


# VIDA

## CEFN ISAF

### ENERGY AND DECARBONISATION

BR0032-VIDA-XX-XX-RP-S3-0002 Part L SAP calculations

Revision Summary						
Issue	Document Prepared			Document Reviewed		
P	O Fuller		10/01/24			

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## 2 INTRODUCTION

This document has been written to show that the development meets the energy and decarbonisation requirements of no fossil fuels and all dwellings to achieve an EPC A as set out in the Welsh Development Quality Requirements 2021 document.

## 3 POLICY

Welsh Development Quality Requirements 2021

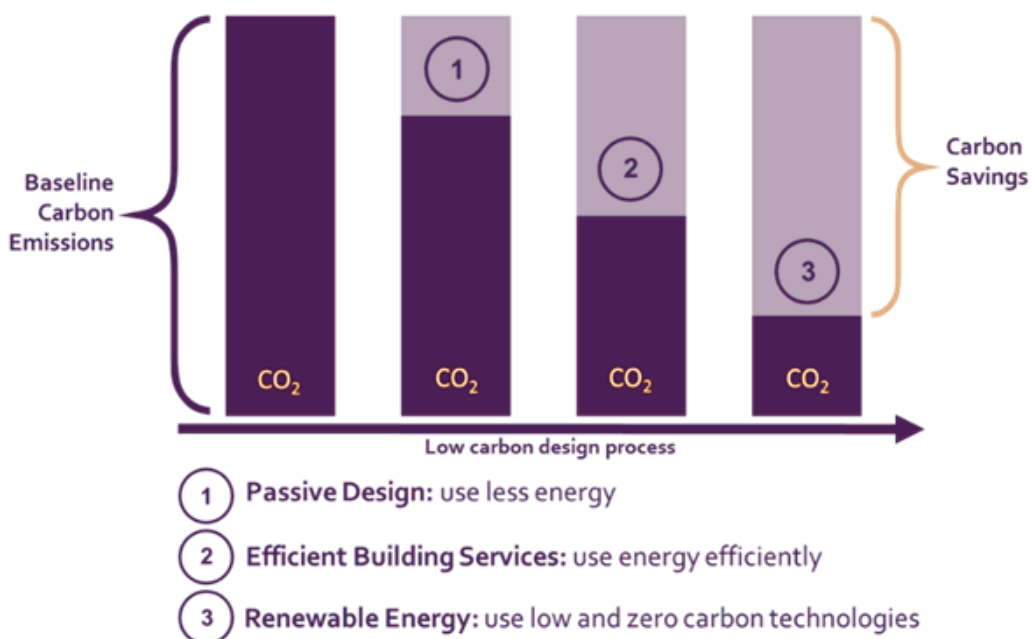
*Creating Beautiful Homes and Places*

(WDQR 2021)

*“Achieving EPC A (SAP92 or greater) through the minimum fabric standard set out in “Appendix E” – Elemental specification for the DER/TER, within the Building Regulations Approved Document Part L Wales 2020 and by not using fossil fuel fired boilers to provide domestic hot water and space heating.”*

## 4 APPROACH – ENERGY HIERACHY

- 1) Passive design: By utilizing a fabric-first approach, the energy demand and associated carbon emissions for space heating and cooling are reduced.
- 2) Efficient building services: The remaining energy is served by energy efficient building services to further reduce the carbon footprint of the building.
- 3) Renewable energy: Use of Low and Zero Carbon technologies (e.g., heat pumps, renewables, etc.) can further reduce the carbon footprint of the building and the dependence on fossil fuels.



## 5 FABRIC STANDARDS

Fabric Element	Part L1 2021 Notional Building Target	Proposed Fabric Specification
External Wall U-value	0.18 W/m <sup>2</sup> K	0.15 W/m <sup>2</sup> K
Exposed Floor U-value	0.13 W/m <sup>2</sup> K	0.12 W/m <sup>2</sup> K
Roof U-value	0.11 W/m <sup>2</sup> K	0.10 W/m <sup>2</sup> K
Window U-value	1.2 W/m <sup>2</sup> K	0.8 - 1.2 W/m <sup>2</sup> K
Door U-value	1.0 W/m <sup>2</sup> K	1.0 W/m <sup>2</sup> K
Air Tightness	5 m <sup>3</sup> /h.m <sup>2</sup> @ 50pa	≤ 3 m <sup>3</sup> /h.m <sup>2</sup> @ 50pa

## 6 BUILDING SERVICES

	Description
Space heating	A large, centralised air source heat pump will be located externally on the ground floor and will maintain the temperature of an ambient loop serving heat pumps located within each apartment. This will generate Low Temperature Hot Water (LTHW) to serve underfloor heating.
Domestic hot water	Hot water will be generated via integrated water-source heat pump and hot water cylinder located within the apartment utility cupboards, using the centralised ambient loop as a heat source. Wastewater heat recovery is also included.
Ventilation	Mechanical ventilation with heat recovery for background ventilation and natural ventilation for purge and summertime overheating
Lighting	All high efficiency LED lighting

## 7 RENEWABLES

A photovoltaic system, also known as a solar PV system is an energy system that is designed to transform the energy from the sun into electricity by means of photovoltaics. This system is safe, reliable, low-maintenance, and provides green energy without on-site pollution or emissions.

To achieve the required EPC A rating the following energy yield required from each building system is 19,450kWh per annum. Approximately 58no. 504W South facing PV panels will be required on each building to meet this requirement. 29.23 kWp per building (1.46 kWp per apartment)



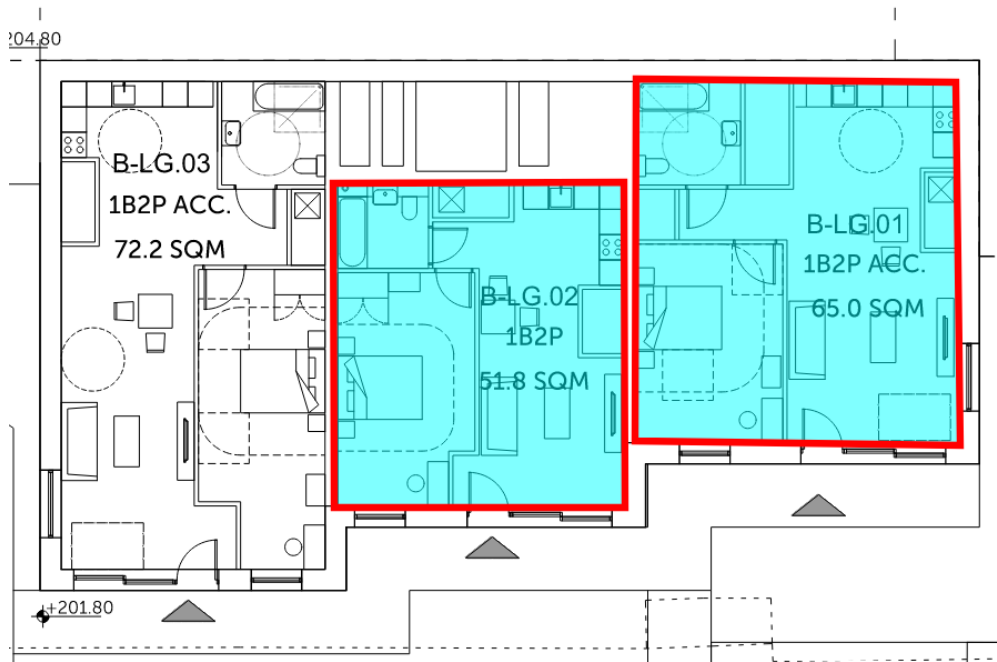
## 8 SAP CALCULATION

We have used the latest compliant software SAP 10.2, which is the methodology currently required by the government to estimate the energy performance of homes. It is used to demonstrate compliance of new homes with Part L of the Building Regulations and to generate Energy Performance Certificates (EPCs) for all homes. SAP 10.2 applies to all building warrants submitted on or after 1 February 2023 and also for all EPC production from the same date.

We have assessed 7 apartments covering the ground floor, mid floor and the top floor of block B to demonstrate that all apartments will achieve an EPC A across both blocks.

We have based our assumptions on the systems and fabric standards as shown in the previous section.

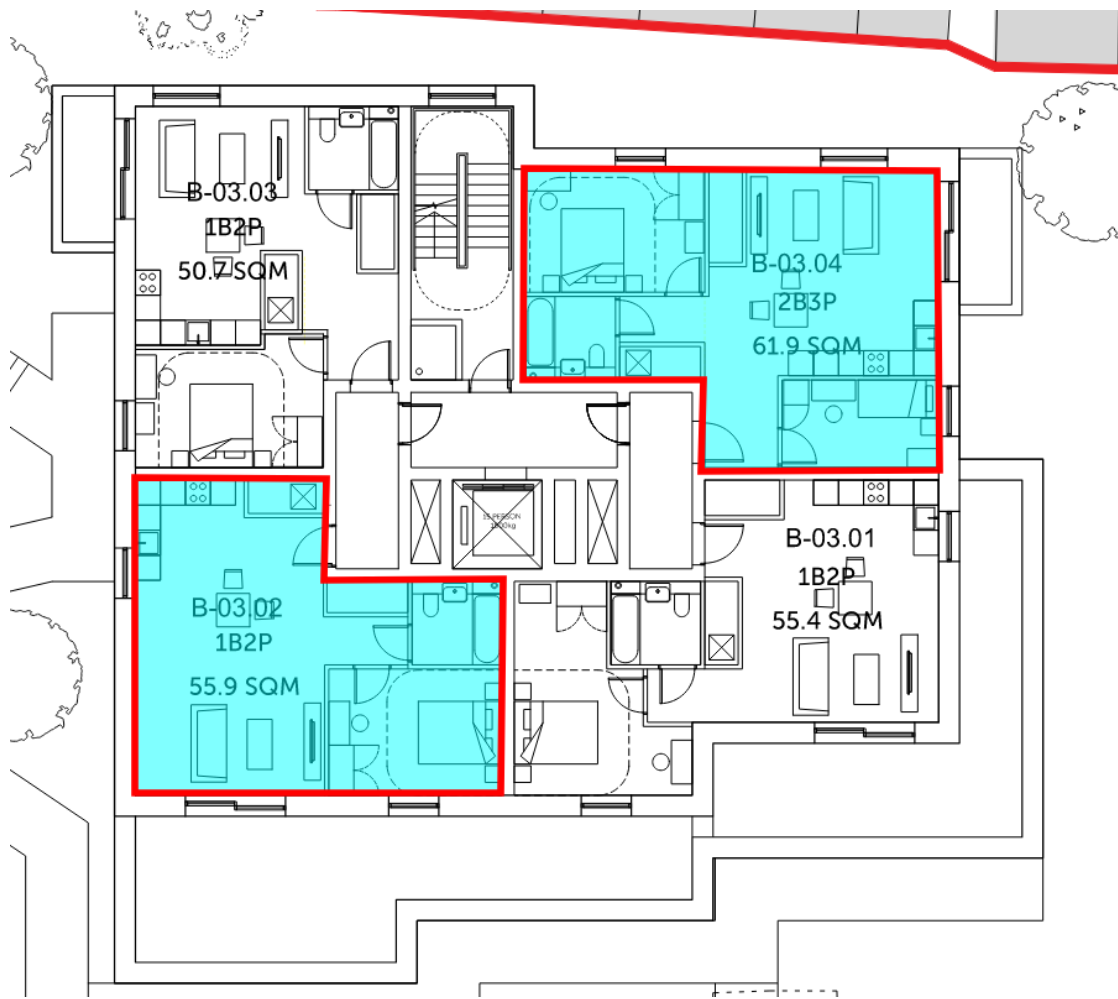
## 8.1 APARTMENTS



Lower Ground floor



Second floor



Top Floor

8.2 RESULTS

Assessment reference	Sap Rating	EPC	DER	TER	%DER<TER	DPER	TPER	%DPER<TPER	Status
B-LG.02 1b2P - proposed	92	A	0.23	13.82	98.34%	13.5	74.09	81.78%	Pass
B-LG.01 1b2P - proposed	92	A	0.59	13.08	95.49%	14.81	69.85	78.80%	Pass
B-02.02 2b3P - proposed	92	A	0.18	11.22	98.40%	12.97	60.06	78.40%	Pass
B-02.05 2b3P - proposed	93	A	0.22	11.71	98.12%	11.21	62.47	82.06%	Pass
B-02.04 2b3P - proposed	93	A	0.18	12.89	98.60%	13.38	68.97	80.60%	Pass
B-03.04 2b3P - proposed	92	A	0.83	12.93	93.58%	17.68	69.04	74.38%	Pass
B-03.02 2b3P - proposed	93	A	0.59	12.85	95.41%	16.25	68.69	76.34%	Pass

The results show that all sample SAP calculations meet the requirement of no fossil fuels and also the target of achieving an EPC A.

