EPS Group
Energy Consultancy and Compliance Services

Project No: 19167

Three Rivers District Council

Energy Statement

New Dwelling, The Woodyard, The Green, Sarratt, WD3 6BH

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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

elmhurst accredited energy assessor

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Executive Summary

This report has been commissioned in response to the Sustainable and Low Carbon Planning Policy requirements of Three Rivers District Council in respect to the proposed construction of a new dwelling at The Woodyard, The Green, Sarratt, WD3 6BH.

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

Further improvements are the proposed through the proposed installation of photovoltaic panels with a minimum output capacity of 3.40 kWp (with a 4 kW battery backup). This is initially expected to comprise of 10 x 340 W panels being installed on the south west facing pitched roof and will require approx. 17 m^2 of the roof space.

An illustrative SAP calculation for the proposed dwelling firmly demonstrates that the proposed energy strategy will result in **5.37%** less regulated carbon dioxide (CO_2) being emitted than would ordinarily be permitted under Approved Document L1 2021 of the Building Regulations.

The proposed development is therefore deemed to far exceed the mandatory planning requirements of *Policy DM4: Carbon Dioxide Emissions and On-Site Renewable Energy* of Three Rivers District Councils *Development Management Policies Local Development Document*.

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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 The Woodyard, The Green, Sarratt, WD3 6BH.

1.2 Since the planning application relates to the construction of a new dwelling, the development will need to comply with the requirements of Approved Document L1 2021 of the Building Regulations if planning is permitted.

1.3 The energy consumption of the proposed dwelling has therefore been assessed using the National Calculations Method (NCM) - SAP 10 (Standard Assessment Procedure), in order to determine the predicted annual carbon dioxide (CO_2) emissions of the development 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):

Table 1: NCM Fuel Emission Factors

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 report 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 dwelling. 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 DM4: Carbon Dioxide Emissions and On-Site Renewable Energy of Three Rivers District Councils *Development Management Policies Local Development Document* outlines the local authority's commitment to reducing the impact of new build development on climate change by requiring a reduction in carbon dioxide (CO_2) emissions beyond the mandatory requirements of the Building Regulations. This policy states:

"a) From 2013, applicants will be required to demonstrate that development will produce 5% less carbon dioxide emissions than Building Regulations Part L requirements (2013) having regard to feasibility and viability. This may be achieved through a combination of energy efficiency measures, incorporation of on-site low carbon and renewable technologies, connection to a local, decentralized, renewable or low carbon energy supply. In the event of a delay to the revision of Part L of the Building Regulations anticipated in October 2013, applicants will be required to demonstrate that development will produce 10% less carbon emissions than

required by Building Regulations Part L 2010 until such a time the revisions are made…."

2.3 Conclusions

On review of the above planning policy, it is evident that is a need to construct dwellings with an energy performance standard beyond the mandatory requirements of Approved Document Part L1A 2013 of the Building Regulations.

However, it should be noted that since the planning policy was written, central Government have subsequently updated Part L of the Building Regulations (Approved Document L1 2021). Dwellings built to the new standards are expected to produce 31% less CO_2 emissions compared to the standards set out in the 2013 Building Regulations.

In reflection of this update, it is evident that there is no longer a requirement to go beyond the minimum requirements of Approved Document L1 2021 of the Building Regulations, since the current standards already far exceed the standards targeted within the planning policy.

3.0 Proposed Energy Strategy and Performance

3.1 The widely regarded Energy Hierarchy advocates the conservation of energy by conventional measures prior to the consideration of alternative low carbon or renewable technologies. In accordance with this principle, the development will incorporate enhanced insulation standards and HVAC efficiencies as a means of reducing the overall regulated energy demand prior to considering the use of renewable technologies.

3.2 This approach will be further supplemented with the installation of a photovoltaic array with a minimum output capacity of 3.40 kWp and a 4 kW battery backup, which will provide a local source of renewable electricity for occupant use as well as a reduction in the calculated carbon dioxide emissions. The installation is initially expected to comprise of 10 x 340 W panels being installed on the south west facing pitched roof and will require approx. 17 m^2 of the roof space.

