

Project No: 15089 North Somerset Council Energy Statement

Proposed New Dwelling at Falcon Crescent, Weston Super Mare, BS22 8RX

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SAP Calculations – SBEM Calculations – Renewable Energy Statements – Energy Performance Certificates Air Tightness Testing – Extract Fan Testing – Water Calculations – DEC Assessments - Room Integrity Testing











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1	21/10/2022	AB	Issued for submission	
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Executive Summary

This report has been commissioned in response to the Sustainable and Low Carbon Planning Policy requirements of North Somerset Council in respect to the proposed construction of a new dwelling at Falcon Crescent, Weston Super Mare, BS22 8RX.

The methodology used herein is consistent with Approved Document L1 2021 of the Building Regulations and the principles of the widely accepted Energy Hierarchy approach to improving the energy performance of new and existing buildings.

The statement outlines an overall commitment to reducing energy consumption under occupancy through the adoption of enhanced insulation standards and improved heating and lighting efficiencies in comparison to the standard requirements of Approved Document L1 2021 of the Building Regulations.

Further improvements are then proposed through the installation of photovoltaic panels with a minimum output capacity of 3.735 kWp. This is expected to comprise of 9 x 415W panels being installed on the south east facing pitched roof and will require approx. 18 m² of the roof space.

Predictive SAP calculations for the proposed development firmly demonstrate that the dwelling will achieve a reduction in regulated CO₂ emissions of **1.88%** in comparison to the standard requirements of Approved Document L1 2021 of the Building Regulations, which is the equivalent to a **32.88%** improvement upon Part L1A 2013. Furthermore, it has also been demonstrated that **60.07%** of the proposed dwelling's annual regulated energy demand will be met through the installation of onsite renewable sources.

In light of the above, the proposal is deemed to be compliant with Policy CS2 of North Somerset Council's Core Strategy (2017), in respect to minor developments and moreover the Supplementary Planning Document (SPD) – Creating Sustainable Buildings and Places in North Somerset: Guidance for energy efficiency, renewable energy and the transition to zero carbon development (2021).

Table of Contents

- Section 1 Introduction
- Section 2 Planning Policy Context
- Section 3 Proposed Energy Strategy and Performance
- Section 4 Proposed Energy Strategy and Performance Green Measures
- Section 5 Calculated Energy Performance (Predicted)

Appendix 1 – Full SAP Calculation Printout

1.0 Introduction

- 1.1 EPS Group have been appointed to provide an Energy Statement to support the planning application for the proposed construction of a new dwelling at Falcon Crescent, Weston Super Mare, BS22 8RX.
- 1.2 It is anticipated that if planning is approved, the development would fall under the requirements of Approved Document L1 (2021) of the Building Regulations.
- 1.3 The energy consumption of the development has therefore been assessed using the National Calculations Method (NCM) SAP 10 (Standard Assessment Procedure), in order to determine the predicted annual carbon dioxide (CO₂) emissions of the dwellings and the associated reduction targets.
- 1.4 The following fuel emissions factors have been utilised within the supporting calculations as defined by the updated National Calculations Method (NCM):

Fuel	CO ₂ emission factor (kgCO ₂ /kWh)
Natural gas	0.210
Grid supplied electricity	0.136
Grid displaced electricity	0.136

- 1.5 This document should be used for planning purposes only and should be reassessed and where necessary, resubmitted at the Building Control stage if alternative building specifications or proposed HVAC systems are adopted as oppose to those outlined within the report.
- 1.6 It is also highlighted that the SAP calculations utilised within the report rely on a number of standard operational parameters which may not ultimately match the actual measures adopted within the finalised dwellings. Whilst they provide a 'like for like' comparison for the purpose of this Energy Statement, they are not valid for Building Control applications or for the actual operation of the development post completion.

2.0 Planning Policy Context

2.1 National

The National Planning Policy Framework (NPPF) outlines the Government's planning policies for England and how these are expected to be applied by local authorities. Section 14 of this document details how local policies should address climate change through the promotion of energy efficiency and the adoption of low carbon and renewable technologies. It states:

"14.0 Meeting the challenge of climate change, flooding and coastal change

- 157. The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and costal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.
- 158. Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.
- 159. New development should be planned for in ways that:

a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and

b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

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

a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

161. Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning. *162. In determining planning applications, local planning authorities should expect new development to:*

a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and

b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

163. When determining planning applications for renewable and low carbon development, local planning authorities should:

a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and

b) approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas; and

c) in the case of applications for the repowering and life-extension of existing renewable sites, give significant weight to the benefits of utilising an established site, and approve the proposal if its impacts are or can be made acceptable.

164. In determining planning applications, local planning authorities should give significant weight to the need to support energy efficiency and low carbon heating improvements to existing buildings, both domestic and non-domestic (including through installation of heat pumps and solar panels where these do not already benefit from permitted development rights). Where the proposals would affect conservation areas, listed buildings or other relevant designated heritage assets, local planning authorities should also apply the policies set out in chapter 16 of this Framework."

2.2 Local

"Policy CS2 – 'Delivering sustainable design and construction" of the *North Somerset Council's Core Strategy (January 2017)* states:

'New development both residential (including conversions) and non-residential should demonstrate a commitment to sustainable design and construction, increasing energy efficiency through design, and prioritising the use of sustainable low or zero carbon forms of renewable energy generation in order to increase the sustainability of the building stock across North Somerset.

The greatest potential for energy saving opportunities is likely to be at larger scale developments particularly at the Weston Villages and Weston town centre. In addition these areas are expected to demonstrate exemplar environmental standards contributing to the objectives of Policy CS1, and adding value to the local economy.

When considering proposals for development the council will:

1. Require designs that are energy efficient and designed to reduce their energy demands;

- 2. Require the use of on-site renewable energy sources or by linking with/contributing to available local off-site renewable energy sources to meet a minimum of 10% of predicted energy use for residential development proposals involving one to nine dwellings, and 15% for 10 or more dwellings; and 10% for non-residential developments over 500m² and 15% for 1000m² and above;
- 3. Require as a minimum Code for Sustainable Homes Level 3 for all new dwellings from October 2010, Level 4 from 2013, rising to Level 6 by 2016. Higher standards will be encouraged ahead of this trajectory where scheme viability specifically supports this. BREEAM 'Very Good' will be required on all non-residential developments over 500m² and 'Excellent' over 1000m²;
- 4. Require all developments of 10 or more new homes to incorporate 50% constructed to the Lifetime Homes standard up to 2013 and 100% from 2013 onwards;
- 5. Require the application of best practice in Sustainable Drainage Systems to reduce the impact of additional surface water run-off from new development. Such environmental infrastructure should be integrated into the design of the scheme and into landscaping features, and be easily maintained. In moving towards zero carbon development, applicants will ensure that sustainable principles are established in the new proposals from the outset.

In moving towards zero carbon development, applicants will ensure that sustainable principles are established in the new proposals from the outset."

The 'Supplementary Planning Document (SPD) – Creating Sustainable Buildings and Places in North Somerset: Guidance for energy efficiency, renewable energy and the transition to zero carbon development' (revised version 2021) provides detailed guidance on the implementation of policies for energy efficiency, renewable and low carbon energy generation and on Sustainable Drainage Systems (SuDS). It also contains information on measures that can be taken for future proofing design in a changing climate and the transition to zero carbon development.

The SPD was originally adopted in 2015 and has been revised as a result of the Council declaring a Climate Emergency in 2019 and in part states...:

- "3. In the same year that the Council adopted the original version of this SPD, the Government released the Housing Standard Review and the Written Ministerial Statement which withdrew the Code for Sustainable Homes and indicated that local planning authorities would be prevented from setting performance improvements for new residential development higher than those of Building Regulations.
- 4. As a direct result of these government policy statements, the Council provided a statement confirming that it would no longer seek Code for Sustainable Homes compliance for new residential development, apart for legacy cases 1. This has meant that from the date of its statement, the Council has not required new residential development proposals to comply with performance standards in excess of those set out in Building Regulations. However, clarification on whether local planning authorities can set performance standards higher than Building Regulations, has subsequently been provided through Planning Practice Guidance.
- 5. In light of the NPPG clarification, the Council has reviewed its position and will now require Code for Sustainable Homes Level 4 equivalent improvement in performance standards in all new residential development applications, which will include the conversion of agricultural, industrial and commercial

properties to residential use. This will apply to all new applications that are registered after the date that this updated SPD is adopted.

- 6. Code for Sustainable Homes Level 4 was equivalent to a 19% improvement on the performance standards of Building Regulations 2013 – Part L1A: Conservation of Fuel and Power for new dwellings. Guidance on the documentation required to demonstrate compliance with this standard can be found in the checklist in Appendix 1.
- 7 In addition to this requirement, the Council will continue to require clause 2 of Policy CS2, which is for new residential development to provide between a minimum of 10% to 15% of the predicted energy use (depending on development size), to be met through renewable and low carbon energy generation – this is detailed in Section 4."

2.3 Conclusions

On review of the above planning policies and in particular the SPD that was originally adopted in 2015 and subsequently revised in 2021, it is evident that there should be no mandatory planning requirement to undertake a formal Code for Sustainable Homes Assessment.

It is however recognised that there is still a need to construct dwellings with an equivalent energy performance standard of Code for Sustainable Homes Level 4 and therefore the dwelling will need to reduce its carbon dioxide emissions by at least 19% in comparison to the standard requirements of Part L1A 2013 of the Building Regulations.

However, it should be noted that in June 2022, the Government implemented an interim uplift to Part L of the Building Regulations, updating the Building Regulations 2013. Dwellings conforming to the interim standard will be expected to produce 31% less CO₂ emissions compared to current standards set out in the 2013 Building Regulations. In reflection of this update to Part L of the Building Regulations, the equivalent energy performance standard of Code for Sustainable Homes Level 4 would be exceeded by developments complying with the latest version of Approved Document L1 2021.

Furthermore, as a minor development (less than 10 dwellings), the proposed development should also provide at least 10% of its predicted regulated energy consumption from decentralised, low carbon or renewable technologies.

3.0 **Proposed Energy Strategy and Performance – Lean Measures**

3.1 In accordance with the 'Lean' principles of the Energy Hierarchy, it is provisionally proposed to adopt the following minimum fabric, heating and lighting standards within the dwellings as a means of reducing the overall regulated energy demand prior to considering the use of low carbon or renewable technologies:

Table 1: Proposed 'Lean' Fabric Standards				
Element / Feature	Current Approved Document L1 2021 Minimal Acceptable Standard	Proposed Development Target		
External Wall U-value	0.26 W/m ² K	0.18 W/m²K		
Ground Floor U-value	0.18 W/m ² K	0.16 W/m²K		
Cold Pitched Roof (Insulated at Joists) U-value	0.16 W/m ² K	0.10 W/m²K		
Glazing U-value	1.60 W/m²K	1.40 W/m²K		
Air Permeability	8.00 m³/m².h	5.00 m³/m².h		
Thermal Bridging	N/A	Recognised Construction Details		
Propos	ed HVAC & Lighting Detail	S		
Lighting	All fixed lighting to have an efficacy of 75 lm/W	LED lighting with a luminous efficacy of 80 lm/W		
Boiler Efficiency (Gas Combi)	Min 88% Efficient (SEDBUK 2009)	89.60% Efficient (Ideal Logic Combi ESP 1 24 or equivalent)		
Boiler Controls	Room Thermostat, Programmer & TRVs	Delayed Start Time and Temperature Zone Control		
Ventilation	-	Natural Ventilation with intermittent extract fans		

3.2 The above build standards will ensure that the proposed dwelling has a reduced energy demand in comparison to the minimum requirements of Approved Document L1 2021 of the Building Regulations. This will help to significantly reduce the associated CO₂ emissions arising from occupancy.

4.0 **Proposed Energy Strategy and Performance – Green Measures**

4.1 In response to the requirements of *Policy CS2* of the *North Somerset Council's Core Strategy (Adopted April 2017)* a number of different low carbon and renewable technologies were reviewed in terms of their overall suitability for use within the proposed development.