The detailed SAP calculation information can be found in Appendix A.

## 9 THERMAL COMFORT

Please refer to separate Part O document - BR0032-VIDA-XX-XX-RP-S3-0003 Part O Thermal comfort

## 10 APPENDIX A



# Full SAP Calculation Printout



Property Reference	Block B		Issued on Date	24/01/2024	
Assessment Reference	B-02.02 2b3P - proposed	Prop Type Ref	Block B		
Property					
SAP Rating	92 A	DER	0.18	TER	11.22
Environmental	100 A	% DER < TER			98.40
CO <sub>2</sub> Emissions (t/year)	0	DPER	12.97	TPER	60.06
Compliance Check	See BRWL	% DPER < TPER			78.40
Assessor Details	Mr. Oliver Fuller			Assessor ID	AW55-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	55.2100 (1b)	x 2.7500 (2b)	= 151.8275 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.2100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 151.8275 (5)

### 2. Ventilation rate

	m <sup>3</sup> 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)

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	3.0000	(17)
Infiltration rate	0.1500	(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) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
Triple Glazing 1.0 (Uw = 1.00)			7.2000	0.9615	6.9231		(27)					
External Wall 1	23.6100	7.2000	16.4100	0.1500	2.4615		(29a)					
Total net area of external elements Aum(A, m <sup>2</sup> )			23.6100				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	9.3846	(33)					
Party Floor 1			55.2100				(32d)					
Party Ceiling 1			55.2100				(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)							1.1805 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	10.5651 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 12.9047	Feb 12.7450	Mar 12.5853	Apr 11.7867	May 11.6270	Jun 10.8285	Jul 10.8285	Aug 10.6688	Sep 11.1479	Oct 11.6270	Nov 11.9465	Dec 12.2659 (38)
Heat transfer coeff	23.4698	23.3100	23.1503	22.3518	22.1921	21.3936	21.3936	21.2339	21.7130	22.1921	22.5115	22.8309 (39)

# Full SAP Calculation Printout



Average = Sum(39)m / 12 =

22.3119

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.4251	0.4222	0.4193	0.4049	0.4020	0.3875	0.3875	0.3846	0.3933	0.4020	0.4077	0.4135 (40)
HLP (average)												0.4041
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.8435 (42)
Hot water usage for mixer showers	68.9114	67.8758	66.3667	63.4794	61.3486	58.9724	57.6217	59.1194	60.7611	63.3124	66.2618	68.6474 (42a)
Hot water usage for baths	23.8306	23.4766	22.9783	22.0593	21.3712	20.6082	20.1961	20.6910	21.2299	22.0463	22.9842	23.7500 (42b)
Hot water usage for other uses	33.5094	32.2909	31.0723	29.8538	28.6353	27.4168	27.4168	28.6353	29.8538	31.0723	32.2909	33.5094 (42c)
Average daily hot water use (litres/day)												116.0918 (43)
Daily hot water use	126.2514	123.6433	120.4173	115.3925	111.3551	106.9974	105.2346	108.4457	111.8448	116.4311	121.5368	125.9068 (44)
Energy conte	199.9513	176.0664	185.0769	157.9666	149.9054	131.5657	127.2721	134.2784	137.9158	157.9958	173.1515	197.1396 (45)
Energy content (annual)												1928.2855
Distribution loss (46)m = 0.15 x (45)m	29.9927	26.4100	27.7615	23.6950	22.4858	19.7349	19.0908	20.1418	20.6874	23.6994	25.9727	29.5709 (46)
Water storage loss:												180.0000 (47)
Store volume												1.2000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.6000 (49)
Temperature factor from Table 2b												0.7200 (55)
Enter (49) or (54) in (55)												0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	245.5337	217.2376	230.6593	202.0786	195.4878	175.6777	172.8545	179.8608	182.0278	203.5782	217.2635	242.7220 (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	245.5337	217.2376	230.6593	202.0786	195.4878	175.6777	172.8545	179.8608	182.0278	203.5782	217.2635	242.7220 (64)
Total per year (kWh/year) = Sum(64)m =												2464.9815 (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	102.9497	91.4790	98.0040	87.8135	86.3095	79.0352	78.7839	81.1135	81.1466	88.9995	92.8625	102.0148 (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	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.2564	17.1034	13.9094	10.5303	7.8715	6.6455	7.1807	9.3337	12.5277	15.9068	18.5655	19.7916 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	239.8905	242.3799	236.1069	222.7524	205.8948	190.0511	179.4665	176.9771	183.2501	196.6046	213.4622	229.3059 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404 (71)
Water heating gains (Table 5)	138.3733	136.1295	131.7258	121.9632	116.0073	109.7711	105.8923	109.0235	112.7036	119.6230	128.9756	137.1167 (72)
Total internal gains	482.2950	480.3875	466.5168	440.0207	414.5485	391.2424	377.3142	380.1091	393.2562	416.9091	445.7781	470.9890 (73)

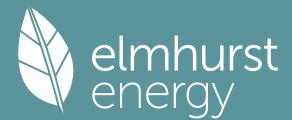
## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
South	7.2000	46.7521	0.5500	0.7500	0.7700	96.2256 (78)						
Solar gains	96.2256	157.5927	200.7451	226.8856	236.4288	227.5306	222.3112	215.8950	209.7020	169.9785	114.0601	83.1477 (83)
Total gains	578.5206	637.9802	667.2620	666.9062	650.9772	618.7730	599.6254	596.0041	602.9582	586.8876	559.8382	554.1368 (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)												
tau	65.3442	65.7919	66.2457	68.6123	69.1061	71.6855	71.6855	72.2247	70.6310	69.1061	68.1256	67.1725
alpha	5.3563	5.3861	5.4164	5.5742	5.6071	5.7790	5.7790	5.8150	5.7087	5.6071	5.5417	5.4782
util living area	0.6479	0.5739	0.4969	0.4040	0.3167	0.2212	0.1570	0.1639	0.2484	0.3920	0.5489	0.6609 (86)
MIT	20.9154	20.9547	20.9798	20.9948	20.9989	20.9999	21.0000	21.0000	20.9998	20.9963	20.9721	20.9141 (87)
Th 2	20.5900	20.5926	20.5953	20.6088	20.6115	20.6250	20.6250	20.6277	20.6196	20.6115	20.6061	20.6007 (88)
util rest of house	0.6346	0.5608	0.4838	0.3911	0.3035	0.2083	0.1436	0.1506	0.2347	0.3776	0.5345	0.6479 (89)
MIT 2	20.4938	20.5417	20.5731	20.6033	20.6104	20.6249	20.6250	20.6277	20.6194	20.6077	20.5755	20.5027 (90)
Living area fraction												fLA = Living area / (4) = 0.6269 (91)

# Full SAP Calculation Printout



MIT	20.7581	20.8006	20.8281	20.8487	20.8539	20.8600	20.8601	20.8611	20.8579	20.8513	20.8241	20.7606 (92)
Temperature adjustment												0.0000
adjusted MIT	20.7581	20.8006	20.8281	20.8487	20.8539	20.8600	20.8601	20.8611	20.8579	20.8513	20.8241	20.7606 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.6401	0.5675	0.4914	0.3990	0.3117	0.2164	0.1520	0.1589	0.2433	0.3865	0.5425	0.6532 (94)
Useful gains	370.2920	362.0408	327.8712	266.0973	202.9411	133.9089	91.1370	94.7245	146.6991	226.8105	303.7073	361.9406 (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	386.2675	370.6437	331.6994	267.0749	203.1451	133.9240	91.1384	94.7263	146.7339	227.4977	308.9501	378.0936 (97)
Space heating kWh	11.8858	5.7811	2.8482	0.7039	0.1518	0.0000	0.0000	0.0000	0.0000	0.5113	3.7748	12.0179 (98a)
Space heating requirement - total per year (kWh/year)												37.6747
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	11.8858	5.7811	2.8482	0.7039	0.1518	0.0000	0.0000	0.0000	0.0000	0.5113	3.7748	12.0179 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												37.6747
Space heating per m2										(98c) / (4) =		0.6824 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	11.8858	5.7811	2.8482	0.7039	0.1518	0.0000	0.0000	0.0000	0.0000	0.5113	3.7748	12.0179 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	13.0744	6.3592	3.1330	0.7743	0.1670	0.0000	0.0000	0.0000	0.0000	0.5624	4.1523	13.2197
Space heating requirement	13.0744	6.3592	3.1330	0.7743	0.1670	0.0000	0.0000	0.0000	0.0000	0.5624	4.1523	13.2197 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	245.5337	217.2376	230.6593	202.0786	195.4878	175.6777	172.8545	179.8608	182.0278	203.5782	217.2635	242.7220 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	270.0871	238.9614	253.7253	222.2864	215.0366	193.2455	190.1399	197.8469	200.2305	223.9361	238.9898	266.9942
Water heating fuel	270.0871	238.9614	253.7253	222.2864	215.0366	193.2455	190.1399	197.8469	200.2305	223.9361	238.9898	266.9942 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	11.7989	10.6570	11.7989	11.4183	11.7989	11.4183	11.7989	11.7989	11.4183	11.7989	11.4183	11.7989 (331)
Lighting	16.8550	13.5217	12.1748	8.9198	6.8899	5.6291	6.2852	8.1697	10.6117	13.9231	15.7261	17.3235 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-24.3255	-34.9316	-51.2327	-58.8186	-64.4595	-60.6181	-59.9073	-56.0471	-49.3383	-40.5123	-26.9785	-20.9550 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-12.2376	-26.0818	-52.6800	-80.4449	-107.5889	-108.5329	-107.0083	-89.7880	-64.8797	-37.4852	-16.3907	-9.6421 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												41.4422 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2711.4796 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												0.4144 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												138.9222 (330a)
Total electricity for the above, kWh/year												138.9222 (331)
Electricity for lighting (calculated in Appendix L)												136.0296 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1260.8848 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												1766.9888 (338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	41.4422	4.4400	1.8400 (340a)
Space heating total			1.8400 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2711.4796	4.4400	120.3897 (342a)
Water heating total			120.3897 (342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (347a)
Pumps, fans and electric keep-hot	138.9222	16.4900	22.9083 (349)

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Energy for lighting	136.0296	16.4900	22.4313 (350)
Additional standing charges			92.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-548.1245	16.4900	-90.3857
PV Unit electricity exported	-712.7603	5.5900	-39.8433
Total			-130.2290 (352)
Total energy cost			129.3402 (355)

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**11b. SAP rating - Community heating scheme**  
 -----

Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4646 (357)
SAP value		92.4680
SAP rating (Section 12)		92 (358)
SAP band		A

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**12b. Carbon dioxide emissions - Community heating scheme**  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	917.6406	0.1597	2.2063 (367)
Electrical energy for heat distribution (space & water)	0.4144	0.0000	3.8881 (372)
Overall CO2 factor for heat network			0.0485 (386)
Total CO2 associated with community systems			133.4927 (373)
Space and water heating			133.4927 (376)
Pumps, fans and electric keep-hot	138.9222	0.1387	19.2702 (378)
Energy for lighting	136.0296	0.1443	19.6333 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-548.1245	0.1342	-73.5320
PV Unit electricity exported	-712.7603	0.1255	-89.4390
Total			-162.9709 (380)
Total CO2, kg/year			9.4252 (383)
CO2 emissions per m2			0.1700 (384)
EI value			99.8740 (384a)
EI rating			100 (385)
EI band			A