3.3 The target design parameters for the proposed dwelling are summarised within Table 2 below:

Table 2: Proposed Fabric, Lighting and HVAC Design Standards

Element / Feature	Current Approved Document L1 2021 Minimal Acceptable Standard	Proposed Development Target
External Wall U-value	0.26 W/m^2K	**0.20 W/m^2K**
Ground Floor U-value	0.18 W/m^2K	**0.12 W/m^2K**
Pitched Roof U-value	0.16 W/m^2K	**0.10 W/m^2K**
Flat Roof U-value	0.16 W/m^2K	**0.13 W/m^2K**
Windows U-value	1.60 W/m^2K	**1.20 W/m^2K**
Glazed Doors U-value	1.60 W/m^2K	**1.40 W/m^2K**
Target Air Permeability	8.00 m^3/m^2·h	**4.00 m^3/m^2.h**
Thermal Bridging	N/A	**Recognised Construction Details**
Lighting	All fixed lighting to have an efficacy of 75 lm/W	**80 lm/W**
Heating & Hot Water (Gas Combi)	Min 88% Efficient (SEDBUK 2009)	**89.60% Efficient (Ideal Logic Combi ESP 1 24 or equivalent)**
Heating Controls	Room Thermostat, Programmer & TRVs	**Independent Time and Temperature Zone Control**
Ventilation	-	**Mechanical Ventilation with Heat Recovery Unit (Nuaire MRXBOXAB-ECO2 or equivalent)**

4.0 Calculated Energy Performance (Illustrative)

4.1 A predicted SAP 10 calculation has been prepared for the proposed dwelling based upon the design specifications outlined within Section 3 of this report.

4.2 Whilst it is noted that the final performance of the proposed dwelling will vary subject to the actual 'Air Leakage Rate' achieved upon completion of the build, the results of the Illustrative SAP Calculation (DER & TER Calculation) is summarised within Table 3 below and the full calculation is provided for detailed review within the Appendix to this report:

Table 3: Illustrative Annual CO_2 Emissions (SAP 10)		
Target Emission Rate (TER)	**Dwelling Emission Rate (DER)**	**CO_2 Reduction**
8.56	8.10	**5.37%**

4.3 **Upon review of the above, it is evident that the proposed development will achieve a minimum reduction in regulated CO_2 emissions of 5.37% in comparison to the current edition of Approved Document L1 2021 of the Building Regulations.**

4.4 The calculated reduction in CO_2 emissions comfortably exceeds the mandatory planning requirement of Three Rivers District Council's *Policy DM4: Carbon Dioxide Emissions and On-Site Renewable Energy.* The development is therefore deemed to be compliant with the local authority's requirements for Low Carbon and Sustainable Development.

EPS Group
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Appendix 1:

Full SAP 10 Calculation Printout

Full SAP Calculation Printout

Property Reference	19167	**Issued on Date**	30/01/2024
Assessment Reference	Renewable	**Prop Type Ref**	EST
Property	The Woodyard, The Green, Sarratt, WD3 6BH		

SAP Rating	95 A	**DER**	8.10	**TER**	8.56
Environmental	92 A	**% DER < TER**			5.37
CO_2 Emissions (t/year)	1.21	**DFEE**	38.94	**TFEE**	40.03
Compliance Check	See BREL	**% DFEE < TFEE**			2.72
% DPER < TPER	1.82	**DPER**	44.27	**TPER**	45.09

Assessor Details	Mr. Samuel Marks	**Assessor ID**	BP82-0001
Client	19167, Collin Manning		

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.0100 (1b)	x	2.4100 (2b)	=	236.2041	(1b) - (3b)
First floor	79.2000 (1c)	x	2.5900 (2c)	=	205.1280	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	177.2100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	441.3321	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	1 * 20 =	20.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.0453	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2453	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2085	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2659	0.2606	0.2554	0.2294	0.2242	0.1981	0.1981	0.1929	0.2085	0.2242	0.2346	0.2450	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	77.4000 (23c)

