.81	970.05		(95)
Monthly ave	erage exte	rnal tem	perature	from Ta	able 8				!				
(96)m= 4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9		(96)
Heat loss ra	ate for me	an intern	al tempe	erature,	Lm , W	=[(39)m	x [(93)m	n— (96)m	]	•	•	•	
(97)m= 1593.4	11 1547.87	1376.14	1184.37	882.58	590.37	359.01	359.01	622.09	975	1344.25	1548.26		(97)
Space heat	ing require	ement fo	r each n	nonth, k\	Wh/mor	nth = 0.02	24 x [(97	')m – (95	j)m] x (4	1)m		•	
(98)m= 426.1	6 270.05	153.54	54.49	3.91	0	0	0	0	23.2	251.59	430.19		
							Tota	al per year	(kWh/year	r) = Sum(9	8)15,912 =	1613.13	(98)
Space heat	ing require	ement in	kWh/m²	<sup>2</sup> /vear								10.75	(99)
,	O = 4		, •	,								<u> </u>	<b>」</b> ` ′

9a. Energy requirements – Individual heating	svstems ir	ncludina	micro-C	HP)					
Space heating:	ayotomo n	Tordanig	1111010 0	7 H )					_
Fraction of space heat from secondary/suppl	ementary	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) = (2	02) × [1 –	(203)] =			1	(204)
Efficiency of main space heating system 1								92.9	(206)
Efficiency of secondary/supplementary heating	ng system	ı, %						0	(208)
Jan Feb Mar Apr May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/y	ear
Space heating requirement (calculated above	e)				1	1	1	I	
426.16 270.05 153.54 54.49 3.91	0	0	0	0	23.2	251.59	430.19		
$(211)$ m = {[(98)m x (204)] + (210)m} x 100 ÷ (	206)		i		ı	1	i	ı	(211)
458.73 290.69 165.27 58.65 4.2	0	0	0	0	24.97	270.82	463.07		_
			Tota	I (kWh/yea	ar) =Sum(2	211) <sub>15,1012</sub>	<b>=</b>	1736.41	(211)
Space heating fuel (secondary), kWh/month									
$= \{ [(98)\text{m x } (201)] + (214) \text{ m} \} \text{ x } 100 \div (208) $ $(215)\text{m} =                                   $	0	0	0	0	0	0	0		
						215) <sub>15.101</sub>	_	0	(215)
Water heating				( ( ) ( ) ( )	,	715,1012	2	0	(210)
Output from water heater (calculated above)									
209.79 184.37 192.36 170.67 165.98	146.47	138.93	154.85	155.33	177.07	189.45	204.15		
Efficiency of water heater			7					82.8	(216)
(217)m= 89.31 88.52 87 85.04 83.01	82.8	82.8	82.8	82.8	83.86	88.27	89.39		(217)
Fuel for water heating, kWh/month							-		
$(219)$ m = $(64)$ m x $100 \div (217)$ m (219)m = $234.91$ $208.28$ $221.11$ $200.71$ $199.96$	176.9	167.79	187.02	187.6	211.15	214.61	228.38		
219/11- 254.31 200.20 221.11 200.71 199.90	170.9	107.79		I = Sum(2		214.01	220.30	2438.41	(219)
Annual totals						Wh/yeaı	• •	kWh/yea	<b></b> `
Space heating fuel used, main system 1						y oa.		1736.41	<u>"</u>
Water heating fuel used								2438.41	=
Electricity for pumps, fans and electric keep-h	ot								
							0.40.40	<u> </u>	(220-
mechanical ventilation - balanced, extract or	positive in	iput fror	n outside	9			343.12		(230a
central heating pump:							130		(2300
boiler with a fan-assisted flue							45		(230e
Total electricity for the above, kWh/year			sum	of (230a).	(230g) =	:		518.12	(231)
Electricity for lighting								619.43	(232)
10a. Fuel costs - individual heating systems:									
	Fue	el			Fuel P	rice		Fuel Cost	ŧ
		h/year			(Table			£/year	
Space heating - main system 1	(211	) x			3.	1	x 0.01 =	53.8288	(240)
Space heating - main system 2	(213	3) x			0		x 0.01 =	0	(241)
	(0.15	9					0 . 0.4		

(215) x

Space heating - secondary

(242)

Water heating cost (other fuel)	(219)	3.1 x 0.01 =	75.59 (247)
Pumps, fans and electric keep-hot	(231)	11.46 × 0.01 =	59.38 (249)
(if off-peak tariff, list each of (230a) to (230g) sepa			-
Energy for lighting	(232)	11.46 x 0.01 =	70.99 (250)
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254) as	needed		
Total energy cost (245)(247	() + (250)(254) =		365.7836 (255)
11a. SAP rating - individual heating systems			
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF) [(255) x (25	6)] ÷ [(4) + 45.0] =		0.8816 (257)
SAP rating (Section 12)			87.7012 (258)
12a. CO2 emissions – Individual heating systems	s including micro-CHP		
	<b>Energy</b> kWh/year	Emission factor kg CO2/kWh	<b>Emissions</b> kg CO2/year
Space heating (main system 1)	(211) x	0.198 =	343.81 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Water heating	(219) x	0.198	482.81 (264)
Space and water heating	(261) + (262) + (263) + (264)		826.62 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		
Electricity for lighting	(232) x		
		0.517 = sum of (265)(271) =	320.25 (268)
Total CO2, kg/year		(272) ÷ (4) =	1414.73 (272)
CO2 emissions per m <sup>2</sup>	,	(272) ÷ (4) =	9.43 (273)
El rating (section 14)			90 (274)
13a. Primary Energy			
	<b>Energy</b> kWh/year	Primary factor	<b>P. Energy</b> kWh/year
Space heating (main system 1)	(211) x	1.02	1771.14 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Energy for water heating	(219) x	1.02 =	2487.18 (264)
Space and water heating	(261) + (262) + (263) + (264)	=	4258.32 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	1512.92 (267)
Electricity for lighting	(232) x	0 =	1808.74 (268)
'Total Primary Energy	:	sum of (265)(271) =	7579.99 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	50.53 (273)

			User D	etails:						
Assessor Name:	Stroma FSAP	2000		Strom Softwa				Vorsio	on: 1.5.0.49	
Software Name.	Silonia FSAF			Address				VEISIC	JII. 1.5.0.49	
Address :			oporty /	taarooo	. 110000	•				
1. Overall dwelling dimens	ions:									
			Area	a(m²)	-	Ave He	eight(m)	<u> </u>	Volume(m³)	_
Ground floor			5	6.67	(1a) x	2	2.5	(2a) =	141.675	(3a)
First floor			5	6.67	(1b) x	2	2.5	(2b) =	141.675	(3b)
Total floor area TFA = (1a)-	-(1b)+(1c)+(1d)	+(1e)+(1n	1)	13.34	(4)					
Dwelling volume					(3a)+(3b	)+(3c)+(3d	l)+(3e)+	(3n) =	283.35	(5)
2. Ventilation rate:										_
	main heating	Secondar heating	У	other		total			m³ per hour	•
Number of chimneys		+ 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					F	0	X	10 =	0	(7b)
Number of flueless gas fires	3				ŀ	0	X ·	40 =	0	(7c)
								Air ch	nanges per ho	ur
Infiltration due to chimneys,  If a pressurisation test has been	n carried out or is in				continue fr	0 rom (9) to (		÷ (5) =	0	<u> </u> (8)
Number of storeys in the Additional infiltration	dwelling (ns)						[(0)	-1]x0.1 =	0	(9)
Structural infiltration: 0.25	for steel or tim	ber frame or	0.35 for	· masoni	ry consti	ruction	[(3)	1]X0.1 =	0	(11)
if both types of wall are preso deducting areas of openings,	ent, use the value c	corresponding to			•					<b>」</b> ` ′
If suspended wooden floo	,	•	1 (seale	d), else	enter 0				0	(12)
If no draught lobby, enter									0	(13)
Percentage of windows a Window infiltration	na aoors araug	nt stripped		0.25 - [0.2	2 x (14) ÷ 1	1001 =			0	(14)
Infiltration rate						12) + (13) -	+ (15) =		0	(16)
Air permeability value, q5	0, expressed in	cubic metre	s per ho	ur per s	quare m	etre of e	nvelope	area	0.6	(17)
If based on air permeability	value, then (18)	$=[(17) \div 20]+(8)$	3), otherwi	se (18) = (	(16)				0.03	(18)
Air permeability value applies if		st has been don	e or a deg	gree air pe	rmeability	is being us	sed			7,,5
Number of sides on which s Shelter factor	rieiterea			(20) = 1 -	[0.075 x (1	19)] =			0.92	(19)
Infiltration rate incorporating	shelter factor			(21) = (18					0.92	(21)
Infiltration rate modified for	•	peed								<b>」</b> ' ′
Jan Feb Ma	ar Apr N	/lay Jun	Jul	Aug	Sep	Oct	Nov	Dec	]	
Monthly average wind spee	d from Table 7									
(22) = 5.4 5.1 5.1	1 4 5 1 4	4 20	2.7	2.7	1.2	1.5	1.0		1	

4.5

3.9

3.7

3.7

4.2

4.8

5.1

Wind Factor (22a)m = (22)m ÷ 4	
(22a)m= 1.35 1.27 1.12 1.02 0.98 0.92 0.92 1.05 1.12 1.2 1.27	
Adjusted infiltration rate (allowing for abolton and wind around) (24a) v (22a) v	
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m  0.04	
Calculate effective air change rate for the applicable case	
If mechanical ventilation:  0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)  [If belonded with heat receivery efficiency in (4 ellewing for in use factor (from Table 4b)	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05	(23c)
a) If balanced mechanical ventilation with heat recovery (MVHR) $(24a)m = (22b)m + (23b) \times [1 - (23c) \div 100]$ $(24a)m = 0.14                                   $	(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 0	(24b)
c) If whole house extract ventilation or positive input ventilation from outside	
if $(22b)m < 0.5 \times (23b)$ , then $(24c) = (23b)$ ; otherwise $(24c) = (22b)m + 0.5 \times (23b)$	
(24c)m= 0 0 0 0 0 0 0 0 0 0 0	(24c)
d) If natural ventilation or whole house positive input ventilation from loft if $(22b)m = 1$ , then $(24d)m = (22b)m$ otherwise $(24d)m = 0.5 + [(22b)m^2 \times 0.5]$	
(24d)m = 0	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)	(= : =)
(25)m= 0.14 0.14 0.14 0.14 0.13 0.13 0.13 0.13 0.13 0.14 0.14 0.14	(25)
area (m²)	X k J/K
Doors 2 / x 1.4 = 2.8	(26)
Windows $10.125   x^{1/[1/(0.8) + 0.04]} = 7.85$	(27)
Floor Type 1	(28)
Floor Type 2 56.67 × 0.15 = 8.5005	(28)
Walls 113.52 12.12 101.39 x 0.15 = 15.21	(29)
Roof 56.67 0 56.67 × 0.15 = 8.5	(30)
Total area of elements, m <sup>2</sup> 283.53	(31)
Party wall  10 x 0 = 0	(32)
* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2  ** include the areas on both sides of internal walls and partitions	
Fabric heat loss, W/K = S (A x U) $(26)(30) + (32) = 51.36$	(33)
Heat capacity Cm = $S(A \times k)$ ((28)(30) + (32) + (32a)(32e) = 27842.1791	(34)
Thermal mass parameter (TMP = $Cm \div TFA$ ) in $kJ/m^2K$ Indicative Value: High 450	(35)
For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.	
Thermal bridges : S (L x Y) calculated using Appendix K	(36)
if details of thermal bridging are not known (36) = $0.15 \times (31)$ Total fabric heat loss (33) + (36) = 62.7	(37)
Ventilation heat loss calculated monthly $(38)m = 0.33 \times (25)m \times (5)$	
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	

(38)m= 13.3	13.1	13.1	12.71	12.45	12.32	12.19	12.19	12.52	12.71	12.91	13.1		(38)
Heat transfer of		<u> </u>	12.71	12.40	12.02	12.10	12.10		= (37) + (		10.1		(55)
(39)m= 76	75.8	75.8	75.41	75.16	75.03	74.9	74.9	75.22	75.41	75.61	75.8		
(33)			<u> </u>			<u> </u>				Sum(39) <sub>1</sub>	12 /12=	75.42	(39)
Heat loss para	meter (l	HLP), W	/m²K					(40)m	= (39)m ÷	(4)			_
(40)m= 0.67	0.67	0.67	0.67	0.66	0.66	0.66	0.66	0.66	0.67	0.67	0.67		(40)
Number of day	Average = Sum(40) <sub>112</sub> /12= 0.67  Number of days in month (Table 1a)												
Jan	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 hea	ting ene	rgy requi	irement:								kWh/ye	ear:	
Assumed occu	upancy,	N								2.8	335		(42)
if TFA > 13.9	9, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9	)2)] + 0.0	0013 x (	ΓFA -13				` '
if TFA £ 13.9 Annual average	,	ater usad	ge in litre	es per da	av Vd.av	erage =	(25 x N)	+ 36		106	8364		(43)
Reduce the annua	al average	hot water	usage by	5% if the $c$	lwelling is	designed i			se target o		0001		( - /
not more that 125		,	<u> </u>			<u> </u>					_	ı	
Jan Hot water usage i	Feb n litres per	Mar r dav for ea	Apr ach month	May $Vd.m = fa$	Jun	Jul Table 1c x	(43)	Sep	Oct	Nov	Dec		
(44)m= 117.52	113.25	108.97	104.7	100.43	96.15	96.15	100.43	104.7	108.97	113.25	117.52		
(44)111= [117.02	110.20	100.07	104.7	100.40	30.10	30.10	100.40			m(44) <sub>112</sub> =		1282.037	(44)
Energy content of	hot water	used - cal	culated me	onthly $= 4$ .	190 x Vd,r	n x nm x E	OTm / 3600	) kWh/mor	oth (see Ta	bles 1b, 1	c, 1d)		_
(45)m= 174.7	152.79	157.67	137.46	131.89	113.81	105.47	121.02	122.47	142.72	155.8	169.18		_
If instantaneous v	vater heati	na at point	of use (no	hot water	r storage).	enter 0 in	boxes (46		Γotal = Su	m(45) <sub>112</sub> =	=	1684.9743	(45)
(46)m= 26.2	22.92	23.65	20.62	19.78	17.07	15.82	18.15	18.37	21.41	23.37	25.38		(46)
Water storage	l	20.00	20.02	10.70	17.01	10.02	10.10	10.01	2	20.01	20.00		( - )
a) If manufacto	urer's de	clared lo	oss facto	r is knov	vn (kWh	/day):				0.0	024		(47)
Temperature f	actor fro	m Table	2b							0.	54		(48)
Energy lost from If manufacture		_	-		s not kna		(47) x (48)	) =		0.0	013		(49)
Cylinder volun		•					<b>!</b>				0		(50)
If community h	eating and	l no tank in	dwelling,	enter 110	litres in bo	ox (50)						l	
Otherwise if no	stored ho	ot water (th	is includes	instantan	eous com!	bi boilers)	enter '0' in	box (50)					
Hot water stor	Ū		om Tabl	e 2 (kW	h/litre/da	ay)					0		(51)
Volume factor Temperature f			2h							-	0		(52)
Energy lost fro				oor			((50) x (51	\ v (52) v i	(52) _		0		(53)
Enter (49) or (		_	;, KVVII/ y	zai			((30) X (3)	) X (32) X (	(33) =		0		(54) (55)
Water storage	, ,	•	for each	month			((56)m = (	55) × (41)ı	m				, ,
(56)m= 0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(56)
If cylinder contains	s dedicate	d solar sto	rage, (57)	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	ix H	
(57)m= 0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(57)
	•	•	-	•	•	-	•			•		•	

Primary circuit loss (annual) from Table 3	360	(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 thermo	ostat)	
(59)m= 30.58 27.62 30.58 29.59 30.58 29.59 30.58 29.59 30.58	29.59 30.58	(59)
Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m		
(61)m= 0 0 0 0 0 0 0 0 0	0 0	(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= 205.67 180.77 188.64 167.43 162.87 143.79 136.44 152 152.45 173.7	185.77 200.16	(62)
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribu	tion 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= 205.67 180.77 188.64 167.43 162.87 143.79 136.44 152 152.45 173.7	185.77 200.16	
Output from water heate	er (annual) <sub>112</sub>	2049.7047 (64)
Heat gains from water heating, kWh/month 0.25 $^{\prime}$ [0.85 $\times$ (45)m + (61)m] + 0.8 $\times$ [(46)m	+ (57)m + (59)m	]
(65)m= 82.55 72.9 76.88 69.38 68.31 61.51 59.53 64.7 64.39 71.92	75.47 80.71	(65)
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is f	rom community h	eating
5. Internal gains (see Table 5 and 5a):	,	Jan J
Metabolic gains (Table 5), Watts  Jan Feb Mar Apr May Jun Jul Aug Sep Oct	Nov Dec	
(66)m= 170.01 170.01 170.01 170.01 170.01 170.01 170.01 170.01 170.01 170.01 170.01	170.01 170.01	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5		
(67)m= 74.65 66.3 53.92 40.82 30.51 25.76 27.84 36.18 48.56 61.66	71.97 76.72	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5		(3)
(68)m= 412.34 416.62 405.84 382.88 353.91 326.68 308.48 304.2 314.99 337.94	366.92 394.15	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	000.02	(55)
(69)m= 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83 54.83	54.83 54.83	(69)
	34.03	(00)
Pumps and fans gains (Table 5a)  (70)m=	0 0	(70)
		(10)
Losses e.g. evaporation (negative values) (Table 5)  (71)m= -113.34 -1	442.24	(71)
	-113.34 -113.34	(7-1)
Water heating gains (Table 5)	T T	(70)
(72)m= 110.95 108.48 103.34 96.36 91.82 85.44 80.01 86.96 89.43 96.66	104.82 108.49	(72)
Total internal gains = $(66)m + (67)m + (68)m + (69)m + (70)m	<del>, , , ,</del>	()
(73)m= 709.44 702.9 674.6 631.56 587.75 549.38 527.83 538.85 564.48 607.77	655.21 690.86	(73)
6. Solar gains:	his saisantation	
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applica		Coine
Orientation: Access Factor Area Flux g_ Table 6d m <sup>2</sup> Table 6a Table 6b T	FF able 6c	Gains (W)
		· <i>′</i>
0.11	0.7 =	
South 0.9x 0.77	0.7	288.11 (78)