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY  
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**1. Overall dwelling characteristics**  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	55.2100 (1b)	x 2.7500 (2b)	= 151.8275 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.2100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 151.8275 (5)

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**2. Ventilation rate**  
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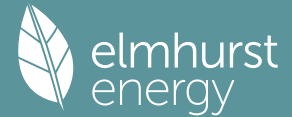
	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number 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)

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			3.0000 (17)
Infiltration rate			0.1500 (18)
Number of sides sheltered			2 (19)

Shelter factor	(20) = $1 - [0.075 \times (19)] =$	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.5000	6.2000	5.9000	5.2000	5.1000	4.7000	4.5000	4.5000	5.0000	5.7000	6.0000	6.0000 (22)
Wind factor	1.6250	1.5500	1.4750	1.3000	1.2750	1.1750	1.1250	1.1250	1.2500	1.4250	1.5000	1.5000 (22a)
Adj infilt rate	0.2072	0.1976	0.1881	0.1658	0.1626	0.1498	0.1434	0.1434	0.1594	0.1817	0.1913	0.1913 (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) =												81.0000 (23c)
Effective ac	0.3022	0.2926	0.2831	0.2607	0.2576	0.2448	0.2384	0.2384	0.2544	0.2767	0.2863	0.2863 (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					
Triple Glazing 1.0 (Uw = 1.00)			7.2000	0.9615	6.9231		(27)					
External Wall 1	23.6100	7.2000	16.4100	0.1500	2.4615		(29a)					
Total net area of external elements Aum(A, m2)			23.6100				(31)					
Fabric heat loss, W/K = Sum (A x U)							(33)					
Party Floor 1			55.2100				(32d)					
Party Ceiling 1			55.2100				(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)							1.1805 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	10.5651 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	15.1405	14.6614	14.1823	13.0644	12.9047	12.2659	11.9465	11.9465	12.7450	13.8629	14.3420	14.3420
Average = Sum(39)m / 12 =	25.7056	25.2265	24.7474	23.6295	23.4698	22.8309	22.5115	22.5115	23.3100	24.4280	24.9071	24.9071
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.4656	0.4569	0.4482	0.4280	0.4251	0.4135	0.4077	0.4077	0.4222	0.4425	0.4511	0.4511
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers												1.8435 (42)
Hot water usage for baths	68.9114	67.8758	66.3667	63.4794	61.3486	58.9724	57.6217	59.1194	60.7611	63.3124	66.2618	68.6474 (42a)
Hot water usage for other uses	23.8306	23.4766	22.9783	22.0593	21.3712	20.6082	20.1961	20.6910	21.2299	22.0463	22.9842	23.7500 (42b)
Average daily hot water use (litres/day)	33.5094	32.2909	31.0723	29.8538	28.6353	27.4168	27.4168	28.6353	29.8538	31.0723	32.2909	33.5094 (42c)
Daily hot water use	126.2514	123.6433	120.4173	115.3925	111.3551	106.9974	105.2346	108.4457	111.8448	116.4311	121.5368	125.9068 (44)
Energy content (annual)	199.9513	176.0664	185.0769	157.9666	149.9054	131.5657	127.2721	134.2784	137.9158	157.9958	173.1515	197.1396 (45)
Distribution loss (46)m = 0.15 x (45)m	29.9927	26.4100	27.7615	23.6950	22.4858	19.7349	19.0908	20.1418	20.6874	23.6994	25.9727	29.5709 (46)
Water storage loss:												180.0000 (47)
Store volume												1.2000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.6000 (49)
Temperature factor from Table 2b												0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	245.5337	217.2376	230.6593	202.0786	195.4878	175.6777	172.8545	179.8608	182.0278	203.5782	217.2635	242.7220 (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	245.5337	217.2376	230.6593	202.0786	195.4878	175.6777	172.8545	179.8608	182.0278	203.5782	217.2635	242.7220 (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	102.9497	91.4790	98.0040	87.8135	86.3095	79.0352	78.7839	81.1135	81.1466	88.9995	92.8625	102.0148 (65)

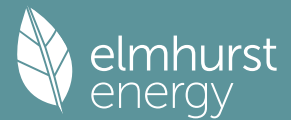
### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.2564	17.1034	13.9094	10.5303	7.8715	6.6455	7.1807	9.3337	12.5277	15.9068	18.5655	19.7916 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	239.8905	242.3799	236.1069	222.7524	205.8948	190.0511	179.4665	176.9771	183.2501	196.6046	213.4622	229.3059 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404 (71)
Water heating gains (Table 5)	138.3733	136.1295	131.7258	121.9632	116.0073	109.7711	105.8923	109.0235	112.7036	119.6230	128.9756	137.1167 (72)
Total internal gains	482.2950	480.3875	466.5168	440.0207	414.5485	391.2424	377.3142	380.1091	393.2562	416.9091	445.7781	470.9890 (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
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South	7.2000		50.7747		0.5500		0.7500		0.7700		104.5049 (78)	
Solar gains	104.5049	161.8493	211.7545	242.4840	248.0185	246.5829	230.3290	224.9395	213.3151	170.3924	117.7544	84.8463 (83)
Total gains	586.7999	642.2369	678.2713	682.5046	662.5669	637.8253	607.6432	605.0486	606.5712	587.3015	563.5325	555.8353 (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	59.6606	60.7937	61.9706	64.9025	65.3442	67.1725	68.1256	68.1256	65.7919	62.7809	61.5733	61.5733	
alpha	4.9774	5.0529	5.1314	5.3268	5.3563	5.4782	5.5417	5.5417	5.3861	5.1854	5.1049	5.1049	
util living area	0.6603	0.5950	0.5194	0.4299	0.3464	0.2612	0.2111	0.2120	0.2880	0.4254	0.5673	0.6676 (86)	
MIT	20.8846	20.9322	20.9679	20.9904	20.9974	20.9996	20.9999	20.9999	20.9992	20.9913	20.9557	20.8906 (87)	
Th 2	20.5525	20.5605	20.5685	20.5873	20.5900	20.6007	20.6061	20.6061	20.5926	20.5739	20.5658	20.5658 (88)	
util rest of house	0.6455	0.5805	0.5050	0.4161	0.3320	0.2469	0.1966	0.1974	0.2724	0.4083	0.5506	0.6530 (89)	
MIT 2	20.4221	20.4846	20.5333	20.5771	20.5874	20.6004	20.6060	20.6060	20.5920	20.5650	20.5177	20.4422 (90)	
Living area fraction									fLA = Living area / (4) =				
MIT	20.7121	20.7652	20.8057	20.8362	20.8444	20.8506	20.8529	20.8529	20.8473	20.8322	20.7923	20.7233 (92)	
Temperature adjustment												0.0000	
adjusted MIT	20.7121	20.7652	20.8057	20.8362	20.8444	20.8506	20.8529	20.8529	20.8473	20.8322	20.7923	20.7233 (93)	

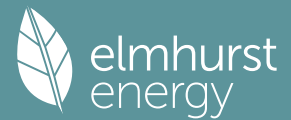
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.6509	0.5873	0.5129	0.4245	0.3409	0.2558	0.2057	0.2066	0.2821	0.4187	0.5593	0.6583 (94)
Useful gains	381.9198	377.1604	347.8958	289.6922	225.8791	163.1863	124.9898	124.9898	171.1299	245.8798	315.1993	365.9311 (95)
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000 (96)
Heat loss rate W												
	403.8881	390.1327	354.0296	291.4977	226.3526	163.2559	125.0053	125.0053	171.2653	247.5095	323.5998	386.6405 (97)
Space heating kWh	16.3444	8.7174	4.5635	1.3000	0.3523	0.0000	0.0000	0.0000	0.0000	1.2125	6.0483	15.4078 (98a)
Space heating requirement - total per year (kWh/year)												53.9463
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	16.3444	8.7174	4.5635	1.3000	0.3523	0.0000	0.0000	0.0000	0.0000	1.2125	6.0483	15.4078 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												53.9463
Space heating per m2												(98c) / (4) =
												0.9771 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	16.3444	8.7174	4.5635	1.3000	0.3523	0.0000	0.0000	0.0000	0.0000	1.2125	6.0483	15.4078 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	17.9789	9.5892	5.0199	1.4300	0.3875	0.0000	0.0000	0.0000	0.0000	1.3337	6.6531	16.9486
Space heating requirement	17.9789	9.5892	5.0199	1.4300	0.3875	0.0000	0.0000	0.0000	0.0000	1.3337	6.6531	16.9486 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	245.5337	217.2376	230.6593	202.0786	195.4878	175.6777	172.8545	179.8608	182.0278	203.5782	217.2635	242.7220 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	270.0871	238.9614	253.7253	222.2864	215.0366	193.2455	190.1399	197.8469	200.2305	223.9361	238.9898	266.9942
Water heating fuel	270.0871	238.9614	253.7253	222.2864	215.0366	193.2455	190.1399	197.8469	200.2305	223.9361	238.9898	266.9942 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	11.7989	10.6570	11.7989	11.4183	11.7989	11.4183	11.7989	11.7989	11.4183	11.7989	11.4183	11.7989 (331)
Lighting	16.8550	13.5217	12.1748	8.9198	6.8899	5.6291	6.2852	8.1697	10.6117	13.9231	15.7261	17.3235 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-26.2226	-35.9746	-53.5308	-61.5133	-66.3814	-63.2182	-61.2308	-57.6206	-50.2716	-40.9939	-27.9176	-21.5121 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-14.0033	-27.6128	-57.8510	-89.5611	-116.2855	-121.9840	-113.6267	-96.4434	-67.7815	-38.4047	-17.4634	-10.0988 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												59.3409 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2711.4796 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												0.5934 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												138.9222 (330a)
mechanical ventilation fans (SFP = 0.7500)												138.9222 (331)
Total electricity for the above, kWh/year												136.0296 (332)
Electricity for lighting (calculated in Appendix L)												

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Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation		-1337.5038 (333)
Wind generation		0.0000 (334)
Hydro-electric generation (Appendix N)		0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)		0.0000 (335)
Appendix Q - special features		
Energy saved or generated		-0.0000 (336)
Energy used		0.0000 (337)
Total delivered energy for all uses		1708.2685 (338)

## 10b. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	59.3409	6.1900	3.6732 (340a)
Space heating total			3.6732 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2711.4796	6.1900	167.8406 (342a)
Water heating total			167.8406 (342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (347a)
Pumps, fans and electric keep-hot	138.9222	25.1600	34.9528 (349)
Energy for lighting	136.0296	25.1600	34.2250 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-566.3875	25.1600	-142.5031
PV Unit electricity exported	-771.1164	5.8100	-44.8019
Total			-187.3049 (352)
Total energy cost			155.3867 (355)

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	923.6069	0.1590	3.1457 (367)
Electrical energy for heat distribution (space & water)	0.5934	0.0000	3.9163 (372)
Overall CO2 factor for heat network			0.0485 (386)
Total CO2 associated with community systems			134.4602 (373)
Space and water heating			134.4602 (376)
Pumps, fans and electric keep-hot	138.9222	0.1387	19.2702 (378)
Energy for lighting	136.0296	0.1443	19.6333 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-566.3875	0.1343	-76.0458
PV Unit electricity exported	-771.1164	0.1256	-96.8685
Total			-172.9143 (380)
Total CO2, kg/year			0.4494 (383)

## 13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			300.0000 (467a)
Space and Water heating from Heat pump	923.6069	1.5886	31.4234 (467)
Electrical energy for heat distribution (space & water)	0.5934	0.0000	42.1897 (472)
Overall CO2 factor for heat network			0.5228 (486)
Total CO2 associated with community systems			1448.5145 (473)
Space and water heating			1448.5145 (476)
Pumps, fans and electric keep-hot	138.9222	1.5128	210.1614 (478)
Energy for lighting	136.0296	1.5338	208.6467 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-566.3875	1.4962	-847.4270
PV Unit electricity exported	-771.1164	0.4611	-355.5754
Total			-1203.0024 (480)
Total Primary energy kWh/year			664.3203 (483)

