EPS Group
Energy Consultancy and Compliance Services

Project No: 18234

Three Rivers District Council

Energy Statement

New Replacement Dwelling, 2 Brookdene Avenue, Watford, WD19 4LF

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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

elmhurst energy APPROVED AIR TIGHTNESS SCHEME MEMBER

SAP

Constructionline Part of Capita plc

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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 replacement dwelling at 2 Brookdene Avenue, Watford, WD19 4LF.

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 energy savings will be achieved through the proposed installation of an MCS Approved Air Source Heat Pump with underfloor zoned heating as a means of providing a decentralised source of low carbon heating and hot water within the dwelling.

An illustrative SAP calculation for the proposed dwelling firmly demonstrates that the proposed energy strategy will result in **53.09%** 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 replacement dwelling at 2 Brookdene Avenue, Watford, WD19 4LF.

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:

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.

Planning for climate change

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 an MCS Approved Air Source Heat Pump with underfloor zoned heating to the basement and ground floors and radiators on the first and second floors as a means of providing a decentralised source of low carbon heating and hot water within the dwelling.

3.3 The target design parameters for the proposed development 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 Masonry Wall U-value	0.26 W/m^{2}K	**0.18 W/m^{2}K**
External Timber Frame Wall U-value	0.26 W/m^{2}K	**0.18 W/m^{2}K**
Basement Floor U-value	0.18 W/m^{2}K	**0.13 W/m^{2}K**
Roof Insulated at Rafters U-value	0.16 W/m^{2}K	**0.11 W/m^{2}K**
Roof Insulated at Joists U-value	0.16 W/m^{2}K	**0.11 W/m^{2}K**
Flat Roof U-value	0.16 W/m^{2}K	**0.11 W/m^{2}K**
Glazing U-value	1.60 W/m^{2}K	**1.40 W/m^{2}K**
Rooflight U-value	2.20 W/m^{2}K	**1.70 W/m^{2}K**
Roof Window U-value	1.60 W/m^{2}K	**1.40 W/m^{2}K**
Target Air Permeability	8.00 m^3/m^2·h	**5.00 m^3/m^2.h**
Thermal Bridging	N/A	**Use of Building Alliance Recognised Construction Details**
Lighting	All fixed lighting to have an efficacy of 75 lm/W	**80 lm/W**
Heating & Hot Water	-	**MCS Approved Air Source Heat Pump to Zoned Underfloor Heating and Radiators**

Hot Water	-	**210 litre storage cylinder with a declared heat loss of 2.30 kWh/day or less & Electric Showers (9.3kW)**
Heating Controls	Independent Time and Temperature Zone Control	**Independent Time and Temperature Zone Control**
Ventilation	-	**D-MEV Extract System (Vent Axia Lo-Carbon NBR dMEV C 100 HT)**

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 and the exact model of Air Source Heat Pump installed, the result of the Illustrative SAP Calculation (DER & TER Calculation) is summarised within Table 3 below with the full calculation provided for detailed review within Appendix 1:

Table 3: Illustrative Annual CO_2 Emissions (SAP 10)		
Target Emission Rate (TER)	**Dwelling Emission Rate (DER)**	**CO_2 Reduction**
6.14	2.88	**53.09**

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 53.09% in comparison to the current edition of Approved Document L1 2021 of the Building Regulations.**

4.4 The calculated reduction in CO_2 emissions therefore comfortably exceeds the mandatory planning requirement of Three Rivers District Council's *Policy DM4: Carbon Dioxide Emissions and On-Site Renewable Energy.* In the circumstances, the development is 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	19557	**Issued on Date**	27/03/2024
Assessment Reference	00001	**Prop Type Ref**	
Property			

SAP Rating	84 B	**DER**	2.88	**TER**	6.14
Environmental	97 A	**% DER < TER**			53.09
CO_2 Emissions (t/year)	1.11	**DFEE**	32.62	**TFEE**	32.71
Compliance Check	See BREL	**% DFEE < TFEE**			0.29
% DPER < TPER	7.75	**DPER**	29.79	**TPER**	32.29