	South 0.9x 0.77 x 10.12 x 94.25 x 0.76 x 0.7 = 351.81 (78)																
South	0.9x	0.77		· [	10.1	2	X	9	4.25	X		0.76	x [	0.7	=	351.81	(78)
South	0.9x	0.77		· [	10.1	2	X	10	05.11	x		0.76	x [	0.7	=	392.38	(78)
South	0.9x	0.77		· [	10.1	2	X	10	08.55	x		0.76	x [	0.7		405.2	(78)
South	0.9x	0.77		· [	10.1	2	X	1	08.9	X		0.76	x [	0.7	=	406.5	(78)
South	0.9x	0.77		<b>(</b> [	10.1	2	X	10	07.14	x		0.76	x [	0.7	=	399.93	(78)
South	0.9x	0.77		<b>(</b> [	10.1	2	X	10	03.88	x		0.76	x [	0.7	=	387.78	(78)
South	0.9x	0.77		· [	10.1	2	X	9	9.99	x		0.76	x [	0.7	=	373.25	(78)
South	0.9x	0.77		· [	10.1	2	X	8	5.29	X		0.76	x [	0.7	=	318.38	(78)
South	0.9x	0.77	:	· [	10.1	2	X	5	6.07	X		0.76	x [	0.7	=	209.3	(78)
South 0.9x 0.77 x 10.12 x 40.89 x 0.76 x 0.7 = 152.64 (78)													(78)				
				-													
Solar gains in watts, calculated for each month (83)m = Sum(74)m(82)m																	
Solar gains in Watts, calculated for each month (83)m = Sum(74)m(82)m (83)m = 176.65   288.11   351.81   392.38   405.2   406.5   399.93   387.78   373.25   318.38   209.3   152.64 (83)																	
Total gains – internal and solar $(84)$ m = $(73)$ m + $(83)$ m, watts																	
(84)m=	886.09	991.01	1026.4	10	023.94	992.95	9	55.87	927.76	926	.63	937.73	926.15	864.51	843.5		(84)
7 Mea	an inter	nal temp	perature	(he	eating	SASSO	n)							1			
		during h			Ĭ			area f	from Tak	ole 9	Th	1 (°C)				21	(85)
-		tor for g	_				_			JIC 0,		1 ( 0)	_			21	
	Jan	Feb	Mar		Apr	May		Jun	Jul	Aı	ug	Sep	Oct	Nov	Dec	l	
(86)m=	1	0.99	0.95	_	0.88	0.7		0.5	0.33	0.3		0.54	0.82	0.99	1		(86)
							_				$\neg$		0.02				, ,
	_	l temper					ollo T			T	$\overline{}$		00.00	T 00 00		1	(07)
(87)m= [	20.8	20.87	20.95	2	20.98	21	+	21	21	2	1	21	20.99	20.89	20.8		(87)
Tempe		during h		peri	iods in	rest o	_			1					_	1	
(88)m=	20.37	20.37	20.37	2	20.37	20.37	2	20.38	20.38	20.3	38	20.37	20.37	20.37	20.37		(88)
Utilisa	tion fac	tor for g	ains foi	res	st of dv	velling,	h2	,m (se	e Table	9a)							
(89)m=	1	0.98	0.93	(	0.84	0.66		0.45	0.28	0.2	28	0.49	0.77	0.98	1		(89)
Mean	interna	l temper	ature ir	the	e rest o	of dwel	lina	T2 (fc	ollow ste	eps 3	to 7	in Tabl	e 9c)	-			
(90)m=	20.11	20.22	20.31	_	20.36	20.37	Ť	20.38	20.38	20.		20.37	20.37	20.24	20.11		(90)
L		ļ								<u> </u>	!	f	LA = Liv	ng area ÷ (	4) =	0.4	(91)
Maaa	:	1 40 000 0 0		ا4 ب دا	م مارین می ما	سام ما	ما:اا	~\ fI	ΛΤ4	. /4	£I	Λ) Το					
(92)m=	20.39	l temper 20.48	20.56	$\overline{}$	20.61	20.62	_	9) = 11 20.62	20.62	20.0		20.62	20.62	20.5	20.38	1	(92)
L		nent to t	<u> </u>		!					L				20.5	20.50		(02)
(93)m=	20.39	20.48	20.56	_	20.61	20.62	_	20.62	20.62	20.0		20.62	20.62	20.5	20.38		(93)
		ting requ															
					eratur	e obtai	ned	l at ste	en 11 of	Tabl	e 9h	so tha	t Ti m=	(76)m an	d re-calc	culate	
		factor fo						at ott	эр тт от	I abi	0 0.0	, 00 tria		(70)111 011	a ro care	diato	
ſ	Jan	Feb	Mar		Apr	May	T	Jun	Jul	Aı	ug	Sep	Oct	Nov	Dec		
Utilisa	tion fac	tor for g	ains, hı	n:							•			•	•	•	
(94)m=	1	0.98	0.94	(	0.86	0.67		0.47	0.3	0.0	3	0.51	0.79	0.98	1		(94)
Useful	l gains,	hmGm	, W = (9	94)n	n x (84	-)m					!			•	•	•	
(95)m=	882.35	973.64	962.98	8	75.96	669.47	4	51.89	278.91	278	.91	475.55	732.83	849.04	840.69		(95)
Month	ly aver	age exte	rnal te	npe	rature	from 7	abl	e 8		•				•	•	•	
(96)m=	4.5	5	6.8	T	8.7	11.7		14.6	16.9	16.	.9	14.3	10.8	7	4.9		(96)
L		_	_		-				-					*	-	-	

Heat loss	s rate for me	an intern	al temp	arature	lm \//-	-[(39)m	v [(03)m	_ (96)m	1				
	07.36 1173.33	1		670.53	451.9	278.91	278.91	475.57	740.3	1020.69	1173.57		(97)
Space he	eating require	ement fo	r each n	nonth, k	Vh/mont	th = 0.02	24 x [(97	ı——— )m – (95	)m] x (4	1)m			
(98)m= 24	1.81 134.19	59.81	15.82	0.79	0	0	0	0	5.56	123.59	247.67		
							Tota	l per year	(kWh/year	r) = Sum(9	8)15,912 =	829.23	(98)
Space he	eating require	ement in	kWh/m²	²/year								7.32	(99)
9a. Energ	9a. Energy requirements – Individual heating systems including micro-CHP)												
Space h	•			/							ı	_	7(004)
	of space hea				mentary	-		(204)				0	(201)
	of space hea		-	` '			(202) = 1	, ,	(000)1			1	(202)
	Fraction of total heating from main system 1 $(204) = (202) \times [1 - (203)] =$												
•	Efficiency of main space heating system 1												
Efficienc	Efficiency of secondary/supplementary heating system, %												
	Jan Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/ye	ar
· —	eating require 1.81 134.19	59.81	alculate 15.82	0.79	)   0	0	0	0	5.56	123.59	247.67		
						U			3.30	123.39	247.07		(244)
	{[(98)m x (20 0.57 144.6	64.45	17.05	0.85	0	0	0	0	5.99	133.17	266.88		(211)
								l (kWh/yea	ar) =Sum(2	211),15,1012		893.56	(211)
Space he	eating fuel (s	econdar	y), kWh/	month									
	x (201)] + (2		•										
(215)m=	0 0	0	0	0	0	0	0	0	0	0	0		_
							Tota	ıl (kWh/yea	ar) =Sum(2	215) <sub>15,1012</sub>	<b>=</b>	0	(215)
Water hea	•		late de										
	m water hea	ter (caic 188.64	<u>ulated a</u> 167.43	162.87	143.79	136.44	152	152.45	173.7	185.77	200.16		
Efficiency	of water hea	ıter								<u> </u>	Į.	79.1	(216)
(217)m= 84	4.54 83.33	81.44	79.92	79.15	79.1	79.1	79.1	79.1	79.39	83.05	84.68		(217)
	ater heating,											l.	
(219)m = 24	(64)m x 100 3.27 216.93	) ÷ (217) 231.65	m 209.5	205.79	181.78	172.49	192.16	192.73	218.79	223.68	236.37		
(213)111= 24	3.27 210.93	231.03	209.5	203.79	101.70	172.43	ļ	I = Sum(2		223.00	230.37	2525.14	(219)
Annual to	otals							`		Wh/yeaı	•	kWh/year	<b>_</b>
	ating fuel use	ed, main	system	1						,		893.56	7
Water hea	ating fuel use	ed										2525.14	
Electricity	for pumps, f	ans and	electric	keep-ho	t						·		-
mechani	cal ventilatio	n - balan	ced, ext	ract or p	ositive ir	nput fror	n outside	Э			229.02		(230a)
central h	eating pump	:									130		(230c)
boiler wit	th a fan-assis	sted flue									45		(230e)
Total elec	tricity for the	above, I	kWh/yea	r			sum	of (230a).	(230g) =	:		404.02	(231)
Electricity	for lighting											527.3	(232)
													_

10a. Fuel costs - individual heating systems:			
	<b>Fuel</b> kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	3.1 × 0.01 =	27.7004 (240)
Space heating - main system 2	(213) x	0 x 0.01 =	0 (241)
Space heating - secondary	(215) x	0 x 0.01 =	0 (242)
Water heating cost (other fuel)	(219)	3.1 × 0.01 =	78.28 (247)
Pumps, fans and electric keep-hot	(231)	11.46 × 0.01 =	46.3 (249)
(if off-peak tariff, list each of (230a) to (230g) septence of the septence of the second of the second of (230a) to (230g) septence of the second of (230a) to (230g) septence of the second of (230a) to (230g) septence of the second of (230a) to (230g) septence of (230a) to (230g) septence of (230a) to (230g) septence of (230a) to (230g) septence of (230a) to (230g) septence of (230a) to (230g) septence of (230a) to (230g) septence of (230a) to (230g) septence of (230a) to (230g) septence of (230a) to (230g) septence of (230a) to (230a) to (230g) septence of (230a) to (230a) to (230a) to (230a) to (230a) septence of (230a) to (230a) to (230a) septence of (230a) to (230a) to (230a) septence of (230a) to (230a) septence of (230a) to (230a) septence of (230a) to (230a) septence of (23	arately as applicable and app (232)	oly fuel price according to  11.46 × 0.01 =	
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254) a	s needed		
Total energy cost (245)(24	7) + (250)(254) =		318.709 (255)
11a. SAP rating - individual heating systems			
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF) [(255) x (2	56)] ÷ [(4) + 45.0] =		0.946 (257)
SAP rating (Section 12)			86.803 (258)
12a. CO2 emissions – Individual heating system  Space heating (main system 1)	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (secondary)	(215) x	0 =	0 (263)
Water heating	(219) x	0.198 =	499.98 (264)
Space and water heating	(261) + (262) + (263) + (264) =		676.9 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517 =	208.88 (267)
Electricity for lighting	(232) x	0.517 =	272.62 (268)
Total CO2, kg/year	sun	of (265)(271) =	1158.4 (272)
CO2 emissions per m <sup>2</sup>	(27)	2) ÷ (4) =	10.22 (273)
El rating (section 14)			90 (274)
13a. Primary Energy			
	<b>Energy</b> kWh/year	<b>Primary</b> factor	<b>P. Energy</b> kWh/year
Space heating (main system 1)	(211) x	1.02 =	911.43 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Energy for water heating	(219) x	1.02	2575.64 (264)
Space and water heating	(261) + (262) + (263) + (264) =		3487.07 (265)

Electricity for pumps, fans and electric keep-hot (231) x (267) 2.92 1179.73 Electricity for lighting (232) x (268) 1539.72 0 sum of (265)...(271) = 'Total Primary Energy (272) 6206.53 Primary energy kWh/m²/year  $(272) \div (4) =$ (273) 54.76



				User D	etails:						
Assessor Name: Software Name:	Stroma FS	SAP 200	9		Strom Softwa				Versio	on: 1.5.0.49	
Continui o ritamor				roperty	Address						
Address :											
1. Overall dwelling dime	ensions:										
				Are	a(m²)	1	Ave He	eight(m)	-	Volume(m <sup>3</sup>	_
Ground floor				4	8.77	(1a) x		2.5	(2a) =	121.925	(3a)
First floor				4	8.77	(1b) x	2	2.5	(2b) =	121.925	(3b)
Total floor area TFA = (1	a)+(1b)+(1c)+	(1d)+(1e	)+(1r	1) 9	7.54	(4)					
Dwelling volume						(3a)+(3b	)+(3c)+(3c	d)+(3e)+	.(3n) =	243.85	(5)
2. Ventilation rate:											
	main heating		econdar eating	у	other		total			m³ per hou	r
Number of chimneys	0	+	0	+ [	0	=	0	X 4	40 =	0	(6a)
Number of open flues	0	<b>-</b> + -	0	Ī + Ē	0	Ī = [	0	x 2	20 =	0	(6b)
Number of intermittent fa	ns						0	x -	10 =	0	(7a)
Number of passive vents						Ī	0	x .	10 =	0	(7b)
Number of flueless gas fi	res					Ì	0	x 4	40 =	0	(7c)
						_		_	-		
									Air ch	nanges per ho	our
Infiltration due to chimne	7						0		÷ (5) =	0	(8)
If a pressurisation test has b Number of storeys in t			d, procee	d to (17),	otherwise (	continue fi	rom (9) to	(16)		0	(9)
Additional infiltration	no awoming (in	3)						[(9)·	-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel o	r timber f	rame or	0.35 fo	r mason	ry const	ruction			0	(11)
if both types of wall are pa deducting areas of openia			oonding to	the great	er wall are	ea (after					
If suspended wooden f			ed) or 0	.1 (seale	ed), else	enter 0				0	(12)
If no draught lobby, en	ter 0.05, else	enter 0								0	(13)
Percentage of windows	s and doors di	aught st	ripped							0	(14)
Window infiltration					0.25 - [0.2			( - <b>-</b> )		0	(15)
Infiltration rate	-50	مانية مناه	: 4				12) + (13)			0	(16)
Air permeability value, If based on air permeabil					•	•	ietre oi e	envelope	area	0.6	(17)
Air permeability value applie	•						is being u	sed		0.03	(10)
Number of sides on whic	h sheltered									1	(19)
Shelter factor					(20) = 1 -		19)] =			0.92	(20)
Infiltration rate incorporat	•				(21) = (18	) x (20) =				0.03	(21)
Infiltration rate modified f		<del>' </del>		Jul	۸۰۰۰	800	Oct	Nov	Dec	]	
	Mar Apr	May May	Jun	Jui	Aug	Sep	Oct	INOV	Dec		
Monthly average wind sp	5.1 4.5	le /	3.9	3.7	3.7	4.2	4.5	4.8	5.1	]	

Wind Factor (2	22a)m =	(22)m ÷	4										
(22a)m= 1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27		
Adjusted infiltra	ation rate	e (allowi	ng for sh	nelter an	d wind s	speed) =	(21a) x	(22a)m					
0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04		
Calculate effect		_	rate for t	he appli	cable ca	se			-	-		0.5	(23a)
If exhaust air he			endix N, (2	3b) = (23a	ı) × Fmv (e	equation (N	N5)) , othe	rwise (23b	) = (23a)			0.5	(23b)
If balanced with	n heat reco	overy: effic	iency in %	allowing f	or in-use f	actor (from	Table 4h	) =				76.5	(23c)
a) If balance	ed mecha	anical ve	entilation	with hea	at recove	ery (MVH	HR) (24a	ı)m = (2:	2b)m + (	23b) × [	1 – (23c)		`` ′
(24a)m= 0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.15	0.15	0.15	0.15		(24a)
b) If balance	d mech	anical ve	entilation	without	heat red	covery (N	ЛV) (24b	)m = (22	2b)m + (	23b)	•	!	
(24b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If whole h	ouse ex	tract ven	tilation o	or positiv	e input v	ventilatio	n from c	utside	-	-			
		(23b), t	<u> </u>	, <u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	· ` `	ŕ	1	I	4
(24c)m = 0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If natural if (22b)n		on or whe en (24d)							0.5]				
(24d)m = 0	0	0	0	0	0	0	0	0	0	0	0		(24d
Effective air	change	rate - er	nter (24a	) or (24b	o) or (24	c) or (24	d) in box	(25)					
(25)m= 0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.15	0.15	0.15	0.15		(25)
3. Heat losse	s and he	eat loss r	paramete	er:									
ELEMENT	Gros area	SS	Openin m	gs	Net Ar A ,r		U-valı W/m2		A X U (W/I	K)	k-value		A X k kJ/K
Doors	alta	(III-)	""		2	×	1		2		KJ/III-•I	`	(26)
Windows					10.12	= .	<u> </u>	0.041 =	7.85	=			(27)
Floor Type 1					48.77		0.15		7.3155	<u> </u>			(28)
Floor Type 2					48.77	_	0.10		7.0100	=		╡	` ′
71 -					10.77		0.15		7 3155				(28)
Walls	97.7	.2	22.25	5	75.47	, x	0.15	=   =	7.3155	<u>'</u>		-	(28)
Walls Roof	97.7		22.25	5	75.47 48.77	=	0.15	<b>=</b>	11.32				(29)
Roof	48.7	77	0	5	48.77	7 X		=					(29)
Roof Total area of e	48.7 elements	77 , m² ows, use e	0 effective with	ndow U-ve	48.77 244.0 alue calcul	7 x	0.15 0.15	= =	7.32		paragraph	3.2	(29)
Roof Total area of e * for windows and ** include the area	48.7 elements I roof windo	77 s, m <sup>2</sup> ows, use e sides of in	0 effective winternal wall	ndow U-ve	48.77 244.0 alue calcul	x 3 lated using	0.15 0.15	=   =   /[(1/U-valu	7.32		paragraph		(29) (30) (31)
Roof Total area of e * for windows and ** include the area Fabric heat los	48.7 elements roof winder as on both ss, W/K =	ows, use e sides of in S (A x	0 effective winternal wall	ndow U-ve	48.77 244.0 alue calcul	x 3 lated using	0.15 0.15	=   =   /[(1/U-valu + (32) =	7.32 7.04] a	as given in	ļ	50.96	(29) (30) (31)
Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity	48.7 elements roof winder as on both ss, W/K = Cm = S(	ows, use e sides of in = S (A x (A x k)	0  iffective winternal walk  U)	ndow U-va	48.77 244.0 alue calcul	x 3 lated using	0.15 0.15	=   =   /[(1/U-value) + (32) = ((28).	7.32 7.32 (e)+0.04] a	as given in 2) + (32a).	ļ	50.96 17942.88	(29) (30) (31) (33) (2) (34)
Roof Total area of e  * for windows and  ** include the area  Fabric heat los  Heat capacity  Thermal mass  For design assess	48.7 elements I roof windo as on both ss, W/K = Cm = S( parame	ows, use e sides of in S (A x k) eter (TMF)	offective winternal walk U)  P = Cm ÷ tails of the	ndow U-vals and part	48.77 244.0 alue calcul titions	x 3 lated using	0.15 0.15 formula 1 (26)(30)	=   	7.32 7.32 (e)+0.04] a	as given in 2) + (32a). : High	(32e) =	50.96	(29) (30) (31)
Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used instead	48.7 elements froof winder as on both as, W/K = Cm = S( parame aments whe ad of a det	ows, use e sides of in = S (A x k) eter (TMF) erer the detailed calculation.	offective winternal walk U) $P = Cm \div tails of the ulation.$	ndow U-ve ls and part - TFA) ir constructi	48.77 244.0 alue calcul titions  kJ/m²K tion are not	x 3 ated using	0.15 0.15 formula 1 (26)(30)	=   	7.32 7.32 (e)+0.04] a	as given in 2) + (32a). : High	(32e) =	50.96 17942.88 450	(29) (30) (31) (33) (2) (34) (35)
Roof Total area of e  * for windows and  ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used instea Thermal bridge	48.7 elements I roof winder as on both ss, W/K = Cm = S( parame sments whe ad of a det es : S (L	ows, use e sides of in S (A x k) eter (TMF) ere the detailed calculation (X Y) calculations.	offective winternal walk U)  P = Cm ÷ tails of the ulation. culated to	ndow U-vals and part - TFA) ir constructi	48.77 244.0 alue calcul titions  kJ/m²K tion are not	x 3 ated using	0.15 0.15 formula 1 (26)(30)	=   	7.32 7.32 (e)+0.04] a	as given in 2) + (32a). : High	(32e) =	50.96 17942.88	(29) (30) (31) (33) (33) (34)
Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used instead	48.7 elements I roof winder as on both as, W/K = Cm = S( parame aments whe ad of a det es : S (L al bridging	ows, use e sides of in S (A x k) eter (TMF) ere the detailed calculation (X Y) calculations.	offective winternal walk U)  P = Cm ÷ tails of the ulation. culated to	ndow U-vals and part - TFA) ir constructi	48.77 244.0 alue calcul titions  kJ/m²K tion are not	x 3 ated using	0.15 0.15 formula 1 (26)(30)	=   =   	7.32 7.32 (e)+0.04] a	as given in 2) + (32a). : High	(32e) =	50.96 17942.88 450	(29) (30) (31) (33) 02 (34) (35)
Roof Total area of e  * for windows and  ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used instea Thermal bridge if details of thermal	48.7 elements I roof winder as on both as, W/K = Cm = S( parame aments whe ad of a det es : S (L al bridging at loss	ows, use e sides of in S (A x k) eter (TMF) erer the detailed calculate (x Y) calculate (x x Y) calcul	offective winternal walk U)  P = Cm ÷ tails of the culation. culated to cown (36) =	ndow U-vals and part - TFA) ir construction using Ap	48.77 244.0 alue calcul titions  kJ/m²K tion are not	x 3 ated using	0.15 0.15 formula 1 (26)(30)	=   =   	11.32 7.32 (e)+0.04] a (30) + (32) tive Value	as given in 2) + (32a). : High : TMP in Ta	(32e) =	50.96 17942.88 450 9.76	(29) (30) (31) (33) (2) (34) (35)
Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used instea Thermal bridge if details of therma Total fabric he	48.7 elements I roof winder as on both as, W/K = Cm = S( parame aments whe ad of a det es : S (L al bridging at loss	ows, use e sides of in S (A x k) eter (TMF) erer the detailed calculate (x Y) calculate (x x Y) calcul	offective winternal walk U)  P = Cm ÷ tails of the culation. culated to cown (36) =	ndow U-vals and part - TFA) ir construction using Ap	48.77 244.0 alue calcul titions  kJ/m²K tion are not	x 3 ated using	0.15 0.15 formula 1 (26)(30)	=   =   	11.32 7.32 (e)+0.04] a (30) + (32 tive Value e values of	as given in 2) + (32a). : High : TMP in Ta	(32e) =	50.96 17942.88 450 9.76	(29) (30) (31) (33) 02 (34) (35)
Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used instea Thermal bridge if details of therma Total fabric he Ventilation hea	48.7 elements froof winder as on both as, W/K = Cm = S( parame and of a det es : S (L al bridging at loss at loss ca	ows, use e sides of in = S (A x (A x k) eter (TMF ere the decentailed calculated are not known alculated	offective winternal walk U)  P = Cm ÷ tails of the culation. culated to cown (36) =	ndow U-vels and part - TFA) ir construction using Ap	48.77 244.0 alue calcul titions  h kJ/m²K tion are not spendix I	x 3 ated using	0.15 0.15 formula 1. (26)(30)	=   =   =   	11.32 7.32 10)+0.04] at tive Value at values of (36) = 0.33 × (	as given in  2) + (32a).  : High  : TMP in Ta	(32e) =	50.96 17942.88 450 9.76	(29) (30) (31) (33) 02 (34) (35)
Roof Total area of e  * for windows and  ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used instea Thermal bridge if details of therma Total fabric he Ventilation hea	48.7 elements I roof winder as on both es, W/K = Cm = S( parame esments whe ad of a det es : S (L al bridging at loss at loss ca Feb 12.3	ows, use e sides of in S (A x k) eter (TMF) ere the detailed calculated are not known alculated Mar 12.3	offective winternal walk U)  P = Cm ÷ tails of the culation. culated to cown (36) = I monthly	ndow U-vals and part  - TFA) ir  construction using Ap = 0.15 x (3)	48.77 244.0 alue calcul titions  kJ/m²K fon are not spendix I	x 3 ated using	0.15 0.15 formula 1. (26)(30) ecisely the	=     =   	11.32 7.32 (e)+0.04] a (30) + (32) (ive Values of (36) = = 0.33 × (	225)m x (5 Nov	(32e) = able 1f	50.96 17942.88 450 9.76	(29) (30) (31) (33) 02 (34) (35) (36) (37)
Roof Total area of e * for windows and ** include the area Fabric heat los Heat capacity Thermal mass For design assess can be used instea Thermal bridge if details of therma Total fabric he Ventilation hea  Jan (38)m= 12.47	48.7 elements I roof winder as on both as, W/K = Cm = S( parame aments whe ad of a det es : S (L al bridging at loss at loss ca Feb 12.3 coefficier 73.03	ows, use e sides of in Sides o	o  effective winternal walk  U)  P = Cm ÷ tails of the ulation. culated the cown (36) =  I monthly Apr 11.97	ndow U-vals and part - TFA) in construction using Ap = 0.15 x (3) / May 11.74	48.77 244.0 alue calcul titions  kJ/m²K ion are not spendix k 1)  Jun 11.63	x 3 sated using t known pro	0.15 0.15 formula 1. (26)(30) ecisely the	=     =   	11.32 7.32 (e)+0.04] a (30) + (32) (ive Values of values of (36) = 0.33 × (	225)m x (5 Nov	(32e) = able 1f	50.96 17942.88 450 9.76 60.73	(29) (30) (31) (33) 02 (34) (35) (36) (37)