4.2 Wind Turbine (Column or Roof Mounted)

Benefits	• When installed in optimum positions, wind turbines can generate a large amount of renewable electricity, the surplus of which can be exported at financial gain to the national grid via the Smart Export Guarantee scheme.
Site Limitations / Restrictions	 Not aesthetically pleasing and will not be in keeping with the immediate local area. The site is too sheltered as a result of its general urban location which would result in unreliable and insufficient outputs. Require on-going maintenance which future occupants may neglect. Can produce unacceptable levels of noise to occupants and neighbours.
Conclusion	• The technology is not deemed as being suitable for use within the proposed development.

4.3 Solar Photovoltaic

Benefits	 When installed in optimum positions photovoltaic (PV) arrays can generate a large amount of renewable electricity which can be used locally or exported at financial gain to the national grid via the Smart Export Guarantee scheme. Minimal on-going costs & maintenance issues following installation. Easy to integrate into a conventional build specification. The dwelling benefits from a south east facing pitched roof space, which would facilitate the installation of panels at a near optimal pitch and orientation to ensure maximum efficiency and generation capacity.
Site Limitations / Restrictions	 PV panels are not always aesthetically pleasing and may detract from the visual appearance of the dwelling. As a result of the rapid decarbonisation of the national grid, the amount of CO₂ savings with this technology is limited as the CO₂ emission factor for grid displaced electricity is relatively low.
Conclusion	• It is proposed to utilise this technology within the proposed development.

4.4 Solar Thermal

Benefits	• Solar hot water systems can provide an efficient way of				
	 contributing to a building's overall hot water requirements. Minimal on-going costs & maintenance issues following installation. 				
	 As with PV, the collectors could be installed on the near optimal south east facing pitched roof space to maximise their efficiency. 				

	 The amount of CO₂ / useful energy savings with this technology is restricted as there is no benefit to producing more hot water than
Site	is used within a dwelling.
Limitations	 Not always aesthetically pleasing and may detract from the visual
/	appearance of the dwelling.
Restrictions	• Requires the installation of a hot water cylinder / thermal store
	which introduces another source of energy loss to the dwelling
	whilst also potentially restricting useable floor space.
Conclusion	It is not proposed to use this technology within the proposed
Conclusion	dwelling.

4.5 Ground Source Heat Pump

Benefits	 High operating efficiencies (CoPs). Reliable and proven technology. Generally low maintenance costs. No visual impact on the development.
Site Limitations / Restrictions	 Detailed ground surveys required. High capital installation costs potentially rendering the technology financially unviable. Trench installations require significant areas of land and there is minimal space to facilitate an installation. Requires the installation of a hot water cylinder / thermal store which introduces another source of energy loss to the dwelling whilst also potentially restricting useable floor space.
Conclusion	 The technology is not deemed as being suitable for use within the proposed development.

4.6 Air Source Heat Pump

Benefits	 High operating efficiencies (CoPs). Reduced visual impact on the property. Reliable and proven technology. Generally low maintenance costs.
Site Limitations / Restrictions	 Often require supplementary immersion heating systems for hot water production. Requires the installation of a hot water cylinder / thermal store which introduces another source of energy loss to the dwelling whilst also potentially restricting useable floor space. The external compressors can result in some noise problems, although this can be limited through the careful selection of particular models with low acoustic levels of operation and the potential use of acoustic housing units.
Conclusion	 It is not proposed to use this technology within the proposed dwelling.

4.7 **Biomass Boilers**

Benefits	Reliable and proven technology.
Site	Require large storage facilities for the fuel.
Limitations	• On-going cleaning, maintenance and management requirements.
/	Require regular fuel deliveries.
Restrictions	Would contribute to poor urban air quality.
Conclusion	 The technology is not deemed as being suitable for use within the proposed development.

- 4.8 On review of the above technologies, the use of photovoltaic (PV) panels is recommended as being the most suitable and cost effective technology for use within the proposed development. This will provide a local source of renewable electricity for occupant use as well as a reduction in the calculated carbon dioxide emissions.
- 4.9 It is therefore provisionally proposed to install a PV array with a minimum total output capacity of 3.735 kWp. This is expected to comprise of 9 x 415W panels being installed on the south east facing pitched roof and will require approx. 18 m² of the roof space.

5.0 Calculated Energy Performance (Predicted)

- 5.1 A predicted SAP calculation has been produced for the dwelling based upon the proposed design parameters outlined within Section 3 of this report and the installation of a photovoltaic (PV) array with a minimum total output capacity of 3.735 kWp, as detailed in paragraph 4.9.
- 5.2 The results of the predicted SAP Calculation are summarised within the tables below with the full calculation Worksheets provided for detailed review within the Appendix to this report:

Table 2: Predicted Annual CO ₂ Emissions (SAP 2012)				
Target Emission Rate (TER)Dwelling Emission Rate (DER)CO2 Reduction				
11.15	10.94	1.88%		

Table 3: Predicted Domestic Annual Energy Consumption (kWh/Yr)				
(A) Space Heating (kWh/Yr)	(B) Hot Water (kWh/Yr)	(C) Auxiliary (kWh/Yr)	(D) Lighting (kWh/Yr)	(E) PV Generation (kWh/Yr)
2,234.98	2,644.39	86.00	154.23	-3,075.21
Total Regulated Energy Consumption (kWh/Year) (A)+(B)+(C)+(D)				5,119.59
Total Energy Produced via PV (kWh/Year) (E)				-3,075.21
Percentage Annual Energy Contribution via PV				60.07%

- 5.3 Upon review of the above, it is evident that the dwelling will achieve a reduction in regulated CO₂ emissions of **1.88%** in comparison to the standard requirements of Approved Document L1 2021 of the Building Regulations. Furthermore, it has also been demonstrated that **60.07%** of the proposed dwelling's annual regulated energy demand will be met through the installation of onsite renewable sources.
- 5.4 In light of the above, the proposal is deemed to be compliant with Policy CS2 of North Somerset Council's Core Strategy (2017), in respect to minor developments and moreover the Supplementary Planning Document (SPD) – Creating Sustainable Buildings and Places in North Somerset: Guidance for energy efficiency, renewable energy and the transition to zero carbon development (2021).



Appendix 1:

Full SAP Calculation Printout



Property Reference	:e	15	089							Issued on D	ate	29/01/2024	
Assessment Refe	rence	00	001					Prop Type F	Ref				
Property		32	, Falcon Cresc	ent, Weston Su	per Mare, BS22	8RX							
SAP Pating					08.4		NER	10	04	ТЕР		11 15	
Environmental					90 A		% DFR < TFR					1.88	
CO ₂ Emissions (t/)	vear)				0.5		DFEE	40	42	TFEE		42 15	
Compliance Check	k				See BRFI		 % DFEE < TFE	E	12			4 10	
% DPER < TPER					1.36		DPER	58	.77	TPER	र	59.58	
											15		
Assessor Details		Mr. Andr	ew Bamford							Asse	ssor ID	F391-000)1
SAP 10 WORKSHEET CALCULATION OF D	FOR New Bu WELLING EMI	ild (As D SSIONS FO	esigned) R REGULATIO 	(Version 10 NS COMPLIANO	.2, February CE	2022)							
1. Overall dwell	ing charact	eristics						Area	St	orev height		Volume	
Ground floor Total floor area Dwelling volume	TFA = (1a)	+(1b)+(1c)+(1d)+(1e)	(ln)	6	0.7200		(m2) 60.7200	(1b) x 3a)+(3b)+(3	(m) 2.3800 c)+(3d)+(3e)	(2b) = (3n) =	(m3) 144.5136 144.5136	(1b) - (3b) (4) (5)
2. Ventilation r	ate												
Number of open c Number of open f Number of chimme Number of flues Number of flues Number of blocke Number of interm Number of fluele	himneys lues ys / flues attached to attached to d chimneys ittent extr e vents ss gas fire	attached solid fu other he ract fans	to closed f el boiler ater	ire							$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 20.0000 0.0000 0.0000	(6a) (6b) (6c) (6d) (6e) (6f) (7a) (7b) (7c)
Infiltration due Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides	to chimney thod AP50 e sheltered	rs, flues	and fans	= (6a)+(6b)-	+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7	7b)+(7c) =		20.0000	Air changes / (5) = Bl	e per hour 0.1384 Yes .ower Door 5.0000 0.3884 2	<pre>(8) (17) (18) (19)</pre>
Shelter factor Infiltration rat	e adjusted	to includ	e shelter f	actor					(20) = 1	- [0.075 x (21) = (18)	x (19)] = x (20) =	0.8500 0.3301	(20) (21)
Wind speed Wind factor	Jan 5.1000 1.2750	Feb 5.0000 1.2500	Mar 4.9000 1.2250	Apr 4.4000 1.1000	May 4.3000 1.0750	Jun 3.8000 0.9500	Jul 3.8000 0.9500	Aug 3.7000 0.9250	Sep 4.0000 1.0000	Oct 4.3000 1.0750	Nov 4.5000 1.1250	Dec 4.7000 1.1750	(22) (22a)
Effective ac	0.4209 0.5886	0.4127 0.5851	0.4044 0.5818	0.3631 0.5659	0.3549 0.5630	0.3136 0.5492	0.3136 0.5492	0.3054 0.5466	0.3301 0.5545	0.3549 0.5630	0.3714 0.5690	0.3879 0.5752	(22b) (25)
3. Heat losses a	nd heat los	s paramet											
Element				Gross	Openings	Net.	Area	U-value	A	X U K	-value	Ахк	
Opening Type 1 (Heatloss Floor 1 External Wall 1 External Roof 1 Total net area o Fabric heat loss	Uw = 1.40) f external , W/K = Sum	elements 1 (A x U)	Aum(A, m2)	m2 76.7300 60.7200	12.8300	12. 60. 63. 60. 198.	m2 8300 7200 9000 7200 1700 (26)(3	W/m2K 1.3258 0.1600 0.1800 0.1000 30) + (32)	17.0 9.7 11.5 6.0 = 44.2	W/K 095 152 020 720 987	kJ/m2K	kJ/K	(27) (28a) (29a) (30) (31) (33)
Thermal mass par List of Thermal K1 Eleme E2 Other E3 Sill E4 Jamb E5 Groun E16 Corn E12 Gabl Thermal bridges Point Thermal br	ameter (TMF Bridges nt lintels (i d floor (nc er (normal) s (insulati e (insulati (Sum(L x Ps idges	<pre>P = Cm / T .ncluding prmal) con at cei con at cei si) calcul</pre>	FA) in kJ/m other steel ling level) ling level) ated using	2K lintels) Appendix K)				2 3 2 1	Length 8.8200 0.6000 2.2400 9.5200 0.2400 2.0000	Psi-value 0.0260 0.0230 0.0180 0.0480 0.0400 0.0550 0.0370	Tota 0.229 0.202 0.370 1.547 0.380 1.113 0.444 (360) =	250.0000 1 3 9 9 8 5 8 2 0 4.2885 0.0000 4.2885 0.0000	(35) (36)