Effective ac	0.3789	0.3736	0.3684	0.3424	0.3372	0.3111	0.3111	0.3059	0.3215	0.3372	0.3476	0.3580	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.20)			22.5100	1.1450	25.7748			(27)
Door (Uw = 1.40)			14.8100	1.3258	19.6345			(27)
Ground Floor			79.2000	0.1200	9.5040	75.0000	5940.0000	(28a)
External Wall	202.5000	37.3200	165.1800	0.2000	33.0360	150.0000	24777.0000	(29a)
Flat Ceiling	79.2000		79.2000	0.1000	7.9200	9.0000	712.8000	(30)
Flat Roof	18.8200		18.8200	0.1300	2.4466	9.0000	169.3800	(30)
Total net area of external elements Aum(A, m2)			379.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		98.3159			(33)
Timber 1			140.4100			9.0000	1263.6900	(32c)
Timber 2			145.3500			9.0000	1308.1500	(32c)
Block			18.4100			75.0000	1380.7500	(32c)
Internal Floor			79.2000			18.0000	1425.6000	(32d)
Internal Ceiling 1			79.2000			9.0000	712.8000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	37690.1700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		212.6865 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	23.3900	0.0150	0.3508
E3 Sill	17.3900	0.0210	0.3652
E4 Jamb	63.7600	0.0160	1.0202
E5 Ground floor (normal)	40.5000	0.1110	4.4955
E6 Intermediate floor within a dwelling	40.5000	0.0020	0.0810
E16 Corner (normal)	35.0000	0.0510	1.7850
E17 Corner (inverted - internal area greater than external area)	15.0000	-0.0910	-1.3650
E14 Flat roof	8.8500	0.0800	0.7080
E10 Eaves (insulation at ceiling level)	22.2300	0.0650	1.4450
E12 Gable (insulation at ceiling level)	17.9200	0.0970	1.7382

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.6239 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	108.9398 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.1774	54.4182	53.6590	49.8629	49.1037	45.3076	45.3076	44.5484	46.8260	49.1037	50.6221	52.1405	(38)
Heat transfer coeff	164.1172	163.3580	162.5987	158.8026	158.0434	154.2473	154.2473	153.4881	155.7658	158.0434	159.5619	161.0803	(39)
Average = Sum(39)m / 12 =												158.6128	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9261	0.9218	0.9175	0.8961	0.8918	0.8704	0.8704	0.8661	0.8790	0.8918	0.9004	0.9090	(40)
HLP (average)												0.8951	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.9721 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
83.3095	82.0576	80.2332	76.7426	74.1666	71.2938	69.6610	71.4716	73.4563	76.5407	80.1063	82.9903	(42a)

Hot water usage for baths

31.9684	31.4936	30.8250	29.5923	28.6692	27.6457	27.0928	27.7567	28.4796	29.5748	30.8330	31.8603	(42b)

Hot water usage for other uses

45.0677	43.4289	41.7901	40.1512	38.5124	36.8736	36.8736	38.5124	40.1512	41.7901	43.4289	45.0677	(42c)
Average daily hot water use (litres/day)											147.4190	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	160.3457	156.9801	152.8483	146.4861	141.3482	135.8131	133.6274	137.7407	142.0871	147.9056	154.3682	159.9184	(44)
Energy conte	253.9483	223.5375	234.9221	200.5321	190.2819	166.9981	161.6108	170.5518	175.2076	200.7065	219.9258	250.3936	(45)
Energy content (annual)										Total = Sum(45)m =		2448.6161	
Distribution loss (46)m = 0.15 x (45)m	38.0923	33.5306	35.2383	30.0798	28.5423	25.0497	24.2416	25.5828	26.2811	30.1060	32.9889	37.5590	(46)
Water storage loss:													
Total storage 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)
If cylinder contains dedicated solar storage	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)
Primary 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	(59)
Combi loss	16.6897	15.0500	16.6097	15.9613	16.4223	15.8205	16.3018	16.3394	15.8550	16.4660	16.0428	16.6747	(61)
Total heat required for water heating calculated for each month	270.6380	238.5876	251.5319	216.4935	206.7041	182.8186	177.9126	186.8912	191.0626	217.1726	235.9686	267.0683	(62)
WWHRS	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)
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	(63b)
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	(63c)
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	(63d)
Output from w/h	270.6380	238.5876	251.5319	216.4935	206.7041	182.8186	177.9126	186.8912	191.0626	217.1726	235.9686	267.0683	(64)
										Total per year (kWh/year) = Sum(64)m =		2642.8494	(64)
12Total per year (kWh/year)												2643	(64)