eat lo	ss para	meter (H	ILP), W	m²K					(40)m	= (39)m ÷	(4)			
·0)m=	0.75	0.75	0.75	0.75	0.74	0.74	0.74	0.74	0.74	0.75	0.75	0.75		
م ما مصر		. !	.4b /Tab	la 4a\					,	Average =	Sum(40) <sub>1</sub>	.12 /12=	0.75	(40
umbe ]	Jan	Feb	nth (Tab Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
.1)m=	31	28	31	30	31	30	31	31	30 30	31	30	31		(4
·/ L		20	0.	- 00	<u> </u>		<u> </u>	0.1	00	0.1	00	<u> </u>		( -
4. Wat	ter heati	ng ener	gy requi	rement:								kWh/ye	ar:	
eeuma	ed occu	nancy 1	NI.								0.7	450		(4
if TF		, N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)	)2)] + 0.0	0013 x (1	ΓFA -13.		156		(4.
educe t	the annua	l average	hot water	usage by	5% if the a	ay Vd,av Iwelling is hot and co	designed t			se target o	103.	8889		(4
]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
ot wate	r usage in	litres per	day for ea	ach month	Vd,m = fa	ctor from	Table 1c x	(43)						
4)m=	114.28	110.12	105.97	101.81	97.66	93.5	93.5	97.66	101.81	105.97	110.12	114.28		
_	antant of	la = 1 1 = 11			and by A	×100 ·· 1/-/ ··		T / 2000			m(44) <sub>112</sub> =		1246.6668	(4
_											bles 1b, 1		_	
5)m= [	169.88	148.57	153.32	133.66	128.25	110.67	102.56	117.68	119.09	138.79	151.5	164.52	4000 4074	( <u>/</u>
nstanta	aneous wa	ater heatir	ng at point	of use (no	hot water	r storage),	enter 0 in	boxes (46)		lotal = Sul	m(45) <sub>112</sub> =		1638.4874	(^
6)m= [	25.48	22.29	23	20.05	19.24	16.6	15.38	17.65	17,86	20.82	22.72	24.68		(4
ater s	storage	loss:												
If ma	anufactu	rer's de	clared lo	ss facto	r is knov	vn (kWh	/day):				0.0	)24		(4
empe	rature fa	ctor fro	m Table	2b							0.	54		(4
•			_	, kWh/ye				(47) x (48)	=		0.0	)13		(4
			,			s not kno age with						)		( !
•		` '	•	0 ,		litres in bo						<u> </u>		(
Otherv	wise if no	stored ho	t water (th	is includes	instantan	eous comb	oi boilers) e	enter '0' in	box (50)					
ot wat	ter stora	ige loss	factor fr	om Tabl	e 2 (kW	h/litre/da	ıy)					0		(5
olume	e factor f	rom Tal	ble 2a								(	)		(5
empe	rature fa	actor fro	m Table	2b							(	)		(!
nergy	lost from	n water	storage	, kWh/ye	ear			((50) x (51	) x (52) x (	(53) =	(	)		(!
nter (4	49) or (5	64) in (5	5)								0.0	)13		(
ater s	storage	loss cal	culated f	or each	month			((56)m = (	55) × (41)r	m				
6)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(!
cylinde	r contains	dedicated	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Appendi	хH	
7)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(5
imary	y circuit	loss (an	nual) fro	m Table	3						36	60		(5
-						59)m = (	(58) ÷ 36	5 × (41)	m					
(mod	lified by	factor fr	om Tab	le H5 if t	here is s	solar wat	er heatir	ng and a	cylinde	thermo	stat)			
` -	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		(5
9)m=	30.30													
9)m=				month (	(61)m =	(60) ÷ 36	65 × (41)	m						

Total heat re	quired for	water he	eating ca	alculated	l for e	each month	(62)m	= 0.85 × (	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m= 200.8	<del>-</del>	184.29	163.64	159.23	140.		148.66		169.76	181.47	195.49		(62)
Solar DHW inp	ut calculated	using App	endix G oı	· Appendix	H (ne	gative quantity	y) (enter	0' if no sola	r contribu	tion to wate	r heating)	ı	
(add addition	nal lines if	FGHRS	and/or \	vwhrs	appl	ies, see Ap	pendix	G)					
(63)m= 0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output from	water hea	ter				•		•	•			•	
(64)m= 200.8	5 176.55	184.29	163.64	159.23	140.	65 133.53	148.66	149.07	169.76	181.47	195.49		
	•					•	Ou	tput from w	ater heate	er (annual) <sub>1</sub>	12	2003.2178	(64)
Heat gains f	om water	heating,	kWh/m	onth 0.2	5 ´[0	.85 × (45)m	+ (61)	m] + 0.8 x	k [(46)m	+ (57)m	+ (59)m	]	
(65)m= 80.94	71.49	75.44	68.11	67.1	60.4	17 58.56	63.59	63.27	70.61	74.04	79.16		(65)
include (5	7)m in cal	culation of	of (65)m	only if c	ylind	er is in the	dwelling	or hot w	ater is f	rom com	munity h	neating	
5. Internal	gains (see	e Table 5	and 5a	):									
Metabolic ga	ins (Table	e 5), Wat	ts										
Jar		Mar	Apr	May	Ju	ın Jul	Aug	Sep	Oct	Nov	Dec		
(66)m= 162.9	3 162.93	162.93	162.93	162.93	162.	93 162.93	162.93	162.93	162.93	162.93	162.93		(66)
Lighting gair	ıs (calcula	ted in Ap	pendix	L, equat	ion L	9 or L9a), a	lso see	Table 5	•	•		•	
(67)m= 57.35	50.94	41.42	31.36	23.44	19.7	79 21.38	27.8	37.31	47.37	55.29	58.94		(67)
Appliances (	gains (calc	ulated ir	Append	dix L, eq	uatio	n L13 or L1	3a), als	o see Ta	ble 5				
(68)m= 376.5	5 380.46	370.61	349.65	323.19	298.	32 281.7	277.8	287.64	308.6	335.07	359.94		(68)
Cooking gair	ns (calcula	ated in A	ppendix	L, equa	ion L	.15 or L15a	), also s	see Table	5				
(69)m= 54.0°	54.01	54.01	54.01	54.01	54.0	01 54.01	54.01	54.01	54.01	54.01	54.01		(69)
Pumps and	ans gains	(Table 5	āa)										
(70)m= 0	0	0	0	0	0	0	0	0	0	0	0		(70)
Losses e.g.	evaporatio	n (nega	tive valu	es) (Tab	le 5)		•				•		
(71)m= -108.6	2 -108.62	-108.62	-108.62	-108.62	-108	62 -108.62	-108.62	-108.62	-108.62	-108.62	-108.62		(71)
Water heatir	ng gains (7	rable 5)							•		•	•	
(72)m= 108.8	106.39	101.39	94.6	90.19	83.9	99 78.71	85.47	87.87	94.9	102.84	106.4		(72)
Total intern	al gains =	:				(66)m + (67)n	n + (68)m	+ (69)m +	(70)m + (7	71)m + (72)	m	•	
(73)m= 651.0	1 646.1	621.75	583.93	545.14	510.	42 490.12	499.38	521.14	559.2	601.51	633.6		(73)
6. Solar ga	ns:												
Solar gains ar	e calculated	using sola	r flux from	Table 6a	and as	sociated equa	ations to	convert to th	ne applical		ion.		
Orientation:			Area			Flux		g_ Tabla 6b	-	FF		Gains	
	Table 6d		m²		_	Table 6a	. –	Table 6b	_ '	able 6c		(W)	,
South 0.9	0.77	X	10.	12	x	47.32	X	0.76	x	0.7	=	353.3	(78)
South 0.9	0.77	X	10.	12	x	77.18	x	0.76	x	0.7	=	576.23	(78)
South 0.9	0.77	X	10.	12	x	94.25	x	0.76	x	0.7	=	703.61	(78)
South 0.9	0.77	X	10.	12	X	105.11	x	0.76	X	0.7	=	784.75	(78)
South 0.9	0.77	X	10.	12	x	108.55	x	0.76	x	0.7	=	810.4	(78)
South 0.9	0.77	X	10.	12	x	108.9	х	0.76	×	0.7	=	813	(78)
South 0.9		X	10.	12	x	107.14	x	0.76	x	0.7	=	799.85	(78)
South 0.9	0.77	X	10.	12	X	103.88	x	0.76	X	0.7	=	775.56	(78)

South	0.9x	0.77	X	10.	12	x	99.99	x	0.76	x	0.7		746.5	(78)
South	0.9x	0.77	X	10.	12	x	85.29	x [	0.76	x	0.7	=	636.76	(78)
South	0.9x	0.77	X	10.	12	x	56.07	x	0.76	x	0.7	=	418.6	(78)
South	0.9x	0.77	x	10.	12	x	40.89	x	0.76	_ x _	0.7		305.28	(78)
	_		<del></del> -					_						
Solar ga	ains in v	watts, ca	alculated	for eacl	h month			(83)m =	Sum(74)m .	(82)m				
(83)m=	353.3	576.23	703.61	784.75	810.4	813	799.85	775.56	746.5	636.76	418.6	305.28		(83)
Total ga	ains – ir	nternal a	nd solar	(84)m =	(73)m -	+ (83)	m , watts	•	•		•	•	•	
(84)m=	1004.31	1222.33	1325.36	1368.68	1355.54	1323.	41 1289.97	1274.9	4 1267.65	1195.96	1020.11	938.87		(84)
7. Mea	an inter	nal temp	erature	(heating	season	)								
							a from Tal	ole 9 T	h1 (°C)				21	(85)
•		_	٠.			•	Table 9a)	J.O O, 1	( 3)				21	(/
Г	Jan	Feb	Mar	Apr	May	Jui		Aug	Sep	Oct	Nov	Dec	]	
(86)m=	0.98	0.9	0.77	0.65	0.5	0.35		0.23	0.38	0.62	0.92	0.99		(86)
` ′ L			ļ.							0.02	0.02	0.00		()
Г							steps 3 to 7	1			1		1	(07)
(87)m=	20.86	20.96	20.99	21	21	21	21	21	21	21	20.95	20.85		(87)
Tempe	erature	during h	eating p	eriods ir	rest of	dwelli	ng from Ta	ble 9,	Th2 (°C)				_	
(88)m=	20.3	20.3	20.3	20.3	20.3	20.3	20.31	20.31	20.3	20.3	20.3	20.3		(88)
Utilisat	tion fac	tor for g	ains for r	est of d	welling.	h2,m	(see Table	9a)						
(89)m=	0.97	0.88	0.74	0.62	0.46	0.31	`	0.19	0.34	0.58	0.9	0.98	]	(89)
Moan	intornal	Ltompor	ature in t	the rest	of dwalli	ng Ta	(follow ste	no 2 to	7 in Tab	0.00)				
(90)m=	20.13	20.26	20.29	20.3	20.3	20.3	<u> </u>	20.31	20.3	20.3	20.25	20.11	1	(90)
(00)		20.20	20.20	20.0	40.0						g area ÷ (4		0.38	(91)
											Ì	,	0.00	(,
Г		· ·	<u> </u>				= fLA × T1		<del>-                                    </del>			T	1	(00)
(92)m=	20.41	20.52	20.56	20.57	20.57	20.5		20.57	20.57	20.57	20.52	20.39		(92)
· · · · r					· ·		from Table	r	<del></del>	<del> </del>	00.50	L 00.00	1	(93)
(93)m=	20.41	20.52	20.56	20.57	20.57	20.5	7 20.57	20.57	20.57	20.57	20.52	20.39		(93)
•		·	uirement			- d - t	atam 11 af	Table		4 T: /	70\	ما ده مماد	v doto	
			emanter or gains t			ieu ai	step 11 of	rable	90, 80 เกล	ıt 11,111=(	rojin an	u re-caic	culate	
Γ	Jan	Feb	Mar	Apr	May	Jui	n Jul	Aug	Sep	Oct	Nov	Dec	]	
Utilisat			ains, hm	•	- 7				1				ı	
(94)m=	0.97	0.88	0.75	0.63	0.47	0.33	0.21	0.21	0.36	0.59	0.91	0.98		(94)
Useful	gains,	hmGm ,	W = (94	I)m x (84	4)m			!		<u>I</u>	!	1	J	
(95)m=	977.42	1081.11	996.06	861.41	642.62	431.8	88 265.09	265.09	454.57	709.44	924.98	920.66		(95)
Month	ly avera	age exte	rnal tem	perature	from Ta	able 8		•				•	•	
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9		(96)
Heat lo	oss rate	for mea	an intern	al tempe	erature,	Lm ِ, ۱	V =[(39)m	x <u>[(9</u> 3)ı	n– (96)m	]			•	
(97)m=	1164.57	1133.63	1004.73	862.57	642.66	431.8	88 265.09	265.09	454.57	709.95	984.93	1131.31		(97)
Space	heatin	g require	ement fo	r each n	nonth, k\	Nh/m	onth = 0.02	24 x [(9	7)m – (95	)m] x (4	1)m		-	
(98)m=	139.24	35.29	6.45	0.83	0.03	0	0	0	0	0.37	43.17	156.72		
								То	tal per year	(kWh/yea	r) = Sum(9	8)15,912 =	382.1	(98)
Space	heatin	g require	ement in	kWh/m²	/year								3.92	(99)
,		. 1												<b></b> ` ′

9a. Energy requirements – Individual heating sy.  Space heating:	stems including	micro-C	HP)					
Fraction of space heat from secondary/supplen	nentary system					ſ	0	(201)
Fraction of space heat from main system(s)		(202) = 1 -	- (201) =			Ì	1	(202)
Fraction of total heating from main system 1		(204) = (20	02) × [1 –	(203)] =		Ì	1	(204)
Efficiency of main space heating system 1						Ì	93.3	(206)
Efficiency of secondary/supplementary heating	system, %					Ī	0	(208)
Jan Feb Mar Apr May	Jun Jul	Aug	Sep	Oct	Nov	Dec	kWh/y	ear
Space heating requirement (calculated above)		i						
139.24 35.29 6.45 0.83 0.03	0 0	0	0	0.37	43.17	156.72		
$(211)m = \{[(98)m \times (204)] + (210)m \} \times 100 \div (204) + (210)m \times (204) + (200)m \times (204) + (200)m \times (204) + (2$	06)	0	0	0.4	46.27	167.98		(211)
149.24 37.02 0.92 0.09 0.03	0   0		_	ar) =Sum(2			409.54	(211)
Space heating fuel (secondary), kWh/month					7 10, 10 12	Ĺ		` ′
$= \{[(98)m \times (201)] + (214) \text{ m} \} \times 100 \div (208)$								
(215)m= 0 0 0 0 0	0 0	0	0	0	0	0		
		Tota	I (kWh/yea	ar) =Sum(2	215) <sub>15,1012</sub>	-	0	(215)
Water heating Output from water heater (calculated above)								
200.85 176.55 184.29 163.64 159.23	140.65 133.53	148.66	149.07	169.76	181.47	195.49	_	
Efficiency of water heater							79.6	(216)
(217)m= 83.66 81.2 79.92 79.65 79.6	79.6 79.6	79.6	79.6	79.62	81.45	84.03		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m								
$ (219)^{m} = 240.09  217.42  230.6  205.46  200.04 $	176.7 167.75	186.76	187.27	213.22	222.79	232.65		
		Tota	I = Sum(2	19a) <sub>112</sub> =			2480.74	(219)
Annual totals				k۱	Nh/year	Г	kWh/yea	ır
Space heating fuel used, main system 1						[	409.54	_
Water heating fuel used						L	2480.74	
Electricity for pumps, fans and electric keep-hot								
mechanical ventilation - balanced, extract or po	sitive input fror	n outside	9			171.06		(230a)
central heating pump:						130		(230c)
boiler with a fan-assisted flue						45		(230e)
Total electricity for the above, kWh/year		sum	of (230a).	(230g) =			346.06	(231)
Electricity for lighting						Ī	405.11	(232)
10a. Fuel costs - individual heating systems:						_		
	Fuel			Fuel P	rica		Fuel Cost	
	kWh/year			(Table			£/year	•
Space heating - main system 1	(211) x			3.1		x 0.01 =	12.6957	(240)
Space heating - main system 2	(213) x			0		x 0.01 =	0	(241)
· · · · · · · · · · · · · · · · · · ·	(2.47)					L		<b></b>

(215) x

Space heating - secondary

(242)