## SAP 10 EPC IMPROVEMENTS

### B-02.02 2b3P - proposed

Current energy efficiency rating: A 92  
 Current environmental impact rating: A 100

N Solar water heating Not applicable  
 U Solar photovoltaic panels Not applicable  
 V2 Wind turbine Not applicable

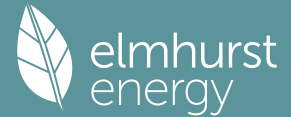
Recommended measures: (none) SAP change Cost change CO2 change

Recommended measures (none) Typical annual savings Energy efficiency Environmental impact  
 Total Savings £0 0.00 kg/m<sup>2</sup>

Potential energy efficiency rating: A 92  
 Potential environmental impact rating: A 100

Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

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Typical heating and lighting costs of this home (per year, Wales):

	Current	Potential	Saving
Electricity	£69	£69	£0
Community scheme	£274	£274	£0
Space heating	£141	£141	£0
Water heating	£168	£168	£0
Lighting	£34	£34	£0
Generated (PV)	-£187	-£187	£0
Total cost of fuels	£156	£156	£0
Total cost of uses	£156	£156	£0
Delivered energy	31 kWh/m <sup>2</sup>	31 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.0 tonnes	0.0 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	0 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	12 kWh/m <sup>2</sup>	12 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	55.2100 (1b)	x 2.7500 (2b)	= 151.8275 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.2100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 151.8275 (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	0 * 10 =											0.0000 (7a)	
Number of passive vents	0 * 10 =											0.0000 (7b)	
Number of flueless gas fires	0 * 40 =											0.0000 (7c)	
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												3.0000 (17)	
Infiltration rate												0.1500 (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) =											0.1275 (21)	
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)
Balanced mechanical ventilation with heat recovery													0.5000 (23a)
If mechanical ventilation													0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448	(25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K						
Triple Glazing 1.0 (Uw = 1.00)			7.2000	0.9615	6.9231		(27)						
External Wall 1	23.6100	7.2000	16.4100	0.1500	2.4615		(29a)						
Total net area of external elements Aum(A, m <sup>2</sup> )			23.6100				(31)						
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	9.3846	(33)						
Party Floor 1			55.2100				(32d)						
Party Ceiling 1			55.2100				(32b)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K								100.0000 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)								1.1805 (36)					
Point Thermal bridges								(36a) = 0.0000					
Total fabric heat loss								(33) + (36) + (36a) = 10.5651 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	12.9047	12.7450	12.5853	11.7867	11.6270	10.8285	10.8285	10.6688	11.1479	11.6270	11.9465	12.2659	(38)
Heat transfer coeff	23.4698	23.3100	23.1503	22.3518	22.1921	21.3936	21.3936	21.2339	21.7130	22.1921	22.5115	22.8309	(39)
Average = Sum(39)m / 12 =													22.3119
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	



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HLP	0.4251	0.4222	0.4193	0.4049	0.4020	0.3875	0.3875	0.3846	0.3933	0.4020	0.4077	0.4135 (40)
HLP (average)												0.4041
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.8435 (42)
Hot water usage for mixer showers	68.9114	67.8758	66.3667	63.4794	61.3486	58.9724	57.6217	59.1194	60.7611	63.3124	66.2618	68.6474 (42a)
Hot water usage for baths	23.8306	23.4766	22.9783	22.0593	21.3712	20.6082	20.1961	20.6910	21.2299	22.0463	22.9842	23.7500 (42b)
Hot water usage for other uses	33.5094	32.2909	31.0723	29.8538	28.6353	27.4168	27.4168	28.6353	29.8538	31.0723	32.2909	33.5094 (42c)
Average daily hot water use (litres/day)												116.0918 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	126.2514	123.6433	120.4173	115.3925	111.3551	106.9974	105.2346	108.4457	111.8448	116.4311	121.5368	125.9068 (44)
Energy content (annual)	199.9513	176.0664	185.0769	157.9666	149.9054	131.5657	127.2721	134.2784	137.9158	157.9958	173.1515	197.1396 (45)
Distribution loss (46)m = 0.15 x (45)m	29.9927	26.4100	27.7615	23.6950	22.4858	19.7349	19.0908	20.1418	20.6874	23.6994	25.9727	29.5709 (46)
Water storage loss:												180.0000 (47)
Store volume												1.2000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.6000 (49)
Temperature factor from Table 2b												0.7200 (55)
Enter (49) or (54) in (55)												0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	245.5337	217.2376	230.6593	202.0786	195.4878	175.6777	172.8545	179.8608	182.0278	203.5782	217.2635	242.7220 (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	245.5337	217.2376	230.6593	202.0786	195.4878	175.6777	172.8545	179.8608	182.0278	203.5782	217.2635	242.7220 (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	102.9497	91.4790	98.0040	87.8135	86.3095	79.0352	78.7839	81.1135	81.1466	88.9995	92.8625	102.0148 (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	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.2564	17.1034	13.9094	10.5303	7.8715	6.6455	7.1807	9.3337	12.5277	15.9068	18.5655	19.7916 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	239.8905	242.3799	236.1069	222.7524	205.8948	190.0511	179.4665	176.9771	183.2501	196.6046	213.4622	229.3059 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404 (71)
Water heating gains (Table 5)	138.3733	136.1295	131.7258	121.9632	116.0073	109.7711	105.8923	109.0235	112.7036	119.6230	128.9756	137.1167 (72)
Total internal gains	482.2950	480.3875	466.5168	440.0207	414.5485	391.2424	377.3142	380.1091	393.2562	416.9091	445.7781	470.9890 (73)

## 6. Solar gains

[Jan]				Area	Solar flux	g	FF	Access	Gains			
				m <sup>2</sup>	Table 6a	W/m <sup>2</sup>	Specific data	factor	W			
						or Table 6b	Specific data	Table 6d				
South				7.2000	46.7521	0.5500	0.7500	0.7700	96.2256 (78)			
Solar gains	96.2256	157.5927	200.7451	226.8856	236.4288	227.5306	222.3112	215.8950	209.7020	169.9785	114.0601	83.1477 (83)
Total gains	578.5206	637.9802	667.2620	666.9062	650.9772	618.7730	599.6254	596.0041	602.9582	586.8876	559.8382	554.1368 (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	65.3442	65.7919	66.2457	68.6123	69.1061	71.6855	71.6855	72.2247	70.6310	69.1061	68.1256	67.1725
alpha	5.3563	5.3861	5.4164	5.5742	5.6071	5.7790	5.7790	5.8150	5.7087	5.6071	5.5417	5.4782
util living area	0.6479	0.5739	0.4969	0.4040	0.3167	0.2212	0.1570	0.1639	0.2484	0.3920	0.5489	0.6609 (86)
MIT	20.9154	20.9547	20.9798	20.9948	20.9989	20.9999	21.0000	21.0000	20.9998	20.9963	20.9721	20.9141 (87)
Th 2	20.5900	20.5926	20.5953	20.6088	20.6115	20.6250	20.6250	20.6277	20.6196	20.6115	20.6061	20.6007 (88)
util rest of house	0.6346	0.5608	0.4838	0.3911	0.3035	0.2083	0.1436	0.1506	0.2347	0.3776	0.5345	0.6479 (89)
MIT 2	20.4938	20.5417	20.5731	20.6033	20.6104	20.6249	20.6250	20.6277	20.6194	20.6077	20.5755	20.5027 (90)
Living area fraction												0.6269 (91)
MIT	20.7581	20.8006	20.8281	20.8487	20.8539	20.8600	20.8601	20.8611	20.8579	20.8513	20.8241	20.7606 (92)
Temperature adjustment												0.0000
adjusted MIT	20.7581	20.8006	20.8281	20.8487	20.8539	20.8600	20.8601	20.8611	20.8579	20.8513	20.8241	20.7606 (93)

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## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.6401	0.5675	0.4914	0.3990	0.3117	0.2164	0.1520	0.1589	0.2433	0.3865	0.5425	0.6532	(94)
Useful gains	370.2920	362.0408	327.8712	266.0973	202.9411	133.9089	91.1370	94.7245	146.6991	226.8105	303.7073	361.9406	(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	386.2675	370.6437	331.6994	267.0749	203.1451	133.9240	91.1384	94.7263	146.7339	227.4977	308.9501	378.0936	(97)
Space heating kWh	11.8858	5.7811	2.8482	0.7039	0.1518	0.0000	0.0000	0.0000	0.0000	0.5113	3.7748	12.0179	(98a)
Space heating requirement - total per year (kWh/year)												37.6747	
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	11.8858	5.7811	2.8482	0.7039	0.1518	0.0000	0.0000	0.0000	0.0000	0.5113	3.7748	12.0179	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												37.6747	
Space heating per m2												0.6824	(99)

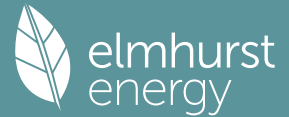
## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(301)
Fraction of space heat from community system													1.0000	(302)
Fraction of heat from community Heat pump-Space and Water													1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating													1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating													1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system													1.1000	(306)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating:														
Space heating requirement	11.8858	5.7811	2.8482	0.7039	0.1518	0.0000	0.0000	0.0000	0.0000	0.5113	3.7748	12.0179	(98)	
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10														
307a	13.0744	6.3592	3.1330	0.7743	0.1670	0.0000	0.0000	0.0000	0.0000	0.5624	4.1523	13.2197		
Space heating requirement	13.0744	6.3592	3.1330	0.7743	0.1670	0.0000	0.0000	0.0000	0.0000	0.5624	4.1523	13.2197	(307)	
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)													0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)	
Water heating														
Annual water heating requirement	245.5337	217.2376	230.6593	202.0786	195.4878	175.6777	172.8545	179.8608	182.0278	203.5782	217.2635	242.7220	(64)	
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10														
310a	270.0871	238.9614	253.7253	222.2864	215.0366	193.2455	190.1399	197.8469	200.2305	223.9361	238.9898	266.9942		
Water heating fuel	270.0871	238.9614	253.7253	222.2864	215.0366	193.2455	190.1399	197.8469	200.2305	223.9361	238.9898	266.9942	(310)	
Cooling System Energy Efficiency Ratio													0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	11.7989	10.6570	11.7989	11.4183	11.7989	11.4183	11.7989	11.7989	11.4183	11.7989	11.4183	11.7989	(331)	
Lighting	16.8550	13.5217	12.1748	8.9198	6.8899	5.6291	6.2852	8.1697	10.6117	13.9231	15.7261	17.3235	(332)	
Electricity generated by PVs (Appendix M) (negative quantity)														
(333a)m	-24.3255	-34.9316	-51.2327	-58.8186	-64.4595	-60.6181	-59.9073	-56.0471	-49.3383	-40.5123	-26.9785	-20.9550	(333a)	
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(334a)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	(334a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(335a)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	(335a)	
Electricity generated by PVs (Appendix M) (negative quantity)														
(333b)m	-12.2376	-26.0818	-52.6800	-80.4449	-107.5889	-108.5329	-107.0083	-89.7880	-64.8797	-37.4852	-16.3907	-9.6421	(333b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(334b)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	(334b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(335b)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	(335b)	
Annual totals kWh/year														
Space heating fuel - community heating													41.4422	(307)
Space heating fuel - secondary													0.0000	(309)
Water heating fuel - community heating													2711.4796	(310)
Efficiency of water heater													0.0000	(311)
Electricity used for heat distribution													0.4144	(313)
Space cooling fuel													0.0000	(321)
Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)														
mechanical ventilation fans (SFP = 0.7500)													138.9222	(330a)
Total electricity for the above, kWh/year													138.9222	(331)
Electricity for lighting (calculated in Appendix L)													136.0296	(332)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-1260.8848	(333)
Wind generation													0.0000	(334)
Hydro-electric generation (Appendix N)													0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)													0.0000	(335)
Appendix Q - special features														
Energy saved or generated													-0.0000	(336)
Energy used													0.0000	(337)
Total delivered energy for all uses													1766.9888	(338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Heat pump	41.4422	4.4400	1.8400	(340a)
Space heating total			1.8400	(340)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Heat pump	2711.4796	4.4400	120.3897	(342a)
Water heating total			120.3897	(342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(347a)
Pumps, fans and electric keep-hot	138.9222	16.4900	22.9083	(349)
Energy for lighting	136.0296	16.4900	22.4313	(350)
Additional standing charges			92.0000	(351)