Assessor Details	Mr. Kian Donoghue	**Assessor ID**	CR84-0001
Client			

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)	
Basement floor	144.5300 (1a)	x	2.4000 (2a)	=	346.8720	(1a) - (3a)
Ground floor	144.5300 (1b)	x	2.6000 (2b)	=	375.7780	(1b) - (3b)
First floor	88.0900 (1c)	x	2.6500 (2c)	=	233.4385	(1c) - (3c)
Second floor	56.4400 (1d)	x	1.9100 (2d)	=	107.8004	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	433.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	1063.8889	(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	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	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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2313	(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	0.2948	0.2891	0.2833	0.2544	0.2486	0.2197	0.2197	0.2139	0.2313	0.2486	0.2602	0.2717	(22b)

Mechanical extract ventilation - decentralised

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5448	0.5391	0.5333	0.5044	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5102	0.5217	(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)			49.0200	1.1450	56.1298			(27)
door			1.8500	1.0000	1.8500			(26)
rooflights			7.9800	1.5918	12.7022			(27a)
NW roof windows			1.2800	1.1450	1.4656			(27a)
SE roof window			0.5300	1.1450	0.6069			(27a)
Heatloss Floor			144.5400	0.1300	18.7902	75.0000	10840.5000	(28a)
Masonry External Wall	182.4200	49.6600	132.7600	0.1800	23.8968	110.0000	14603.6000	(29a)
Timber External Wall	124.0600	1.2100	122.8500	0.1800	22.1130	9.0000	1105.6500	(29a)
stud walls to loft (0.72*roof)	24.6300		24.6300	0.0800	1.9704	9.0000	221.6700	(29a)
Sloped Roof	73.6800	1.8100	71.8700	0.1100	7.9057	9.0000	646.8300	(30)
Flat Roof	56.4500	7.9800	48.4700	0.1100	5.3317	9.0000	436.2300	(30)
sloped roof, flat ceiling	5.3800		5.3800	0.1100	0.5918	9.0000	48.4200	(30)
ceiling to loft (0.72*roof)	26.2800		26.2800	0.0800	2.1024	9.0000	236.5200	(30)

Total net area of external elements Aum(A, m2)	637.4400		(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) = 155.4565		(33)
Internal Floor 1	144.5300	18.0000 2601.5400	(32d)
Internal Floor 2	88.0900	18.0000 1585.6200	(32d)
Internal Floor 3	56.4400	18.0000 1015.9200	(32d)
Internal Ceiling	144.5300	9.0000 1300.7700	(32e)
Internal Ceiling 2	88.0900	9.0000 792.8100	(32e)
Internal Ceiling 3	82.7100	9.0000 744.3900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 36180.4700	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	83.4440	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	32.0000	0.0170	0.5440
E3 Sill	31.1000	0.0220	0.6842
E4 Jamb	48.9000	0.0170	0.8313
R1 Head of roof window	2.4000	0.1070	0.2568
R2 Sill of roof window	2.4000	0.1060	0.2544
R3 Jamb of roof window	4.5000	0.0780	0.3510
R11 Upstands or kerbs of rooflights	0.8800	0.2400	0.2112
E4 Jamb	2.2000	0.0310	0.0682
E2 Other lintels (including other steel lintels)	1.1000	0.0370	0.0407
E3 Sill	1.1000	0.0330	0.0363
E22 Basement floor	55.9000	0.2200	12.2980
E6 Intermediate floor within a dwelling	55.9000	0.0010	0.0559
E6 Intermediate floor within a dwelling	46.6800	0.0650	3.0342
E10 Eaves (insulation at ceiling level)	2.5000	0.0430	0.1075
E12 Gable (insulation at ceiling level)	4.3000	0.0510	0.2193
E11 Eaves (insulation at rafter level)	23.3000	0.0180	0.4194
E13 Gable (insulation at rafter level)	18.5400	0.0360	0.6674
E14 Flat roof	23.0000	0.1600	3.6800
E16 Corner (normal)	13.2500	0.0380	0.5035
E16 Corner (normal)	15.4000	0.0460	0.7084
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0880	-0.4400
E17 Corner (inverted - internal area greater than external area)	2.6500	-0.0290	-0.0769
R8 Roof to wall (rafter)	23.3000	0.0200	0.4660