Water heating cost (other fuel)	(219)	3.1 x 0.01 =	76.9 (247)
Pumps, fans and electric keep-hot	(231)	11.46 x 0.01 =	39.66 (249)
(if off-peak tariff, list each of (230a) to (230g) separa			1
Energy for lighting	(232)	11.46 x 0.01 =	46.43 (250)
Additional standing charges (Table 12)			106 (251)
Appendix Q items: repeat lines (253) and (254) as r	needed		
Total energy cost (245)(247)	+ (250)(254) =		281.6824 (255)
11a. SAP rating - individual heating systems			
Energy cost deflator (Table 12)			0.47 (256)
Energy cost factor (ECF) [(255) x (256)	)] ÷ [(4) + 45.0] =		0.9288 (257)
SAP rating (Section 12)			87.0433 (258)
12a. CO2 emissions – Individual heating systems i	including micro-CHP		
	Energy	Emission factor	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating (main system 1)	(211) x	0.198 =	81.09 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Water heating	(219) x	0.198 =	491.19 (264)
Space and water heating	(261) + (262) + (263) + (264) =		572.27 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517 =	178.91 (267)
Electricity for lighting	(232) x	0.517 =	209.44 (268)
Total CO2, kg/year	sum	of (265)(271) =	960.63 (272)
CO2 emissions per m²	(272)	) ÷ (4) =	9.85 (273)
EI rating (section 14)			91 (274)
13a. Primary Energy			
	<b>Energy</b> kWh/year	Primary factor	<b>P. Energy</b> kWh/year
Space heating (main system 1)	(211) x	1.02 =	417.73 (261)
Space heating (secondary)	(215) x	0 =	0 (263)
Energy for water heating	(219) x	1.02 =	2530.35 (264)
Space and water heating	(261) + (262) + (263) + (264) =		2948.08 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92 =	1010.5 (267)
Electricity for lighting	(232) x	0 =	1182.91 (268)
'Total Primary Energy	sum	of (265)(271) =	5141.49 (272)
Primary energy kWh/m²/year	(272)	) ÷ (4) =	52.71 (273)

				User De							
Assessor Name:	0, 50	A D 0000				a Num				4.5.0.40	
Software Name:	Stroma FS	SAP 2009	D.,			are Ve			Versic	on: 1.5.0.49	
Address :			Pr	operty A	\aaress	: House	1				
Address :  1. Overall dwelling dime	nsions:										
g.ag.ag				Area	(m²)		Ave He	eight(m)		Volume(m <sup>3</sup>	3)
Ground floor					• •	(1a) x		2.5	(2a) =	103.75	<u>,</u> (3
First floor				4	1.5	(1b) x	2	2.5	(2b) =	103.75	(3
Total floor area TFA = (1a	a)+(1b)+(1c)+	(1d)+(1e)+	·(1n)	) :	83	(4)			_		
Dwelling volume	, , , , ,	, , , ,	, ,				o)+(3c)+(3c	l)+(3e)+	.(3n) =	207.5	(5
								, , ,	,	201.5	
2. Ventilation rate:	main		ondary	y (	other		total			m³ per hou	ır
Number of chimneys	heating 0	hea	ating 0	] + [	0	<b>Л</b> = Г	0	x ·	40 =	0	(6
Number of open flues		<b>-</b>   +   -	0	]   +	0	]	0	x	20 =	0	` (6
' Number of intermittent far				J L		_	0	x	10 =	0	`` (7
Number of passive vents						L	0	×	10 =	0	(7
Number of flueless gas fir	res					L	0		40 =	0	(7
ivaliber of fideless gas in						L	0	ш.		0	(′
_									Air ch	nanges per ho	our
Infiltration due to chimney	s, flues and f	ans = (6a)+	+(6b)+(7a	a)+(7b)+(7	(c) =		0	$\vdash$	÷ (5) =	0	(8
If a pressurisation test has be			proceed	to (17), o	therwise o	continue fi	rom (9) to (	(16)			_
Number of storeys in the Additional infiltration	ne dw <mark>elling</mark> (n	s)						[(0)	11v0 1 =	0	(9 (1
Structural infiltration: 0.	25 for steel o	r timber fra	me or (	0.35 for	masoni	rv consti	ruction	[(9)]	-1]x0.1 =	0	= \'\   <sub>(1</sub>
if both types of wall are pr	esent, use the va	alue correspo				•					
deducting areas of openin			4) or 0 1	1 (20010)	مام (ا	ontor O					<b>–</b> ,,
If suspended wooden fluid If no draught lobby, ent		`	a) OI U.	i (Sealed	u), eise	enter 0				0	— (1 — (1
Percentage of windows			ped							0	= \'\ 
Window infiltration		aag. ii oii ip		(	0.25 - [0.2	! x (14) ÷ 1	100] =			0	<b>-</b>  (1
Infiltration rate				(	(8) + (10)	+ (11) + (	12) + (13) -	+ (15) =		0	<b>=</b> (1
Air permeability value,	q50, express	ed in cubic	metres	s per ho	ur per s	quare m	etre of e	nvelope	area	0.6	(1
lf based on air permeabili	-									0.03	(1
Air permeability value applies		on test has b	een done	e or a degi	ree air pe	rmeability	is being u	sed			<b></b> ,
Number of sides on which Shelter factor	i sneitered			(	(20) = 1 -	[0.075 x ( <sup>*</sup>	19)] =			0.85	— (1 (2
Infiltration rate incorporati	ing shelter fac	ctor			(21) = (18					0.03	=\\(^2
Infiltration rate modified for	•										
	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind spe			1				•	•	•	•	
<del>``</del>	5.1 4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1	1	

Wind Footor (220) (22) (22)	4										
Wind Factor (22a)m = $(22)$ m $\div$ (22a)m= 1.35 1.27 1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27		
	<u> </u>										
Adjusted infiltration rate (allowing				<del>`                                    </del>	<del>`</del>	<u>`                                    </u>	I	T	T	1	
0.03 0.03 0.03  Calculate effective air change	0.03 rate for the	0.03 <b>e appli</b> o	0.02 Cable ca	0.02 S <b>e</b>	0.02	0.03	0.03	0.03	0.03		
If mechanical ventilation:										0.5	(23a)
If exhaust air heat pump using Appe	endix N, (23b	b) = (23a	ı) × Fmv (e	equation (N	N5)) , othe	rwise (23b	) = (23a)			0.5	(23b)
If balanced with heat recovery: effic	iency in % a	llowing fo	or in-use f	actor (fron	n Table 4h	) =				78.2	(23c)
a) If balanced mechanical ve	entilation w	vith hea	at recove	ery (MVI	HR) (24a	a)m = (22)	2b)m + (	23b) × [	1 – (23c)	÷ 100]	
(24a)m= 0.14 0.14 0.14	0.14	0.14	0.13	0.13	0.13	0.14	0.14	0.14	0.14		(24a)
b) If balanced mechanical ve				<del>-                                    </del>	<del>- ^ `</del>	<del>``</del>	<del> </del>	<del>- ´</del>	ı	1	(0.41.)
(24b)m= 0 0 0	0	0	0	0	0	0	0	0	0		(24b)
c) If whole house extract ver if (22b)m < 0.5 x (23b), 1		•	•				5 v (23h	<b>5)</b>			
(24c)m =	0	0	0	0	0	0	0	0	0		(24c)
d) If natural ventilation or wh	ole house	positiv	e input	ventilatio	n from I	oft	<u> </u>	<u> </u>	<u> </u>	ļ	
if (22b)m = 1, then (24d)		•	•				0.5]			_	
(24d)m = 0 0 0	0	0	0	0	0	0	0	0	0		(24d)
Effective air change rate - er	nter (24a)	or (24b	o) or (24	c) or (24	d) in box	(25)					
(25)m= 0.14 0.14 0.14	0.14	0.14	0.13	0.13	0.13	0.14	0.14	0.14	0.14		(25)
3. Heat losses and heat loss	oarameter	:									
ELEMENT Gross	Opening	s	Net Ar		U-val		AXU		k-value		A X k
area (m²)	m²		A ,r		W/m2		(W/	K)	kJ/m²-l	K	kJ/K
Doors			2	× ,	1.2	0.041	2.4	Ц.			(26)
Windows			6.125		/[1/( 0.8 )+		4.75	맂 ,			(27)
Floor Type 1			41.5	×	0.15	=	6.225	닠 ¦		╡	(28)
Floor Type 2 Walls		$\neg$	41.5	x	0.15	= [	6.225	닠 ¦		╡	(28)
56.10	14.25	=	68.93	=	0.15	= [	10.34	닠 ¦		╡	(29)
Roof 41.5	0		41.5	x	0.15	= [	6.23				(30)
Total area of elements, m <sup>2</sup> * for windows and roof windows, use e	offoctivo wind	dow II vo	207.6		ı formula 1	/[/1/  Lyol	(0) 1 0 041 4	as aivon in	naraaranh	. 2 2	(31)
** include the areas on both sides of in				ateu using	TOTTIUIA T	/[(	1 <del>0</del> )+0.04] a	as giveri iii	paragrapi	1 3.2	
Fabric heat loss, W/K = S (A x	U)				(26)(30)	+ (32) =				40.91	(33)
Heat capacity $Cm = S(A \times k)$						((28)	(30) + (32	2) + (32a).	(32e) =	15904.05	(34)
Thermal mass parameter (TMF	P = Cm ÷ <sup>-</sup>	TFA) in	kJ/m²K			Indica	tive Value	: High		450	(35)
For design assessments where the de can be used instead of a detailed calc		onstructi	ion are not	t known pr	ecisely the	indicative	e values of	TMP in Ta	able 1f		
Thermal bridges : S (L x Y) cal		sing Ap	pendix ł	<						7.89	(36)
if details of thermal bridging are not kr	nown (36) = 0	0.15 x (3	1)						!		
Total fabric heat loss							(36) =			48.8	(37)
Ventilation heat loss calculated	<del>. i</del>			·				(25)m x (5)		1	
Jan Feb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		(20)
(38)m= 9.82 9.69 9.69	9.43	9.25	9.17	9.08	9.08	9.3	9.43	9.56	9.69		(38)
Heat transfer coefficient, W/K	E9 22	E0 00	F7 07	F7 00	F7.00		= (37) + (		F0 40	1	
(39)m= 58.62 58.49 58.49 Stroma FSAP 2009 Version: 1.5.0.49		58.06 http://wv	57.97 ww.stroma	57.88 .com	57.88	58.1	58.23 Average =	58.36 Sum(39) <sub>1</sub>	58.49	58 2Rac	ge 2 <b>o</b> f <u>3</u> 9)
	•					•	woraye =	Juiii(39)1	12 / 12=	30.23	(00)

eat lo	ss para	meter (F	HLP), W	m²K					(40)m	= (39)m ÷	(4)			
0)m=	0.71	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7		_
umba	r of dov	a in mar	oth (Tob	lo 1o\					1	Average =	Sum(40) <sub>1</sub>	.12 /12=	0.7	(4
umbe 1	i i	Feb	nth (Tab Mar		Mov	lup	Jul	Λιια	Son	Oct	Nov	Dec		
1)m=	Jan 31	28	31	Apr 30	May 31	Jun 30	31	Aug 31	Sep 30	31	30	31		(4
L	01		01				01	01	00	01		01		( •
4 Wat	ter heat	ina ener	gy requi	rement:								kWh/ye	ar.	
				rement.								RVVIII y C	var.	
if TF	ed occu A > 13.9 A £ 13.9	), N = 1		[1 - exp	(-0.0003	349 x (TF	FA -13.9)	)2)] + 0.0	0013 x (	ΓFA -13.		173		(4
nnual	average	e hot wa				ay Vd,av						9331		(4
		_				lwelling is hot and co	-	o achieve	a water us	se target o	f			
Г	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
L ot wate						ctor from 7		,	ОСР	Oct	1407	DCC		
4)m=	108.83	104.87	100.91	96.95	93	89.04	89.04	93	96.95	100.91	104.87	108.83		
	-										m(44) <sub>112</sub> =		1187.197	(4
nergy c	content of	hot water	used - cal	culated m	onthly $= 4$ .	190 x Vd,r	n x nm x C	Tm / 3600	kWh/mor	nth (see Ta	ables 1b, 1	c, 1d)		
5)m= [	161.77	141.49	146	127.29	122.14	105.39	97.66	112.07	113.41	132.17	144.27	156.67		_
nstanta	aneous w	ater heati	na at noint	of use (no	hot water	storage),	enter () in	hoves (46		Total = Su	m(45) <sub>112</sub> =	<u> </u>	1560.3265	(4
	24.27	21.22	21.9	19.09	18.32	15.81	14.65	16.81	17.01	19.82	21.64	23.5		(4
1	storage		21.9	19.09	10.32	15.61	14.03	10.01	17.01	19.02	21.04	23.5		(-
If ma	anufactu	rer's de	clared lo	ss facto	r is knov	vn (kWh	/day):				0.0	)24		(-
empe	rature fa	actor fro	m Table	2b							0.	54		(4
٠.			storage					(47) x (48)	=		0.0	)13		(4
			,			s not kno age with								
•		` '	•	0 ,		litres in bo						)		(
	-	-		_		eous com		enter '0' in	box (50)					
ot wa	ter stora	ige loss	factor fr	om Tabl	e 2 (kW	h/litre/da	ıy)					o		(!
	e factor f	•			,		• /							(!
empe	rature fa	actor fro	m Table	2b							(	)		(
nergy	lost fro	m water	storage	, kWh/ye	ear			((50) x (51	) x (52) x	(53) =		<u> </u>		(
nter (4	49) or (5	54) in (5	5)								0.0	)13		(
ater s	storage	loss cal	culated f	or each	month			((56)m = (	55) × (41)ı	m				
6)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(
cylinde	r contains	dedicated	d solar sto	rage, (57)	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Appendi	хH	
7)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(!
- ∙imar	y circuit	loss (an	nual) fro	m Table	 3						36	60		(!
-						59)m = (	(58) ÷ 36	55 × (41)	m					
(mod	dified by	factor fr	om Tab	le H5 if t	here is s	solar wat	er heatir	ng and a	cylinde	r thermo	stat)			
	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		(!
9)m=														
′ L	loss cal	culated	for each	month (	(61)m =	(60) ÷ 36	65 × (41)	)m						

Total he	at requ	ired for	water he	eating ca	alculated	l fo	r each	n month	(62)r	n =	0.85 × (	45)m	) + (	(46)m +	(57)n	n +	(59)m + (61)m	
_	192.75	169.47	176.98	157.27	153.11	_	35.37	128.64	143.		143.39	163.		174.25	187.0	$\neg$	( ) ( )	(62)
Solar DHV	V input c	alculated i	using App	endix G or	· Appendix	<b>Ц</b> Н (	negativ	e quantity	) (ente	er '0'	if no sola	r contr	ibuti	on to wate	r heati	ப் ing)		
(add add	ditional	lines if I	FGHRS	and/or V	vwhrs	ар	plies,	see Ap	pend	ix G	3)							
(63)m=	0	0	0	0	0		0	0	0		0	0		0	0			(63)
Output fi	rom wa	ter heat	ter							•								
(64)m=	192.75	169.47	176.98	157.27	153.11	13	35.37	128.64	143.	05	143.39	163.	14	174.25	187.0	65		
_	•	•				•				Outp	ut from wa	ater he	eater	r (annual) <sub>1.</sub>	12		1925.0569	(64)
Heat gai	ins fron	n water	heating,	kWh/mo	onth 0.2	5 ′	[0.85	× (45)m	+ (6	1)m	] + 0.8 x	(46	)m	+ (57)m	+ (59	9)m	]	
(65)m=	78.25	69.14	73.01	65.99	65.07	5	8.71	56.93	61.7	72	61.38	68.4	11	71.64	76.5	55		(65)
includ	e (57)n	n in calc	culation	of (65)m	only if c	ylir	nder is	s in the o	dwelli	ing	or hot w	ater i	s fr	om comi	munit	ty h	eating	
5. Inter	rnal ga	ins (see	Table 5	and 5a	):													
Metaboli	ic gains	s (Table	5), Wat	ts														
	Jan	Feb	Mar	Apr	May	Ι,	Jun	Jul	Αι	лg	Sep	0	ct	Nov	De	ЭС		
(66)m=	151.04	151.04	151.04	151.04	151.04	15	51.04	151.04	151.	04	151.04	151.	04	151.04	151.0	04		(66)
Lighting	gains (	calculat	ted in Ap	pendix	L, equat	ion	L9 or	· L9a), a	lso s	ee 7	Table 5			-				
(67)m=	54.91	48.77	39.66	30.03	22.44	1	8.95	20.48	26.6	61	35.72	45.3	36	52.94	56.4	3		(67)
Applianc	es gai	ns (calci	ulated ir	Append	dix L, eq	uat	ion L′	13 or L1	3a), a	also	see Tal	ble 5					_	
(68)m=	336.71	340.2	331.4	312.66	288.99	26	6.76	251.9	248.	41	257.21	275.	95	299.62	321.8	85		(68)
Cooking	gains	(calcula	ted in A	ppendix	L, equat	tion	L15	or L15a)	, also	o se	e Table	5						
(69)m=	52.62	52.62	52.62	52.62	52.62	5	2.62	52.62	52.6	52	52.62	52.6	52	52.62	52.6	32		(69)
Pumps a	and fan	s gains	(Table 5	ōa)														
(70)m=	0	0	0	0	0		0	0	0		0	0		0	0			(70)
Losses	e.g. eva	aporatio	n (nega	tive valu	es) (Tab	le t	5)											
(71)m= -	100.69	-100.69	-100.69	-100.69	-100.69	-10	00.69	-100.69	-100.	.69	-100.69	-100	.69	-100.69	-100.	69		(71)
Water he	eating	gains (T	able 5)															
(72)m=	105.17	102.88	98.13	91.66	87.46	8	1.55	76.52	82.9	96	85.25	91.9	94	99.5	102.8	89		(72)
Total in	ternal	gains =					(66)	m + (67)m	+ (68	)m +	- (69)m + (	(70)m	+ (7	1)m + (72)	m			
(73)m= [5	599.76	594.82	572.16	537.31	501.87	47	70.22	451.87	460.	95	481.15	516.	22	555.02	584.	15		(73)
6. Sola	r gains	:																
•			•	r flux from	Table 6a	and		•	tions t	0 CO	nvert to th	e appl	licab	le orientati	on.			
Orientati		ccess F able 6d		Area m²			Flu	x ole 6a		т	g_ able 6b		T,	FF able 6c			Gains (W)	
Occusto	_								ı <b>г</b>			_	_			г		٦
South	0.9x	0.77	X	6.1		X	4	7.32	X		0.76	_ ×	H	0.7	_	= [	213.73	[78]
South	0.9x	0.77	X	6.1	2	X	7	7.18	X		0.76	_ ×	Ļ	0.7	_	= [	348.58	<u> </u> (78)
South	0.9x	0.77	X	6.1	2	X	9	4.25	X		0.76	×	Ļ	0.7	_	= [	425.64	<u> </u> (78)
South	0.9x	0.77	X			X		)5.11	X		0.76	×	Ļ	0.7	_	= [	474.73	<u> </u> (78)
South	0.9x	0.77	X			X		08.55	X		0.76	×	Ļ	0.7	_	= [	490.24	<u> </u> (78)
South	0.9x	0.77	X	6.1	2	X	1	08.9	X		0.76	_  ×	Ļ	0.7	_	= [	491.81	(78)
South	0.9x	0.77	X	6.1	2	x	10	)7.14	X		0.76	_ ×	Ļ	0.7	_	= [	483.86	(78)
South	0.9x	0.77	X	6.1	2	X	10	3.88	X		0.76	X	L	0.7		=	469.16	(78)