Electric shower(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)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000 (64a)

Heat gains from water heating, kWh/month

88.6102	78.0887	82.2640	70.6673	67.3743	59.4820	57.8110	60.7933	62.2203	70.8514	77.1360	87.4245	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	176.3943	195.2937	176.3943	182.2741	176.3943	182.2741	176.3943	176.3943	182.2741	176.3943	182.2741	176.3943	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	348.8333	352.4531	343.3313	323.9121	299.3989	276.3599	260.9685	257.3487	266.4705	285.8896	310.4029	333.4418	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	(71)
Water heating gains (Table 5)	119.0998	116.2035	110.5700	98.1490	90.5568	82.6139	77.7030	81.7114	86.4171	95.2304	107.1334	117.5061	(72)
Total internal gains	714.9095	734.5324	700.8777	674.9173	636.9322	608.8300	582.6479	583.0366	602.7438	628.0965	670.3924	697.9244	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	11.8200	11.2829	0.6300	0.7000	0.7700	40.7579	(75)
Southeast	2.0300	36.7938	0.6300	0.7000	0.7700	22.8267	(77)
Southwest	5.6700	36.7938	0.6300	0.7000	0.7700	63.7573	(79)
Northwest	2.9900	11.2829	0.6300	0.7000	0.7700	10.3102	(81)
Northeast	2.0500	11.2829	0.6300	0.7000	0.7700	7.0688	(75)