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	24.9209	(36)
Point Thermal bridges	(36a) = 0.0000	
Total fabric heat loss	(33) + (36) + (36a) = 180.3774	(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	191.2856	189.2559	187.2262	177.0777	175.5417	175.5417	175.5417	175.5417	175.5417	175.5417	179.1074	183.1668	(38)
Heat transfer coeff	371.6630	369.6333	367.6036	357.4551	355.9191	355.9191	355.9191	355.9191	355.9191	355.9191	359.4848	363.5442	(39)
Average = Sum(39)m / 12 =												360.4082	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8572	0.8525	0.8478	0.8244	0.8209	0.8209	0.8209	0.8209	0.8209	0.8209	0.8291	0.8385	(40)
HLP (average)												0.8312	
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	3.3056	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

34.3727	33.8622	33.1434	31.8179	30.8254	29.7249	29.1305	29.8443	30.6215	31.7991	33.1519	34.2565	(42b)

Hot water usage for other uses

48.4826	46.7196	44.9566	43.1936	41.4306	39.6676	39.6676	41.4306	43.1936	44.9566	46.7196	48.4826	(42c)

Average daily hot water use (litres/day)	75.9440	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	82.8553	80.5819	78.1000	75.0115	72.2560	69.3925	68.7981	71.2749	73.8151	76.7557	79.8715	82.7391	(44)
Energy conte	131.2226	114.7475	120.0368	102.6870	97.2705	85.3262	83.2053	88.2532	91.0215	104.1568	113.7916	129.5495	(45)
Energy content (annual)											Total = Sum(45)m =	1261.2684	

Distribution loss (46)m = 0.15 x (45)m

19.6834	17.2121	18.0055	15.4031	14.5906	12.7989	12.4808	13.2380	13.6532	15.6235	17.0687	19.4324	(46)

Water storage loss:		
Store volume	210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	2.3000	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	1.2420	(55)

Total storage loss

38.5020	34.7760	38.5020	37.2600	38.5020	37.2600	38.5020	38.5020	37.2600	38.5020	37.2600	38.5020	(56)

If cylinder contains dedicated solar storage

38.5020	34.7760	38.5020	37.2600	38.5020	37.2600	38.5020	38.5020	37.2600	38.5020	37.2600	38.5020	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi 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	(61)

Total heat required for water heating calculated for each month

192.9870	170.5347	181.8012	162.4590	159.0349	145.0982	144.9697	150.0176	150.7935	165.9212	173.5636	191.3139	(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

192.9870	170.5347	181.8012	162.4590	159.0349	145.0982	144.9697	150.0176	150.7935	165.9212	173.5636	191.3139	(64)
									Total per year (kWh/year) = Sum(64)m =		1988.4944	(64)
12Total per year (kWh/year)											1988	(64)

Electric shower(s)

63.7815	56.8299	62.0560	59.2193	60.3305	57.5495	59.4678	60.3305	59.2193	62.0560	60.8891	63.7815	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 725.5111 (64a)

Heat gains from water heating, kWh/month

108.9884	96.9908	104.8378	96.7659	96.8366	90.5759	91.9442	93.8384	92.8871	99.5577	100.8756	108.4321	(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	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	(66)

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

302.4695	334.8769	302.4695	312.5518	302.4695	312.5518	302.4695	302.4695	312.5518	302.4695	312.5518	302.4695	(67)