South	0.9x	0.77	X	6.1	2	x [	99	9.99	x		0.76	x	0.7	=	451.59	(78)
South	0.9x	0.77	х	6.1	2	x	85	5.29	x		0.76	x [	0.7	=	385.2	(78)
South	0.9x	0.77	х	6.1	2	x	56	6.07	х		0.76	x	0.7	=	253.22	(78)
South	0.9x	0.77	x	6.1	2	х	40	0.89	х		0.76	x	0.7	_ =	184.67	(78)
						_			_							_
Solar gai	ns in w	atts, ca	lculated	for eacl	h month				(83)m :	= Su	ım(74)m .	(82)m				
(83)m= 2	13.73	348.58	425.64	474.73	490.24	49	1.81	483.86	469.1	6	451.59	385.2	253.22	184.67	]	(83)
Total gair	ns – in	ternal a	nd solar	(84)m =	(73)m -	+ (8	3)m ,	watts					•	•	_	
(84)m= 8	13.49	943.41	997.8	1012.03	992.11	96	2.03	935.73	930.1	1	932.74	901.42	808.25	768.82	]	(84)
7. Mean	intern	al temp	erature (	heating	season	)										
Tempera							rea f	rom Tab	ole 9,	Th1	I (°C)				21	(85)
Utilisatio		_	•			-			,		( )					``
	Jan	Feb	Mar	Apr	May	Ù.	Jun	Jul	Au	aT	Sep	Oct	Nov	Dec	1	
_	0.98	0.92	0.82	0.71	0.54	_	.39	0.25	0.26	<del>-</del>	0.42	0.66	0.93	0.99	†	(86)
` ′	1		-1 !- !		T4 //									<u> </u>	J	
Mean in	1ternal 20.88	1empera 20.95	20.99	IVING are	21 (10		Ť			able		21	20.95	20.87	1	(87)
(87)m= 2	20.88	20.95	20.99	21	21		21	21	21		21	<u> </u>	20.95	20.87	J	(07)
Temper	ature c	during h		eriods ir	rest of	dwe	elling	from Ta	ble 9,	Th	2 (°C)				7	
(88)m = 2	20.34	20.34	20.34	20.34	20.34	20	).34	20.34	20.3	4	20.34	20.34	20.34	20.34		(88)
Utilisatio	n facto	or for ga	ains for r	est of d	welling, l	n2,r	n (se	e Table	9a)							
(89)m = 0	0.97	0.9	0.78	0.67	0.51	0.	.35	0.21	0.21	T	0.38	0.62	0.91	0.98		(89)
Mean in	ternal	tempera	ature in t	he rest	of dwelli	na -	T2 (fc	ollow ste	ns 3 t	n 7	in Tabl	e 9c)				
	0.19	20.29	20.33	20.34	20.34		).34	20.34	20.3	$\overline{}$	20.34	20.34	20.29	20.18	1	(90)
										_	f	LA = Livi	ng area ÷ (4	4) =	0.36	(91)
Magazia	اممسمه	1 a man a m	-t (f.	مارین و ملک ب	امريام مام	lin o	٤١	ΛΤ4	. /4	£I.	A) To					_
Mean in (92)m= 2	20.44	20.53	20.57	20.58	20.58	Ť	).58	20.58	20.5	-	20.58	20.58	20.53	20.43	1 —	(92)
` ′			ne mean										20.55	20.43	]	(02)
· · · · -	20.44	20.53	20.57	20.58	20.58		).58	20.58	20.5	-	20.58	20.58	20.53	20.43	1	(93)
8. Space				20.00	20.00		,,,,,	20.00	20.0	<u> </u>	20.00	20.00	20.00	20.10		(3.3)
•				nperatur	re obtain	ed :	at ste	n 11 of	Table	9h	so tha	t Ti m=	(76)m an	d re-cal	culate	
the utilis						ou .	at oto	,p 11 01	rabio		, 00 1110		(70)111 a11	a ro oan	odiato	
	Jan	Feb	Mar	Apr	May	J	Jun	Jul	Au	g	Sep	Oct	Nov	Dec		
Utilisatio	on facto	or for ga	ains, hm:	•									•	•	_	
(94)m=	0.97	0.91	0.8	0.68	0.52	0.	.36	0.23	0.23	3	0.39	0.63	0.92	0.98		(94)
Useful g	gains, h	nmGm ,	W = (94)	)m x (84	4)m										- -	
(95)m = 79	92.51	857.37	794.79	689.98	515.48	34	6.68	213.07	213.0	)7	364.84	568.82	740.8	753.34		(95)
Monthly	avera	ge exte	rnal tem	perature	from Ta	able	8								-	
(96)m=	4.5	5	6.8	8.7	11.7	14	4.6	16.9	16.9		14.3	10.8	7	4.9	]	(96)
Heat los	s rate	for mea	an intern	al tempe	erature,	Lm	, W =	:[(39)m	x [(93	)m-	- (96)m	]	•		-	
(97)m= 93	34.34	908.31	805.28	691.62	515.53	34	6.68	213.07	213.0	)7	364.84	569.39	789.71	908.14	]	(97)
· —	Ť		ment for	each m	nonth, k\	Nh/	mont	h = 0.02	4 x [(	97)	m – (95)	)m] x (4	1)m		7	
(98)m= 10	05.52	34.23	7.8	1.18	0.04		0	0	0		0	0.42	35.21	115.17		_
									Т	otal	per year	(kWh/yea	ir) = Sum(9	8)15,912 =	299.58	(98)
Space h	neating	require	ement in	kWh/m²	/year										3.61	(99)
																_

9a. Energy requirements – Individual heating Space heating:	g systems i	ncluding	micro-C	CHP)					
Fraction of space heat from secondary/sup	plementary	/ 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) = (2	02) <b>x</b> [1 –	(203)] =			1	(204)
Efficiency of main space heating system 1								93.3	(206)
Efficiency of secondary/supplementary hea	iting systen	n, %						0	(208)
Jan Feb Mar Apr Ma	ay Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/y	 rear
Space heating requirement (calculated abo					l				
105.52 34.23 7.8 1.18 0.0	4 0	0	0	0	0.42	35.21	115.17		
$(211)$ m = {[(98)m x (204)] + (210)m} x 100 -	- (206)					_		•	(211)
113.1 36.69 8.36 1.26 0.0	4 0	0	0	0	0.45	37.74	123.45		_
			Tota	ıl (kWh/yea	ar) =Sum(2	211) <sub>15,101</sub>	2=	321.09	(211)
Space heating fuel (secondary), kWh/mont	h								
$= \{[(98)m \times (201)] + (214) \text{ m} \} \times 100 \div (208)$ $(215)m = 0                                  $	0	0	0	0	0	0	0		
				l (kWh/yea	_			0	(215)
Water heating						10, 10			`′
Output from water heater (calculated above)									
192.75 169.47 176.98 157.27 153.	11 135.37	128.64	143.05	143.39	163.14	174.25	187.65		
Efficiency of water heater								79.6	(216)
(217)m= 83.08 81.22 80 79.67 79.	6 79.6	79.6	79.6	79.6	79.62	81.22	83.36		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m									
(219)m= 232 208.66 221.22 197.4 192.	35 170.07	161.61	179.71	180.13	204.89	214.54	225.11		
			Tota	al = Sum(2	19a) <sub>112</sub> =		•	2387.68	(219)
Annual totals					k'	Wh/yea	r	kWh/yea	ar
Space heating fuel used, main system 1								321.09	
Water heating fuel used								2387.68	
Electricity for pumps, fans and electric keep-	-hot								
mechanical ventilation - balanced, extract of	or positive i	nput fror	n outside	е			170.88		(230a)
central heating pump:							130		(230c)
boiler with a fan-assisted flue							45		(230e)
Total electricity for the above, kWh/year			sum	of (230a).	(230g) =	:		345.88	(231)
Electricity for lighting					, ,			387.88	(232)
	0.1							307.00	(202)
10a. Fuel costs - individual heating system	S:								
	Fu kV	i <b>el</b> Vh/year			Fuel P (Table			Fuel Cos £/year	t
Space heating - main system 1	(21	1) x			3.	1	x 0.01 =	9.9538	(240)
Space heating - main system 2	(21	3) x			0		x 0.01 =	0	(241)
Space heating - secondary	(21	5) x					x 0.01 =	0	(242)
, , , , , , , , , , , , , , , , , , , ,								ı	

Valer heating cost (other fuel)   (219)   (231)   (231)   (231)   (231)   (231)   (231)   (231)   (231)   (231)   (231)   (231)   (231)   (231)   (231)   (231)   (232)   (2					
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a Energy for lighting (232)	Water heating cost (other fuel)	(219)	3.1 x 0.01 =	74.02	247)
Energy for lighting (332)	Pumps, fans and electric keep-hot	(231)	11.46 x 0.01 =	39.64 (2	249)
Additional standing charges (Table 12)			0.04		
Appendix Q items: repeat lines (253) and (254) as needed  Total energy cost (245, (247) + (250), (254) =		(232)	11.46 X 0.01 =	44.45	
Total energy cost (245)(247) + (250)(254) =	Additional standing charges (Table 12)			106	251)
Energy cost deflator (Table 12) Energy cost factor (ECF)	Appendix Q items: repeat lines (253) and (254) as	s needed			
Energy cost deflator (Table 12) Energy cost factor (ECF) ((255) x (256)] + [(4) + 45.0] = 1.0063 (1257)  SAP rating (Section 12) 85.9619 (258)  12a. CO2 emissions – Individual heating systems including micro-CHP    Energy kWh/year kg CO2/kWh kg CO2/kWh kg CO2/kwh kg CO2/year kg CO2/kwh kg CO2/year kg CO2/kwh kg CO2/year kg CO2/kwh kg CO2/year kg CO2/kwh kg CO2/year kg CO2/kwh kg CO2/kwh kg CO2/year kg CO2/kwh kg CO2/kwh kg CO2/kwh kg CO2/year kg CO2/kwh kg CO2/year kg CO2/kwh kg CO2/kwh kg CO2/kwh kg CO2/year kg CO2/kwh kg	<u> </u>	7) + (250)(254) =		274.06	255)
Energy cost factor (ECF) [(255) x (256)] + [(4) + 45.0] =	11a. SAP rating - individual heating systems				
SAP rating (Section 12)   S5.9618   (258)	Energy cost deflator (Table 12)			0.47	256)
Space heating (main system 1)   (211)   x   0.198   = 63.58   (261)	Energy cost factor (ECF) [(255) x (25	[66]] ÷ [(4) + 45.0] =		1.0063 (2	257)
Energy kWh/year kg CO2/kWh kg CO2/kwh kg CO2	SAP rating (Section 12)			85.9619 (2	258)
Space heating (main system 1)   (211)   x   0.198   = 63.58   (261)	12a. CO2 emissions – Individual heating system	s including micro-CHP			
Space heating (secondary)       (215) x       0       0       (268)         Water heating       (219) x       0.198       =       472.76       (264)         Space and water heating       (261) + (262) + (263) + (264) =       536.34       (265)         Electricity for pumps, fans and electric keep-hot       (231) x       0.517       =       178.82       (267)         Electricity for lighting       (232) x       0.517       =       200.53       (268)         Total CO2, kg/year       sum of (265)(271) =       915.69       (272)         CO2 emissions per m²       (272) + (4) =       11.03       (273)         EI rating (section 14)       90       (274)         13a. Primary Energy         Space heating (main system 1)       (211) x       1.02       =       327.51       (261)         Space heating (secondary)       (215) x       0       =       0       (263)         Energy for water heating       (219) x       1.02       =       2435.44       (264)         Space and water heating       (261) + (262) + (263) + (264) =       2762.95       (265)         Electricity for pumps, fans and electric keep-hot       (231) x       2.92       =       1009.96       (267)		<b>3</b> 7			
Water heating  (219) x  (219) x  (219) x  (261) + (262) + (263) + (264) =  (261) + (262) + (263) + (264) =  (261) + (262) + (263) + (264) =  (261) + (262) + (263) + (264) =  (261) + (262) + (263) + (264) =  (261) + (262) + (263) + (264) =  (261) + (262) + (263) + (264) =  (261) + (262) + (263) + (264) =  (261) + (262) + (263) + (264) =  (272) + (4) =  (272) + (4) =  (272) + (4) =  (272) + (4) =  (273) + (264) =  (273) + (264) =  (272) + (4) =  (272) + (4) =  (273) + (264) =  (273) + (264) =  (274) + (264) + (264) =  (274) + (264) + (264) + (264) + (264) =  (275) + (264) + (26	Space heating (main system 1)	(211) x	0.198 =	63.58	261)
Space and water heating    (261) + (262) + (263) + (264) =	Space heating (secondary)	(215) x	0 =	0 (2	263)
Electricity for pumps, fans and electric keep-hot (231) x	Water heating	(219) x	0.198 =	472.76 (2	264)
Electricity for lighting  (232) x  (232) x  (232) x  (232) x  (232) x  (233) (268)  (271) = 200.53 (268)  (272) + (4) = 11.03 (273)  (273) El rating (section 14)  (274) 13a. Primary Energy  Energy kWh/year factor  Space heating (main system 1)  (211) x  (211) x  (215) x  (215) x  (219) x  (219) x  (219) x  (219) x  (219) x  (210) x  (210) x  (210) x  (211) x  (211) x  (212) + (4) = 11.03 (273)  (274)  P. Energy kWh/year  (214) 2 (214)  (215) 3 (261)  (261) 2 (263)  (261) 2 (263)  (261) 2 (263) 2 (264)  Electricity for water heating  (261) 2 (262) 2 (263) 2 (264)  Electricity for pumps, fans and electric keep-hot  Electricity for lighting  (232) x  (232) x  (232) x  (232) x  (233) x  (249) 2 (249) 3 (267)  Electricity for lighting  (232) x  (232) x  (233) x  (249) 3 (268)  (255)(271) 3 (268)	Space and water heating	(261) + (262) + (263) + (264) =		536.34 (2	265)
Total CO2, kg/year  CO2 emissions per m²  (272) ÷ (4) =  11.03  (273)  El rating (section 14)  13a. Primary Energy  Energy  kWh/year  Space heating (main system 1)  Space heating (secondary)  Energy (211) x  1.02  Energy (215) x  0  Energy (215) x  0  Energy (215) x  0  Energy (215) x  0  Energy (215) x  Energy (215) x  0  Energy (215) x  Energy (215) x  0  Energy (215) x  Energy (215) x  D  Energy (215) x  Energy (2	Electricity for pumps, fans and electric keep-hot	(231) x	0.517 =	178.82 (2	267)
Total CO2, kg/year  CO2 emissions per m²  El rating (section 14)  Energy	Electricity for lighting	(232) x	0.517 =	200.53 (2	268)
CO2 emissions per m²  El rating (section 14)  Energy	Total CO2, kg/year	sur	n of (265)(271) =		272)
El rating (section 14)    13a. Primary Energy   Primary   factor   factor   kWh/year   sum of (215) x     2100 year   2100 yea	CO2 emissions per m <sup>2</sup>	(27	(2) ÷ (4) =		273)
Energy kWh/year factor   F. Energy kWh/year   F.	EI rating (section 14)				
Energy kWh/year         Primary factor         P. Energy kWh/year           Space heating (main system 1)         (211) x         1.02         = 327.51 (261)           Space heating (secondary)         (215) x         0         = 0 (263)           Energy for water heating         (219) x         1.02         = 2435.44 (264)           Space and water heating         (261) + (262) + (263) + (264) =         2762.95 (265)           Electricity for pumps, fans and electric keep-hot         (231) x         2.92         = 1009.96 (267)           Electricity for lighting         (232) x         0         = 1132.6 (268)           'Total Primary Energy         sum of (265)(271) =         4905.51 (272)					·
kWh/year       factor       kWh/year         Space heating (main system 1)       (211) x       1.02       = 327.51       (261)         Space heating (secondary)       (215) x       0       = 0       (263)         Energy for water heating       (219) x       1.02       = 2435.44       (264)         Space and water heating       (261) + (262) + (263) + (264) =       2762.95       (265)         Electricity for pumps, fans and electric keep-hot       (231) x       2.92       = 1009.96       (267)         Electricity for lighting       (232) x       0       = 1132.6       (268)         'Total Primary Energy       sum of (265)(271) =       4905.51       (272)	,	Enorgy	Drimory	P Energy	
Space heating (secondary)       (215) x       0       =       0       (263)         Energy for water heating       (219) x       1.02       =       2435.44       (264)         Space and water heating       (261) + (262) + (263) + (264) =       2762.95       (265)         Electricity for pumps, fans and electric keep-hot       (231) x       2.92       =       1009.96       (267)         Electricity for lighting       (232) x       0       =       1132.6       (268)         'Total Primary Energy       sum of (265)(271) =       4905.51       (272)		<b>-</b>			
Energy for water heating (219) x 1.02 = 2435.44 (264)  Space and water heating (261) + (262) + (263) + (264) = 2762.95 (265)  Electricity for pumps, fans and electric keep-hot (231) x 2.92 = 1009.96 (267)  Electricity for lighting (232) x 0 = 1132.6 (268)  'Total Primary Energy sum of (265)(271) = 4905.51 (272)	Space heating (main system 1)	(211) x	1.02 =	327.51 (2	261)
Space and water heating (261) + (262) + (263) + (264) = 2762.95 (265)  Electricity for pumps, fans and electric keep-hot (231) × 2.92 = 1009.96 (267)  Electricity for lighting (232) × 0 = 1132.6 (268)  'Total Primary Energy sum of (265)(271) = 4905.51 (272)	Space heating (secondary)	(215) x	0 =	0 (2	263)
Electricity for pumps, fans and electric keep-hot (231) x	Energy for water heating	(219) x	1.02 =	2435.44 (2	264)
Electricity for lighting (232) x 0 = 1132.6 (268)  'Total Primary Energy sum of (265)(271) = 4905.51 (272)	Space and water heating	(261) + (262) + (263) + (264) =		2762.95 (2	265)
'Total Primary Energy sum of (265)(271) = 4905.51 (272)	Electricity for pumps, fans and electric keep-hot	(231) x	2.92 =	1009.96 (2	267)
'Total Primary Energy sum of (265)(271) = 4905.51 (272)	Electricity for lighting	(232) x	0 =	1132.6 (2	268)
	'Total Primary Energy	sur	m of (265)(271) =	4905.51 (2	272)
	Primary energy kWh/m²/year	(27	(2) ÷ (4) =	59.1 (2	273)

		User D	etails:						
Assessor Name:			Strom						
Software Name:	Stroma FSAP 2009		Softwa				Versio	n: 1.5.0.49	
A dalage en	P	Property A	Address:	House	1				
Address: 1. Overall dwelling dime	ensions:								
1. Overall awailing airlie	, 1010110.	Area	a(m²)		Ave He	eight(m)	•	Volume(m <sup>3</sup>	3)
Ground floor			<u>`                                    </u>	(1a) x		2.39	(2a) =	149.7574	(3a)
Total floor area TFA = (1a	a)+(1b)+(1c)+(1d)+(1e)+(1ı	n)	2.66	(4)			J 1		
Dwelling volume		′			o)+(3c)+(3c	d)+(3e)+	(3n) =	149.7574	(5)
							` '	140.7074	
2. Ventilation rate:	main Seconda	ry	other		total			m³ per hou	r
Number of chimneys	heating heating  0 + 0	<b>-</b> + -	0	1 = Г	0	<b>x</b>	40 =	0	(6a)
Number of open flues	0 + 0	┧╷┝	0	Ј <u>L</u> ] = Г	0	x	20 =	0	(6b)
Number of intermittent fa		_	0	J L			10 =	-	<b>=</b>   ` ` `
				Ļ	0		ļ	0	(7a)
Number of passive vents				L	0		10 =	0	(7b)
Number of flueless gas fi	res				0	X	40 =	0	(7c)
							Δir ch	anges per ho	nur.
Infiltration due to chimne	ys, flues and fans = (6a)+(6b)+(7	7a)+(7b)+(	70) -	_		_			_
	peen carried out or is intended, procee			continue fi	0 rom (9) to		÷ (5) =	0	(8)
Number of storeys in the					(5) 15			0	(9)
Additional infiltration						[(9)	-1]x0.1 =	0	(10)
Structural infiltration: 0	.25 for steel or timber frame or	r 0.35 for	masonr	y const	ruction			0	(11)
if both types of wall are pu deducting areas of openir	resent, use the value corresponding to	o the greate	er wall are	a (after					
= -	floor, enter 0.2 (unsealed) or 0	.1 (seale	d), else	enter 0				0	(12)
If no draught lobby, en	ter 0.05, else enter 0							0	(13)
Percentage of windows	s and doors draught stripped						į	0	(14)
Window infiltration			0.25 - [0.2	x (14) ÷ 1	100] =			0	(15)
Infiltration rate			(8) + (10)					0	(16)
•	q50, expressed in cubic metre	•	•	•	etre of e	envelope	area	0.6	(17)
·	lity value, then $(18) = [(17) \div 20] + ($				. i.a. In i.a			0.03	(18)
Number of sides on which	es if a pressurisation test has been dor h sheltered	ne or a deg	ree air pei	теаршту	is being u	sea	ı	2	(19)
Shelter factor	TI GITOROTOG		(20) = 1 -	[0.0 <b>75</b> x (	19)] =			0.85	(20)
Infiltration rate incorporat	ting shelter factor		(21) = (18)	) x (20) =				0.03	(21)
Infiltration rate modified f	or monthly wind speed						'		
Jan Feb	Mar Apr May Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	eed from Table 7								
(22)m= 5.4 5.1	5.1 4.5 4.1 3.9	3.7	3.7	4.2	4.5	4.8	5.1		
Wind Factor (22a)m = (22	2)m <i>± 1</i>								
	1.27	0.92	0.92	1.05	1.12	1.2	1.27		
1.21	12 0.00	1 3.02	3.02	1.00	12	L	,	l	