Southwest			12.7600		36.7938		0.6300		0.7000		0.7700	143.4820	(79)
Solar gains	288.2029	510.2269	749.4074	1014.5266	1214.8278	1240.5607	1181.6681	1026.9573	840.3881	577.7392	348.7173	244.3661	(83)
Total gains	1003.1124	1244.7592	1450.2851	1689.4439	1851.7600	1849.3907	1764.3160	1609.9938	1443.1319	1205.8357	1019.1098	942.2904	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	63.7928	64.0893	64.3885	65.9277	66.2444	67.8747	67.8747	68.2104	67.2130	66.2444	65.6140	64.9955	
alpha	5.2529	5.2726	5.2926	5.3952	5.4163	5.5250	5.5250	5.5474	5.4809	5.4163	5.3743	5.3330	
util living area	0.9968	0.9897	0.9691	0.8925	0.7331	0.5259	0.3835	0.4360	0.7004	0.9423	0.9917	0.9976	(86)
MIT	20.0021	20.1865	20.4270	20.7180	20.8818	20.9359	20.9427	20.9418	20.9085	20.6671	20.2876	19.9859	(87)
Th 2	20.1454	20.1490	20.1526	20.1708	20.1744	20.1927	20.1927	20.1964	20.1854	20.1744	20.1672	20.1599	(88)
util rest of house	0.9959	0.9869	0.9609	0.8669	0.6837	0.4627	0.3137	0.3611	0.6327	0.9226	0.9890	0.9970	(89)
MIT 2	18.9613	19.1990	19.5045	19.8705	20.0499	20.1159	20.1202	20.1237	20.0885	19.8216	19.3435	18.9521	(90)
Living area fraction										fLA = Living area / (4) =		0.3355	(91)
MIT	19.3105	19.5303	19.8140	20.1548	20.3290	20.3910	20.3962	20.3982	20.3636	20.1052	19.6602	19.2989	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1605	19.3803	19.6640	20.0048	20.1790	20.2410	20.2462	20.2482	20.2136	19.9552	19.5102	19.1489	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9944	0.9837	0.9550	0.8611	0.6840	0.4666	0.3184	0.3660	0.6352	0.9162	0.9861	0.9959	(94)
Useful gains	997.5383	1224.4217	1385.0619	1454.8476	1266.5912	862.9040	561.7176	589.2111	916.6999	1104.8102	1004.9777	938.4296	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2438.8602	2365.4690	2140.4482	1763.4733	1340.0451	870.1058	562.4099	590.6486	952.2876	1478.5351	1980.1989	2407.9748	(97)
Space heating kWh	1072.3436	766.7837	562.0074	222.2105	54.6497	0.0000	0.0000	0.0000	0.0000	278.0513	702.1593	1093.3416	(98a)
Space heating requirement - total per year (kWh/year)												4751.5470	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1072.3436	766.7837	562.0074	222.2105	54.6497	0.0000	0.0000	0.0000	0.0000	278.0513	702.1593	1093.3416	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4751.5470	
Space heating per m2											(98c) / (4) =	26.8131	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Efficiency of main space heating system 1 (in %)	89.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1072.3436	766.7837	562.0074	222.2105	54.6497	0.0000	0.0000	0.0000	0.0000	278.0513	702.1593	1093.3416	(98)
Space heating efficiency (main heating system 1)	89.0000	89.0000	89.0000	89.0000	89.0000	0.0000	0.0000	0.0000	0.0000	89.0000	89.0000	89.0000	(210)
Space heating fuel (main heating system)	1084.3924	775.3993	568.3221	224.7072	55.2637	0.0000	0.0000	0.0000	0.0000	281.1755	710.0487	1105.6263	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	164.9759	117.9667	86.4627	34.1862	8.4076	0.0000	0.0000	0.0000	0.0000	42.7771	108.0245	168.2064	(215)
Water heating													
Water heating requirement	270.6380	238.5876	251.5319	216.4935	206.7041	182.8186	177.9126	186.8912	191.0626	217.1726	235.9686	267.0683	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.6220	88.5570	88.4281	88.1081	87.6217	87.3000	87.3000	87.3000	87.3000	88.2020	88.5313	88.6316	(217)
Fuel for water heating, kWh/month	305.3845	269.4170	284.4479	245.7134	235.9052	209.4142	203.7945	214.0792	218.8575	246.2219	266.5369	301.3241	(219)
Space cooling fuel requirement													
(221)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	(221)
Pumps and Fa	57.1033	51.5772	57.1033	55.2612	57.1033	55.2612	57.1033	57.1033	55.2612	57.1033	55.2612	57.1033	(231)
Lighting	36.6512	29.4030	26.4741	19.3961	14.9821	12.2405	13.6672	17.7651	23.0751	30.2758	34.1964	37.6699	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-67.4302	-106.9937	-171.0563	-209.2726	-236.7635	-224.7981	-222.0602	-204.5374	-173.1217	-130.7707	-78.1290	-56.7129	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)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	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(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 used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)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	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-7.5083	-21.4735	-55.3343	-102.7498	-154.4129	-161.6830	-158.5465	-124.5443	-78.8543	-35.6668	-11.4679	-5.5000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)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	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(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)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)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	(235d)

Annual totals kWh/year

Space heating fuel - main system 1	4804.9352	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	731.0072	(215)
Efficiency of water heater	87.3000	
Water heating fuel used	3001.0963	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 1.0890)		
mechanical ventilation fans (SFP = 1.0890)	586.3450	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	672.3450	(231)
Electricity for lighting (calculated in Appendix L)	295.7966	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2799.3879	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	6705.7924	(238)