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

	559.2024	565.0052	550.3824	519.2522	479.9559	443.0229	418.3494	412.5467	427.1695	458.2997	497.5960	534.5289	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	(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)													
	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	(71)
Water heating gains (Table 5)													
	146.4898	144.3315	140.9110	134.3970	130.1567	125.7999	123.5810	126.1268	129.0098	133.8141	140.1050	145.7421	(72)
Total internal gains													
	1083.7457	1119.7976	1069.3468	1041.7850	988.1660	953.9586	916.9838	913.7269	941.3150	970.1672	1025.8367	1058.3244	(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	12.3100	11.2829	0.6300	0.7000	0.7700	42.4475	(75)
Southeast	1.2100	36.7938	0.6300	0.7000	0.7700	13.6061	(77)
Southwest	32.1300	36.7938	0.6300	0.7000	0.7700	361.2914	(79)
Northwest	3.3700	11.2829	0.6300	0.7000	0.7700	11.6205	(81)
Southwest	7.9800	26.0000	0.6300	0.7000	1.0000	82.3488	(82)
Southeast	0.5300	39.2172	0.6300	0.7000	1.0000	8.2496	(82)
Northwest	1.2800	16.8560	0.6300	0.7000	1.0000	8.5634	(82)

Solar gains	528.1272	952.7559	1432.7523	1972.0366	2374.2131	2425.9785	2310.4952	2002.4318	1619.5704	1088.9846	642.5477	445.3554	(83)
Total gains	1611.8729	2072.5535	2502.0991	3013.8216	3362.3792	3379.9371	3227.4790	2916.1587	2560.8854	2059.1518	1668.3844	1503.6798	(84)