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Energy saving/generation technologies			
PV Unit electricity used in dwelling	-548.1245	16.4900	-90.3857
PV Unit electricity exported	-712.7603	5.5900	-39.8433
Total			-130.2290 (352)
Total energy cost			129.3402 (355)

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 11b. SAP rating - Community heating scheme  
 -----

Energy cost deflator (Table 12):			0.3600 (356)
Energy cost factor (ECF)		$[(255) \times (256)] / [(4) + 45.0] =$	0.4646 (357)
SAP value			92.4680
SAP rating (Section 12)			92 (358)
SAP band			A

-----  
 12b. Carbon dioxide emissions - Community heating scheme  
 -----

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	917.6406	0.1597	2.2063 (367)
Electrical energy for heat distribution (space & water)	0.4144	0.0000	3.8881 (372)
Overall CO2 factor for heat network			0.0485 (386)
Total CO2 associated with community systems			133.4927 (373)
Space and water heating			133.4927 (376)
Pumps, fans and electric keep-hot	138.9222	0.1387	19.2702 (378)
Energy for lighting	136.0296	0.1443	19.6333 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-548.1245	0.1342	-73.5320
PV Unit electricity exported	-712.7603	0.1255	-89.4390
Total			-162.9709 (380)
Total CO2, kg/year			9.4252 (383)
CO2 emissions per m2			0.1700 (384)
EI value			99.8740 (384a)
EI rating			100 (385)
EI band			A

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING  
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-----  
 1. Overall dwelling characteristics  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	55.2100 (1b)	x 2.7500 (2b)	= 151.8275 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.2100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	151.8275 (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	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	Air changes per hour 0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.5000	6.2000	5.9000	5.2000	5.1000	4.7000	4.5000	4.5000	5.0000	5.7000	6.0000	6.0000 (22)
Wind factor	1.6250	1.5500	1.4750	1.3000	1.2750	1.1750	1.1250	1.1250	1.2500	1.4250	1.5000	1.5000 (22a)
Adj infilt rate	0.2072	0.1976	0.1881	0.1658	0.1626	0.1498	0.1434	0.1434	0.1594	0.1817	0.1913	0.1913 (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) =												81.0000 (23c)
Effective ac	0.3022	0.2926	0.2831	0.2607	0.2576	0.2448	0.2384	0.2384	0.2544	0.2767	0.2863	0.2863 (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						
Triple Glazing 1.0 (Uw = 1.00)			7.2000	0.9615	6.9231			(27)					
External Wall 1	23.6100	7.2000	16.4100	0.1500	2.4615			(29a)					
Total net area of external elements Aum(A, m2)			23.6100					(31)					
Fabric heat loss, W/K = Sum (A x U)					9.3846			(33)					
Party Floor 1			55.2100					(32d)					
Party Ceiling 1			55.2100					(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)								1.1805 (36)					
Point Thermal bridges								0.0000 (36a) =					
Total fabric heat loss								(33) + (36) + (36a) = 10.5651 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	15.1405	14.6614	14.1823	13.0644	12.9047	12.2659	11.9465	11.9465	12.7450	13.8629	14.3420	14.3420	(38)
Average = Sum(39)m / 12 =	25.7056	25.2265	24.7474	23.6295	23.4698	22.8309	22.5115	22.5115	23.3100	24.4280	24.9071	24.9071	(39)
													24.0154
HLP	0.4656	0.4569	0.4482	0.4280	0.4251	0.4135	0.4077	0.4077	0.4222	0.4425	0.4511	0.4511	(40)
HLP (average)													0.4350
Days in mont	31	28	31	30	31	30	31	31	30	31	30		31

## 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy													1.8435 (42)
Hot water usage for mixer showers	68.9114	67.8758	66.3667	63.4794	61.3486	58.9724	57.6217	59.1194	60.7611	63.3124	66.2618	68.6474	(42a)
Hot water usage for baths	23.8306	23.4766	22.9783	22.0593	21.3712	20.6082	20.1961	20.6910	21.2299	22.0463	22.9842	23.7500	(42b)
Hot water usage for other uses	33.5094	32.2909	31.0723	29.8538	28.6353	27.4168	27.4168	28.6353	29.8538	31.0723	32.2909	33.5094	(42c)
Average daily hot water use (litres/day)													116.0918 (43)
Daily hot water use	126.2514	123.6433	120.4173	115.3925	111.3551	106.9974	105.2346	108.4457	111.8448	116.4311	121.5368	125.9068	(44)
Energy conte	199.9513	176.0664	185.0769	157.9666	149.9054	131.5657	127.2721	134.2784	137.9158	157.9958	173.1515	197.1396	(45)
Energy content (annual)													Total = Sum(45)m = 1928.2855
Distribution loss (46)m = 0.15 x (45)m	29.9927	26.4100	27.7615	23.6950	22.4858	19.7349	19.0908	20.1418	20.6874	23.6994	25.9727	29.5709	(46)
Water storage loss:													
Store volume													180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.2000 (48)
Temperature factor from Table 2b													0.6000 (49)
Enter (49) or (54) in (55)													0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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	245.5337	217.2376	230.6593	202.0786	195.4878	175.6777	172.8545	179.8608	182.0278	203.5782	217.2635	242.7220	(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	245.5337	217.2376	230.6593	202.0786	195.4878	175.6777	172.8545	179.8608	182.0278	203.5782	217.2635	242.7220	(64)
													Total per year (kWh/year) = Sum(64)m = 2464.9815 (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)
													0.0000 (64a)
Heat gains from water heating, kWh/month	102.9497	91.4790	98.0040	87.8135	86.3095	79.0352	78.7839	81.1135	81.1466	88.9995	92.8625	102.0148	(65)

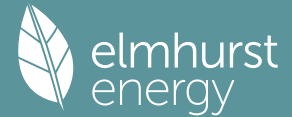
## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	110.6106	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.2564	17.1034	13.9094	10.5303	7.8715	6.6455	7.1807	9.3337	12.5277	15.9068	18.5655	19.7916	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	239.8905	242.3799	236.1069	222.7524	205.8948	190.0511	179.4665	176.9771	183.2501	196.6046	213.4622	229.3059	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	47.9046	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	-73.7404	(71)
Water heating gains (Table 5)	138.3733	136.1295	131.7258	121.9632	116.0073	109.7711	105.8923	109.0235	112.7036	119.6230	128.9756	137.1167	(72)
Total internal gains	482.2950	480.3875	466.5168	440.0207	414.5485	391.2424	377.3142	380.1091	393.2562	416.9091	445.7781	470.9890	(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
South	7.2000	50.7747	0.5500	0.7500	0.7700	104.5049 (78)

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Solar gains	104.5049	161.8493	211.7545	242.4840	248.0185	246.5829	230.3290	224.9395	213.3151	170.3924	117.7544	84.8463 (83)
Total gains	586.7999	642.2369	678.2713	682.5046	662.5669	637.8253	607.6432	605.0486	606.5712	587.3015	563.5325	555.8353 (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	59.6606	60.7937	61.9706	64.9025	65.3442	67.1725	68.1256	68.1256	65.7919	62.7809	61.5733	61.5733
alpha	4.9774	5.0529	5.1314	5.3268	5.3563	5.4782	5.5417	5.5417	5.3861	5.1854	5.1049	5.1049
util living area	0.6603	0.5950	0.5194	0.4299	0.3464	0.2612	0.2111	0.2120	0.2880	0.4254	0.5673	0.6676 (86)
MIT	20.8846	20.9322	20.9679	20.9904	20.9974	20.9996	20.9999	20.9999	20.9992	20.9913	20.9557	20.8906 (87)
Th 2	20.5525	20.5605	20.5685	20.5873	20.5900	20.6007	20.6061	20.6061	20.5926	20.5739	20.5658	20.5658 (88)
util rest of house	0.6455	0.5805	0.5050	0.4161	0.3320	0.2469	0.1966	0.1974	0.2724	0.4083	0.5506	0.6530 (89)
MIT 2	20.4221	20.4846	20.5333	20.5771	20.5874	20.6004	20.6060	20.6060	20.5920	20.5650	20.5177	20.4422 (90)
Living area fraction												fLA = Living area / (4) = 0.6269 (91)
MIT	20.7121	20.7652	20.8057	20.8362	20.8444	20.8506	20.8529	20.8529	20.8473	20.8322	20.7923	20.7233 (92)
Temperature adjustment												0.0000
adjusted MIT	20.7121	20.7652	20.8057	20.8362	20.8444	20.8506	20.8529	20.8529	20.8473	20.8322	20.7923	20.7233 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.6509	0.5873	0.5129	0.4245	0.3409	0.2558	0.2057	0.2066	0.2821	0.4187	0.5593	0.6583 (94)
Useful gains	381.9198	377.1604	347.8958	289.6922	225.8791	163.1863	124.9898	124.9894	171.1299	245.8798	315.1993	365.9311 (95)
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000 (96)
Heat loss rate W	403.8881	390.1327	354.0296	291.4977	226.3526	163.2559	125.0053	125.0053	171.2653	247.5095	323.5998	386.6405 (97)
Space heating kWh	16.3444	8.7174	4.5635	1.3000	0.3523	0.0000	0.0000	0.0000	0.0000	1.2125	6.0483	15.4078 (98a)
Space heating requirement - total per year (kWh/year)												53.9463
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	16.3444	8.7174	4.5635	1.3000	0.3523	0.0000	0.0000	0.0000	0.0000	1.2125	6.0483	15.4078 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												53.9463
Space heating per m2												(98c) / (4) = 0.9771 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	16.3444	8.7174	4.5635	1.3000	0.3523	0.0000	0.0000	0.0000	0.0000	1.2125	6.0483	15.4078 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	17.9789	9.5892	5.0199	1.4300	0.3875	0.0000	0.0000	0.0000	0.0000	1.3337	6.6531	16.9486
Space heating requirement	17.9789	9.5892	5.0199	1.4300	0.3875	0.0000	0.0000	0.0000	0.0000	1.3337	6.6531	16.9486 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	245.5337	217.2376	230.6593	202.0786	195.4878	175.6777	172.8545	179.8608	182.0278	203.5782	217.2635	242.7220 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	270.0871	238.9614	253.7253	222.2864	215.0366	193.2455	190.1399	197.8469	200.2305	223.9361	238.9898	266.9942
Water heating fuel	270.0871	238.9614	253.7253	222.2864	215.0366	193.2455	190.1399	197.8469	200.2305	223.9361	238.9898	266.9942 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	11.7989	10.6570	11.7989	11.4183	11.7989	11.4183	11.7989	11.7989	11.4183	11.7989	11.4183	11.7989 (331)
Lighting	16.8550	13.5217	12.1748	8.9198	6.8899	5.6291	6.2852	8.1697	10.6117	13.9231	15.7261	17.3235 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-26.2226	-35.9746	-53.5308	-61.5133	-66.3814	-63.2182	-61.2308	-57.6206	-50.2716	-40.9939	-27.9176	-21.5121 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-14.0033	-27.6128	-57.8510	-89.5611	-116.2855	-121.9840	-113.6267	-96.4434	-67.7815	-38.4047	-17.4634	-10.0988 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												59.3409 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2711.4796 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												0.5934 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												138.9222 (330a)
Total electricity for the above, kWh/year												138.9222 (331)
Electricity for lighting (calculated in Appendix L)												136.0296 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1337.5038 (333)
Wind generation												0.0000 (334)

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Hydro-electric generation (Appendix N)	0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (335)
Appendix Q - special features	
Energy saved or generated	-0.0000 (336)
Energy used	0.0000 (337)
Total delivered energy for all uses	1708.2685 (338)