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	4804.9352	0.2100	1009.0364	(261)
Total CO2 associated with community systems			0.0000	(373)
Space heating - secondary	731.0072	0.0280	20.4682	(263)
Water heating (other fuel)	3001.0963	0.2100	630.2302	(264)
Space and water heating			1659.7348	(265)
Pumps, fans and electric keep-hot	672.3450	0.1387	93.2625	(267)
Energy for lighting	295.7966	0.1443	42.6926	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1881.6465	0.1328	-249.9405	
PV Unit electricity exported	-917.7414	0.1207	-110.7999	
Total			-360.7404	(269)
Total CO2, kg/year			1434.9495	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			8.1000	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4804.9352	1.1300	5429.5768	(275)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	731.0072	1.0460	764.6336	(277)
Water heating (other fuel)	3001.0963	1.1300	3391.2388	(278)
Space and water heating			9585.4492	(279)
Pumps, fans and electric keep-hot	672.3450	1.5128	1017.1235	(281)
Energy for lighting	295.7966	1.5338	453.7026	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1881.6465	1.4908	-2805.2104	
PV Unit electricity exported	-917.7414	0.4429	-406.4830	
Total			-3211.6933	(283)
Total Primary energy kWh/year			7844.5820	(286)
Dwelling Primary energy Rate (DPER)			44.2700	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.0100 (1b)	x	2.4100 (2b)	=	236.2041	(1b) - (3b)
First floor	79.2000 (1c)	x	2.5900 (2c)	=	205.1280	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 177.2100						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	441.3321	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0906	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3406	(18)
Number of sides sheltered		2	(19)

Shelter factor								(20) = 1 - [0.075 x (19)] =				0.8500	(20)
Infiltration rate adjusted to include shelter factor								(21) = (18) x (20) =				0.2895	(21)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3692	0.3619	0.3547	0.3185	0.3113	0.2751	0.2751	0.2678	0.2895	0.3113	0.3257	0.3402	(22b)
Effective ac	0.5681	0.5655	0.5629	0.5507	0.5484	0.5378	0.5378	0.5359	0.5419	0.5484	0.5531	0.5579	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			37.3200	1.1450	42.7328			(27)
Ground Floor			79.2000	0.1300	10.2960			(28a)
External Wall	202.5000	37.3200	165.1800	0.1800	29.7324			(29a)
Flat Ceiling	79.2000		79.2000	0.1100	8.7120			(30)
Flat Roof	18.8200		18.8200	0.1100	2.0702			(30)
Total net area of external elements Aum(A, m2)			379.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		93.5434			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 212.6865 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	23.3900	0.0500	1.1695
E3 Sill	17.3900	0.0500	0.8695
E4 Jamb	63.7600	0.0500	3.1880
E5 Ground floor (normal)	40.5000	0.1600	6.4800
E6 Intermediate floor within a dwelling	40.5000	0.0000	0.0000
E16 Corner (normal)	35.0000	0.0900	3.1500
E17 Corner (inverted - internal area greater than external area)	15.0000	-0.0900	-1.3500
E14 Flat roof	8.8500	0.0800	0.7080
E10 Eaves (insulation at ceiling level)	22.2300	0.0600	1.3338
E12 Gable (insulation at ceiling level)	17.9200	0.0600	1.0752