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7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	27.0410	27.1895	27.3396	28.1158	28.2371	28.2371	28.2371	28.2371	28.2371	28.2371	27.9570	27.6449	
alpha	2.8027	2.8126	2.8226	2.8744	2.8825	2.8825	2.8825	2.8825	2.8825	2.8825	2.8638	2.8430	
util living area													
	0.9830	0.9658	0.9336	0.8575	0.7366	0.5841	0.4522	0.5093	0.7267	0.9088	0.9708	0.9859	(86)
MIT	18.8499	19.1438	19.5639	20.1136	20.5197	20.7573	20.8457	20.8253	20.6267	20.0726	19.3835	18.8335	(87)
Th 2	20.2041	20.2081	20.2121	20.2322	20.2353	20.2353	20.2353	20.2353	20.2353	20.2353	20.2282	20.2201	(88)
util rest of house													
	0.9808	0.9616	0.9251	0.8396	0.7037	0.5317	0.3832	0.4386	0.6807	0.8935	0.9665	0.9841	(89)
MIT 2	17.6106	17.9874	18.5221	19.2215	19.7120	19.9786	20.0658	20.0493	19.8452	19.1837	18.3089	17.6005	(90)
Living area fraction									fLA = Living area / (4) =			0.0736	(91)
MIT	17.7018	18.0725	18.5988	19.2871	19.7714	20.0359	20.1231	20.1063	19.9027	19.2491	18.3880	17.6912	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7018	18.0725	18.5988	19.2871	19.7714	20.0359	20.1231	20.1063	19.9027	19.2491	18.3880	17.6912	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9710	0.9459	0.9030	0.8135	0.6815	0.5171	0.3725	0.4260	0.6582	0.8685	0.9523	0.9757	(94)
Useful gains	1565.0743	1960.4968	2259.3673	2451.8210	2291.4632	1747.6069	1202.3858	1242.2155	1685.5042	1788.4026	1588.7482	1467.1157	(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													
	4980.9562	4868.9857	4447.5455	3712.9254	2872.7639	1934.7318	1253.9525	1319.1595	2065.2901	3078.3956	4057.8538	4904.6376	(97)
Space heating kWh													
	2541.4161	1954.5046	1628.0046	907.9952	432.4878	0.0000	0.0000	0.0000	0.0000	959.7548	1777.7560	2557.5164	(98a)
Space heating requirement - total per year (kWh/year)												12759.4355	
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													
	2541.4161	1954.5046	1628.0046	907.9952	432.4878	0.0000	0.0000	0.0000	0.0000	959.7548	1777.7560	2557.5164	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												12759.4355	
Space heating per m2											(98c) / (4) =	29.4274	(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 %) 219.3000 (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													
	2541.4161	1954.5046	1628.0046	907.9952	432.4878	0.0000	0.0000	0.0000	0.0000	959.7548	1777.7560	2557.5164	(98)
Space heating efficiency (main heating system 1)													
	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)													
	1158.8765	891.2469	742.3642	414.0425	197.2128	0.0000	0.0000	0.0000	0.0000	437.6447	810.6503	1166.2181	(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													
	192.9870	170.5347	181.8012	162.4590	159.0349	145.0982	144.9697	150.0176	150.7935	165.9212	173.5636	191.3139	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month													
	101.3587	89.5665	95.4838	85.3251	83.5267	76.2070	76.1395	78.7908	79.1982	87.1435	91.1573	100.4800	(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	16.4213	14.8322	16.4213	15.8916	16.4213	15.8916	16.4213	16.4213	15.8916	16.4213	15.8916	16.4213	(231)
Lighting	62.8472	50.4183	45.3961	33.2591	25.6903	20.9892	23.4356	30.4624	39.5677	51.9150	58.6378	64.5939	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)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	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	5818.2560	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.4000	
Water heating fuel used	1044.3773	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 12.6620, total flow = 85.0000, SFP = 0.1490)		
mechanical ventilation fans (SFP = 0.1490)	193.3479	(230a)
Total electricity for the above, kWh/year	193.3479	(231)
Electricity for lighting (calculated in Appendix L)	507.2128	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(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	8288.7052	(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	5818.2560	0.1551	902.3397	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1044.3773	0.1405	146.7658	(264)
Energy for instantaneous electric shower(s)	725.5111	0.1391	100.9346	(264a)
Space and water heating			1049.1054	(265)
Pumps, fans and electric keep-hot	193.3479	0.1387	26.8197	(267)
Energy for lighting	507.2128	0.1443	73.2065	(268)
Total CO2, kg/year			1250.0663	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.8800	(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	5818.2560	1.5742	9158.8687	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1044.3773	1.5196	1587.0440	(278)
Energy for instantaneous electric shower(s)	725.5111	1.5143	1098.6663	(278a)
Space and water heating			10745.9126	(279)
Pumps, fans and electric keep-hot	193.3479	1.5128	292.4967	(281)
Energy for lighting	507.2128	1.5338	777.9799	(282)
Total Primary energy kWh/year			12915.0555	(286)
Dwelling Primary energy Rate (DPER)			29.7900	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	144.5300 (1a)	x	2.4000 (2a)	=	346.8720	(1a) - (3a)
Ground floor	144.5300 (1b)	x	2.6000 (2b)	=	375.7780	(1b) - (3b)
First floor	88.0900 (1c)	x	2.6500 (2c)	=	233.4385	(1c) - (3c)
Second floor	56.4400 (1d)	x	1.9100 (2d)	=	107.8004	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	433.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	1063.8889	(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	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) =	0.0376	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2876	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2660	(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	0.3392	0.3325	0.3259	0.2926	0.2860	0.2527	0.2527	0.2461	0.2660	0.2860	0.2993	0.3126	(22b)
Effective ac	0.5575	0.5553	0.5531	0.5428	0.5409	0.5319	0.5319	0.5303	0.5354	0.5409	0.5448	0.5489	(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	
TER Opaque door			1.8500	1.0000	1.8500			(26)
TER Opening Type (Uw = 1.20)			49.0200	1.1450	56.1298			(27)
NW roof windows			1.2800	1.5038	1.9248			(27a)
SE roof window			0.5300	1.5038	0.7970			(27a)
rooflights			7.9800	2.0221	16.1360			(27a)
Heatloss Floor			144.5400	0.1300	18.7902			(28a)
Masonry External Wall	182.4200	49.6600	132.7600	0.1800	23.8968			(29a)
Timber External Wall	124.0600	1.2100	122.8500	0.1800	22.1130			(29a)
stud walls to loft (0.72*roof)	24.6300		24.6300	0.1800	4.4334			(29a)
Sloped Roof	73.6800	1.8100	71.8700	0.1100	7.9057			(30)
Flat Roof	56.4500	7.9800	48.4700	0.1100	5.3317			(30)
sloped roof, flat ceiling	5.3800		5.3800	0.1100	0.5918			(30)
ceiling to loft (0.72*roof)	26.2800		26.2800	0.1100	2.8908			(30)
Total net area of external elements Aum(A, m2)			637.4400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		162.7910			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		83.4440 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	32.0000	0.0500	1.6000
E3	Sill	31.1000	0.0500	1.5550
E4	Jamb	48.9000	0.0500	2.4450
R1	Head of roof window	2.4000	0.0800	0.1920
R2	Sill of roof window	2.4000	0.0600	0.1440
R3	Jamb of roof window	4.5000	0.0800	0.3600
R11	Upstands or kerbs of rooflights	0.8800	0.0800	0.0704
E4	Jamb	2.2000	0.0500	0.1100
E2	Other lintels (including other steel lintels)	1.1000	0.0500	0.0550
E3	Sill	1.1000	0.0500	0.0550
E22	Basement floor	55.9000	0.0700	3.9130
E6	Intermediate floor within a dwelling	55.9000	0.0000	0.0000
E6	Intermediate floor within a dwelling	46.6800	0.0000	0.0000
E10	Eaves (insulation at ceiling level)	2.5000	0.0600	0.1500
E12	Gable (insulation at ceiling level)	4.3000	0.0600	0.2580
E11	Eaves (insulation at rafter level)	23.3000	0.0400	0.9320
E13	Gable (insulation at rafter level)	18.5400	0.0800	1.4832
E14	Flat roof	23.0000	0.0800	1.8400
E16	Corner (normal)	13.2500	0.0900	1.1925
E16	Corner (normal)	15.4000	0.0900	1.3860
E17	Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500
E17	Corner (inverted - internal area greater than external area)	2.6500	-0.0900	-0.2385
R8	Roof to wall (rafter)	23.3000	0.0600	1.3980