	at loss cal	culated mo	nthly (38)m	n = 0.33 x	(25)m x (5)								
(38) m	Jan 28.0695	Feb 27.9054	Mar 27.7446	Apr 26.9893	May 26.8480	Jun 26.1902	Jul 26.1902	Aug 26.0684	Sep 26.4436	Oct 26.8480	Nov 27.1339	Dec 27.4328	(38)
Heat transfer Average = Sum(coeff 76.6566 39)m / 12 =	76.4926	76.3318	75.5765	75.4352	74.7774	74.7774	74.6555	75.0307	75.4352	75.7211	76.0199 75.5758	(39)
UTD	Jan 1 2625	Feb	Mar	Apr	May	Jun 1 2315	Jul 1 2315	Aug	Sep	Oct	Nov	Dec	(40)
HLP (average)	1.2025	1.2598	1.25/1	1.244/	1.2423	1.2315	1.2315	1.2295	1.2357	1.2423	1.24/1	1.2447	(40)
Days in mont	31	28	31	30	31	30	51	31	30	31	30	31	
4. Water heati	ng energy r	equirement	s (kWh/year	:)									
Assumed occupa Hot water usag	ncy e for mixer	showers										2.0019	(42)
Hot water usag	79.4546	78.2605	76.5206	73.1915	70.7347	67.9949	66.4376	68.1644	70.0572	72.9990	76.3996	79.1501	(42a)
Hot water usag	24.9727	24.6018	24.0796	23.1166	22.3955	21.5960	21.1641	21.6827	22.2474	23.1029	24.0858	24.8883	(42b)
Average daily	35.1316	33.8541	32.5766	31.2991	30.0216	28.7441	28.7441	30.0216	31.2991	32.5766	33.8541	35.1316	(42c)
Average daily	Jan	Feb	Mar	Apr	Mav	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(45)
Daily hot wate	r use 139.5589	136.7165	133,1767	127.6071	123.1518	118.3349	116.3457	119.8686	123.6037	128.6785	134.3394	139.1701	(44)
Energy conte Energy content	221.0272 (annual)	194.6825	204.6877	174.6878	165.7859	145.5066	140.7101	148.4224	152.4158	174.6155 Total = Si	191.3912 um(45)m =	217.9067 2131.8393	(45)
Water storage	33.1541 loss:	= 0.15 x (29.2024	45)m 30.7032	26.2032	24.8679	21.8260	21.1065	22.2634	22.8624	26.1923	28.7087	32.6860	(46)
Total storage	10ss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
it cylinder co	ntains dedi 0.0000	cated sola. 0.0000	r storage 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss Combi loss	0.0000 16.5514	0.0000 14.9288	0.0000 16.4828	0.0000 15.8528	0.0000 16.3194	0.0000 15.7302	0.0000 16.2141	0.0000 16.2464	0.0000 15.7592	0.0000 16.3565	0.0000 15.9229	0.0000 16.5383	(59) (61)
Total heat req	uired for w 237.5786	ater heati 209.6113	ng calculat 221.1704	ed for eac! 190.5406	h month 182.1053	161.2368	156.9241	164.6689	168.1750	190.9720	207.3141	234.4450	(62)
WWHRS PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a) (63b)
Solar input FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c) (63d)
Output from w/	h 237.5786	209.6113	221.1704	190.5406	182.1053	161.2368	156.9241	164.6689	168.1750	190.9720	207.3141	234.4450	(64)
12Total per ye	ar (kWh/yea	ir)						Total pe	er year (kWł	n/year) = Si	um(64)m =	2324.7421 2325	(64) (64)
Electric showe	r(s) 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Heat gains fro	m water hea	ting, kWh/	month	TO	tal Energy us	sed by inst	antaneous e.	Lectric show	ver(s) (kwn,	(year) = Sur	m(64a)m =	0.0000	(64a)
	//.0294	00.4041	12.1195	02.0409	39.2037	32.3133	50.0550	33.4121	24.0101	02.1400	07.0105	/0.3000	(65)
5. Internal ga	ins (see Ta	ble 5 and	5a)										
5. Internal ga Metabolic gain	ins (see Ta s (Table 5) Jan	able 5 and , Watts Feb	5a) Mar	 Apr	Мау	Jun	 Jul	 Aug	Sep	Oct	Nov	Dec	
5. Internal ga Metabolic gain (66)m Lighting gains	ins (see Ta s (Table 5) Jan 100.0958 (calculate	Watts Feb 100.0958 d in Appen	5a) Mar 100.0958 dix L, equa	Apr 100.0958 ation L9 or	May 100.0958 L9a), also s	Jun 100.0958 see Table 5	Jul 100.0958	Aug 100.0958	Sep 100.0958	Oct 100.0958	Nov 100.0958	Dec 100.0958	(66)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai	ins (see Ta Jan 100.0958 (calculate 88.3507 ns (calcula	Watts Feb 100.0958 ed in Appen 97.8169 ated in App	5a) Mar 100.0958 dix L, equa 88.3507 endix L, eq	Apr 100.0958 tion L9 or 91.2958 quation L13	May 100.0958 L9a), also s 88.3507 or L13a), al	Jun 100.0958 see Table 5 91.2958 lso see Tab	Jul 100.0958 88.3507 1e 5	Aug 100.0958 88.3507	Sep 100.0958 91.2958	Oct 100.0958 88.3507	Nov 100.0958 91.2958	Dec 100.0958 88.3507	(66) (67)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains	ins (see Ta Jan 100.0958 (calculate 88.3507 ns (calcula 174.7591 (calculated	ble 5 and , Watts Feb 100.0958 ed in Appen 97.8169 atted in App 176.5725 i n Append	5a) Mar 100.0958 dix L, equa 88.3507 endix L, equa 172.0027 ix L, equat	Apr 100.0958 ation L9 or 91.2958 puation L13 162.2740 ion L15 or	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also	Jun 100.0958 see Table 5 91.2958 lso see Tab 138.4513 see Table	Jul 100.0958 88.3507 1e 5 130.7404 5	Aug 100.0958 88.3507 128.9270	Sep 100.0958 91.2958 133.4968	Oct 100.0958 88.3507 143.2255	Nov 100.0958 91.2958 155.5061	Dec 100.0958 88.3507 167.0482	(66) (67) (68)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans	ins (see Ta Jan 100.0958 (calculate 88.3507 ns (calculate 174.7591 (calculated 33.0096 3.0000	ble 5 and , Watts Feb 100.0958 dd in Appen 97.8169 176.5725 d in Append 33.0096 3.0000	5a) Mar 100.0958 dix L, equa 88.3507 endix L, equa 172.0027 ix L, equat 33.0096 3.0000	Apr 100.0958 tition L9 or 91.2958 puation L13 162.2740 tion L15 or 33.0090 3.0000	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000	Jun 100.0958 see Table 5 91.2958 lso see Tab 138.4513 see Table 33.0096 0.0000	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000	Aug 100.0958 88.3507 128.9270 33.0096 0.0000	Sep 100.0958 91.2958 133.4968 33.0096 0.0000	Oct 100.0958 88.3507 143.2255 33.0096 3.0000	Nov 100.0958 91.2958 155.5061 33.0096 3.0000	Dec 100.0958 88.3507 167.0482 33.0096 3.0000	(66) (67) (68) (69) (70)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev	ins (see Ta (Table 5) Jan 100.0958 (calculate 88.3507 ns (calculate 33.0096 3.0000 (calculated) 3.0000 (calculated) 3.0000	watts Feb 100.0958 td in Appen 97.8169 tted in App 176.5725 d in Append 33.0096 3.0000 (negative v -80.0767	5a) Mar 100.0958 dix L, equa 88.3507 endix L, equa 172.0027 ix L, equat 3.0096 3.0000 alues) (Tab	Apr 100.0958 ation L9 or 91.2958 quation L13 162.2740 cion L15 or 33.0096 3.0000 cle 5) -80.0767	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767	Jun 100.0958 see Table 5 91.2958 lso see Tab 138.4513 see Table 33.0096 0.0000 -80.0767	Jul 100.0958 88.3507 1e5 130.7404 5 33.0096 0.0000 -80.0767	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767	Sep 100.0958 91.2958 133.4968 33.0096 0.0000	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767	Nov 100.0958 91.2958 155.5061 33.0096 3.0000	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767	(66) (67) (68) (69) (70)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating	ins (see Ta Jan 100.0958 (calculate 83.507 ns (calculate 33.0096 3.0009 raporation (-80.0767 gains (Tabl)	ble 5 and , Watts Feb 100.0958 d in Appen 97.8169 176.5725 d in Append 176.5725 d in Append 33.0096 3.0009 (negative v -80.0767 .e 5)	Mar 100.0958 dix L, equa 88.3507 endix L, equa 172.0027 ix L, equat 33.0096 3.0000 alues) (Tab -80.0767 97.0152	Apr 100.0958 htion L9 or 91.2958 mation L13 162.2740 cion L15 or 33.0096 3.0000 ble 5) -80.0767 96 1762	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767 79.5748	Jun 100.0958 see Table 5 91.2958 138.4513 see Table 33.0096 0.0000 -80.0767 72.6576	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000 -80.0767 60 3320	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8544	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767	(66) (67) (68) (69) (70) (71)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal	ins (see Ta Jan 100.0958 (calculate 88.3507 ns (calculate 33.0096 3.0000 3.0000 aporation (-80.0767 gains (Tabl) 104.3406 gains	ble 5 and , Watts Feb 100.0958 d in Appen 97.8169 176.5725 d in Append 33.0096 3.0006 0.0047 	Mar 100.0958 dix L, equa 88.3507 endix L, eq 172.0027 ix L, equat 33.0096 3.0000 alues) (Tab -80.0767 97.0152	Apr 100.0958 ttion L9 or 91.2958 yuation L13 162.2740 tion L15 or 3.0096 3.0000 yle 5) -80.0767 86.1762	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767 79.5748	Jun 100.0958 see Table 5 10.2958 138.4513 see Table 33.0096 0.0000 -80.0767 72.6576	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000 -80.0767 68.3328 240.4577	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767 83.5333	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416	 (66) (67) (68) (69) (70) (71) (72) (73)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal	ins (see Ta 	ble 5 and , Watts Feb 100.0958 d in Appen 97.8169 176.5725 d in Appen 176.5725 d in Appen 3.0009 (negative v -80.0767 .e 5) 101.8811 432.2993	Mar 100.0958 dix L, equa 88.3507 endix L, equa 172.0027 ix L, equat 33.0096 3.0000 alues) (Tab -80.0767 97.0152 413.3974	Apr 100.0958 htion L9 or 91.2958 nation L13 162.2740 cion L15 or 3.0096 3.0000 ble 5) -80.0767 86.1762 395.7748	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767 79.5748 373.9477	Jun 100.0958 see Table 5 91.2958 138.4513 see Table 33.0096 0.0000 -80.0767 72.6576 355.4334	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000 -80.0767 68.3328 340.4527	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904 342.0969	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767 83.5333 371.1383	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143 396.7450	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693	(66) (67) (68) (69) (70) (71) (71) (72) (73)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 6. Solar gains	ins (see Ta s (Table 5) Jan 100.0958 (calculated 33.0096 (calculated 3.0000 raporation (-80.0767 gains (Tabl 104.3406 gains 423.4792	ble 5 and , Watts Feb 100.0958 d in Appen 97.8169 116.5725 in Append 33.0096 (negative v -80.0767 .e.5) 101.8811 432.2993	5a) Mar 100.0958 dix L, equa 88.3507 endix L, equa 172.0027 ix L, equat 33.0096 3.0000 alues) (Tab -80.0767 97.0152 413.3974	Apr 100.0958 ttion L9 or 91.2958 guation L13 162.2740 icion L15 or 33.0096 3.0000 ble 5) -80.0767 86.1762 395.7748	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767 79.5748 373.9477	Jun 100.0958 see Table 5 91.2958 lso see Tab 33.0096 0.0000 -80.0767 72.6576 355.4334	Jul 100.0958 88.3507 15 33.0096 0.0000 -80.0767 68.3328 340.4527	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904 342.0969	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767 83.5333 371.1383	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143 396.7450	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693	(66) (67) (68) (70) (71) (72) (73)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 6. Solar gains	ins (see Ta 	ble 5 and , Watts Feb 100.0958 ed in Appen 97.8169 176.5725 d in Append 33.0096 3.0009 (negative v -80.0767 .e 5) 101.8811 432.2993	5a) Mar 100.0958 dix L, equa 88.3507 endix L, equa 172.0027 ix L, equat 33.0096 3.0000 alues) (Tab -80.0767 97.0152 413.3974	Apr 100.0958 ution L9 or 91.2958 ution L13 162.2740 cion L15 or 33.0096 3.0000 ole 5) -80.0767 86.1762 395.7748	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767 79.5748 373.9477	Jun 100.0958 see Table 5 91.2958 iso see Table 33.0096 0.0000 -80.0767 72.6576 355.4334	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000 -80.0767 68.3328 340.4527	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904 342.0969	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767 83.5333 371.1383	Nov 100.0958 91.2958 155.5061 33.0090 -80.0767 93.9143 396.7450	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693	(66) (67) (68) (70) (71) (72) (73)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 6. Solar gains [Jan]	ins (see Ta 	ble 5 and , Watts Feb 100.0958 d in Appen 97.8169 176.5725 i in Append 33.0096 (negative v -80.0767 .e 5) 101.8811 432.2993	5a) Mar 100.0958 dix L, equat 88.3507 endix L, equat 33.0096 3.0000 alues) (Tab -80.0767 97.0152 413.3974 	Apr 100.0958 ttion L9 or 91.2958 guation L13 162.2740 cion L15 or 33.0096 3.0000 cle 5) -80.0767 86.1762 395.7748	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767 79.5748 373.9477 Solar flux Table 6a W/m2	Jun 100.0958 see Table 5 91.2958 lso see Tab 138.4513 see Table 33.0096 0.0000 -80.0767 72.6576 355.4334	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000 -80.0767 68.3328 340.4527 	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904 342.0969 	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767 83.5333 371.1383 371.1383	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143 396.7450	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693 Gains W	(66) (67) (68) (70) (71) (72) (73)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 	ins (see Ta s (Table 5) Jan 100.0958 (calculated 33.0096 (calculated 3.0000 raporation (-80.0767 gains (Tabl 104.3406 gains 423.4792	ble 5 and , Watts Feb 100.0958 dd in Appen 97.8169 176.5725 in Append 33.0096 3.0090 (negative v -80.0767 .e.5) 101.8811 432.2993	5a) Mar 100.0958 dix L, equa 88.3507 endix L, equa 172.0027 ix L, equati 3.0090 alues) (Tab -80.0767 97.0152 413.3974 	Apr 100.0958 ttion L9 or 91.2958 guation L13 162.2740 icion L15 or 33.0096 3.0000 ble 5) -80.0767 86.1762 395.7748	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767 79.5748 373.9477 Solar flux Table 6a W/m2 11.2829 36.7938	Jun 100.0958 see Table 5 91.2958 lso see Table 33.0096 0.0000 -80.0767 72.6576 355.4334 Speci or	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000 -80.0767 68.3328 340.4527 g fic data Table 6b 0.6300 0.6300	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904 342.0969 Specific or Tab	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797 FF data 16.6c .7000	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767 83.5333 371.1383 371.1383 Acces fact Table 0 0.777 0.774	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143 396.7450	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693 Gains W 17.3445 52.4002	 (66) (67) (68) (70) (71) (72) (73)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal G. Solar gains (Jan) Northeast Southeast Southeast	ins (see Ta 	ble 5 and , Watts Feb 100.0958 d in Appen 97.8169 176.5725 in Append 33.0096 (negative v -80.0767 .e 5) 101.8811 432.2993		Apr 100.0958 ttion L9 or 91.2958 guation L13 162.2740 tion L15 or 33.0096 3.0000 ble 5) -80.0767 86.1762 395.7748 	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767 79.5748 373.9477 Solar flux Table 6a W/m2 11.2829 36.7938 36.7938	Jun 100.0958 see Table 5 91.2958 Iso see Tab 138.4513 see Table 33.0096 0.0000 -80.0767 72.6576 355.4334 Speci or	Jul 100.0958 88.3507 15 33.0096 0.0000 -80.0767 68.3328 340.4527 fic dat Table 6b 0.6300 0.6300 0.6300	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904 342.0969 	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797 FF data le 6c .7000 .7000	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767 83.5333 371.1383 371.1383 Acces fact Table 0 0.777 0.770	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143 396.7450	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693 Gains W 17.3445 52.4002 35.3083	 (66) (67) (68) (70) (71) (72) (73)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 6. Solar gains [Jan] Northeast Southeast Southeast Solar gains Total gains	ins (see Ta s (Table 5) Jan 100.0958 (calculate 88.3507 ns (calculated 3.0096 (calculated 3.0000 raporation (-80.0767 gains (Tabl 104.3406 gains 423.4792 	ble 5 and , Watts Feb 100.0958 din Appen 97.8169 ated in App 176.5725 in Append 33.0096 3.0096 (negative v -80.0767 .65) 101.8811 432.2993 		Apr 100.0958 ttion L9 or 91.2958 guation L13 162.2740 ion L15 or 33.0096 3.0000 ble 5) -80.0767 86.1762 395.7748 	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767 79.5748 373.9477 Solar flux Table 6a 36.7938 36.7938 36.7938	Jun 100.0958 see Table 5 91.2958 lso see Table 33.0096 0.0000 -80.0767 72.6576 355.4334 	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000 -80.0767 68.3328 340.4527 fic data Table 6b 0.6300 0.6300 0.6300 0.6300	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904 342.0969 	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797 FF data le 6c .7000 .7000 .7000 .7000	Oct 100.0958 88.3507 143.2255 33.0096 -80.0767 83.5333 371.1383 Acces fact. Table 0.777 0.777 0.777 0.777	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143 396.7450 396.7450 ss or 6d 00 00 00 126.8784 523.6234	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693 Gains W 17.3445 52.4002 35.3083 89.2246 503.5939	 (66) (67) (68) (70) (71) (72) (73)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 	ins (see Ta 	ble 5 and , Watts Feb 100.0958 ed in Appen 97.8169 176.5725 1 in Append 33.0096 3.0000 (negative v -80.0767 e 5) 101.8811 432.2993 		Apr 100.0958 ttion L9 or 91.2958 µation L13 162.2740 ciion L15 or 33.0096 3.0000 ble 5) -80.0767 86.1762 395.7748 	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 3.0000 -80.0767 79.5748 373.9477 Solar flux Table 6a W/m2 11.2829 36.7938 36.7938 36.7938	Jun 100.0958 see Table 5 91.2958 Iso see Table 33.0096 0.0000 -80.0767 72.6576 355.4334 Speci or 431.3467 786.7801	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000 -80.0767 68.3328 340.4527 fic data Table 6b 0.6300 0.6300 0.6300 411.5787 752.0314	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904 342.0969 	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797 FF data le 6c .7000 .7000 .7000 .7000 .298.8472 652.5269	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767 83.5333 371.1383 371.1383 371.1383 Acces fact Table 0 0.777 0.777 0.777 208.2646 579.4028	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143 396.7450 396.7450 \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693 Gains W 17.3445 52.4002 35.3083 89.2246 503.5939	 (66) (67) (68) (70) (71) (72) (73)
5. Internal ga Metabolic gain (66) m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 	ins (see Ta 	ble 5 and , Watts Feb 100.0958 d in Appen 97.8169 176.5725 in Append 33.0096 (negative v -80.0767 .e 5) 101.8811 432.2993 		Apr 100.0958 ttion L9 or 91.2958 guation L13 162.2740 tion L15 or 33.0096 3.0000 cle 5) -80.0767 86.1762 395.7748 	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767 79.5748 373.9477 Solar flux Table 6a W/m2 11.2829 36.7938 36.7938 36.7938	Jun 100.0958 see Table 5 91.2958 Iso see Table 33.0096 0.0000 -80.0767 72.6576 355.4334 Speci or 431.3467 786.7801	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000 -80.0767 68.3328 340.4527 fic ds at Table 6b 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904 342.0969 Specific or Tab: 0 0 0 360.4886 702.5855	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797 FF data le 6c .7000 .7000 .7000 298.8472 652.5269	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767 83.5333 371.1383 371.1383 Acces fact Table 0 0.777 0.770 0.770 208.2646 579.4028	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143 396.7450 396.7450 ss or 6d 00 00 126.8784 523.6234	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693 Gains W 17.3445 52.4002 35.3083 89.2246 503.5939	 (66) (67) (68) (70) (71) (72) (73)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 6. Solar gains [Jan] Northeast Southeast Southeast Solar gains Total gains 7. Mean intern Temperature du	ins (see Ta s (Table 5) Jan 100.0958 (calculate 88.3507 ns (calculate 3.0096 (calculated 3.0000 aporation (-80.0767 gains (Tabl 104.3406 gains 423.4792 	ble 5 and , Watts Feb 100.0958 d in Append 97.8169 176.5725 in Append 33.0096 3.0000 Inegative v -80.0767 .e 101.8811 432.2993 101.8811 432.2993 184.7052 617.0045 		Apr 100.0958 ttion L9 or 91.2958 Juation L13 162.2740 iion L15 or 33.0096 3.0000 ble 5) -80.0767 86.1762 395.7748 395.7748 	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 3.0096 3.0000 -80.0767 79.5748 373.9477 Solar flux Table 6a W/m2 11.2829 36.7938 36.7938 424.1157 798.0633	Jun 100.0958 500 Table 5 91.2958 Iso see Table 33.0096 0.0000 -80.0767 72.6576 355.4334 Speci or 431.3467 786.7801	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000 -80.0767 68.3328 340.4527 fic data Table 6b 0.6300 0.6300 0.6300 411.5787 752.0314	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904 342.0969 	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797 FF data le 6c .7000 .7000 .7000 .298.8472 652.5269	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767 83.5333 371.1383 371.1383 Acces fact. Table 0 0.777 0.770 208.2646 579.4028	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143 396.7450 00 00 126.8784 523.6234	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693 Gains W 17.3445 52.4002 35.3083 89.2246 503.5939	 (66) (67) (68) (70) (71) (72) (73) (75) (77) (77) (79) (83) (84) (85)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 6. Solar gains [Jan] Northeast Southeast Solar gains Total gains 7. Mean intern Temperature du Utilisation fa	ins (see Ta s (Table 5) Jan 100.0958 (calculated 3.0096 (calculated 3.0090 (calculated 3.0000 (calculated 3.0000 (calculated 3.0096 (calculate	ble 5 and , Watts Feb 100.0958 din Append 33.0096 33.0096 33.0096 33.0006 (negative v -80.0767 e5) 101.8811 432.2993 432.2993 184.7052 617.0045 cure (heati Feb Erios		Apr 100.0958 ttion L9 or 91.2958 guation L13 162.2740 oble 5) -80.0767 86.1762 395.7748 395.7748 395.7748 	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767 79.5748 373.9477 Solar flux Table 6a 36.7938 36.7938 36.7938 36.7938 36.7938 36.7938	Jun 100.0958 see Table 5 91.2958 so see Table 33.0096 0.0000 -80.0767 72.6576 355.4334 	Jul 100.0958 88.3507 le 5 130.7404 5 33.0096 0.0000 -80.0767 68.3328 340.4527 fic data Table 6b 0.6300 0.6300 0.6300 0.6300 411.5787 752.0314	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904 342.0969 	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797 FF data le 6c .7000 .7000 .7000 .7000 .298.8472 652.5269	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767 83.5333 371.1383 Acces fact. Table 0 0.777 0.777 0.777 0.777 0.777 0.777	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143 396.7450 3.96.7450 3.96.7450 126.8784 523.6234	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693 414.3693 Gains W 17.3445 52.4002 35.3083 89.2246 503.5939 21.0000 Dec	 (66) (67) (68) (70) (71) (72) (73) (73) (83) (84) (85)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal G. Solar gains (Jan) Northeast Southeast Southeast Southeast Solar gains Total gains 7. Mean intern Temperature du Utilisation du	ins (see Ta s (Table 5) Jan 100.0958 (calculated 3.0096 (calculated 3.0090 aporation (-80.0767 gains (Tabl 104.3406 gains (Tabl 104.3406 gains (Tabl 105.0530 528.5321 	ble 5 and , Watts Feb 100.0958 din Appen 97.8169 ated in App 176.5725 in Append 33.0096 3.0096 (negative v -80.0767 .e.5) 101.8811 432.2993 432.2993 184.7052 617.0045 184.7052 617.0045		Apr 100.0958 ttion L9 or 91.2958 guation L13 162.2740 ion L15 or 33.0096 3.0000 ble 5) -80.0767 86.1762 395.7748 395.7748 395.7748 4.7195 	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767 79.5748 373.9477 Solar flux Table 6 36.7938 37.9477	Jun 100.0958 see Table 5 91.2958 lso see Table 33.0096 0.0000 -80.0767 72.6576 355.4334 	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000 -80.0767 68.3328 340.4527 66.3328 340.4527 9 fic data Table 6b 0.6300 0.6300 0.6300 0.6300 411.5787 752.0314 56.3896 4.7593	Aug 100.0958 88.3507 128.9270 33.0096 -80.0767 71.7904 342.0969 	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797 75.8584 353.6797 25.8584 353.6797 298.8472 652.5269 Sep 56.1992 4.7466	Oct 100.0958 88.3507 143.2255 33.0096 .3.0000 -80.0767 83.5333 371.1383 371.1383 Acces fact Table 0 0.777 0.777 0.777 0.777 0.777 0.777 208.2646 579.4028	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143 396.7450 93.9143 396.7450 \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693 414.3693 W 17.3445 52.4002 35.3083 89.2246 503.5939 21.0000 Dec 55.4679 4.6979	 (66) (67) (68) (70) (71) (72) (73)
5. Internal ga Metabolic gain (66) m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal 	ins (see Ta 	ble 5 and , Watts Feb 100.0958 d in Appen 97.8169 176.5725 in Append 3.0096 (negative v -80.0767 .e. 5) 101.8811 432.2993 	5a) Mar 100.0958 dix L, equat 88.3507 endix L, equat 33.0096 alues) (Tab -80.0767 97.0152 413.3974 	Apr 100.0958 ttion L9 or 91.2958 guation L13 icon L15 or 33.0096 3.0000 ole 5) -80.0767 86.1762 395.7748 395.7748 395.7748 395.7748 3000 5600 357.7447 753.5195 	May 100.0958 L9a), also s 88.3507 or L13a), al 149.9934 L15a), also 33.0096 3.0000 -80.0767 79.5748 373.9477 Solar flux Table 6a W/m2 11.2829 36.7938 36.7938 36.7938 424.1157 798.0633 424.1157 798.0633	Jun 100.0958 see Table 5 91.2958 Iso see Table 33.0096 0.0000 -80.0767 72.6576 355.4334 	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000 -80.0767 68.3328 340.4527 fic data Table 6b 0.63000 0.63000 0.630000000000	Aug 100.0958 88.3507 128.9270 33.0096 -80.0767 71.7904 342.0969 	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797 75.8584 353.6797 45.5569 298.8472 652.5269 298.8472 652.5269 56.1992 4.7466 0.7191	Oct 100.0958 88.3507 143.2255 33.0096 -80.0767 83.5333 371.1383 371.1383 Accee fact Table 0 0.777 0.770	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143 396.7450 396.7450 00 00 126.8784 523.6234 126.8784 523.6234	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693 414.3693 Gains W 17.3445 52.4002 35.3083 89.2246 503.5939 21.0000 Dec 55.4679 4.6979 0.9923	 (66) (67) (68) (71) (72) (73) (73) (83) (84) (85) (86)
5. Internal ga Metabolic gain (66)m Lighting gains Appliances gai Cooking gains Pumps, fans Losses e.g. ev Water heating Total internal G. Solar gains (Jan] Northeast Southeast Southeast Solar gains Total gains Total gains Total gains Total gains Total gains Total gains Total gains MIT	ins (see Ta s (Table 5) Jan 100.0958 (calculated 88.3507 ns (calculated 3.0096 (calculated 3.0000 raporation (-80.0767 gains (Tabl 104.3406 gains 423.4792 	ble 5 and , Watts Feb 100.0958 din Append 33.0096 33.0096 33.0096 33.0006 (negative v -80.0767 e5) 101.8811 432.2993 1432.2993 184.7052 617.0045 Sure (heati Feb 55.1252 4.6750 0.9799 19.9149	5a) Mar 100.0958 dix L, equat 88.3507 endix L, equat 33.0096 3.0000 alues) (Tab -80.0767 97.0152 413.3974 413.3974 413.3974 A 5.00 4.6 3.1 268.0244 681.4218 ng season) in the livi ving area, Mar 5.2413 4.6828 0.9577 20.2134	Apr 100.0958 ttion L9 or 91.2958 guation L13 162.2740 of 15 or 33.0096 3.0000 ole 5) -80.0767 86.1762 395.7748 395.7748 	May 100.0958 L9a), also s 88.3507 or L13a), al L15a), also 33.0096 3.0000 -80.0767 79.5748 373.9477 Solar flux Table 6a 36.7938 37.7946 37.79477 37.7946 37.79	Jun 100.0958 500 Table 5 91.2958 138.4513 see Table 33.0096 0.0000 -80.0767 72.6576 355.4334 	Jul 100.0958 88.3507 1e 5 130.7404 5 33.0096 0.0000 -80.0767 68.3328 340.4527 68.3328 340.4527 fic data Table 6b 0.6300 0.6300 0.6300 0.6300 411.5787 752.0314 Jul 56.3896 4.7593 0.4327 20.9936	Aug 100.0958 88.3507 128.9270 33.0096 0.0000 -80.0767 71.7904 342.0969 Specific or Tab: 0 0 0 360.4886 702.5855 360.4886 702.5855 Aug 56.4816 4.7654 0.4804 20.9898	Sep 100.0958 91.2958 133.4968 33.0096 0.0000 -80.0767 75.8584 353.6797 75.8584 353.6797 85.61997 4.7466 0.7191 20.9157	Oct 100.0958 88.3507 143.2255 33.0096 3.0000 -80.0767 83.5333 371.1383 371.1383 Acces fact. Table 0 0.777	Nov 100.0958 91.2958 155.5061 33.0096 3.0000 -80.0767 93.9143 396.7450 396.7450 126.8784 523.6234 Nov 55.6868 4.7125 0.9809 20.0652	Dec 100.0958 88.3507 167.0482 33.0096 3.0000 -80.0767 102.9416 414.3693 414.3693 414.3693 414.3693 89.2246 503.5939 21.0000 Dec 55.4679 4.6979 0.9923 19.6526	 (66) (67) (68) (70) (71) (72) (73) (73) (83) (84) (85) (86) (87)