0.03	0.03	0.03	0.03	0.03	0.02	0.02	(21a) x	0.03	0.03	0.03	0.03		
Calculate effe					1 ' '		0.02	0.03	0.03	0.03	0.03		
If mechanica	al ventila	ition:										0.5	(2
If exhaust air h	eat pump i	using Appe	endix N, (2	3b) = (23a	a) × Fmv (e	equation (I	N5)) , othe	rwise (23b	) = (23a)			0.5	(2
If balanced with	heat reco	overy: effic	iency in %	allowing f	for in-use f	actor (fron	n Table 4h	) =				78.2	(2
a) If balance	d mech	anical ve	entilation	with he	at recov	ery (MVI	HR) (24a	m = (22)	2b)m + (	23b) × [	1 – (23c)	÷ 100]	
4a)m= 0.14	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.14	0.14	0.14	0.14		(2
b) If balance	d mech	anical ve	entilation	without	heat red	covery (I	MV) (24b	)m = (22	2b)m + (	23b)			
4b)m= 0	0	0	0	0	0	0	0	0	0	0	0		(
c) If whole h	ouse ex	tract ver	tilation o	or positiv	e input	ventilatio	on from o	utside	-	-			
if (22b)n	า < 0.5 ×	(23b), t	hen (24	c) = (23b	o); other	wise (24	c) = (22h	) m + 0.	5 × (23b	)		i	
4c)m= 0	0	0	0	0	0	0	0	0	0	0	0		(:
d) If natural													
		en (24d)	<u> </u>		· `	<del></del>	<del> </del>			1	1	I	,
4d)m= 0	0	0	0	0	0	0	0	0	0	0	0		(
Effective air			<u> </u>	<u> </u>	ŕ	<del>r``</del>	<del></del>					ı	
5)m= 0.14	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.14	0.14	0.14	0.14		(
. Heat losse	s and he	eat loss	paramete	er:								_	
LEMENT	Gros		Openin		Net Ar	rea	U-val	ıe	ΑXU		k-value	)	ΑΧk
	area	(m²)	· m		A ,r	m²	W/m2	K	(W/	K)	kJ/m²-l	ζ Ι	kJ/K
oors					2	X	1.2	= [	2.4				(
indows					6.125	5 x1	/[1/( 0.8 )+	0.04] =	4.75				(
oor					62.66	x	0.15	1 - [	9.399	пι			(:
alls	62.8	34	14.2	5	48.59	) x	0.15	=	7.29	٦ i			
oof	62.6	6	0		62.66	3 x	0.15	<b>=</b>	9.4	= i		7 <b>—</b>	<u> </u>
otal area of e	lements	 . m²			188.1	<u></u>							(
arty wall		,			10	X	0		0	<b>—</b> 1			(
ternal wall **						╡ ^			0				<b>—</b>
or windows and	roof wind	04/0 1/00 6	effootivo wi	ndow I I v	0	lotod uning	y formula 1	/[/1/  L volu	(0) ( 0 (04) (	no airean ir	norogrank		(
include the area						aleu using	y iorriula i	/[( 1/ <b>U-</b> vaic	1 <del>0</del> )+0.04] a	is giveri ii	i paragrapi.	3.2	
abric heat los	s, W/K	= S (A x	U)				(26)(30)	+ (32) =				37.98	(
eat capacity	Cm = S(	(Axk)						((28)	(30) + (32	2) + (32a)	(32e) =	12523.09	) (
nermal mass	parame	ter (TMF	P = Cm ÷	- TFA) ir	n kJ/m²K	,		Indica	tive Value	: Medium		250	(1
r design assess	•	•		,			recisely the	indicative	values of	TMP in T	able 1f		
n be used inste	ad of a de	tailed calcı	ulation.										
nermal bridge	es : S (L	x Y) cal	culated ı	using Ap	pendix I	K						1.88	(
letails of therma		are not kn	own (36) =	= 0.15 x (3	31)								
otal fabric he									(36) =			39.86	(
	at loss ca	1				1			= 0.33 × (	25)m x (5	)	I	
			I Anr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
entilation hea	Feb	Mar	Apr	iviay	<del> </del>	<del>                                     </del>	<del>l                                     </del>		<b>†</b>	î e	†		
	Feb 6.99	6.99	6.8	6.68	6.62	6.55	6.55	6.71	6.8	6.9	6.99		(;
Jan	6.99	6.99			<del> </del>	6.55	<del>                                     </del>		6.8 = (37) + (		6.99		(

leat lo	ss para	meter (H	HLP), W	m²K					(40)m	= (39)m ÷	(4)			
10)m=	0.75	0.75	0.75	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.75	0.75		
lumbo	r of dov	o in mor	nth (Tab	lo 1o\					,	Average =	Sum(40) <sub>1</sub> .	12 /12=	0.74	(4
lumbe ]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
l1)m=	31	28	31	30	31	30	31	31	30	31	30	31		(4
L	l l													
4. Wa	ter heat	ing ener	gy requi	rement:								kWh/ye	ar:	
ccum	ed occu	nancy I	NI.									T		(
if TF	A > 13.9	, N = 1		[1 - exp	(-0.0003	349 x (TF	A -13.9	)2)] + 0.0	0013 x (	ΓFA -13.		558		(4
	A £ 13.9	•	ater usac	na in litra	s nar da	ıy Vd,av	arage –	(25 v NI)	<b>+</b> 36		07.6	2020		(4
educe t	the annua	l average	hot water	usage by	5% if the a	lwelling is	designed t			se target o		3939		(-
ot more T		litres per p		day (all w	ater use, l	not and co	ld)							
ot water	Jan	Feb	Mar	Apr	May	Jun ctor from 7	Jul	Aug	Sep	Oct	Nov	Dec		
г			•					, ,	05.05	00.44	00.04	00.40		
4)m= [	96.13	92.64	89.14	85.65	82.15	78.65	78.65	82.15	85.65	89.14	92.64 m(44) <sub>112</sub> =	96.13	1048.7273	
nergy c	content of	hot water	used - cal	culated mo	onthly $= 4$ .	190 x Vd,n	n x nm x E	Tm / 3600			ables 1b, 1		1040.7273	
5)m=	142.9	124.98	128.97	112.44	107.89	93.1	86.27	99	100.18	116.75	127.44	138.39		
										Γotal = Su	m(45) <sub>112</sub> =		1378.3365	(
nstanta	aneous w	ater heatii	ng at point	of use (no	hot water	storage),	enter 0 in	boxes (46,	to (61)					
	21.44	18.75	19.35	16.87	16.18	13.97	12.94	14.85	15.03	17.51	19.12	20.76		(
	storage anufactu		clared lo	ss facto	r is knov	vn (kWh	/day)·				0.0	024		(
			m Table		1 10 141.01		uay).				_	54		(
•			storage		ear			(47) x (48)	=			013		(
٠.			_			s not kno	own:	( ) ( )				710		`
ylinde	er volum	e (litres	) includir	ng any s	olar stor	age with	in same					0		(
		•		-		litres in bo	. ,	antar 101 in	hov (FO)					
						eous comb		enter o m	DOX (30)					,
		Ū		om rabi	e z (KVVI	h/litre/da	l <b>y</b> )					0		(
	e factor f rature fa		oie ∠a m Table	2h								0		(
•			storage		ar			((50) x (51	) x (52) x (	(53) =		0		(
•	49) or (5		_	, 100011/y	Jui			((00) x (0)	) X (02) X (	(00) =		013		(
•	, ,	, ,	culated f	or each	month			((56)m = (	55) × (41)r	m				Ì
6)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(
cylinde	er contains	dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	H11)] ÷ (5	0), else (57	7)m = (56)	m where (	H11) is fro	m Appendi	x H	
7)m=	0.4	0.36	0.4	0.39	0.4	0.39	0.4	0.4	0.39	0.4	0.39	0.4		(
imar\	v circuit	loss (an	nual) fro	m Table	9.3						3(	60		(
-		•	•			59)m = (	58) ÷ 36	55 × (41)	m					
-	dified by	factor fi	om Tab	le H5 if t	here is s	olar wat	er heatir	ng and a	cylinde	r thermo	stat)			
(mod	20.50	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58		(
(mod 9)m= [	30.58	27.02	00.00								L			
9)m=					(61)m =	(60) ÷ 36	65 × (41)	)m						

(62)   Column   173.88   152.96   159.95   142.42   138.87   123.08   117.25   129.39   130.16   147.73   157.42   169.37     Column   173.88   152.96   159.95   142.42   138.87   123.08   117.25   129.39   130.16   147.73   157.42   169.37     Column   173.88   152.96   159.95   142.42   138.87   123.08   117.25   129.39   130.16   147.73   157.42   169.37     Column   173.88   152.96   159.95   142.42   138.87   123.08   117.25   129.39   130.16   147.73   157.42   169.37     Column   173.88   152.96   159.95   142.42   138.87   123.08   117.25   129.39   130.16   147.73   157.42   169.37     Column   173.88   152.96   159.95   142.42   138.87   123.08   117.25   129.39   130.16   147.73   157.42   169.37     Column   173.88   152.96   159.95   142.42   138.87   123.08   117.25   129.39   130.16   147.73   157.42   169.37     Column   173.88   152.96   159.95   142.42   138.87   123.08   117.25   129.39   130.16   147.73   157.42   169.37     Column   173.88   152.96   159.95   142.42   138.87   123.08   147.25   129.39   130.16   147.73   157.42   169.37     Column   173.88   152.96   159.95   142.42   138.87   123.35   123.3	Solar DHW input calculated using Appendix G or Appendix H (regative 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
Company   Comp	(63)m
(63)me	Gay ma
Output from water heater  ((64)m= 173.86   152.96   159.95   142.42   138.87   123.08   117.25   128.96   130.16   147.73   157.42   169.37      Heat gains from water heating, kWh/month 0.25 * [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (57)m + (59)m]     (65)m= 172.3   63.94   67.67   61.37   60.66   54.94   53.47   57.75   57.29   63.6   66.36   70.8     (65)m include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating    S. Internal gains (see Table 5 and 5a):    Metabolic qains (Table 5), Watts	Output from water heater  (84)ms
Resign   173.88   152.96   159.95   142.42   138.87   123.08   117.25   129.98   130.16   147.73   157.42   169.37	173.88   152.96   159.95   142.42   138.87   123.08   117.25   129.98   130.16   147.73   157.42   169.37
Compute from water heater   Compute from water heater   Computer	Coupus from water heater (annual)   1743.0669   (64)
Heat gains from water heating, kWh/morth 0.25 ' [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (65)m 72.3 63.94 67.67 61.37 60.86 54.94 53.47 57.7 57.29 63.6 66.36 70.8 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating    Summary    Heat gains from water heating, kWh/month 0.25 ´ [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] (65)m   72.3 63.94 67.67 61.37 60.66 54.94 53.47 57.7 57.29 63.6 66.36 70.8 (65) include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating  5. Internal gains (See Table 5 and 5a):  Metabolic gains (Table 5), Watts  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec (66)m   123.35 123.35 123.35 123.35 123.35 123.35 123.35 123.35 123.35 123.35 123.35 123.35 123.35 (66)   Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 (67)m   41.24 36.63 29.79 22.55 16.86 14.23 15.38 19.99 26.83 34.07 39.76 42.38 (67)   Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68)m   288.06 270.84 28.38 248.91 230.07 212.37 200.54 197.76 204.77 219.69 238.53 256.24 (68)   Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m   49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 (69)   Pumps and fans gains (Table 5a) (70)m   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
(65)m    72.3   63.94   67.67   61.37   60.66   54.94   53.47   57.7   57.29   63.6   66.36   70.8   (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):	Cooking gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
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    Same	include (67)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    May
Metabolic gains (Table 5), Watts	Metabolic gains (Table 5), Watts   Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec   (66)m=   123.35   12
Metabolic gains (Table 5), Watts    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec	Metabolic gains (Table 5), Watts    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec     123.35	Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec
Cooling pains (calculated in Appendix L, equation L9 or L9a), also see Table 5	Cocking gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5  (67)	Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5  (67)m= 41.24
(67) m=	(67)m= 41.24 36.63 29.79 22.55 16.66 14.23 15.38 19.99 26.83 34.07 39.76 42.38 (67)  Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 (68)m= 268.06 270.84 263.83 248.91 230.07 212.37 200.54 197.76 204.77 219.69 238.53 256.24 (68)  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 (69)m= 49.39 (69)  Pumps and fans gains (Table 5a) (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5  (68)mi= 268.06 270.84 263.83 248.91 230.07 212.37 200.54 197.76 204.77 219.69 238.53 256.24 (68)  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69)mi= 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 (69)  Pumps and fans gains (Table 5a)  (70)mi= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5  (68)m = 268.06   270.84   263.83   248.91   230.07   212.37   200.54   197.76   204.77   219.69   238.53   256.24   (68)  Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69)m = 49.39   49.39
(68)m= 268.06	(68)m= 268.06
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69)m= 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 (69)  Pumps and fans gains (Table 5a)  (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5  (69)m = 49.39
(69)m= 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 49.39 (69)  Pumps and fans gains (Table 5a)  (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Company   Comp
Pumps and fans gains (Table 5a) (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Pumps and fans gains (Table 5a)  (70)m= 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Common	Crown = 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Losses e.g. evaporation (negative values) (Table 5) (71)m=	Losses e.g. evaporation (negative values) (Table 5)  (71)m=
Water heating gains (Table 5)  (72)m= 97.17 95.15 90.95 85.24 81.53 76.3 71.86 77.55 79.57 85.49 92.16 95.16 (72)  Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m (73)m= 496.98 493.13 475.08 447.2 418.96 393.41 378.29 385.81 401.68 429.75 460.96 484.28 (73)  6. Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Table 6d m2 Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 6.12 x 47.32 x 0.76 x 0.7 = 213.73 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 348.58 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 474.73 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 4474.73 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)	(71)m=
Water heating gains (Table 5)  (72)m= 97.17 95.15 90.95 85.24 81.53 76.3 71.86 77.55 79.57 85.49 92.16 95.16 (72)  Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m  (73)m= 496.98 493.13 475.08 447.2 418.96 393.41 378.29 385.81 401.68 429.75 460.96 484.28 (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 Table 6b Table 6c (W)  South 0.9x 0.77 x 6.12 x 47.32 x 0.76 x 0.7 = 213.73 (78)  South 0.9x 0.77 x 6.12 x 77.18 x 0.76 x 0.7 = 348.58 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 4425.64 (78)  South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 4490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 491.81 (78)	Water heating gains (Table 5)  (72)m= 97.17 95.15 90.95 85.24 81.53 76.3 71.86 77.55 79.57 85.49 92.16 95.16 (72)  Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m  (73)m= 496.98 493.13 475.08 447.2 418.96 393.41 378.29 385.81 401.68 429.75 460.96 484.28 (73)  6. Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Area Flux g_ FF Gains Table 6d m² Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 × 6.12 × 47.32 × 0.76 × 0.7 = 213.73 (78)  South 0.9x 0.77 × 6.12 × 77.18 × 0.76 × 0.7 = 348.58 (78)  South 0.9x 0.77 × 6.12 × 94.25 × 0.76 × 0.7 = 425.64 (78)  South 0.9x 0.77 × 6.12 × 94.25 × 0.76 × 0.7 = 474.73 (78)
Total internal gains =   G66)m + (67)m + (68)m + (70)m + (71)m + (72)m	(72)m=         97.17         95.15         90.95         85.24         81.53         76.3         71.86         77.55         79.57         85.49         92.16         95.16         (72)           Total internal gains =         (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m           (73)m=         496.98         493.13         475.08         447.2         418.96         393.41         378.29         385.81         401.68         429.75         460.96         484.28         (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         Table 6b         Table 6c         (W)           South 0.9x 0.77         x         6.12         x         47.32         x         0.76         x         0.7         =         213.73         (78)           South 0.9x 0.77         x         6.12         x         77.18         x         0.76         x         0.7         =         425.64         (78)           South 0.9x 0.77         x         6.12         x         94.25         x
Total internal gains =	Total internal gains =
(73)m= 496.98 493.13 475.08 447.2 418.96 393.41 378.29 385.81 401.68 429.75 460.96 484.28 (73)  6. Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Table 6d m² Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 6.12 x 47.32 x 0.76 x 0.7 = 213.73 (78)  South 0.9x 0.77 x 6.12 x 77.18 x 0.76 x 0.7 = 348.58 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 474.73 (78)  South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)	(73)m= 496.98 493.13 475.08 447.2 418.96 393.41 378.29 385.81 401.68 429.75 460.96 484.28 (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 May Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 6.12 x 47.32 x 0.76 x 0.7 = 213.73 (78)  South 0.9x 0.77 x 6.12 x 77.18 x 0.76 x 0.7 = 348.58 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 474.73 (78)
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         Table 6b         Table 6c         (W)           South 0.9x 0.77	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 Area Flux g_ FF Gains Table 6d m² Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 6.12 x 47.32 x 0.76 x 0.7 = 213.73 (78)  South 0.9x 0.77 x 6.12 x 77.18 x 0.76 x 0.7 = 348.58 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 474.73 (78)
Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Table 6d	Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.  Orientation: Access Factor Table 6d $m^2$ Table 6a $Table 6b$ Table 6b Table 6c $m^2$ Table 6a Table 6b Table 6c $m^2$ Table 6a $m^2$ Table 6a $m^2$ Table 6b Table 6c $m^2$ Table 6b Table 6c $m^2$ Table 6c $m^$
Orientation:         Access Factor Table 6d         Area m²         Flux Table 6a         g_ Table 6b         FF Table 6c         Gains (W)           South 0.9x 0.77	Orientation:         Access Factor Table 6d         Area m²         Flux Table 6a $g_{-}$ Table 6b         FF Table 6c         Gains (W)           South 0.9x 0.77
Table 6d m <sup>2</sup> Table 6a Table 6b Table 6c (W)  South 0.9x 0.77 x 6.12 x 47.32 x 0.76 x 0.7 = 213.73 (78)  South 0.9x 0.77 x 6.12 x 77.18 x 0.76 x 0.7 = 348.58 (78)  South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78)  South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 474.73 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78)  South 0.9x 0.77 x 6.12 x 108.9 x 0.76 x 0.7 = 491.81 (78)	Table 6d $m^2$ Table 6a Table 6b Table 6c (W)  South $0.9x$ $0.77$ $x$ $6.12$ $x$ $47.32$ $x$ $0.76$ $x$ $0.7$ $= 213.73$ (78)  South $0.9x$ $0.77$ $x$ $6.12$ $x$ $77.18$ $x$ $0.76$ $x$ $0.7$ $= 348.58$ (78)  South $0.9x$ $0.77$ $x$ $6.12$ $x$ $94.25$ $x$ $0.76$ $x$ $0.7$ $= 425.64$ (78)  South $0.9x$ $0.77$ $x$ $6.12$ $x$ $105.11$ $x$ $0.76$ $x$ $0.7$ $= 474.73$ (78)
South       0.9x       0.77       x       6.12       x       47.32       x       0.76       x       0.7       =       213.73       (78)         South       0.9x       0.77       x       6.12       x       77.18       x       0.76       x       0.7       =       348.58       (78)         South       0.9x       0.77       x       6.12       x       94.25       x       0.76       x       0.7       =       425.64       (78)         South       0.9x       0.77       x       6.12       x       105.11       x       0.76       x       0.7       =       474.73       (78)         South       0.9x       0.77       x       6.12       x       108.55       x       0.76       x       0.7       =       490.24       (78)         South       0.9x       0.77       x       6.12       x       108.9       x       0.76       x       0.7       =       491.81       (78)	South       0.9x       0.77       x       6.12       x       47.32       x       0.76       x       0.7       =       213.73       (78)         South       0.9x       0.77       x       6.12       x       77.18       x       0.76       x       0.7       =       348.58       (78)         South       0.9x       0.77       x       6.12       x       94.25       x       0.76       x       0.7       =       425.64       (78)         South       0.9x       0.77       x       6.12       x       105.11       x       0.76       x       0.7       =       474.73       (78)
South       0.9x       0.77       x       6.12       x       77.18       x       0.76       x       0.7       =       348.58       (78)         South       0.9x       0.77       x       6.12       x       94.25       x       0.76       x       0.7       =       425.64       (78)         South       0.9x       0.77       x       6.12       x       105.11       x       0.76       x       0.7       =       474.73       (78)         South       0.9x       0.77       x       6.12       x       108.55       x       0.76       x       0.7       =       490.24       (78)         South       0.9x       0.77       x       6.12       x       108.9       x       0.76       x       0.7       =       491.81       (78)	South       0.9x       0.77       x       6.12       x       77.18       x       0.76       x       0.7       =       348.58       (78)         South       0.9x       0.77       x       6.12       x       94.25       x       0.76       x       0.7       =       425.64       (78)         South       0.9x       0.77       x       6.12       x       105.11       x       0.76       x       0.7       =       474.73       (78)
South       0.9x       0.77       x       6.12       x       94.25       x       0.76       x       0.7       =       425.64       (78)         South       0.9x       0.77       x       6.12       x       105.11       x       0.76       x       0.7       =       474.73       (78)         South       0.9x       0.77       x       6.12       x       108.55       x       0.76       x       0.7       =       490.24       (78)         South       0.9x       0.77       x       6.12       x       108.9       x       0.76       x       0.7       =       491.81       (78)	South 0.9x 0.77 x 6.12 x 94.25 x 0.76 x 0.7 = 425.64 (78) South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 474.73 (78)
South       0.9x       0.77       x       6.12       x       105.11       x       0.76       x       0.7       =       474.73       (78)         South       0.9x       0.77       x       6.12       x       108.55       x       0.76       x       0.7       =       490.24       (78)         South       0.9x       0.77       x       6.12       x       108.9       x       0.76       x       0.7       =       491.81       (78)	South 0.9x 0.77 x 6.12 x 105.11 x 0.76 x 0.7 = 474.73 (78)
South 0.9x 0.77 x 6.12 x 108.55 x 0.76 x 0.7 = 490.24 (78) South 0.9x 0.77 x 6.12 x 108.9 x 0.76 x 0.7 = 491.81 (78)	
South 0.9x 0.77 x 6.12 x 108.9 x 0.76 x 0.7 = 491.81 (78)	
	South $0.9x$ 0.77
South 0.9x 0.77 x 6.12 x 1.07.14 x 0.76 x 0.7 = 483.86 (78)	South 0.9x 0.77 x 6.12 x 108.9 x 0.76 x 0.7 = 491.81 (78)
0.00 0.77	South 0.9x 0.77 x 6.12 x 107.14 x 0.76 x 0.7 = 483.86 (78)
South 0.9x 0.77 x 6.12 x 103.88 x 0.76 x 0.7 = 469.16 (78)	South $0.9x$ $0.77$ $x$ $6.12$ $x$ $1.03.88$ $x$ $0.76$ $x$ $0.7$ = $1.02.48$ $(78)$