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.4506 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	181.2416 (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	195.7372	194.9530	194.1843	190.5738	189.8983	186.7536	186.7536	186.1713	187.9649	189.8983	191.2648	192.6935	(38)
Heat transfer coeff	376.9788	376.1946	375.4259	371.8154	371.1399	367.9953	367.9953	367.4129	369.2065	371.1399	372.5064	373.9351	(39)
Average = Sum(39)m / 12 =												371.8122	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8694	0.8676	0.8659	0.8575	0.8560	0.8487	0.8487	0.8474	0.8515	0.8560	0.8591	0.8624	(40)
HLP (average)												0.8575	
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		3.3056 (42)

Hot water usage for mixer showers

79.6439	78.4471	76.7029	73.3659	70.9033	68.1569	66.5959	68.3268	70.2242	73.1729	76.5817	79.3388	(42a)

Hot water usage for baths

34.3727	33.8622	33.1434	31.8179	30.8254	29.7249	29.1305	29.8443	30.6215	31.7991	33.1519	34.2565	(42b)

Hot water usage for other uses

48.4826	46.7196	44.9566	43.1936	41.4306	39.6676	39.6676	41.4306	43.1936	44.9566	46.7196	48.4826	(42c)

Average daily hot water use (litres/day)	149.3731 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	162.4993	159.0289	154.8029	148.3774	143.1593	137.5494	135.3940	139.6017	144.0394	149.9287	156.4532	162.0779	(44)