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		16.6240	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	110.1674	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	82.7438	82.3584	81.9807	80.2065	79.8746	78.3293	78.3293	78.0431	78.9245	79.8746	80.5461	81.2481	(38)
Heat transfer coeff	192.9112	192.5258	192.1481	190.3739	190.0420	188.4967	188.4967	188.2106	189.0919	190.0420	190.7135	191.4155	(39)
Average = Sum(39)m / 12 =												190.3723	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0886	1.0864	1.0843	1.0743	1.0724	1.0637	1.0637	1.0621	1.0671	1.0724	1.0762	1.0802	(40)
HLP (average)												1.0743	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9721	(42)
Hot water usage for mixer showers	74.0529	72.9401	71.3184	68.2156	65.9258	63.3723	61.9209	63.5303	65.2945	68.0362	71.2056	73.7692	(42a)
Hot water usage for baths	31.9684	31.4936	30.8250	29.5923	28.6692	27.6457	27.0928	27.7567	28.4796	29.5748	30.8330	31.8603	(42b)
Hot water usage for other uses	45.0677	43.4289	41.7901	40.1512	38.5124	36.8736	36.8736	38.5124	40.1512	41.7901	43.4289	45.0677	(42c)
Average daily hot water use (litres/day)												138.8847	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.0891	147.8626	143.9335	137.9591	133.1075	127.8916	125.8873	129.7994	133.9253	139.4011	145.4675	150.6972	(44)
Energy conte	239.2881	210.5543	221.2204	188.8592	179.1883	157.2576	152.2498	160.7188	165.1433	189.1660	207.2451	235.9555	(45)
Energy content (annual)										Total = Sum(45)m =		2306.8463	
Distribution loss (46)m = 0.15 x (45)m	35.8932	31.5832	33.1831	28.3289	26.8782	23.5886	22.8375	24.1078	24.7715	28.3749	31.0868	35.3933	(46)
Water storage loss:													
Total storage 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)
If cylinder contains dedicated solar storage	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)
Primary 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	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	290.2470	256.5817	272.1793	238.1742	230.1472	206.5727	203.2087	211.6777	214.4584	240.1249	256.5602	286.9144	(62)
WWHRS	-33.8539	-29.9407	-31.3521	-25.9608	-24.1945	-20.7034	-19.4062	-20.6365	-21.4206	-25.2525	-28.6080	-33.2270	(63a)
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	(63b)
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	(63c)
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	(63d)
Output from w/h	256.3931	226.6411	240.8272	212.2134	205.9526	185.8692	183.8025	191.0412	193.0378	214.8724	227.9521	253.6874	(64)
										Total per year (kWh/year) = Sum(64)m =		2592.2900	(64)
12Total per year (kWh/year)												2592	(64)
Electric shower(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)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	92.3030	81.5162	86.2955	75.1244	72.3198	64.6169	63.3628	66.1787	67.2389	75.6374	81.2378	91.1949	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	148.6072	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	176.3943	195.2937	176.3943	182.2741	176.3943	182.2741	176.3943	176.3943	182.2741	176.3943	182.2741	176.3943	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													

	348.8333	352.4531	343.3313	323.9121	299.3989	276.3599	260.9685	257.3487	266.4705	285.8896	310.4029	333.4418	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	37.8607	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	-118.8857	(71)
Water heating gains (Table 5)													
	124.0632	121.3038	115.9886	104.3395	97.2041	89.7457	85.1650	88.9499	93.3874	101.6632	112.8302	122.5738	(72)
Total internal gains													
	719.8729	739.6327	706.2963	681.1079	643.5794	615.9619	590.1099	590.2750	609.7141	634.5292	676.0893	702.9921	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	13.8700	11.2829	0.6300	0.7000	0.7700	47.8267	(75)
Southeast	2.0300	36.7938	0.6300	0.7000	0.7700	22.8267	(77)
Southwest	18.4300	36.7938	0.6300	0.7000	0.7700	207.2393	(79)
Northwest	2.9900	11.2829	0.6300	0.7000	0.7700	10.3102	(81)