South 0.9% 0.77 × 6.12 × 96.20 × 0.76 × 0.7 = 451.50 /79   South 0.9% 0.77 × 6.12 × 96.20 × 96.20 × 0.76 × 0.7 = 386.2 /76   South 0.9% 0.77 × 6.12 × 96.20 × 96.20 × 0.76 × 0.7 = 386.2 /76   South 0.9% 0.77 × 6.12 × 40.89 × 0.76 × 0.7 = 125.22 /79   South 0.9% 0.77 × 6.12 × 40.89 × 0.76 × 0.7 = 125.22 /79   South 0.9% 0.77 × 6.12 × 40.89 × 0.76 × 0.7 = 141.67 /78   Solar gains in watts, calculated for each month																	
South 0.9x 0.77 x 6.12 x 6.02 x 0.76 x 0.7 = 255.22 76) South 0.9x 0.77 x 6.12 x 40.89 x 0.76 x 0.7 = 255.22 76) South 0.9x 0.77 x 6.12 x 40.89 x 0.76 x 0.7 = 184.67 78)  Solar gains in watts, calculated for each month (83)m = \$\text{Sum(74)m}\$(82)m  Solar gains in watts, calculated for each month (83)m = \$\text{Sum(74)m}\$(82)m  Total gains - internal and solar (84)m = (73)m + (83)m, watts  (84)m = 70.71 81.71 00.72 21.93 000.21 885.22 865.22 862.15 845.97 853.27 814.95 714.18 668.96 (84)  7. Mean internal temperature (heating season)  Temperature during heating periods in the living area from Table 9, Th1 (°C)  Utilisation factor for gains for living area, h1,m (see Table 9a)  Mean internal temperature in living area Th (follow steps 3 to 7 in Table 9c)  (87)m = 20.8 2.93 2.037 2.039 2.1 21 21 21 21 21 20.99 2.031 20.72 (87)  When internal temperature in the rest of dwelling from Table 9, Th2 (°C)  (88)m = 20.3 2.03 2.03 20.3 20.3 20.3 20.3 20.3	South	0.9x	0.77	X	6.1	2	X	9	9.99	X		0.76	x	0.7	=	451.59	(78)
Solar gains in watts, calculated for each month (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m (83)m - swm(74)m - (82)m - swm(84)m	South	0.9x	0.77	X	6.1	2	X	8	35.29	x		0.76	x [	0.7	=	385.2	(78)
Solar gains in watts, calculated for each month  (83)m = 213.73 348.58 425.64 474.73 490.24 491.81 483.66 469.10 451.59 385.2 253.22 184.67  (83)m = 710.71 841.71 900.72 921.93 909.21 885.22 862.15 864.97 863.27 814.95 714.18 688.96  (84)m = 710.71 841.71 900.72 921.93 909.21 885.22 862.15 864.97 863.27 814.95 714.18 688.96  (84)m = 710.71 841.71 900.72 921.93 909.21 885.22 862.15 864.97 863.27 814.95 714.18 688.96  (84)m = 710.71 841.71 900.72 921.93 909.21 885.22 862.15 864.97 863.27 814.95 714.18 688.96  (85)m = 1.0	South	0.9x	0.77	X	6.1	2	x	5	6.07	x		0.76	x	0.7		253.22	(78)
13,73   345,8   425,64   47,73   490,24   491,81   483,86   489,16   451,59   385,2   253,22   184,67   (83)	South	0.9x	0.77	x	6.1	2	X	4	0.89	x		0.76	_ x [	0.7		184.67	(78)
13,73   345,8   425,64   47,73   490,24   491,81   483,86   489,16   451,59   385,2   253,22   184,67   (83)		_															
Total gains — Internal and solar (84)m = (73)m + (83)m, watts  (84)m = 710.71 841.71 900.72 921.93 909.21 885.22 862.15 864.97 863.27 814.95 714.18 668.96 (84)  7. Mean internal temperature (tring persisted in the living area from Table 9, Th1 (°C)	Solar g	ains in	watts, ca	alculated	d for eac	h month				(83)m	= St	um(74)m .	(82)m				
(84) (84) (84) (84) (84) (84) (84) (84)	(83)m=	213.73	348.58	425.64	474.73	490.24	4	91.81	483.86	469.	.16	451.59	385.2	253.22	184.67		(83)
Temperature during heating periods in the living area from Table 9, Th1 (°C)  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 0.91 0.82 0.71 0.61 0.47 0.34 0.22 0.22 0.37 0.58 0.84 0.92 (86)  Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)  (87)m 20.8 20.91 20.97 20.99 21 21 21 21 21 21 20.99 20.91 20.78 (87)  Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)  (88)m 20.3 20.3 20.3 20.3 20.3 20.3 20.3 20.3	Total g	ains – ii	nternal a	nd sola	r (84)m =	= (73)m	+ (8	83)m	, watts		•			•	•	_	
Temperature during heating periods in the living area from Table 9, Th1 (°C)	(84)m=	710.71	841.71	900.72	921.93	909.21	8	85.22	862.15	854.	.97	853.27	814.95	714.18	668.96		(84)
Temperature during heating periods in the living area from Table 9, Th1 (°C)	7. Mea	an inter	nal temp	erature	(heating	season	)										
Utilisation factor for gains for living area, h1,m (see Table 9a)  Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)  (86)m= 20.8					,		<b>_</b>	area t	from Tal	ole 9,	Th	1 (°C)				21	(85)
Separate   Separate	•		•	•			-			,		( )					`
(86)me			Ŭ	l	<del></del>		È			Aı	ua	Sep	Oct	Nov	Dec	]	
Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)  (87)me   20.8   20.91   20.97   20.99   21   21   21   21   21   21   20.99   20.91   20.78   (87)  Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)  (88)mis   20.3   20.3   20.3   20.3   20.3   20.3   20.3   20.3   20.31   20.31   20.31   20.3	(86)m=				<del></del>		-			<del>                                     </del>	Ť			<del> </del>			(86)
(87)ms	` ′ [		1 4		L	T4 /5	- " -	4-	0 to <del>-</del>			- 0-)	<u> </u>	<u> </u>		J	
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C) (88)m² = 20.3	Г		<del></del>	r		<u> </u>	JIIO		<del>i                                      </del>		$\neg$		20.00	20.01	20.79	1	(87)
(88) rile 20.3 20.3 20.3 20.3 20.3 20.3 20.3 20.3	(67)111=	20.0	20.91	20.97	20.99	21	<u> </u>	21	21		<u>'  </u>	21	20.99	20.91	20.76		(01)
Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)  Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)  Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)  (90)m= 20.05 20.19 20.26 20.29 20.3 20.3 20.31 20.31 20.31 20.3 20.2 20.03 (90)  ILA = Living area + (4) = 0.64 (91)  Mean internal temperature (for the whole dwelling) = ft.A × T1 + (1 - ft.A) × T2  (92)m= 20.53 20.65 20.71 20.74 20.75 20.75 20.75 20.75 20.75 20.75 20.74 20.65 20.51 (92)  Apply adjustment to the mean internal temperature from Table 4e, where appropriate  (93)m= 20.53 20.65 20.71 20.74 20.75 20.75 20.75 20.75 20.75 20.76 20.74 20.65 20.51 (93)  8. Space heating requirement  Set T1 to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  Utilisation factor for gains, hm:  (94)m= 0.9 0.81 0.7 0.6 0.46 0.32 0.21 0.21 0.35 0.56 0.82 0.91 (94)  Useful gains, hmGm, W = (94)m x (84)m (95)m= 640.53 681.46 632.9 555.46 420.19 285.73 178.66 178.66 300.21 460.48 588.18 610.97  Monthly average external temperature from Table 8  (96)m= 4.5 5 6.8 8.7 11.7 14.6 16.9 16.9 16.9 14.3 10.8 7 4.9 (96)  Heat loss rate for mean internal temperature, Lm , W = ((39)m x ((93)m - (96)m) (97)m - (75.44 7.33.2 651.84 561.71 421.06 285.78 178.66 178.66 300.31 463.95 638.35 731.37 (97)  Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m (98)m= 83.26 34.77 14.09 4.5 0.64 0 0 0 0 0 2.58 36.13 89.58  Total per year (kWh/year) = Sum(98). 28.55 [98)	· r						$\overline{}$					· ·				1	
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)   Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)   Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2   Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2   Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2   Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2   Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2   Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2   Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2   Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2   Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 - fLA) × T2   Mean internal temperature (for Table 4e, where appropriate (93)m = 20.53   20.65   20.71   20.74   20.75   20.75   20.75   20.75   20.75   20.74   20.65   20.51   (92)	(88)m=	20.3	20.3	20.3	20.3	20.3		20.3	20.31	20.3	31	20.3	20.3	20.3	20.3		(88)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)  (90)m= 20.05   20.19   20.26   20.29   20.3   20.3   20.31   20.31   20.31   20.3   20.3   20.2   20.03   (90)  (LA = Living area ÷ (4) = 0.64   (91)  Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 - fLA) x T2  (92)m= 20.53   20.65   20.71   20.74   20.75   20.75   20.75   20.75   20.75   20.75   20.74   20.65   20.51   (92)  Apply adjustment to the mean internal temperature from Table 4e, where appropriate  (93)m= 20.53   20.65   20.71   20.74   20.75   20.75   20.75   20.75   20.75   20.75   20.74   20.65   20.51   (93)  8. Space heating requirement  Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  Utilisation factor for gains, hm:  (94)m= 0.9 0.81 0.7 0.6 0.46 0.32 0.21 0.21 0.35 0.56 0.82 0.91	Utilisa	ition fac	tor for g	ains for	rest of d	welling,	h2,	m (se	e Table	9a)							
(90)m= 20.05	(89)m=	0.9	0.8	0.68	0.58	0.44		0.3	0.18	0.1	8	0.33	0.54	0.81	0.91		(89)
(90)m= 20.05	Mean	interna	l temper	ature in	the rest	of dwell	ing	T2 (f	ollow ste	eps 3	to 7	in Tabl	e 9c)				
Mean internal temperature (for the whole dwelling) = ft_A x T1 + (1 - ft_A) x T2  (92)m= 20.53	Г						Ť				$\neg$			20.2	20.03	]	(90)
(92)m= 20.53				7							_	f	LA = Livir	g area ÷ (4	4) =	0.64	(91)
(92)m= 20.53	Moan	intorna	Ltompor	atura (fo	or the wh	olo dwo	llin	a) – f	Λ ν Τ1	<b>⊥</b> /1 .	_ fl	Λ) ~ T2					
Apply adjustment to the mean internal temperature from Table 4e, where appropriate  (93)m= 20.53	Г			· `	1		_	<u> </u>	i	<u>`</u> _	-		20.74	20.65	20.51	1	(92)
Sepace   S	` ′ [			<u> </u>	ļ _		_		<u> </u>							J	,
8. Space heating requirement  Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  Utilisation factor for gains, hm:  (94)m= 0.9 0.81 0.7 0.6 0.46 0.32 0.21 0.21 0.35 0.56 0.82 0.91  Useful gains, hmGm, W = (94)m x (84)m  (95)m= 640.53 681.46 632.9 555.46 420.19 285.73 178.66 178.66 300.21 460.48 588.18 610.97  Monthly average external temperature from Table 8  (96)m= 4.5 5 6.8 8.7 11.7 14.6 16.9 16.9 14.3 10.8 7 4.9  Heat loss rate for mean internal temperature, Lm , W = ((39)m x ((93)m - (96)m)    (97)m= 752.44 733.2 651.84 561.71 421.06 285.78 178.66 178.66 300.31 463.95 638.35 731.37  Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m  (98)m= 83.26 34.77 14.09 4.5 0.64 0 0 0 0 0 2.58 36.13 89.58  Total per year (kWh/year) = Sum(98) <sub>1.58.12</sub> = 265.55 (98)	г			I	1		т —		1				·	20.65	20.51	]	(93)
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a  Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  Utilisation factor for gains, hm:  (94)m= 0.9 0.81 0.7 0.6 0.46 0.32 0.21 0.21 0.35 0.56 0.82 0.91  Useful gains, hmGm, W = (94)m x (84)m  (95)m= 640.53 681.46 632.9 555.46 420.19 285.73 178.66 178.66 300.21 460.48 588.18 610.97  Monthly average external temperature from Table 8  (96)m= 4.5 5 6.8 8.7 11.7 14.6 16.9 16.9 14.3 10.8 7 4.9  Heat loss rate for mean internal temperature, Lm, W = ((39)m x ((93)m - (96)m)    (97)m= 752.44 733.2 651.84 561.71 421.06 285.78 178.66 178.66 300.31 463.95 638.35 731.37  Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m  (98)m= 83.26 34.77 14.09 4.5 0.64 0 0 0 0 0 2.58 36.13 89.58  Total per year (kWh/year) = Sum(98) <sub>1-59-12</sub> 265.55 (98)	8. Spa	ace hea	ting regu	uirement													
the utilisation factor for gains using Table 9a    Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec						e obtair	ned	l at ste	ep 11 of	Table	e 9b	o, so tha	t Ti,m=(	76)m an	d re-cald	culate	
Utilisation factor for gains, hm:  (94)m=	the uti	ilisation	factor fo	or gains	using Ta	ble 9a										•	
(94)m= 0.9 0.81 0.7 0.6 0.46 0.32 0.21 0.21 0.35 0.56 0.82 0.91  Useful gains, hmGm , W = (94)m x (84)m  (95)m= 640.53 681.46 632.9 555.46 420.19 285.73 178.66 178.66 300.21 460.48 588.18 610.97  Monthly average external temperature from Table 8  (96)m= 4.5 5 6.8 8.7 11.7 14.6 16.9 16.9 14.3 10.8 7 4.9  Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m - (96)m]]  (97)m= 752.44 733.2 651.84 561.71 421.06 285.78 178.66 178.66 300.31 463.95 638.35 731.37  Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m  (98)m= 83.26 34.77 14.09 4.5 0.64 0 0 0 0 2.58 36.13 89.58  Total per year (kWh/year) = Sum(98) <sub>159.12</sub> = 265.55 (98)				<u> </u>	<u> </u>	May		Jun	Jul	Αι	ug	Sep	Oct	Nov	Dec		
Useful gains, hmGm , W = (94)m x (84)m  (95)m= 640.53 681.46 632.9 555.46 420.19 285.73 178.66 178.66 300.21 460.48 588.18 610.97  Monthly average external temperature from Table 8  (96)m= 4.5 5 6.8 8.7 11.7 14.6 16.9 16.9 14.3 10.8 7 4.9  Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m - (96)m]  (97)m= 752.44 733.2 651.84 561.71 421.06 285.78 178.66 178.66 300.31 463.95 638.35 731.37  Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m  (98)m= 83.26 34.77 14.09 4.5 0.64 0 0 0 0 0 2.58 36.13 89.58  Total per year (kWh/year) = Sum(98) <sub>189.12</sub> = 265.55 (98)	Г			T					i				i	T	1	1	
(95)m= 640.53 681.46 632.9 555.46 420.19 285.73 178.66 178.66 300.21 460.48 588.18 610.97 (95)  Monthly average external temperature from Table 8  (96)m= 4.5 5 6.8 8.7 11.7 14.6 16.9 16.9 14.3 10.8 7 4.9 (96)  Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m - (96)m] (97)m= 752.44 733.2 651.84 561.71 421.06 285.78 178.66 178.66 300.31 463.95 638.35 731.37 (97)  Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m (98)m= 83.26 34.77 14.09 4.5 0.64 0 0 0 0 0 2.58 36.13 89.58   Total per year (kWh/year) = Sum(98) <sub>15912</sub> = 265.55 (98)					<u> </u>			0.32	0.21	0.2	:1	0.35	0.56	0.82	0.91		(94)
Monthly average external temperature from Table 8  (96)m= 4.5 5 6.8 8.7 11.7 14.6 16.9 16.9 14.3 10.8 7 4.9  Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m- (96)m]  (97)m= 752.44 733.2 651.84 561.71 421.06 285.78 178.66 178.66 300.31 463.95 638.35 731.37  Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m  (98)m= 83.26 34.77 14.09 4.5 0.64 0 0 0 0 2.58 36.13 89.58  Total per year (kWh/year) = Sum(98) <sub>15912</sub> = 265.55 (98)	r			<del>- `</del>	<del>ŕ `</del>		_		ı				1	ı		1	(n=)
(96)m= 4.5 5 6.8 8.7 11.7 14.6 16.9 16.9 14.3 10.8 7 4.9  Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m- (96)m]  (97)m= 752.44 733.2 651.84 561.71 421.06 285.78 178.66 178.66 300.31 463.95 638.35 731.37  Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m  (98)m= 83.26 34.77 14.09 4.5 0.64 0 0 0 0 2.58 36.13 89.58  Total per year (kWh/year) = Sum(98) <sub>15912</sub> = 265.55 (98)	L						_		178.66	178.	.66	300.21	460.48	588.18	610.97		(95)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m- (96)m ]  (97)m= 752.44 733.2 651.84 561.71 421.06 285.78 178.66 178.66 300.31 463.95 638.35 731.37  Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m  (98)m= 83.26 34.77 14.09 4.5 0.64 0 0 0 0 2.58 36.13 89.58  Total per year (kWh/year) = Sum(98) <sub>15912</sub> = 265.55 (98)	г	-			<del>i                                     </del>		$\overline{}$		400	1 40		440	400			1	(00)
(97)m= 752.44 733.2 651.84 561.71 421.06 285.78 178.66 178.66 300.31 463.95 638.35 731.37 (97)  Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m  (98)m= 83.26 34.77 14.09 4.5 0.64 0 0 0 0 2.58 36.13 89.58  Total per year (kWh/year) = Sum(98) <sub>15912</sub> = 265.55 (98)	L			l			_		<u> </u>	l .			l	7	4.9		(96)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m  (98)m= 83.26 34.77 14.09 4.5 0.64 0 0 0 0 2.58 36.13 89.58  Total per year (kWh/year) = Sum(98) <sub>15912</sub> = 265.55 (98)	r						_			<del>- ` ` </del>	_	· <i>′</i>	ī	1 000 05	704.07	1	(07)
(98)m= 83.26 34.77 14.09 4.5 0.64 0 0 0 0 2.58 36.13 89.58  Total per year (kWh/year) = Sum(98) <sub>15912</sub> = 265.55 (98)					<u> </u>		_						<u> </u>		/31.3/	J	(91)
Total per year (kWh/year) = Sum(98) <sub>15,912</sub> = 265.55 (98)	. г						vvn T				Ì		<del>í - `</del>	<del></del>	80 E0	1	
	(90)111=	os.∠0	34.11	14.09	4.5	0.04	<u> </u>	U					<u> </u>	L		205 55	(08)
Space heating requirement in kWh/m²/year 4.24 (99)	-	_									rotal	per year	(kvvn/yea	i) = Sum(9	10)15,912	∠05.55	亅
	Space	heatin	g require	ement in	kWh/m²	/year										4.24	(99)