Energy conte	257.3591	226.4550	237.9263	203.1213	192.7199	169.1331	163.7473	172.8561	177.6149	203.4518	222.8962	253.7749	(45)
Energy content (annual)										Total = Sum(45)m =		2481.0560	
Distribution loss (46)m = 0.15 x (45)m													
	38.6039	33.9683	35.6889	30.4682	28.9080	25.3700	24.5621	25.9284	26.6422	30.5178	33.4344	38.0662	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi 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	(61)
Total heat required for water heating calculated for each month													
	309.1057	273.1939	289.6729	253.1986	244.4665	219.2104	215.4939	224.6027	227.6923	255.1984	272.9736	305.5215	(62)
WWHRS	-36.4099	-32.2012	-33.7192	-27.9209	-26.0212	-22.2666	-20.8714	-22.1946	-23.0378	-27.1591	-30.7679	-35.7356	(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													
	272.6958	240.9927	255.9537	225.2777	218.4452	196.9439	194.6225	202.4081	204.6544	228.0393	242.2056	269.7858	(64)
										Total per year (kWh/year) = Sum(64)m =		2752.0249	(64)
12Total per year (kWh/year)												2752	(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													
	126.9692	112.6874	120.5078	107.5997	105.4766	96.2986	95.8432	98.8719	99.1188	109.0450	114.1749	125.7774	(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	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	165.2798	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	302.4695	334.8769	302.4695	312.5518	302.4695	312.5518	302.4695	302.4695	312.5518	302.4695	312.5518	302.4695	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	559.2024	565.0052	550.3824	519.2522	479.9559	443.0229	418.3494	412.5467	427.1695	458.2997	497.5960	534.5289	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	39.5280	(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)													
	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	-132.2239	(71)
Water heating gains (Table 5)													
	170.6575	167.6896	161.9728	149.4440	141.7697	133.7481	128.8216	132.8924	137.6651	146.5659	158.5762	169.0557	(72)
Total internal gains													
	1107.9134	1143.1556	1090.4086	1056.8320	999.7790	961.9068	922.2244	920.4925	949.9703	982.9190	1044.3079	1081.6380	(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	12.3100	11.2829	0.6300	0.7000	0.7700	42.4475	(75)
Southeast	1.2100	36.7938	0.6300	0.7000	0.7700	13.6061	(77)
Southwest	32.1300	36.7938	0.6300	0.7000	0.7700	361.2914	(79)
Northwest	3.3700	11.2829	0.6300	0.7000	0.7700	11.6205	(81)
Southeast	0.5300	39.2172	0.6300	0.7000	1.0000	8.2496	(82)
Northwest	1.2800	16.8560	0.6300	0.7000	1.0000	8.5634	(82)
Southwest	7.9800	26.0000	0.6300	0.7000	1.0000	82.3488	(82)

Solar gains	528.1272	952.7559	1432.7523	1972.0366	2374.2131	2425.9785	2310.4952	2002.4318	1619.5704	1088.9846	642.5477	445.3554	(83)
Total gains	1636.0406	2095.9115	2523.1610	3028.8686	3373.9921	3387.8853	3232.7196	2922.9243	2569.5406	2071.9036	1686.8556	1526.9934	(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	26.6597	26.7152	26.7699	27.0299	27.0791	27.3105	27.3105	27.3538	27.2209	27.0791	26.9797	26.8767	
alpha	2.7773	2.7810	2.7847	2.8020	2.8053	2.8207	2.8207	2.8236	2.8147	2.8053	2.7986	2.7918	
util living area													
	0.9824	0.9652	0.9333	0.8614	0.7455	0.5940	0.4626	0.5190	0.7347	0.9108	0.9704	0.9853	(86)
MIT	18.2547	18.6362	19.1886	19.8876	20.4486	20.7974	20.9269	20.8977	20.6107	19.8381	18.9173	18.1940	(87)
Th 2	20.1936	20.1951	20.1966	20.2038	20.2051	20.2113	20.2113	20.2125	20.2089	20.2051	20.2024	20.1996	(88)
util rest of house													
	0.9801	0.9608	0.9248	0.8434	0.7122	0.5402	0.3907	0.4460	0.6881	0.8953	0.9659	0.9835	(89)
MIT 2	16.8965	17.3827	18.0830	18.9587	19.6355	20.0332	20.1613	20.1387	19.8398	18.9129	17.7485	16.8224	(90)
Living area fraction										fLA = Living area / (4) =		0.0736	(91)
MIT	16.9964	17.4749	18.1643	19.0271	19.6953	20.0894	20.2176	20.1945	19.8965	18.9810	17.8345	16.9233	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.9964	17.4749	18.1643	19.0271	19.6953	20.0894	20.2176	20.1945	19.8965	18.9810	17.8345	16.9233	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9660	0.9393	0.8958	0.8112	0.6882	0.5313	0.3913	0.4442	0.6672	0.8643	0.9463	0.9712	(94)
Useful gains	1580.4578	1968.7223	2260.1849	2456.9096	2322.1039	1799.8401	1264.9133	1298.3430	1714.4793	1790.6973	1596.3334	1482.9676	(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													
	4786.2871	4730.6069	4379.0882	3765.4061	2967.3847	2020.0714	1331.2653	1394.1592	2140.1145	3110.5149	3998.6774	4757.6952	(97)
Space heating kWh													
	2385.1370	1855.9864	1576.4640	942.1175	480.0889	0.0000	0.0000	0.0000	0.0000	981.9443	1729.6876	2436.3973	(98a)