Th 2 util rest of h	19.8704	19.8725	19.8746	19.8844	19.8863	19.8949	19.8949	19.8965	19.8916	19.8863	19.8825	19.8786	(88)
MIT 2	0.9874 18.3793	0.9736 18.6630	0.9443 19.0359	0.8626 19.4832	0.7061 19.7660	0.4935 19.8778	0.3265 19.8930	0.3694 19.8932	0.6302 19.8395	0.8936 19.4792	0.9738 18.8631	0.9898 18.3364	(89) (90)
Living area fr MIT	raction 18.6774	18.9475	19.3035	19.7331	20.0116	20.1255	20.1432	20.1424	fLA = 20.0841	Living area 19.7265	/ (4) = 19.1363	0.2273 18.6356	(91) (92)
Temperature ac adjusted MIT	ljustment 18.5274	18.7975	19.1535	19.5831	19.8616	19.9755	19.9932	19.9924	19.9341	19.5765	18.9863	-0.1500 18.4856	(93)
8 Snace heati	ing requirem												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(0.4)
Useful gains Ext temp.	0.9822 519.1106 4.3000	0.9654 595.6821 4.9000	0.9333 635.9843 6.5000	0.8524 642.2869 8.9000	562.3211 11.7000	393.7495 14.6000	252.7766 16.6000	266.5019 16.4000	413.6496 14.1000	0.8830 511.6068 10.6000	0.9659 505.7589 7.1000	496.1967 4.2000	(94) (95) (96)
Heat loss rate	≥ W 1090.6246	1063.0595	965.8675	807.3902	615.6684	401.9650	253.7332	268.1930	437.7377	677.1471	900.0405	1085.9874	(97)
Space heating	kWh 425.2064	314.0776	245.4331	118.8744	39.6904	0.0000	0.0000	0.0000	0.0000	123.1620	283.8828	438.8043	(98a)
Space heating Solar heating	requirement kWh	- total p	per year (kW	h/year)	0.0000	0.0000		0.0000	0.0000	0.0000		1989.1310	(0.01.)
Solar heating Space heating	contributio kWh	n - total	per year (k	Wh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(386)
Space heating	425.2064 requirement	314.0776 after sol	245.4331 ar contribu	118.8744 tion - tota	39.6904 L per year	0.0000 (kWh/year)	0.0000	0.0000	0.0000	123.1620	283.8828	438.8043 1989.1310	(98c)
Space neating	per mz									(300)	/ (4) -	52.7551	(55)
9a. Energy rec	quirements -	Individua	al heating s	ystems, inc	luding mic:	ro-CHP							
Fraction of sp Fraction of sp	bace heat fr	om seconda om main sy	ary/suppleme vstem(s)	ntary system	n (Table 11	L)						0.0000 1.0000	(201) (202)
Efficiency of Efficiency of	main space main space	heating sy heating sy	vstem 1 (in vstem 2 (in	8) 8)								89.0000	(206) (207)
Efficiency of	secondary/s	upplementa	iry heating	system, %		_		_				0.0000	(208)
Space heating	requirement	rep	Mar	Apr	мау	Jun	JUI	Aug	sep	UCE	NOV	Dec	
Space heating	425.2064 efficiency	314.0776 (main heat	245.4331 ing system	118.8/44	39.6904	0.0000	0.0000	0.0000	0.0000	123.1620	283.8828	438.8043	(98)
Space heating	89.0000 fuel (main	89.0000 heating sy	89.0000 /stem)	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating	477.7600 efficiency	352.8962 (main heat	275.7676 ing system	133.5667	44.5959	0.0000	0.0000	0.0000	0.0000	138.3842	318.9694	493.0385	(211)
Space heating	0.0000 fuel (main	0.0000 heating sy	0.0000 /stem 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating	0.0000 fuel (secon	0.0000 dary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating Water heating	requirement	200 (112	001 1704	100 5400	100 1050	161 0060	150 0041	164 6690	1.00 1.750	100 0700	207 2141	224 4450	(64)
Efficiency of	water heate	209.0113 r	221.1704	97 0464	07 5004	97 2000	97 2000	104.0003	200.1/30	07 0507	207.3141	87.3000	(216)
Fuel for water	heating, k	Wh/month 237 3540	250 7999	216 6578	207 8841	184 6928	179 7527	188 6241	192 6403	217 1155	234 8517	265 2076	(219)
Space cooling	fuel requir	ement	0 0000	0 0000	0 0000	0 0000	0 0000	0 0000	0 0000	0 0000	0 0000	0 0000	(221)
Pumps and Fa Lighting	7.3041 19.1096	6.5973 15.3304	7.3041	7.0685	7.3041 7.8115	7.0685	7.3041 7.1259	7.3041 9.2625	7.0685	7.3041 15.7855	7.0685	7.3041	(231) (232)
Electricity ge (233a)m	-45.2498	PVs (Appen -61.5062	ndix M) (neg -85.1002	ative quant: -90.8848	ity) -93.4619	-85.6503	-84.5905	-82.0523	-76.5558	-68.3028	-48.8337	-39.2797	(233a)
Electricity ge (234a)m	0.0000	wind turbi 0.0000	.nes (Append 0.0000	1x M) (negat 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity us (235c)m	or net e 0.0000	0.0000	generated 0.0000	0.0000	0.0000	(negativ 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
(233b)m	-37.0724	-79.6189	-163.5966	-251.8810	-336.2569	-338.9105	-333.5171	-279.4537	-200.2473	-114.5336	-49.5911	-29.0630	(233b)
Electricity ge (234b)m	0.0000	0.0000	.nes (Append 0.0000	1x M) (negat 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
(235d)m Annual totals	sed or net e 0.0000 kWh/year	0.0000	0.0000	0.0000	0.0000	(negativ 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Space heating Space heating	fuel - main fuel - main	system 1 system 2										2234.9786 0.0000	(211) (213)
Space heating Efficiency of	fuel - seco water heate	ndary										0.0000 87.3000	(215)
Water heating Space cooling	fuel used fuel											2644.3861 0.0000	(219) (221)
Electricity fo	or pumps and	fans:											
central hea main heatir	ating pump ng flue fan											41.0000 45.0000	(230c) (230e)
Total electric Electricity fo	city for the or lighting	above, kW (calculate	Nh/year ed in Append	ix L)								86.0000 154.2253	(231) (232)
Energy saving/	generation	technologi	.es (Appendi	ces M ,N and	1 Q)								
PV generation Wind generation	on											-3075.2099 0.0000	(233) (234)
Hydro-electric Electricity ge	c generation enerated - M	(Appendix licro CHP ((Appendix N)									0.0000 0.0000	(235a) (235)
Appendix Q - s Energy saved of	special feat or generated	ures										-0.0000	(236)
Energy used Total delivere	ed energy fo	r all uses	3									0.0000 2044.3801	(237) (238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP



								Energy kWh/year	Emi	ssion factor kg CO2/kWh	1	Emissions kg CO2/year	
Space heating - Total CO2 associ	main system	1 ommunity s	systems					2234.9786		0.2100)	469.3455	(261)
Water heating (c	ther fuel)							2644.3861		0.2100)	555.3211	(264)
Pumps, fans and	electric ke	ep-hot						86.0000		0.1387	,	11.9293	(267)
Energy for light	.1ng							154.2253		0.1443	\$	22.2393	(208)
PV Unit electric	ity used in	dwelling	es					-861.4680		0.1356	5	-116.8334	
PV Unit electric Total	ity exporte	d					-	2213.7419		0.1253	5	-277.4745 -394.3080	(269)
Total CO2, kg/ye EPC Dwelling Car	ar bon Dioxide	Emission	Rate (DER)									664.5474 10.9400	(272) (273)
13a. Primary ene	ergy - Indiv	idual heat	ing systems	including	micro-CHP								
								Energy kWh/year	Primary e	hergy factor	Pr	imary energy	
Space heating -	main system	1						2234.9786		1.1300)	2525.5258	(275)
Water heating (c	ther fuel)	ommunity s	systems					2644.3861		1.1300)	2988.1563	(278)
Space and water Pumps, fans and	heating electric ke	ep-hot						86.0000		1.5128	1	130.1008	(279) (281)
Energy for light	ing							154.2253		1.5338	1	236.5558	(282)
Energy saving/g PV Unit electric	eneration to ty used in	echnologie dwelling	es					-861.4680		1.5013	5	-1293.3171	
PV Unit electric	ity exporte	d					-	2213.7419		0.4601		-1018.4798	(283)
Total Primary en	ergy kWh/ye	ar > (DPFR)										3568.5419	(286)
Dwelling filmary	energy nac	C (DIBR)										30.7700	(207)
SAP 10 WORKSHEET	FOR New Bu	ild (As De	esigned) (Version 10	.2, Februar	ry 2022)							
CALCULATION OF T	ARGET EMISS	IONS 											
1. Overall dwell	ing charact	eristics											
								Area	S	torev height		Volume	
Cround floor								(m2)	(1b)	(m)	. (2b) –	(m3)	(1b) (2b
Total floor area	a TFA = (1a)	+(1b)+(1c)	+(1d)+(1e).	(ln)		60.7200		00.7200	(III) X	2.3000	(20) -	144.3130	(1D) = (3D) (4)
DWelling Volume								(.	3a) + (3b) + (3C) + (3a) + (3e	e)(3n) =	144.5136	
													(5)
													(5)
2. Ventilation r													(5)
	ate												(5)
	ate											m3 per hour	(5)
Number of open of	thimneys										0 * 80 =	m3 per hour 0.0000 0.0000	(6a) (6b)
Number of open of Number of open f Number of chimne	chimneys flues eys / flues	attached t	co closed fi	re							0 * 80 = 0 * 20 = 0 * 10 =	m3 per hour 0.0000 0.0000 0.0000	(6a) (6b) (6c)
Number of open c Number of open f Number of chimne Number of flues Number of flues	chimneys flues eys / flues attached to attached to	attached t solid fue other hea	co closed fi el boiler ater	re							0 * 80 = 0 * 20 = 0 * 10 = 0 * 20 = 0 * 35 =	m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000	(6a) (6b) (6c) (6d) (6e)
Number of open of Number of open f Number of chimme Number of flues Number of blocke Number of interm	thimneys flues ys / flues attached to attached to d chimneys iittent extr.	attached t solid fue other hea act fans	co closed fi el boiler ater	re							0 * 80 = 0 * 20 = 0 * 20 = 0 * 20 = 0 * 35 = 0 * 20 = 2 * 10 =	m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 20.0000	(6a) (6b) (6c) (6d) (6e) (6f) (7a)
Number of open of Number of open f Number of chimne Number of flues Number of blocke Number of interm Number of flues	chimneys clues eys / flues of attached to attached to d chimneys hittent extra- re vents	attached t solid fue other hea act fans	to closed fi l boiler ater	re							0 * 80 = 0 * 20 = 0 * 20 = 0 * 20 = 0 * 20 = 2 * 10 = 0 * 10 = 0 * 10 =	m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 20.0000 0.0000 0.0000	(6a) (6b) (6c) (6d) (6f) (7a) (7b)
Number of open of Number of open f Number of chimme Number of flues Number of blocke Number of blocke Number of passiv Number of fluele	thimneys flues sys / flues : attached to attached to attached to d chimneys hittent extr. e vents ss gas fire:	attached t solid fue other hea act fans s	co closed fi el boiler tter	re							0 * 80 = 0 * 20 = 0 * 20 = 0 * 20 = 0 * 20 = 2 * 10 = 0 * 20 = 2 * 10 = 0 * 40 =	m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 20.0000 0.0000 0.0000 0.0000	(6a) (6b) (6c) (6d) (6f) (7a) (7b) (7c)
Number of open of Number of open f Number of chimme Number of flues Number of blocke Number of blocke Number of blocke Number of flues Infiltration due Proseuro toot	thimneys llues attached to attached to attached to d chimneys hittent extr. re vents ss gas fire: e to chimney.	attached t solid fue other hea act fans s s, flues a	co closed fi el boiler tter and fans =	re : (6a)+(6b)	+ (6c) + (6d) -	+(6e)+(6f)+(b)+(7c) =		20.000	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	m3 per hour 0.0000 0.0000 0.0000 0.0000 20.0000 0.0000 0.0000 0.0000 ges per hour 0.1384	(6a) (6b) (6c) (6d) (6f) (7a) (7b) (7c) (8)
Number of open c Number of open f Number of chimne Number of flues Number of blocke Number of passiv Number of fluele Infiltration due Pressure test Pressure Test Me	thimneys llues attached to attached to d chinneys littent extr. es gas fire: to chinney.	attached t solid fue other hea act fans s s, flues a	co closed fi el boiler iter and fans =	re : (6a)+(6b)	+ (6c) + (6d) -	+(6e)+(6f)+(6g)+(7a)+(7	b)+(7c) =		20.000	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	m3 per hour 0.0000 0.0000 0.0000 0.0000 20.0000 0.0000 0.0000 0.0000 ges per hour 0.1384 Yes Blower Door	(6a) (6b) (6c) (6d) (6e) (7a) (7b) (7c) (8)
Number of open c Number of open f Number of chimne Number of flues Number of blocke Number of interm Number of jassiv Number of fluele Infiltration due Pressure test Pressure test Measured/design Infiltration rat	thimneys ilues sys / flues a attached to attached to d chimneys iittent extr. e vents ss gas fire: to chimney: thog hep50 .e	attached t solid fue other hea act fans s s, flues a	co closed fi el boiler ater and fans =	re • (6a)+(6b)	+ (6c) + (6d) ·	+(6e)+(6f)+(6g)+(7a)+(7	b)+(7c) =		20.000	0 * 80 = 0 * 20 = 0 * 20 = 0 * 20 = 0 * 20 = 2 * 10 = 0 * 10 = 0 * 40 = Air chan 0 / (5) =	m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 ges per hour 0.1384 Yes Blower Door 5.0000 0.3884	(6a) (6b) (6c) (6d) (6f) (7a) (7b) (7c) (8) (17) (18)
Number of open of Number of open f Number of chimne Number of flues Number of flues Number of blocke Number of interm Number of fluele Infiltration due Pressure test Pressure test Measured/design Infiltration rat Number of sides	thimneys llues eys / flues . attached to attached to d chimneys wittent extr. re vents ess gas fire: to chimney. ethod APSO re sheltered	attached t solid fue other hea act fans s s, flues a	to closed fi boiler ater	re : (6a)+(6b)		+(6e)+(6f)+(6g)+(7a)+(7			20.000	0 * 80 = 0 * 20 = 0 * 10 = 0 * 35 = 0 * 20 = 2 * 10 = 0 * 10 = 0 * 40 = Air chan 0 / (5) =	m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 ges per hour 0.1384 Yes Blower Door 5.0000 0.3884 2	(6a) (6b) (6c) (6d) (6e) (7a) (7b) (7c) (8) (17) (18) (19)
Number of open of Number of open f Number of chimne Number of flues Number of blocke Number of blocke Number of passiv Number of passiv Number of fluele Infiltration due Pressure test Pressure test Measured/design Infiltration rat Number of sides Shelter factor Infiltration rat	thimneys llues sys / flues a attached to attached to attached to d chimneys hittent extr. re vents uss gas fire: to chimney. thod AP50 ie sheltered te adjusted	attached t solid fue other hea act fans s s, flues a to include	co closed fi el boiler ater and fans =	re (6a)+(6b)	+ (6c) + (6d) -	+ (6e) + (6f) + (6g)+(7a)+(7	b)+(7c) =	(20) = 1	- [0.075 (21) = (18)	0 * 80 = 0 * 20 = 0 * 20 = 0 * 20 = 0 * 20 = 2 * 10 = 0 * 40 = Air chan 0 / (5) = x (19)] = x (20) =	m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1384 Yes Blower Door 5.0000 0.3884 22 0.8500 0.3301	(6a) (6b) (6c) (6d) (6f) (7a) (7b) (7c) (8) (17) (18) (19) (20) (21)
Number of open c Number of open f Number of chimne Number of flues Number of flues Number of interm Number of passiv Number of fluele Infiltration due Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides Shelter factor Infiltration rat	thimneys llues attached to attached to attached to attached to d chimneys hittent extr. re vents uss gas fire: e to chimney. ethod AP50 e sheltered e adjusted	attached t solid fue other hea act fans s s, flues a to include	co closed fi el boiler ater and fans = e shelter fa	re • (6a)+(6b) .ctor		+(6e)+(6f)+(6g)+(7a)+(7	 b)+(7c) =	(20) = 1	- [0.075 (21) = (18)	$\begin{array}{cccccc} 0 & * & 80 & = \\ 0 & * & 20 & = \\ 0 & * & 10 & = \\ 0 & * & 35 & = \\ 2 & * & 10 & = \\ 0 & * & 10 & = \\ 0 & * & 10 & = \\ 0 & * & 40 & = \\ \text{Air chan} \\ 10 & / & (5) & = \\ \end{array}$ $\begin{array}{c} x & (19) &] & = \\ x & (20) & = \\ \end{array}$	m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1384 Yes Blower Door 5.0000 0.3884 2 0.8500 0.3301	(6a) (6b) (6c) (6d) (6f) (7a) (7b) (7c) (8) (17) (18) (19) (20) (21)
Number of open of Number of open f Number of flues Number of flues Number of blocke Number of blocke Number of blocke Number of fluele Infiltration due Pressure test Pressure Test Me Measured/design Infiltration rat Number of sides Shelter factor Infiltration rat	thimneys llues attached to attached to attached to dchinneys hittent extr. re vents sistent extr. re vents to chimney. thod AP50 re sheltered te adjusted to Jan 5,1000	attached t solid fue other hea act fans s s, flues a to include Feb 5.0000	o closed fi el boiler tter and fans = e shelter fa Mar 4,9000	re (6a)+(6b) ctor Apr 4,4000	+ (6c) + (6d) -	Jun 3 8000	Jul 3 8000	 b)+(7c) =	(20) = 1 Sep	- [0.075 (21) = (18) 0 cct	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1384 Yes Blower Door 5.0000 0.3884 2 0.8500 0.3301 Dec 0 4 7000	(6a) (6b) (6c) (6d) (6d) (7a) (7b) (7c) (8) (17) (18) (19) (20) (21)
Number of open of Number of open f Number of chimne Number of flues Number of flues Number of blocke Number of blocke Number of blocke Number of fluele Infiltration due Pressure Test Me Measured/design Infiltration rat Shelter factor Infiltration rat	thimneys llues attached to attached to attached to attached to attached to attached to attached to attached to attached to shittent extr. ss gas fire: to chimney. thod AP50 .e sheltered .e attached to attached to attached attached to attached to attached	attached t solid fue other hea act fans s s, flues a to include Feb 5.0000 1.2500	o closed fi el boiler tter and fans = e shelter fa Mar 4.9000 1.2250	re (6a)+(6b) ctor Apr 4.4000 1.1000	+(6c)+(6d) +(6c)+(6d) 4.3000 1.0750	Jun 3.8000 0.9500	Jul 3.8000 0.9500	Aug 3.7000 0.9250	(20) = 1 Sep 4.000 1.000	- [0.075 (21) = (18) 0 4.3000 0 1.0750	0 * 80 = 0 * 20 = 0 * 20 = 0 * 20 = 0 * 20 = 2 * 10 = 0 * 10 = 0 * 40 = Air chan 0 / (5) = x (19)] = x (20) = Nov 0 * 4.500 0 1.125	m3 per hour 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1384 Yes Blower Door 5.0000 0.3884 2 0.8500 0.3301 Dec 0 4.7000 0 1.1750	(6a) (6b) (6c) (6d) (6e) (7a) (7b) (7c) (8) (17) (18) (19) (20) (21) (22) (22a)
Number of open of Number of open f Number of chimme Number of flues Number of flues Number of blocke Number of blocke Number of fluele Infiltration due Pressure Test Me Measured/design Infiltration rat Shelter factor Infiltration rat Wind speed Wind factor Adj infilt rate	thimneys llues attached to attached to d chimneys littent extr. ex to chimneys thod AP50 te sheltered te adjusted Jan 5.1000 1.2750 0.4209 0.500	attached t solid fue other hea act fans s s, flues a to include Feb 5.0000 1.2500 0.4127	o closed fi bl boiler iter and fans = e shelter fa Mar 4.9000 1.2250 0.4044 0.0000	re (6a)+(6b) .ctor Apr 4.4000 1.1000 0.3631 0.9670	May 4.3000 1.0750 0.3549	Jun 3.8000 0.9500 0.3136	Jul 3.8000 0.9500 0.3136	Aug 3.7000 0.9250 0.3054	(20) = 1 Sep 4.000 1.000 0.330 0.5 ref	- [0.075 (21) = (18) 0 - (1.0750) 0 - (1.0750) 1 - 0.3546	0 * 80 = 0 * 20 = 0 * 20 = 0 * 20 = 0 * 20 = 2 * 10 = 0 * 40 = Air chan 0 / (5) = x (19)] = x (20) = Nov 4.500 0 1.125 0 0.371	m3 per hour 0.0000 0.03844 2 0.3850 0.3301 Dec 0.4.7000 0.1.1750 4.0.3879 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0	(6a) (6b) (6c) (6d) (6e) (7a) (7b) (7c) (8) (17) (18) (19) (21) (22) (22a) (22b) (2b)
Number of open of Number of open f Number of chimne Number of flues Number of flues Number of interm Number of passiv Number of fluele Infiltration due Pressure test Pressure test Pressure test Measured/design Infiltration rat Number of sides Shelter factor Infiltration rat Wind speed Wind factor Adj infilt rate	thimneys llues stucked to attached to attached to attached to attached to attached to d chimneys iittent extr. e to chimneys thod AP50 te sheltered a adjusted Jan 5.1000 1.2750 0.4209 0.5886	attached t solid fue other hea act fans s s, flues a to include Feb 5.0000 1.2500 0.4127 0.5851	o closed fi boiler ater and fans = e shelter fa Mar 4.9000 1.2250 0.4044 0.5818	re (6a)+(6b) .ctor Apr 4.4000 1.1000 0.3631 0.5659	May 4.3000 1.0750 0.3549 0.5630	Jun 3.8000 0.5500 0.3136 0.5492	Jul 3.8000 0.9500 0.3136 0.5492	Aug 3.7000 0.9250 0.3054 0.5466	(20) = 1 Sep 4.000 1.000 0.330 0.554	- [0.075 (21) = (18) 0 4.3000 1.0750 1 0.3549 5 0.5630	0 * 80 = 0 * 20 = 0 * 20 = 0 * 20 = 0 * 20 = 2 * 10 = 0 * 40 = Air chan 0 / (5) = x (19)] = x (20) = x (20) = Nov 0 4.500 1.125 0 0.371 0 .569	m3 per hour 0.0000 0.3884 2 0.8500 0.3301 Dec 0.4.7000 0.1.1750 4.0.3879 0.0.5752	(6a) (6b) (6c) (6d) (7a) (7b) (7c) (8) (17) (18) (19) (21) (22) (22a) (22b) (25)