9a. Energy requirements – Individual heating	systems in	ncludino	n micro-C	CHP)					
Space heating:	oyotorno n	nordanig	, 1111010 C	<i>,</i>					_
Fraction of space heat from secondary/supp	lementary	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) = (2	02) × [1 –	(203)] =			1	(204)
Efficiency of main space heating system 1								93.3	(206)
Efficiency of secondary/supplementary heat	ng system	n, %						0	(208)
Jan Feb Mar Apr May	/ Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/y	ear
Space heating requirement (calculated above	e)					1	1	1	
83.26 34.77 14.09 4.5 0.64	0	0	0	0	2.58	36.13	89.58		
$(211)$ m = {[(98)m x (204)] + (210)m} x 100 ÷	(206)						1	Ī	(211)
89.24 37.27 15.11 4.83 0.69	0	0	0	0	2.76	38.72	96.01		_
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } x 100 ÷ (208)			i			211) <sub>15,1012</sub>	ī	284.62	(211)
(215)m= 0 0 0 0 0	0	0	0	0	0	0	0		<b>—</b> ,,
			rota	i (kwn/yea	ar) =Sum(2	215) <sub>15,1012</sub>	2=	0	(215)
Water heating Output from water heater (calculated above)									
173.88 152.96 159.95 142.42 138.8°	7 123.08	117.25	129.98	130.16	147.73	157.42	169.37		
Efficiency of water heater							<u>.                                    </u>	79.6	(216)
(217)m= 82.78 81.39 80.37 79.89 79.64	79.6	79.6	79.6	79.6	79.76	81.4	83		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m									
(219)m= 210.06 187.95 199.01 178.27 174.3(	5 154.62	147.3	163.29	163.52 I = Sum(2	185.21	193.39	204.06		<b>—</b> ,
Annual totals			Tota	1 = Sum(2			_	2161.04	(219)
Annual totals Space heating fuel used, main system 1					K	Wh/yeaı	ſ	kWh/yea 284.62	ar 
Water heating fuel used								2161.04	$\dashv$
-	4							2101.04	
Electricity for pumps, fans and electric keep-h								1	
mechanical ventilation - balanced, extract or	positive in	nput fror	n outside	9			123.33		(230a
central heating pump:							130		(2300
boiler with a fan-assisted flue							45		(2306
Total electricity for the above, kWh/year			sum	of (230a).	(230g) =	:		298.33	(231)
Electricity for lighting								291.31	(232)
10a. Fuel costs - individual heating systems	:								
	<b>Fu</b> ckW	<b>el</b> /h/year			Fuel P (Table			Fuel Cos	t
Space heating - main system 1	(211	) x			3.	1	x 0.01 =	8.8232	(240)
Space heating - main system 2	(213	3) x					x 0.01 =	0	(241)
	(0.15	-					0.04		<b>`</b>

(215) x

Space heating - secondary

(242)

Valer heating cost (other fuel)   (219)   (231)   (11.46)   x 0.01   (249)   (341)   (249)   (47)					
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a Energy for lighting (232) 11.46 x 0.01 = 33.3.8 (250) Additional standing charges (Table 12) 106 (281) Appendix Q items: repeat lines (253) and (254) as needed Total energy cost (245)(247) + (250)(254) = 249.3881 (255) 11.8. SAP rating - individual heating systems  Energy cost deflator (Table 12) 0.47 (256) 11.8. SAP rating - individual heating systems including micro-CHP  Energy cost factor (ECF) ((255) × (256)) + ((4) + 45.0) = 1.0.0827 (257) SAP rating (Section 12) 1.0.0827 (257) SAP rating (Section 12) 1.0.0827 (257) SAP rating (Section 12) 1.0.0827 (257) SAP rating (Section 12) 1.0.0827 (257) SAP rating (Geographic order) 1.0.0827 (257) SAP rating (Geographic order) 1.0.0827 (257) SAP rating (Section 12) 1.0.0827 (257) SAP rating (Section 12) 1.0.0827 (257) SAP rating (Geographic order) 1.0.0827 (257) SAP rating (Geographic	Water heating cost (other fuel)	(219)	3.1 × 0.01 =	66.99 (247	7)
Energy for lighting (332)	Pumps, fans and electric keep-hot	(231)	11.46 x 0.01 =	34.19 (249	9)
Additional standing charges (Table 12)			0.04		
Appendix Q items: repeat lines (253) and (254) as needed  Total energy cost (245)(247) + (250)(254) =		(232)	11.46 X 0.01 =	33.30	
Total energy cost (245)(247) + (250)(254) =	Additional standing charges (Table 12)			106 (251	1)
Energy cost deflator (Table 12) Energy cost factor (ECF)	Appendix Q items: repeat lines (253) and (254) as	needed			
Energy cost deflator (Table 12)  Energy cost factor (ECF) ((255) x (256)) + [(4) + 45.0] =	Total energy cost (245)(247	() + (250)(254) =		249.3881 (255	5)
Energy cost factor (ECF) [(255) x (256)] + [(4) + 45.0] =	11a. SAP rating - individual heating systems				
SAP rating (Section 12)   84.8123   (258)	Energy cost deflator (Table 12)			0.47	6)
Space heating (main system 1)   (211)   x   0.198   = 56.35   (261)	Energy cost factor (ECF) [(255) x (25	(6)] ÷ [(4) + 45.0] =		1.0887 (257	7)
Energy kWh/year kg CO2/kWh kg CO2/kWh kg CO2/kwh kg CO2	SAP rating (Section 12)			84.8123 (258	8)
Space heating (main system 1)   (211)   x   0.198   =   56.35   (261)	12a. CO2 emissions – Individual heating systems	s including micro-CHP			
Space heating (secondary)  Water heating  (219) x  (210) x  (210) x  (211)					
Water heating  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (221) x  (221) x  (221) x  (221) x  (221) x  (222) x  (222) x  (222) x  (222) x  (222) x  (222) x  (222) x  (222) x  (222) x  (222) x  (223) x  (224) x  (224) x  (225) x  (226) x  (226) x  (226) x  (226) x  (226) x  (226) x  (227) x  (227) x  (227) x  (227) x  (227) x  (227) x  (227) x  (227) x  (227) x  (228) x  (229) x  (229) x  (229) x  (229) x  (229) x  (229) x  (229) x  (229) x  (229) x  (229) x  (229) x  (229) x  (229) x  (229) x  (229) x  (229) x  (2204.26 (264) x  (2265) x  (227) x  (228) x  (229) x  (229) x  (229) x  (229) x  (229) x  (229) x  (2204.26 (264) x  (265) x  (265) x  (266) x  (267) x  (267) x  (267) x  (268) x  (268) x  (268) x  (272) x  (273) x  (274) x  (274) x  (275) x  (277)	Space heating (main system 1)	(211) x	0.198 =	56.35 (261	1)
Space and water heating    (261) + (262) + (263) + (264) =	Space heating (secondary)	(215) x	0 =	0 (263	3)
Electricity for pumps, fans and electric keep-hot (231) ×	Water heating	(219) x	0.198	427.89 (264	<b>4</b> )
Electricity for lighting  Total CO2, kg/year  CO2 emissions per m²  El rating (section 14)  Energy kWh/year  Space heating (main system 1)  Space heating (secondary)  Energy for water heating  (219) x  Energy kWh/year  Space and water heating  (219) x  Energy kWh/year  (211) x  (215) x  (216) x  (217) = 150.61  (268)  P. Energy kWh/year  P. Energy kWh/year  Space heating (secondary)  (211) x  (212) x  (213) x  (214)  P. Energy kWh/year  Space heating (secondary)  (215) x  (216) x  (219) x  (219) x  (219) x  (219) x  (210) x  (210) x  (211) x  (211) x  (211) x  (211) x  (212) x  (213) x  (214) x  (215) x  (215) x  (217) = 2204.26  (264)  Space and water heating  (219) x  (219) x  (210) x  (211) x  (211) x  (211) x  (211) x  (211) x  (211) x  (211) x  (211) x  (212) x  (212) x  (213) x  (213) x  (214) x  (215) x  (215) x  (216) x  (217) x  (217) x  (218) x  (219) x  (210) x	Space and water heating	(261) + (262) + (263) + (264)	=	484.24 (265	5)
Electricity for lighting  Total CO2, kg/year  CO2 emissions per m²  El rating (section 14)  Energy kWh/year  Space heating (main system 1)  Space heating (secondary)  Energy for water heating  Energy for water heating  (219) x  (219) x  (219) x  (219) x  (219) x  (219) x  (210) x  (210) x  (211) x  (211) x  (211) x  (211) x  (212) x  (213) x  (214) x  (215) x  (215) x  (216) x  (217) x  (218) x  (219) x  (210) x	Electricity for pumps, fans and electric keep-hot	(231) x	0.517 =	154.23 (267	7)
Total CO2, kg/year  CO2 emissions per m²  El rating (section 14)  Energy	Electricity for lighting	(232) x	0.517 =		
CO2 emissions per m²   (272) ÷ (4) =   12.59   (273)					
El rating (section 14)    13a. Primary Energy   Primary   factor   F. Energy   kWh/year   factor   Space heating (main system 1)   (211)   x			272) ÷ (4) =		
Energy kWh/year factor   F. Energy kWh/year   Factor   F. Energy kWh/year   Factor   F. Energy kWh/year   Factor   F. Energy kWh/year   Factor   F. Energy kWh/year   Factor   F. Energy kWh/year   Factor   F. Energy kWh/year   Factor	·				
Energy kWh/year factor				,	
kWh/year       factor       kWh/year         Space heating (main system 1)       (211) x       1.02       = 290.31       (261)         Space heating (secondary)       (215) x       0       = 0       (263)         Energy for water heating       (219) x       1.02       = 2204.26       (264)         Space and water heating       (261) + (262) + (263) + (264) =       2494.57       (265)         Electricity for pumps, fans and electric keep-hot       (231) x       2.92       = 871.11       (267)         Electricity for lighting       (232) x       0       = 850.64       (268)         'Total Primary Energy       sum of (265)(271) =       4216.32       (272)	3,	F	Delegan	D	
Space heating (secondary)       (215) x       0       =       0       (263)         Energy for water heating       (219) x       1.02       =       2204.26       (264)         Space and water heating       (261) + (262) + (263) + (264) =       2494.57       (265)         Electricity for pumps, fans and electric keep-hot       (231) x       2.92       =       871.11       (267)         Electricity for lighting       (232) x       0       =       850.64       (268)         'Total Primary Energy       sum of (265)(271) =       4216.32       (272)					
Energy for water heating (219) x 1.02 = 2204.26 (264)  Space and water heating (261) + (262) + (263) + (264) = 2494.57 (265)  Electricity for pumps, fans and electric keep-hot (231) x 2.92 = 871.11 (267)  Electricity for lighting (232) x 0 = 850.64 (268)  'Total Primary Energy sum of (265)(271) = 4216.32 (272)	Space heating (main system 1)	(211) x	1.02 =	290.31 (261	1)
Space and water heating (261) + (262) + (263) + (264) = 2494.57 (265)  Electricity for pumps, fans and electric keep-hot (231) x 2.92 = 871.11 (267)  Electricity for lighting (232) x 0 = 850.64 (268)  'Total Primary Energy sum of (265)(271) = 4216.32 (272)	Space heating (secondary)	(215) x	0 =	0 (263	3)
Electricity for pumps, fans and electric keep-hot (231) x 2.92 = 871.11 (267)  Electricity for lighting (232) x 0 = 850.64 (268)  'Total Primary Energy sum of (265)(271) = 4216.32 (272)	Energy for water heating	(219) x	1.02 =	2204.26 (264	4)
Electricity for lighting (232) $\times$ 0 = 850.64 (268)  'Total Primary Energy sum of (265)(271) = 4216.32 (272)	Space and water heating	(261) + (262) + (263) + (264)	=	2494.57 (265	5)
'Total Primary Energy sum of (265)(271) = 4216.32 (272)	Electricity for pumps, fans and electric keep-hot	(231) x	2.92 =	871.11 (267	7)
'Total Primary Energy sum of (265)(271) = 4216.32 (272)	Electricity for lighting	(232) x	0 =		8)
	'Total Primary Energy	\$	sum of (265)(271) =		
	Primary energy kWh/m²/year	(	272) ÷ (4) =		

# **UnRegulated Energy Demand Calculations**

House Tyne								
	TFA/Unit	No of Occupants	TFA XN	(TFA X N) ^ 0.4714	Total Electricity Appliances Demand (kWh)	Total Ele ctricity Emissions (kgCO2)		
1bed	63	2.06	129.49	9:30	2057.60	1063.78		
2beds	83	2.52	208.00	12.38	2572.68	1330.07		
3beds	86	2.72	264.88	13.87	2883.17	1490.60		
4beds	113	2.83	321.15	15.19	3157.24	1632.29		
Speds	150	2.93	440.13	17.63	3662.94	1893.74		
Based upon the formula 207.8X(NXTFA)^0.4714 X 0.517	X(NXTFA)^0.4714 X 0.517							
Cooking (All Electric)								
House Type	No of Occupants (N)	55xN	275+(55XN) Cooking (All Electric) (kWh)	TFA/Unit	Total Cooking (All Electric) (KWh)			
1bed	2.0558	113	388	63	6.16			
2beds	2.5173	138	413	83	5.00			
3beds	2.7156	149	424	86	4.35			
4beds	2.8335	156	431	113	3.80			
Sbeds	2.9342	161	436	150	2.91			
						Cooking (half electric,		Total Cooking
House Type	No of Occupants (N)	27.5xN	137.5+(27.5XN)	48.15xN	280.5+(48.15XN)	half gas) (kWh)	TFA/Unit	(nair electric, half gas) (kWh/m2)
1bed	2.0558	22	194	66	379	573.52	63	9.10
2beds	2.5173	09	198	121	402	599.62	83	7.26
3beds	2.7156	92	203	131	411	613.93	86	6.29
4beds	2.8335	89	206	136	417	622.44	113	5.49
Speds	2.9342	70	208	141	422	629.70	150	4.20
Based upon the forumula (137.5+(27.5XN)X0.517)+(280.5+(48.15XN)X0.198)	.5+(27.5XN)X0.517)+(280.5+	-(48.15XN)X0.198)						
Cooking (gas oven, gas hob)								
House Type	No of Occupants (N)	96.3xN	481+(96.3XN) Cooking (All Gas) (kwh)	TFA/Unit	Total Cooking (All Gas) (kWh/m2)			
1bed	2.0558	198	629	63	10.78			
2beds	2.5173	242	723	83	8.75			
3beds	2.7156	262	743	86	7.61			
4beds	2.8335	273	754	113	6.65			
Speds	2.9342	283	764	150	00 1			

## CIBSE TM46 table1

Table 1 Benchmark categories and values; (b) benchmarks and building size metrics

							_	_	_							
[R]	for use by assessors	Default multiplier (applied to alternate metric to obtain primary metric)	g		1.80	1.80	<u>135</u>	2.00								
IOI	Building size metric for use by assessors	Approved alternate metric	Not lettable area (NLA) measured as RBCS	(hons)	Sales floor area (SFA)	(hond)	(hors)	(hond)	(hond)	(hond)	(hond)	(hond)	(hond)			
[8]		Primary metric (as in energy benchmarks)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)
lol	ad from a 3)	Illustrative total typical benchmark (kgCO <sub>2</sub> /m²)	751	77.0	808	70.8	170.5	240.0	119.8	138.0	120.5	76.5	162.3	340.5	171.6	115.0
INI	Illustrative CO <sub>2</sub> benchmarks calculated from the energy benchmarks (see Table 3)	likastrativo fossil-thormal typical benchmark (kg00 <sub>2</sub> /m²)	22.8	0.0	0.0	323	0.0	20.0	70.3	599	62.7	38.0	79.8	214.7	83.6	62.7
IMI	Illustrative the enx	illustrative electricity typical benchmark (kgCO <sub>2</sub> /m²)	523	77.0	806	38.5	170.5	220.0	49.5	71.5	57.8	38.5	82.5	134.8	88.0	523
Ш	Energy benchmarks	Fossil-thermal typical benchmark (kW-him²)	120	0	0	0.71	•	105	370	350	330	200	420	1130	440	330
Did	Energy b	Бастину турка! Белатак (кW. лип?)	8	140	165	70	310	450	8	130	105	04	051	245	160	8S 8
ICI	cription	Brief description	General office and commercial working areas	High street	General struct retail and services	Ratal warehouse or other large non-food store		Supermarket or other	Restaurant	Bar, pub or dub	House house	Museum, art gallery or other public building with normal occupancy	Entertainment halls	Swimming pool hall, changing and andlanks		Dry sports and lefsure facility
[8]	Name and description		General office	High straet agency	General retail	Large non-tood shop	Small food store	Large food store	Restaurant	Bar, pub or licensed dub	Hotel	22	Entertainment halls	Swimming pool centre	Rimess and health centre	Dry sports and leisure facility
M		Catagory	-	2	m	4	ın	ů.	-	DG.	a	0	= 1	12	E	4

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measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)	Gross floor area measured as RICS gross Internal area (GIA)
	5.05	9768	76.5	129.3	9.5.6	90.0	112.6	18.4	39.3	79.3	53.5	49.7	95.0
	28.5	45.6	38.0	79.8	79.8	07.5	74.1	30.4	22.8	0'85	34.2	30.4	152
!	22.0	44.0	38.5	49.5	35.8	33.0	38.5	88.0	16.5	£! <del>}</del>	193	193	79.8
1	150	240	200	420	420	300	390	160	120	200	180	160	08
1	40	08	70	06	59	09	70	160	0E	5.2	in M	32	145
With light usage Institutional buildings	Public buildings nominally used for part of the year	University campus	Health centres, clinics and surgenles	Clinical and research hospital	Long term residential accommodation	General accommodation	Emergency sentices	Laboratory or operating theatre	Bus or train station, shopping centre mall	Regional transport terminal with concourse	Workshop or open working area (not office)	Stockage warehouse or depor	Refrigerated Warehouse
with light usage	Schools and seasonal public buildings	University	Olnk	Hospital (dinical and research)	Long term residential	General accommodation		_	Public waiting or chrulation	Terminal	Workshop	Storage facility	Cold smrage
1	17	89	61	30	21	72	я	77	25	36	77	28	R