Solar gains	288.2029	510.2269	749.4074	1014.5266	1214.8278	1240.5607	1181.6681	1026.9573	840.3881	577.7392	348.7173	244.3661	(83)
Total gains	1008.0758	1249.8596	1455.7037	1695.6344	1858.4072	1856.5226	1771.7781	1617.2323	1450.1022	1212.2685	1024.8066	947.3581	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.2710	54.3797	54.4866	54.9944	55.0904	55.5420	55.5420	55.6265	55.3672	55.0904	54.8964	54.6951	
alpha	4.6181	4.6253	4.6324	4.6663	4.6727	4.7028	4.7028	4.7084	4.6911	4.6727	4.6598	4.6463	
util living area													
	0.9968	0.9910	0.9758	0.9233	0.8024	0.6170	0.4610	0.5218	0.7781	0.9580	0.9926	0.9976	(86)
MIT	19.4601	19.7066	20.0505	20.4859	20.8075	20.9575	20.9912	20.9847	20.8769	20.4319	19.8622	19.4199	(87)
Th 2	20.0102	20.0119	20.0137	20.0219	20.0234	20.0306	20.0306	20.0319	20.0278	20.0234	20.0203	20.0171	(88)
util rest of house													
	0.9959	0.9884	0.9687	0.9013	0.7516	0.5358	0.3629	0.4184	0.7048	0.9414	0.9901	0.9969	(89)
MIT 2	18.2036	18.5191	18.9551	19.4953	19.8579	20.0047	20.0274	20.0257	19.9393	19.4424	18.7250	18.1569	(90)
Living area fraction										fLA = Living area / (4) =		0.3355	(91)
MIT	18.6251	18.9175	19.3226	19.8276	20.1765	20.3243	20.3507	20.3475	20.2539	19.7744	19.1065	18.5806	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6251	18.9175	19.3226	19.8276	20.1765	20.3243	20.3507	20.3475	20.2539	19.7744	19.1065	18.5806	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9939	0.9845	0.9623	0.8962	0.7602	0.5613	0.3958	0.4529	0.7234	0.9361	0.9868	0.9954	(94)
Useful gains	1001.9751	1230.5286	1400.8380	1519.6062	1412.8342	1042.1357	701.3196	732.5215	1049.0182	1134.8031	1011.2997	942.9729	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2763.4754	2698.7300	2463.8369	2080.3302	1610.8882	1079.0206	706.9977	742.9551	1163.6450	1743.5156	2289.8100	2752.6678	(97)
Space heating kWh													
	1310.5562	986.6313	790.8712	403.7213	147.3522	0.0000	0.0000	0.0000	0.0000	452.8821	920.5274	1346.4130	(98a)
Space heating requirement - total per year (kWh/year)												6358.9548	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	1310.5562	986.6313	790.8712	403.7213	147.3522	0.0000	0.0000	0.0000	0.0000	452.8821	920.5274	1346.4130	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6358.9548	
Space heating per m2										(98c) / (4) =		35.8837	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1310.5562	986.6313	790.8712	403.7213	147.3522	0.0000	0.0000	0.0000	0.0000	452.8821	920.5274	1346.4130	(98)
Space heating efficiency (main heating system 1)													
	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)													
	1418.3509	1067.7828	855.9212	436.9278	159.4721	0.0000	0.0000	0.0000	0.0000	490.1322	996.2418	1457.1570	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	256.3931	226.6411	240.8272	212.2134	205.9526	185.8692	183.8025	191.0412	193.0378	214.8724	227.9521	253.6874	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.3689	87.1563	86.7317	85.7364	83.6760	80.3000	80.3000	80.3000	80.3000	85.9384	87.0496	87.4157	(217)
Fuel for water heating, kWh/month													
	293.4603	260.0397	277.6691	247.5186	246.1310	231.4686	228.8948	237.9093	240.3958	250.0308	261.8647	290.2081	(219)
Space cooling fuel requirement													
(221)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	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	36.6512	29.4030	26.4741	19.3961	14.9821	12.2405	13.6672	17.7651	23.0751	30.2758	34.1964	37.6699	(232)

Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-80.9333	-109.0234	-149.7635	-160.5864	-166.7177	-153.1678	-151.0257	-145.4840	-135.1114	-120.5815	-87.0401	-70.5601 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)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 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(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 used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)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 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-62.5726	-129.2433	-252.7038	-373.7670	-488.9050	-489.5163	-483.9702	-412.3674	-305.5989	-183.1198	-82.9441	-49.6864 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)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 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(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)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)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 (235d)

Annual totals kWh/year		
Space heating fuel - main system 1	6881.9857	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.3000	
Water heating fuel used	3065.5905	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	295.7966	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4844.3898	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	5484.9830	(238)

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	6881.9857	0.2100	1445.2170	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3065.5905	0.2100	643.7740	(264)
Space and water heating			2088.9910	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	295.7966	0.1443	42.6926	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1529.9950	0.1356	-207.4855	
PV Unit electricity exported	-3314.3948	0.1263	-418.7551	
Total			-626.2406	(269)
Total CO2, kg/year			1517.3723	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.5600	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	6881.9857	1.1300	7776.6438	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3065.5905	1.1300	3464.1173	(278)
Space and water heating			11240.7611	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	295.7966	1.5338	453.7026	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1529.9950	1.5013	-2296.9130	
PV Unit electricity exported	-3314.3948	0.4638	-1537.1829	
Total			-3834.0959	(283)
Total Primary energy kWh/year			7990.4687	(286)
Target Primary Energy Rate (TPER)			45.0900	(287)