3. Heat losses and heat loss parameter -----NetArea U-value m2 W/m2K 12.8300 1.1450 60.7200 0.1300 63.9000 0.1800 60.7200 0.1100 198.1700 (26)...(30) + (32) = A x U W/K 14.6908 7.8936 11.5020 A x K kJ/K Element Openings K-value Gross m2 m2 kJ/m2K TER Opening Type (Uw = 1.20) Heatloss Floor 1 External Wall 1 External Roof 1 Total net area of external elements Aum(A, m2) Fabric heat loss, W/K = Sum (A x U) (27) (28a) (29a) (30) (31) (33) 76.7300 60.7200 12.8300 6.6792 40.7656



Thermal mass pa	arameter (TMP = Cm /	TFA) in kJ/r	n2K								250.0000	(35)
List of Thermal K1 Eler	l Bridges ment		1111, 111 10,1					Le	ength	Psi-value	Tot	al	(00)
E2 Othe E3 Sill	er lintels l	(including	other steel	l lintels)				8	.8200 .8200	0.0500	0.44	10 10	
E4 Jami E5 Grou	b und floor	(normal)						20 32	.6000 .2400	0.0500 0.1600	1.03 5.15	00 84	
E16 Con E10 Eav	rner (norma ves (insula	al) ation at ce	iling level)				9 20	.5200	0.0900	0.85	68 44	
E12 Gar Thermal bridges	ole (insula s (Sum(L x	Psi) calcu	llated using	Appendix F	()			12	.0000	0.0600	(26-)	9.8616	(36)
Total fabric he	eat loss								(33) + (36)	(36a) = + (36a) =	50.6272	(37)
Ventilation hea	at loss cai Jan	lculated mc Feb	onthly (38)m Mar	= 0.33 x (25)m x (5) Mav	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m Heat transfer d	28.0695 coeff	27.9054	27.7446	26.9893	26.8480	26.1902	26.1902	26.0684	26.4436	26.8480	27.1339	27.4328	(38)
Average = Sum(3	78.6967 39)m / 12 =	78.5327	78.3719	77.6166	77.4753	76.8174	76.8174	76.6956	77.0708	77.4753	77.7611	78.0600 77.6159	(39)
HLP	Jan 1.2961	Feb 1.2934	Mar 1.2907	Apr 1.2783	May 1.2759	Jun 1.2651	Jul 1.2651	Aug 1.2631	Sep 1.2693	Oct 1.2759	Nov 1.2807	Dec 1.2856	(40)
HLP (average) Days in mont	31	28	31	30	31	30	31	31	30	31	30	1.2783 31	
4. Water heatin	ng energy i	requirement	s (kWh/year))									
Assumed occupar Hot water usage	ncy e for mixe:	r showers										2.0019	(42)
Hot water usage	57.7851 e for baths	56.9167	55.6513	53.2302	51.4434	49.4508	48.3182	49.5741	50.9507	53.0901	55.5633	57.5637	(42a)
Hot water usage	24.9727 e for other	24.6018 r uses	24.0796	23.1166	22.3955	21.5960	21.1641	21.6827	22.2474	23.1029	24.0858	24.8883	(42b)
Average daily h	35.1316 hot water 1	33.8541 use (litres	32.5766 /day)	31.2991	30.0216	28.7441	28.7441	30.0216	31.2991	32.5766	33.8541	35.1316 108.3675	(42c) (43)
Daily bot water	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	117.8895 186.7082	115.3727 164.2892	112.3075 172.6124	107.6458 147.3618	103.8605 139.8162	99.7908 122.7045	98.2264 118.7963	101.2784 125.4038	104.4972 128.8555	108.7697 147.5995	113.5032 161.7061	117.5837 184.1076	(44) (45)
Energy content Distribution lo	(annual) oss (46)m	= 0.15 x ((45) m							Total = S	um(45)m =	1799.9610	
Water storage :	28.0062 loss:	24.6434	25.8919	22.1043	20.9724	18.4057	17.8194	18.8106	19.3283	22.1399	24.2559	27.6161	(46)
Total storage 1	loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
lf cylinder cor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	0.0000 50.9589	46.0274	50.9589	49.3151	50.9589	49.2119	50.0551	50.9589	49.3151	50.9589	49.3151	50.9589	(59) (61)
WWHRS	237.6671	210.3166 -23 3634	223.5713 -24 4648	196.6768 -20 2578	190.7751	171.9164	168.8514	176.3627	178.1706	198.5584	211.0212	235.0665	(62) (63a)
PV diverter Solar input	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b) (63c)
FGHRS Output from w/H	0.0000 h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
-	211.2501	186.9532	199.1066	176.4190	171.8955	155.7610	153.7083	160.2595 Total pe	161.4556 er year (kW	178.8533 h/year) = S	188.6977 um(64)m =	209.1388 2153.4987	(64) (64)
12Total per yea Electric shower	ar (kWh/yea r(s)	ar)										2153	(64)
	0.0000	0.0000	0.0000	0.0000 Tot	0.0000 al Energy us	0.0000 sed by inst	0.0000 antaneous e	0.0000 lectric show	0.0000 wer(s) (kWh	0.0000 /year) = Su	0.0000 m(64a)m =	0.0000	(64a) (64a)
Heat gains from	m water nea 74.8202	66.1330	70.1334	61.3266	59.2286	53.1022	52.0135	54.4365	55.1732	61.8165	66.0960	73.9555	(65)
5. Internal gai	ins (see Ta	able 5 and	5a)										
Metabolic gains	s (Table 5)	, Watts Feb	Mar	Apr	May	.Tun		Aug	Sen	Oct	Nov	Dec	
(66)m Lighting gains	100.0958 (calculate	100.0958 ad in Appen	100.0958 dix L, equat	100.0958 tion L9 or	100.0958 L9a), also s	100.0958 see Table 5	100.0958	100.0958	100.0958	100.0958	100.0958	100.0958	(66)
Appliances gain	88.3507 ns (calcula	97.8169 ated in App	88.3507 endix L, equ	91.2958 ation L13	88.3507 or L13a), al	91.2958 lso see Tab	88.3507 le 5	88.3507	91.2958	88.3507	91.2958	88.3507	(67)
Cooking gains	174.7591 (calculated	176.5725 d in Append	172.0027 lix L, equat:	162.2740 ion L15 or	149.9934 L15a), also	138.4513 see Table	130.7404	128.9270	133.4968	143.2255	155.5061	167.0482	(68)
Pumps, fans	33.0096 3.0000	33.0096 3.0000	33.0096 3.0000	33.0096 3.0000	33.0096 3.0000	33.0096 0.0000	33.0096 0.0000	33.0096 0.0000	33.0096 0.0000	33.0096 3.0000	33.0096 3.0000	33.0096 3.0000	(69) (70)
Losses e.g. eva	aporation -80.0767	(negative v -80.0767	alues) (Tab) -80.0767	le 5) -80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	-80.0767	(71)
Water heating o	gains (Tab) 100.5648	le 5) 98.4122	94.2653	85.1758	79.6083	73.7531	69.9107	73.1673	76.6295	83.0868	91.8001	99.4026	(72)
Total internal	gains 419.7033	428.8304	410.6474	394.7743	373.9812	356.5289	342.0306	343.4738	354.4508	370.6917	394.6307	410.8303	(73)
6. Solar gains													
[Jan]			A	rea m2	Solar flux Table 62	Sneci	g fic data	Specific	FF	Acce	ss or	Gains W	
					W/m2	or '	Table 6b	or Tab	le 6c	Table	6d	64	
Northeast Southeast Southwest			5.03 4.60 3.14	300 500 400	11.2829 36.7938 36.7938		0.6300 0.6300 0.6300	0 0 0	.7000 .7000 .7000	0.77	00 00 00	17.3445 52.4002 35.3083	(75) (77) (79)