## 10b. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	59.3409	6.1900	3.6732 (340a)
Space heating total			3.6732 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2711.4796	6.1900	167.8406 (342a)
Water heating total			167.8406 (342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (347a)
Pumps, fans and electric keep-hot	138.9222	25.1600	34.9528 (349)
Energy for lighting	136.0296	25.1600	34.2250 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-566.3875	25.1600	-142.5031
PV Unit electricity exported	-771.1164	5.8100	-44.8019
Total			-187.3049 (352)
Total energy cost			155.3867 (355)

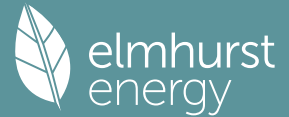
## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	923.6069	0.1590	3.1457 (367)
Electrical energy for heat distribution (space & water)	0.5934	0.0000	3.9163 (372)
Overall CO2 factor for heat network			0.0485 (386)
Total CO2 associated with community systems			134.4602 (373)
Space and water heating			134.4602 (376)
Pumps, fans and electric keep-hot	138.9222	0.1387	19.2702 (378)
Energy for lighting	136.0296	0.1443	19.6333 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-566.3875	0.1343	-76.0458
PV Unit electricity exported	-771.1164	0.1256	-96.8685
Total			-172.9143 (380)
Total CO2, kg/year			0.4494 (383)

## 13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			300.0000 (467a)
Space and Water heating from Heat pump	923.6069	1.5886	31.4234 (467)
Electrical energy for heat distribution (space & water)	0.5934	0.0000	42.1897 (472)
Overall CO2 factor for heat network			0.5228 (486)
Total CO2 associated with community systems			1448.5145 (473)
Space and water heating			1448.5145 (476)
Pumps, fans and electric keep-hot	138.9222	1.5128	210.1614 (478)
Energy for lighting	136.0296	1.5338	208.6467 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-566.3875	1.4962	-847.4270
PV Unit electricity exported	-771.1164	0.4611	-355.5754
Total			-1203.0024 (480)
Total Primary energy kWh/year			664.3203 (483)

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Property Reference	Block B		Issued on Date	24/01/2024	
Assessment Reference	B-02.04 2b3P - proposed	Prop Type Ref	Block B		
Property					
SAP Rating	93 A	DER	0.18	TER	12.89
Environmental	100 A	% DER < TER			98.60
CO <sub>2</sub> Emissions (t/year)	0	DPER	13.38	TPER	68.97
Compliance Check	See BRWL	% DPER < TPER			80.60
Assessor Details	Mr. Oliver Fuller			Assessor ID	AW55-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	53.0900 (1b)	x 2.7500 (2b)	= 145.9975 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	53.0900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 145.9975 (5)

### 2. Ventilation rate

	m <sup>3</sup> 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)

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		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		2 (19)

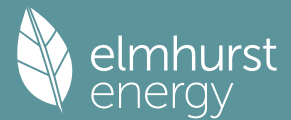
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (21)

	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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
Triple Glazing 1.0 (Uw = 1.00)			9.7600	0.9615	9.3846		(27)					
External Wall 1	41.9700	9.7600	32.2100	0.1500	4.8315		(29a)					
Total net area of external elements Aum(A, m <sup>2</sup> )			41.9700				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	14.2161	(33)					
Party Floor 1			53.0900				(32d)					
Party Ceiling 1			53.0900				(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)							2.0985 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	16.3146 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	12.4091	12.2556	12.1020	11.3342	11.1806	10.4127	10.4127	10.2592	10.7199	11.1806	11.4877	11.7949 (38)
	28.7238	28.5702	28.4166	27.6488	27.4952	26.7273	26.7273	26.5738	27.0345	27.4952	27.8023	28.1095 (39)

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Average = Sum(39)m / 12 =

27.6104

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.5410	0.5381	0.5353	0.5208	0.5179	0.5034	0.5034	0.5005	0.5092	0.5179	0.5237	0.5295 (40)
HLP (average)												0.5201
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												1.7812 (42)
Hot water usage for mixer showers												67.3467 (42a)
Hot water usage for baths												23.3023 (42b)
Hot water usage for other uses												32.8714 (42c)
Average daily hot water use (litres/day)												113.8916 (43)
Daily hot water use	123.8585	121.3000	118.1352	113.2056	109.2447	104.9696	103.2402	106.3903	109.7250	114.2244	119.2334	123.5205 (44)
Energy content (annual)	196.1617	172.7296	181.5694	154.9728	147.0644	129.0724	124.8600	131.7335	135.3019	155.0014	169.8698	193.4032 (45)
Distribution loss (46)m = 0.15 x (45)m												1891.7399
Water storage loss:												29.0105 (46)
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.7200 (55)
Total storage loss												22.3200 (56)
If cylinder contains dedicated solar storage												22.3200 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	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	241.7441	213.9008	227.1518	199.0848	192.6468	173.1844	170.4424	177.3159	179.4139	200.5838	213.9818	238.9856 (62)
WWHRS	-39.2544	-34.7170	-36.3536	-30.1022	-28.0542	-24.0062	-22.5019	-23.9286	-24.8377	-29.2809	-33.1717	-38.5275 (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	202.4896	179.1838	190.7982	168.9826	164.5926	149.1782	147.9405	153.3873	154.5762	171.3029	180.8101	200.4581 (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)
Heat gains from water heating, kWh/month	101.6897	90.3695	96.8377	86.8181	85.3648	78.2062	77.9819	80.2673	80.2775	88.0039	91.7713	100.7725 (65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Metabolic gains (Table 5), Watts	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.3124	15.3767	12.5052	9.4672	7.0769	5.9746	6.4558	8.3914	11.2630	14.3009	16.6913	17.7936 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	231.7177	234.1222	228.0629	215.1634	198.8802	183.5762	173.3522	170.9477	177.0070	189.9064	206.1897	221.4937 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485 (71)
Water heating gains (Table 5)	136.6797	134.4785	130.1583	120.5806	114.7377	108.6197	104.8144	107.8862	111.4965	118.2848	127.4601	135.4469 (72)
Total internal gains	468.8025	467.0702	453.8191	428.3041	403.7875	381.2632	367.7151	370.3180	382.8592	405.5849	433.4339	457.8269 (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						
North	2.5600	10.6334	0.5500	0.7500	0.7700	7.7816 (74)						
West	7.2000	19.6403	0.5500	0.7500	0.7700	40.4238 (80)						
Solar gains	48.2054	93.9485	155.4989	230.5211	287.4461	296.8140	281.5012	238.2197	181.8443	111.5341	60.0033	39.7297 (83)
Total gains	517.0079	561.0187	609.3180	658.8252	691.2336	678.0772	649.2163	608.5378	564.7035	517.1191	493.4372	497.5566 (84)

#### 7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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)												
tau	51.3415	51.6175	51.8965	53.3377	53.6356	55.1765	55.1765	55.4954	54.5497	53.6356	53.0431	52.4635
alpha	4.4228	4.4412	4.4598	4.4558	4.5757	4.6784	4.6784	4.6997	4.6366	4.5757	4.5362	4.4976
util living area	0.7838	0.7274	0.6329	0.4961	0.3675	0.2520	0.1811	0.2008	0.3290	0.5359	0.7076	0.7961 (86)
MIT	20.6375	20.7469	20.8710	20.9622	20.9916	20.9990	20.9998	20.9997	20.9964	20.9566	20.8171	20.6275 (87)
Th 2	20.4834	20.4860	20.4886	20.5018	20.5045	20.5177	20.5177	20.5203	20.5124	20.5045	20.4992	20.4939 (88)
util rest of house	0.7698	0.7117	0.6150	0.4773	0.3483	0.2331	0.1613	0.1799	0.3061	0.5130	0.6895	0.7827 (89)
MIT 2	20.0657	20.1982	20.3460	20.4620	20.4963	20.5168	20.5176	20.5202	20.5092	20.4600	20.2957	20.0633 (90)



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Living area fraction										FLA = Living area / (4) =	0.5626 (91)	
MIT	20.3874	20.5069	20.6414	20.7434	20.7750	20.7881	20.7889	20.7900	20.7833	20.7394	20.5890	20.3807 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3874	20.5069	20.6414	20.7434	20.7750	20.7881	20.7889	20.7900	20.7833	20.7394	20.5890	20.3807 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.7671	0.7124	0.6204	0.4865	0.3588	0.2437	0.1724	0.1916	0.3188	0.5239	0.6928	0.7796	(94)
Useful gains	396.5981	399.6445	378.0182	320.4985	248.0067	165.2218	111.9336	116.6184	180.0550	270.9287	341.8420	387.8830	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.4000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	462.0915	445.8924	401.8501	327.4566	249.5176	165.3918	111.9585	116.6585	180.6793	278.7844	375.0266	454.8318	(97)
Space heating kWh	48.7271	31.0787	17.7310	5.0098	1.1241	0.0000	0.0000	0.0000	0.0000	5.8446	23.8929	49.8099	(98a)
Space heating requirement - total per year (kWh/year)												183.2181	
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	48.7271	31.0787	17.7310	5.0098	1.1241	0.0000	0.0000	0.0000	0.0000	5.8446	23.8929	49.8099	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												183.2181	
Space heating per m2												(98c) / (4) =	3.4511 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (301)
Fraction of space heat from community system													1.0000 (302)
Fraction of heat from community Heat pump-Space and Water													1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating													1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating													1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system													1.1000 (306)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating:													
Space heating requirement	48.7271	31.0787	17.7310	5.0098	1.1241	0.0000	0.0000	0.0000	0.0000	5.8446	23.8929	49.8099	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10													
307a	53.5999	34.1865	19.5041	5.5108	1.2365	0.0000	0.0000	0.0000	0.0000	6.4291	26.2822	54.7909	
Space heating requirement	53.5999	34.1865	19.5041	5.5108	1.2365	0.0000	0.0000	0.0000	0.0000	6.4291	26.2822	54.7909	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)													0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating													
Annual water heating requirement	202.4896	179.1838	190.7982	168.9826	164.5926	149.1782	147.9405	153.3873	154.5762	171.3029	180.8101	200.4581	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10													
310a	222.7386	197.1022	209.8780	185.8809	181.0519	164.0960	162.7345	168.7260	170.0338	188.4331	198.8911	220.5039	
Water heating fuel	222.7386	197.1022	209.8780	185.8809	181.0519	164.0960	162.7345	168.7260	170.0338	188.4331	198.8911	220.5039	(310)
Cooling System Energy Efficiency Ratio													0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	11.3458	10.2478	11.3458	10.9798	11.3458	10.9798	11.3458	10.9798	11.3458	10.9798	11.3458	11.3458	(331)
Lighting	15.1534	12.1567	10.9457	8.0193	6.1943	5.0608	5.6507	7.3450	9.5404	12.5175	14.1385	15.5746	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-24.1305	-34.5548	-50.5478	-57.8842	-63.3186	-59.5091	-58.8065	-55.0640	-48.5555	-39.9970	-26.7257	-20.7978	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)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	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)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	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-12.4327	-26.4586	-53.3650	-81.3794	-108.7298	-109.6419	-108.1091	-90.7710	-65.6625	-38.0005	-16.6435	-9.7994	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)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	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)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	(335b)
Annual totals kWh/year													
Space heating fuel - community heating													201.5400 (307)
Space heating fuel - secondary													0.0000 (309)
Water heating fuel - community heating													2270.0700 (310)
Efficiency of water heater													0.0000 (311)
Electricity used for heat distribution													2.0154 (313)
Space cooling fuel													0.0000 (321)

Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)													
mechanical ventilation fans (SFP = 0.7500)													133.5877 (330a)
Total electricity for the above, kWh/year													133.5877 (331)
Electricity for lighting (calculated in Appendix L)													122.2970 (332)

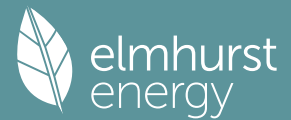
## Energy saving/generation technologies (Appendices M, N and Q)

PV generation													-1260.8848 (333)
Wind generation													0.0000 (334)
Hydro-electric generation (Appendix N)													0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)													0.0000 (335)
Appendix Q - special features													
Energy saved or generated													-0.0000 (336)
Energy used													0.0000 (337)
Total delivered energy for all uses													1466.6099 (338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	201.5400	4.4400	8.9484 (340a)
Space heating total			8.9484 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2270.0700	4.4400	100.7911 (342a)
Water heating total			100.7911 (342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (347a)