Space heating requirement - total per year (kWh/year)												12387.8230	
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													
	2385.1370	1855.9864	1576.4640	942.1175	480.0889	0.0000	0.0000	0.0000	0.0000	981.9443	1729.6876	2436.3973	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												12387.8230	
Space heating per m2											(98c) / (4) =	28.5704	(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 %)												92.3000	(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													
	2385.1370	1855.9864	1576.4640	942.1175	480.0889	0.0000	0.0000	0.0000	0.0000	981.9443	1729.6876	2436.3973	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	2584.1137	2010.8195	1707.9784	1020.7123	520.1396	0.0000	0.0000	0.0000	0.0000	1063.8617	1873.9844	2639.6504	(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													
	272.6958	240.9927	255.9537	225.2777	218.4452	196.9439	194.6225	202.4081	204.6544	228.0393	242.2056	269.7858	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.7842	87.6638	87.4228	86.9085	85.7748	79.8000	79.8000	79.8000	79.8000	86.9518	87.5867	87.8127	(217)
Fuel for water heating, kWh/month													
	310.6434	274.9057	292.7768	259.2125	254.6730	246.7968	243.8879	253.6442	256.4592	262.2594	276.5325	307.2288	(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	62.8472	50.4183	45.3961	33.2591	25.6903	20.9892	23.4356	30.4624	39.5677	51.9150	58.6378	64.5939	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-121.7174	-165.1024	-228.2211	-246.1152	-256.4169	-235.6588	-232.2115	-223.2251	-206.6158	-183.1806	-131.2545	-105.9613	(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	-89.9030	-186.2565	-365.2755	-541.8667	-710.3941	-712.0724	-704.1822	-599.4080	-443.2756	-264.6711	-119.4120	-71.3596	(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												13421.2601	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3239.0204	(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)												507.2128	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-7143.7574	(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												10109.7358	(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	13421.2601	0.2100	2818.4646	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3239.0204	0.2100	680.1943	(264)
Space and water heating			3498.6589	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	507.2128	0.1443	73.2065	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2335.6805	0.1355	-316.4822	
PV Unit electricity exported	-4808.0768	0.1262	-607.0122	
Total			-923.4944	(269)
Total CO2, kg/year			2660.3002	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			6.1400	(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	13421.2601	1.1300	15166.0239	(275)

Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3239.0204	1.1300	3660.0930	(278)
Space and water heating			18826.1169	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	507.2128	1.5338	777.9799	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2335.6805	1.5008	-3505.4641	
PV Unit electricity exported	-4808.0768	0.4634	-2228.2211	
Total			-5733.6853	(283)
Total Primary energy kWh/year			14000.5123	(286)
Target Primary Energy Rate (TPER)			32.2900	(287)