 Solar gains
 105.0530
 184.7052
 268.0244
 357.7447
 424.1157
 431.3467
 411.5787
 360.4886
 298.8472
 208.2646
 126.8784
 89.2246
 (83)

 Total gains
 524.7563
 613.5356
 678.6718
 752.5191
 798.0968
 787.8756
 753.6093
 703.9624
 653.2980
 578.9563
 521.5091
 500.0549
 (84)

7. Mean internal temperature (heating season)



Temperature d Utilisation f	uring heati actor for g	ng periods ains for li	in the livi iving area,	ng area from nil,m (see I	able 9,	Th1 (C)						21.0000	(85)
tau alpha	Jan 53.5812 4.5721	Feb 53.6932 4.5795	Mar 53.8033 4.5869	Apr 54.3269 4.6218	May 54.4260 4.6284	Jun 54.8921 4.6595	Jul 54.8921 4.6595	Aug 54.9792 4.6653	Sep 54.7116 4.6474	Oct 54.4260 4.6284	Nov 54.2259 4.6151	Dec 54.0183 4.6012	
util living a	rea 0.9909	0.9809	0.9599	0.8998	0.7779	0.5960	0.4425	0.4910	0.7293	0.9278	0.9818	0.9926	(86)
MIT Th 2 util rost of	19.6341 19.8439	19.8601 19.8460	20.1653 19.8481	20.5479 19.8579	20.8279 19.8597	20.9618 19.8683	20.9922 19.8683	20.9876 19.8698	20.9044 19.8650	20.5365 19.8597	20.0190 19.8560	19.5958 19.8522	(87) (88)
MIT 2 Living area f	0.9880 18.2886	0.9749 18.5752	0.9470 18.9571	0.8685 19.4219	0.7155 19.7243	0.5022 19.8482	0.3318 19.8660	0.3755 19.8659	0.6392 19.8057 fLA =	0.8979 19.4223 Living area	0.9749 18.7862 / (4) =	0.9902 18.2457 0.2273	(89) (90) (91)
MIT Temperature a	18.5944 diustment	18.8672	19.2317	19.6778	19.9751	20.1013	20.1220	20.1208	20.0554	19.6755	19.0664	18.5526	(92)
adjusted MIT	18.5944	18.8672	19.2317	19.6778	19.9751	20.1013	20.1220	20.1208	20.0554	19.6755	19.0664	18.5526	(93)
8. Space heat	ing require	ment											
Utilisation Useful gains Ext temp. Heat loss rat	Jan 0.9834 516.0620 4.3000 e W	Feb 0.9679 593.8681 4.9000	Mar 0.9382 636.7535 6.5000	Apr 0.8627 649.1875 8.9000	May 0.7224 576.5302 11.7000	Jun 0.5223 411.5166 14.6000	Jul 0.3571 269.0803 16.6000	Aug 0.4018 282.8439 16.4000	Sep 0.6557 428.3504 14.1000	Oct 0.8920 516.4069 10.6000	Nov 0.9684 505.0311 7.1000	Dec 0.9863 493.2152 4.2000	(94) (95) (96)
Space heating	1124.9251 kWh	1096.8812	997.8045	836.5353	641.1159	422.5966	270.5507	285.3722	458.9901	703.1258	930.5193	1120.3610	(97)
Space heating Solar heating	452.9942 requiremen kWh	338.0248 t - total p	268.6219 ber year (kW	134.8904 h/year)	48.0518	0.0000	0.0000	0.0000	0.0000	138.9189	306.3515	466.5965 2154.4499	(98a)
Solar heating Space heating	0.0000 contributi kWh	0.0000 on - total	0.0000 per year (k	0.0000 Wh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 0.0000	(98b)
Space heating Space heating	452.9942 requiremen per m2	338.0248 t after sol	268.6219 lar contribu	134.8904 tion - total	48.0518 per year	0.0000 (kWh/year)	0.0000	0.0000	0.0000	138.9189 (98c)	306.3515 / (4) =	466.5965 2154.4499 35.4817	(98c) (99)
9a. Energy re Fraction of s Fraction of s	quirements pace heat f pace heat f	- Individua rom seconda rom main sy	al heating s ary/suppleme ystem(s)	ystems, incl	uding micr 	CO-CHP .)						0.0000	(201) (202)
Efficiency of Efficiency of	main space secondary/	heating sy supplementa	ystem 2 (in ary heating	%) system, %								0.0000	(200) (207) (208)
Space heating	Jan requiremen	Feb t	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating	452.9942 efficiency	338.0248 (main heat	268.6219 ting system	134.8904	48.0518	0.0000	0.0000	0.0000	0.0000	138.9189	306.3515	466.5965	(98)
Space heating	92.4000 fuel (main	heating sy	92.4000 /stem)	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating	efficiency	(main heat	ing system	2) 0.0000	0 0000	0.0000	0.0000	0.0000	0.0000	0 0000	0 0000	0 0000	(212)
Space heating	fuel (main	heating sy	(stem 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating	fuel (seco	ndary)	0 0000	0 0000	0 0000	0.0000	0 0000	0 0000	0.0000	0 0000	0 0000	0.0000	(215)
Water heating Water heating	requiremen	t	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(210)
Efficiency of	211.2501 water heat	186.9532 er	199.1066	176.4190	171.8955	155.7610	153.7083	160.2595	161.4556	178.8533	188.6977	209.1388 80.3000	(64) (216)
(217)m Fuel for wate	85.9718 r heating,	85.6340 kWh/month	85.0237	83.8132	82.0337	80.3000	80.3000	80.3000	80.3000	83.8459	85.4132	86.0478	(217)
Space cooling	245.7204 fuel requi	218.3167 rement	234.1777	210.4908	209.5425	193.9739	191.4176	199.5760	201.0655	213.3119	220.9233	243.0495	(219)
(221)m Pumps and Fa	0.0000 7.3041	0.0000 6.5973	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	0.0000 7.0685	0.0000 7.3041	(221) (231)
Lighting Electricity g	18.3575 enerated by	14.7271 PVs (Apper	13.2601 ndix M) (neg	9.7149 ative quanti	7.5041 ty)	6.1309	6.8455	8.8980	11.5576	15.1643	17.1280	18.8678	(232)
(233a)m Electricity g	-47.6617 enerated by	-63.0269 wind turbi	-85.0883 ines (Append	-89.7398 ix M) (negat	-92.1421 ive quanti	-84.4889 .ty)	-83.4809	-81.0072	-/6.0619	-69.1641	-50.9143	-41.7198	(233a)
(234a)m Electricity g	enerated by	0.0000 hydro-elec	0.0000 ctric genera	0.0000 tors (Append	0.0000 lix M) (neg	0.0000 gative quant	0.0000 ity)	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
(235a)m Electricity u	0.0000 sed or net	0.0000 electricity	0.0000 generated i	0.0000 by micro-CHF	0.0000 (Appendix	0.0000 N) (negati	0.0000 ve if net g	0.0000 generation)	0.0000	0.0000	0.0000	0.0000	(235a)
(235c)m Electricity g	0.0000 enerated by	0.0000 PVs (Apper	0.0000 ndix M) (neg	0.0000 ative quanti	0.0000 ty)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
(233b)m Electricity g	-41.2443 enerated by	-84.5861 wind turbi	-164.2517 ines (Append	-241.3075 ix M) (negat	-314.0349 ive quanti	-313.6724 .ty)	-309.9172	-264.5977	-196.9707	-118.9876	-54.3958	-32.7763	(233b)
(234b)m Electricity g	0.0000 enerated by	0.0000 hydro-elec	0.0000 ctric genera	0.0000 tors (Append	0.0000 ix M) (neg	0.0000 gative quant	0.0000 ity)	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
(235b)m Electricity u	0.0000 sed or net	0.0000 electricity	0.0000 generated	0.0000 by micro-CHF	0.0000 (Appendix	0.0000 (N) (negati	0.0000 ve if net g	0.0000 (eneration)	0.0000	0.0000	0.0000	0.0000	(235b)
(235d)m Annual totals	0.0000 kWh/year	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Space heating Space heating Space heating	fuel - mai fuel - mai fuel - sec	n system 1 n system 2 ondary										2331.6558 0.0000 0.0000	(211) (213) (215)
EIFICIENCY of Water heating Space cooling	water heat fuel used fuel	er										80.3000 2581.5659 0.0000	(219) (221)
Electricity f Total electri Electricity f	or pumps an city for th or lighting	d fans: e above, kW (calculate	Wh/year ed in Append	ix L)								86.0000 148.1559	(231) (232)

Energy saving/generation technologies (Appendices M ,N and Q) PV generation

-3001.2381 (233)



0.0000 (234) 0.0000 (235a) 0.0000 (235)

-0.0000 (236) 0.0000 (237) 2146.1394 (238)

Wind generation Hydro-electric generation (Appendix N) Electricity generated - Micro CHP (Appendix N) Appendix Q - special features Energy saved or generated Energy used Total delivered energy for all uses

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP			
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1 Total CO2 associated with community systems	2331.6558	0.2100	489.6477 (261) 0.0000 (373)
Water heating (other fuel) Space and water heating	2581.5659	0.2100	542.1288 (264) 1031.7765 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for righting	140.1335	0.1445	21.3033 (200)
Energy saving/generation technologies PV Unit electricity used in dwelling PV Unit electricity exported	-864.4959 -2136.7423	0.1359 0.1266	-117.5193 -270.4360 -387.9553 (269)
Total CO2, kg/year EPC Target Carbon Dioxide Emission Rate (TER)			677.1340 (272) 11.1500 (273)

13a. Primary energy - Individual heating systems including micro-CHP				
	Energy Prima	Primary energy		
	kWh/year	kg CO2/kWh	kWh/year	
Space heating - main system 1	2331.6558	1.1300	2634.7710	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2581.5659	1.1300	2917.1695	(278)
Space and water heating			5551.9405	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	148.1559	1.5338	227.2464	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-864.4959	1.5025	-1298.8908	
PV Unit electricity exported	-2136.7423	0.4646	-992.7504	
Total			-2291.6412	(283)
Total Primary energy kWh/year			3617.6464	(286)
Target Primary Energy Rate (TPER)			59.5800	(287)