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Pumps, fans and electric keep-hot	133.5877	16.4900	22.0286 (349)
Energy for lighting	122.2970	16.4900	20.1668 (350)
Additional standing charges			92.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-539.8916	16.4900	-89.0281
PV Unit electricity exported	-720.9932	5.5900	-40.3035
Total			-129.3316 (352)
Total energy cost			114.6032 (355)

## 11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4206 (357)
SAP value		93.1820
SAP rating (Section 12)		93 (358)
SAP band		A

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			270.0000 (367)
Space and Water heating from Heat pump	915.4111	0.1584	11.8207 (367)
Electrical energy for heat distribution (space & water)	2.0154	0.0000	3.5135 (372)
Overall CO2 factor for heat network			0.0541 (386)
Total CO2 associated with community systems			133.6423 (373)
Space and water heating			133.6423 (376)
Pumps, fans and electric keep-hot	133.5877	0.1387	18.5303 (378)
Energy for lighting	122.2970	0.1443	17.6512 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-539.8916	0.1342	-72.4561
PV Unit electricity exported	-720.9932	0.1255	-90.4999
Total			-162.9561 (380)
Total CO2, kg/year			6.8678 (383)
CO2 emissions per m2			0.1300 (384)
EI value			99.9062 (384a)
EI rating			100 (385)
EI band			A

## SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	53.0900 (1b)	x 2.7500 (2b)	= 145.9975 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	53.0900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	145.9975 (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	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)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.1500 (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) = 0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.5000	6.2000	5.9000	5.2000	5.1000	4.7000	4.5000	4.5000	5.0000	5.7000	6.0000	6.0000 (22)
Wind factor	1.6250	1.5500	1.4750	1.3000	1.2750	1.1750	1.1250	1.1250	1.2500	1.4250	1.5000	1.5000 (22a)
Adj infilt rate	0.2072	0.1976	0.1881	0.1658	0.1626	0.1498	0.1434	0.1434	0.1594	0.1817	0.1913	0.1913 (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) =												81.0000 (23c)
Effective ac	0.3022	0.2926	0.2831	0.2607	0.2576	0.2448	0.2384	0.2384	0.2544	0.2767	0.2863	0.2863 (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					
Triple Glazing 1.0 (Uw = 1.00)			9.7600	0.9615	9.3846		(27)					
External Wall 1	41.9700	9.7600	32.2100	0.1500	4.8315		(29a)					
Total net area of external elements Aum(A, m2)			41.9700				(31)					
Fabric heat loss, W/K = Sum (A x U)					14.2161		(33)					
Party Floor 1			53.0900				(32d)					
Party Ceiling 1			53.0900				(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)							2.0985 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	16.3146 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	14.5591	14.0984	13.6377	12.5627	12.4091	11.7949	11.4877	11.4877	12.2556	13.3306	13.7913	13.7913
Average = Sum(39)m / 12 =	30.8738	30.4130	29.9523	28.8773	28.7238	28.1095	27.8023	27.8023	28.5702	29.6452	30.1059	30.1059
HLP	0.5815	0.5729	0.5642	0.5439	0.5410	0.5295	0.5237	0.5237	0.5381	0.5584	0.5671	0.5671
HLP (average)												0.5509
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	67.6058	66.5898	65.1093	62.2766	60.1862	57.8550	56.5299	57.9992	59.6098	62.1129	65.0063	67.3467
Hot water usage for baths	23.3814	23.0341	22.5451	21.6435	20.9684	20.2198	19.8154	20.3010	20.8297	21.6307	22.5509	23.3023
Hot water usage for other uses	32.8714	31.6761	30.4808	29.2854	28.0901	26.8948	26.8948	28.0901	29.2854	30.4808	31.6761	32.8714
Average daily hot water use (litres/day)	123.8585	121.3000	118.1352	113.2056	109.2447	104.9696	103.2402	106.3903	109.7250	114.2244	119.2334	123.5205
Daily hot water use	196.1617	172.7296	181.5694	154.9728	147.0644	129.0724	124.8600	131.7335	135.3019	155.0014	169.8698	193.4032
Energy conte	29.4242	25.9094	27.2354	23.2459	22.0597	19.3609	18.7290	19.7600	20.2953	23.2502	25.4805	29.0105
Distribution loss (46)m = 0.15 x (45)m	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200
Water storage loss:												
Store volume												180.0000
a) If manufacturer declared loss factor is known (kWh/day):												1.2000
Temperature factor from Table 2b												0.6000
Enter (49) or (54) in (55)												0.7200
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	22.5120	23.2624
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
Total heat required for water heating calculated for each month	241.7441	213.9008	227.1518	199.0848	192.6468	173.1844	170.4424	177.3159	179.4139	200.5838	213.9818	238.9856
WWHRS	-39.2544	-34.7170	-36.3536	-30.1022	-28.0542	-24.0062	-22.5019	-23.9286	-24.8377	-29.2809	-33.1717	-38.5275
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
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
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
Output from w/h	202.4896	179.1838	190.7982	168.9826	164.5926	149.1782	147.9405	153.3873	154.5762	171.3029	180.8101	200.4581
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
Heat gains from water heating, kWh/month	101.6897	90.3695	96.8377	86.8181	85.3648	78.2062	77.9819	80.2673	80.2775	88.0039	91.7713	100.7725

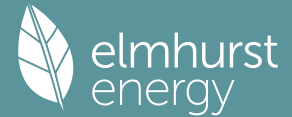
### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.3124	15.3767	12.5052	9.4672	7.0769	5.9746	6.4558	8.3914	11.2630	14.3009	16.6913	17.7936
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	231.7177	234.1222	228.0629	215.1634	198.8802	183.5762	173.3522	170.9477	177.0070	189.9064	206.1897	221.4937
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Losses e.g. evaporation (negative values) (Table 5)	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485
Water heating gains (Table 5)	136.6797	134.4785	130.1583	120.5806	114.7377	108.6197	104.8144	107.8862	111.4965	118.2848	127.4601	135.4469
Total internal gains	468.8025	467.0702	453.8191	428.3041	403.7875	381.2632	367.7151	370.3180	382.8592	405.5849	433.4339	457.8269

### 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
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North	2.5600	11.7244	0.5500	0.7500	0.7700	8.5800 (74)
West	7.2000	21.7541	0.5500	0.7500	0.7700	44.7745 (80)

Solar gains	53.3545	98.5129	167.6321	251.2438	306.2914	325.9838	295.8753	252.7286	188.9608	114.2264	63.1696	41.2904 (83)
Total gains	522.1570	565.5831	621.4512	679.5479	710.0789	707.2470	663.5904	623.0466	571.8199	519.8113	496.6035	499.1174 (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	47.7662	48.4898	49.2356	51.0685	51.3415	52.4635	53.0431	53.0431	51.6175	49.7457	48.9845	48.9845
alpha	4.1844	4.2327	4.2824	4.4046	4.4228	4.4976	4.5362	4.5362	4.4412	4.3164	4.2656	4.2656
util living area	0.7841	0.7350	0.6454	0.5153	0.3924	0.2893	0.2385	0.2540	0.3717	0.5615	0.7108	0.7901 (86)
MIT	20.5955	20.7033	20.8400	20.9476	20.9861	20.9973	20.9991	20.9988	20.9916	20.9349	20.7862	20.6086 (87)
Th 2	20.4466	20.4545	20.4623	20.4807	20.4834	20.4939	20.4992	20.4992	20.4860	20.4676	20.4597	20.4597 (88)
util rest of house	0.7689	0.7184	0.6269	0.4960	0.3724	0.2695	0.2177	0.2318	0.3469	0.5364	0.6907	0.7751 (89)
MIT 2	19.9837	20.1183	20.2854	20.4251	20.4696	20.4915	20.4985	20.4982	20.4784	20.4010	20.2243	20.0116 (90)
Living area fraction	20.3279	20.4474	20.5974	20.7191	20.7602	20.7760	20.7801	20.7799	20.7671	20.7014	20.5404	0.5626 (91)
MIT	20.3279	20.4474	20.5974	20.7191	20.7602	20.7760	20.7801	20.7799	20.7671	20.7014	20.5404	20.3475 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3279	20.4474	20.5974	20.7191	20.7602	20.7760	20.7801	20.7799	20.7671	20.7014	20.5404	20.3475 (93)

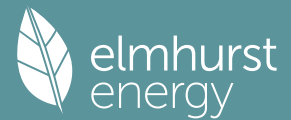
## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	399.7028	406.2013	392.5264	343.1123	272.0695	198.4277	152.2125	152.2125	206.1476	284.6039	344.5342	385.2381 (94)
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000 (96)
Heat loss rate W	473.2314	460.6793	422.2512	352.8538	274.6049	198.9039	152.3607	152.3538	207.6235	296.4931	383.5619	456.0295 (97)
Space heating kWh	54.7053	36.6092	22.1153	7.0139	1.8864	0.0000	0.0000	0.0000	0.0000	8.8455	28.0999	52.6688 (98a)
Space heating requirement - total per year (kWh/year)												211.9443
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	54.7053	36.6092	22.1153	7.0139	1.8864	0.0000	0.0000	0.0000	0.0000	8.8455	28.0999	52.6688 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												211.9443
Space heating per m2												(98c) / (4) = 3.9922 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	54.7053	36.6092	22.1153	7.0139	1.8864	0.0000	0.0000	0.0000	0.0000	8.8455	28.0999	52.6688 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	60.1758	40.2702	24.3268	7.7153	2.0750	0.0000	0.0000	0.0000	0.0000	9.7301	30.9099	57.9357
Space heating requirement	60.1758	40.2702	24.3268	7.7153	2.0750	0.0000	0.0000	0.0000	0.0000	9.7301	30.9099	57.9357 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	202.4896	179.1838	190.7982	168.9826	164.5926	149.1782	147.9405	153.3873	154.5762	171.3029	180.8101	200.4581 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	222.7386	197.1022	209.8780	185.8809	181.0519	164.0960	162.7345	168.7260	170.0338	188.4331	198.8911	220.5039
Water heating fuel	222.7386	197.1022	209.8780	185.8809	181.0519	164.0960	162.7345	168.7260	170.0338	188.4331	198.8911	220.5039 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	11.3458	10.2478	11.3458	10.9798	11.3458	10.9798	11.3458	11.3458	10.9798	11.3458	10.9798	11.3458 (331)
Lighting	15.1534	12.1567	10.9457	8.0193	6.1943	5.0608	5.6507	7.3450	9.5404	12.5175	14.1385	15.5746 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-26.0019	-35.5783	-52.7895	-60.4949	-65.1703	-62.0074	-60.0790	-56.5815	-49.4606	-40.4678	-27.6499	-21.3480 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)	
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-14.2240	-28.0090	-58.5923	-90.5796	-117.4966	-123.1949	-114.7786	-97.4825	-68.5926	-38.9309	-17.7311	-10.2629 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)	
Annual totals kWh/year												
Space heating fuel - community heating												233.1388 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2270.0700 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												2.3314 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												133.5877 (330a)
Total electricity for the above, kWh/year												133.5877 (331)

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Electricity for lighting (calculated in Appendix L)	122.2970 (332)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1337.5038 (333)
Wind generation	0.0000 (334)
Hydro-electric generation (Appendix N)	0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (335)
Appendix Q - special features	
Energy saved or generated	-0.0000 (336)
Energy used	0.0000 (337)
Total delivered energy for all uses	1421.5897 (338)

## 10b. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	233.1388	6.1900	14.4313 (340a)
Space heating total			14.4313 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2270.0700	6.1900	140.5173 (342a)
Water heating total			140.5173 (342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (347a)
Pumps, fans and electric keep-hot	133.5877	25.1600	33.6107 (349)
Energy for lighting	122.2970	25.1600	30.7699 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-557.6289	25.1600	-140.2994
PV Unit electricity exported	-779.8749	5.8100	-45.3107
Total			-185.6102 (352)
Total energy cost			135.7191 (355)

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			270.0000 (367)
Space and Water heating from Heat pump	927.1144	0.1578	13.6242 (367)
Electrical energy for heat distribution (space & water)	2.3314	0.0000	3.5622 (372)
Overall CO2 factor for heat network			0.0541 (386)
Total CO2 associated with community systems			135.4945 (373)
Space and water heating			135.4945 (376)
Pumps, fans and electric keep-hot	133.5877	0.1387	18.5303 (378)
Energy for lighting	122.2970	0.1443	17.6512 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-557.6289	0.1343	-74.9003
PV Unit electricity exported	-779.8749	0.1257	-97.9992
Total			-172.8995 (380)
Total CO2, kg/year			-1.2235 (383)

## 13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			270.0000 (467a)
Space and Water heating from Heat pump	927.1144	1.5841	136.7804 (467)
Electrical energy for heat distribution (space & water)	2.3314	0.0000	38.2050 (472)
Overall CO2 factor for heat network			0.5805 (486)
Total CO2 associated with community systems			1453.2048 (473)
Space and water heating			1453.2048 (476)
Pumps, fans and electric keep-hot	133.5877	1.5128	202.0915 (478)
Energy for lighting	122.2970	1.5338	187.5832 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-557.6289	1.4964	-834.4367
PV Unit electricity exported	-779.8749	0.4613	-359.7271
Total			-1194.1638 (480)
Total Primary energy kWh/year			648.7157 (483)

## SAP 10 EPC IMPROVEMENTS

### B-02.04 2b3P - proposed

Current energy efficiency rating:	A 93
Current environmental impact rating:	A 100

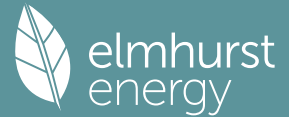
N Solar water heating	Not applicable
U Solar photovoltaic panels	Not applicable
V2 Wind turbine	Not applicable

Recommended measures: (none)	SAP change	Cost change	CO2 change
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Recommended measures (none)	Typical annual savings	Energy efficiency	Environmental impact
	Total Savings	£0	0.00 kg/m²

Potential energy efficiency rating:	A 93
Potential environmental impact rating:	A 100

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Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Wales):

	Current	Potential	Saving
Electricity	£64	£64	£0
Community scheme	£257	£257	£0
Space heating	£150	£150	£0
Water heating	£141	£141	£0
Lighting	£31	£31	£0
Generated (PV)	-£186	-£186	£0
Total cost of fuels	£135	£135	£0
Total cost of uses	£136	£136	£0
Delivered energy	27 kWh/m <sup>2</sup>	27 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Carbon dioxide emissions	-0.0 tonnes	-0.0 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	-0 kg/m <sup>2</sup>	-0 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	12 kWh/m <sup>2</sup>	12 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	53.0900 (1b)	x 2.7500 (2b)	= 145.9975 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	53.0900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 145.9975 (5)

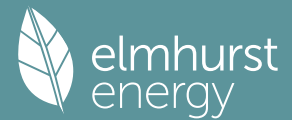
## 2. Ventilation rate

	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	0 * 10 =											0.0000 (7a)	
Number of passive vents	0 * 10 =											0.0000 (7b)	
Number of flueless gas fires	0 * 40 =											0.0000 (7c)	
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												3.0000 (17)	
Infiltration rate												0.1500 (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) =											0.1275 (21)	
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(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) =													81.0000 (23c)
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448	(25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K						
Triple Glazing 1.0 (Uw = 1.00)			9.7600	0.9615	9.3846		(27)						
External Wall 1	41.9700	9.7600	32.2100	0.1500	4.8315		(29a)						
Total net area of external elements Aum(A, m <sup>2</sup> )			41.9700				(31)						
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	14.2161	(33)						
Party Floor 1			53.0900				(32a)						
Party Ceiling 1			53.0900				(32b)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K								100.0000 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)								2.0985 (36)					
Point Thermal bridges								(36a) = 0.0000					
Total fabric heat loss								(33) + (36) + (36a) = 16.3146 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	12.4091	12.2556	12.1020	11.3342	11.1806	10.4127	10.4127	10.2592	10.7199	11.1806	11.4877	11.7949	(38)
Heat transfer coeff	28.7238	28.5702	28.4166	27.6488	27.4952	26.7273	26.7273	26.5738	27.0345	27.4952	27.8023	28.1095	(39)
Average = Sum(39)m / 12 =													27.6104

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.5410	0.5381	0.5353	0.5208	0.5179	0.5034	0.5034	0.5005	0.5092	0.5179	0.5237	0.5295 (40)
HLP (average)												0.5201
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												1.7812 (42)
Hot water usage for mixer showers	67.6058	66.5898	65.1093	62.2766	60.1862	57.8550	56.5299	57.9992	59.6098	62.1129	65.0063	67.3467 (42a)
Hot water usage for baths	23.3814	23.0341	22.5451	21.6435	20.9684	20.2198	19.8154	20.3010	20.8297	21.6307	22.5509	23.3023 (42b)
Hot water usage for other uses	32.8714	31.6761	30.4808	29.2854	28.0901	26.8948	26.8948	28.0901	29.2854	30.4808	31.6761	32.8714 (42c)
Average daily hot water use (litres/day)												113.8916 (43)
Daily hot water use	123.8585	121.3000	118.1352	113.2056	109.2447	104.9696	103.2402	106.3903	109.7250	114.2244	119.2334	123.5205 (44)
Energy conte	196.1617	172.7296	181.5694	154.9728	147.0644	129.0724	124.8600	131.7335	135.3019	155.0014	169.8698	193.4032 (45)
Energy content (annual)										Total = Sum(45)m =		1891.7399
Distribution loss (46)m = 0.15 x (45)m	29.4242	25.9094	27.2354	23.2459	22.0597	19.3609	18.7290	19.7600	20.2953	23.2502	25.4805	29.0105 (46)
Water storage loss:												
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	241.7441	213.9008	227.1518	199.0848	192.6468	173.1844	170.4424	177.3159	179.4139	200.5838	213.9818	238.9856 (62)
WWHRS	-39.2544	-34.7170	-36.3536	-30.1022	-28.0542	-24.0062	-22.5019	-23.9286	-24.8377	-29.2809	-33.1717	-38.5275 (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	202.4896	179.1838	190.7982	168.9826	164.5926	149.1782	147.9405	153.3873	154.5762	171.3029	180.8101	200.4581 (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)
Heat gains from water heating, kWh/month	101.6897	90.3695	96.8377	86.8181	85.3648	78.2062	77.9819	80.2673	80.2775	88.0039	91.7713	100.7725 (65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Metabolic gains (Table 5), Watts												
(66)m	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.3124	15.3767	12.5052	9.4672	7.0769	5.9746	6.4558	8.3914	11.2630	14.3009	16.6913	17.7936 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	231.7177	234.1222	228.0629	215.1634	198.8802	183.5762	173.3522	170.9477	177.0070	189.9064	206.1897	221.4937 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485 (71)
Water heating gains (Table 5)	136.6797	134.4785	130.1583	120.5806	114.7377	108.6197	104.8144	107.8862	111.4965	118.2848	127.4601	135.4469 (72)
Total internal gains	468.8025	467.0702	453.8191	428.3041	403.7875	381.2632	367.7151	370.3180	382.8592	405.5849	433.4339	457.8269 (73)

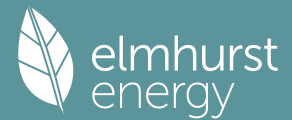
## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W						
North	2.5600	10.6334	0.5500	0.7500	0.7700	7.7816 (74)						
West	7.2000	19.6403	0.5500	0.7500	0.7700	40.4238 (80)						
Solar gains	48.2054	93.9485	155.4989	230.5211	287.4461	296.8140	281.5012	238.2197	181.8443	111.5341	60.0033	39.7297 (83)
Total gains	517.0079	561.0187	609.3180	658.8252	691.2336	678.0772	649.2163	608.5378	564.7035	517.1191	493.4372	497.5566 (84)

## 7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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)												
tau	51.3415	51.6175	51.8965	53.3377	53.6356	55.1765	55.1765	55.4954	54.5497	53.6356	53.0431	52.4635
alpha	4.4228	4.4412	4.4598	4.5558	4.5757	4.6784	4.6784	4.6997	4.6366	4.5757	4.5362	4.4976
util living area	0.7838	0.7274	0.6329	0.4961	0.3675	0.2520	0.1811	0.2008	0.3290	0.5359	0.7076	0.7961 (86)
MIT	20.6375	20.7469	20.8710	20.9622	20.9916	20.9990	20.9998	20.9997	20.9964	20.9566	20.8171	20.6275 (87)
Th 2	20.4834	20.4860	20.4886	20.5018	20.5045	20.5177	20.5177	20.5203	20.5124	20.5045	20.4992	20.4939 (88)
util rest of house	0.7698	0.7117	0.6150	0.4773	0.3483	0.2331	0.1613	0.1799	0.3061	0.5130	0.6895	0.7827 (89)
MIT 2	20.0657	20.1982	20.3460	20.4620	20.4963	20.5168	20.5176	20.5202	20.5092	20.4600	20.2957	20.0633 (90)
Living area fraction									fLA = Living area / (4) =			0.5626 (91)

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MIT	20.3874	20.5069	20.6414	20.7434	20.7750	20.7881	20.7889	20.7900	20.7833	20.7394	20.5890	20.3807 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3874	20.5069	20.6414	20.7434	20.7750	20.7881	20.7889	20.7900	20.7833	20.7394	20.5890	20.3807 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7671	0.7124	0.6204	0.4865	0.3588	0.2437	0.1724	0.1916	0.3188	0.5239	0.6928	0.7796 (94)
Useful gains	396.5981	399.6445	378.0182	320.4985	248.0067	165.2218	111.9336	116.6184	180.0550	270.9287	341.8420	387.8830 (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	462.0915	445.8924	401.8501	327.4566	249.5176	165.3918	111.9585	116.6585	180.6793	278.7844	375.0266	454.8318 (97)
Space heating kWh	48.7271	31.0787	17.7310	5.0098	1.1241	0.0000	0.0000	0.0000	0.0000	5.8446	23.8929	49.8099 (98a)
Space heating requirement - total per year (kWh/year)												183.2181
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	48.7271	31.0787	17.7310	5.0098	1.1241	0.0000	0.0000	0.0000	0.0000	5.8446	23.8929	49.8099 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												183.2181
Space heating per m2										(98c) / (4) =		3.4511 (99)

## 9b. Energy requirements

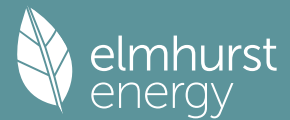
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	48.7271	31.0787	17.7310	5.0098	1.1241	0.0000	0.0000	0.0000	0.0000	5.8446	23.8929	49.8099 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	53.5999	34.1865	19.5041	5.5108	1.2365	0.0000	0.0000	0.0000	0.0000	6.4291	26.2822	54.7909
Space heating requirement	53.5999	34.1865	19.5041	5.5108	1.2365	0.0000	0.0000	0.0000	0.0000	6.4291	26.2822	54.7909 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	202.4896	179.1838	190.7982	168.9826	164.5926	149.1782	147.9405	153.3873	154.5762	171.3029	180.8101	200.4581 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	222.7386	197.1022	209.8780	185.8809	181.0519	164.0960	162.7345	168.7260	170.0338	188.4331	198.8911	220.5039
Water heating fuel	222.7386	197.1022	209.8780	185.8809	181.0519	164.0960	162.7345	168.7260	170.0338	188.4331	198.8911	220.5039 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	11.3458	10.2478	11.3458	10.9798	11.3458	10.9798	11.3458	11.3458	10.9798	11.3458	10.9798	11.3458 (331)
Lighting	15.1534	12.1567	10.9457	8.0193	6.1943	5.0608	5.6507	7.3450	9.5404	12.5175	14.1385	15.5746 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-24.1305	-34.5548	-50.5478	-57.8842	-63.3186	-59.5091	-58.8065	-55.0640	-48.5555	-39.9970	-26.7257	-20.7978 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-12.4327	-26.4586	-53.3650	-81.3794	-108.7298	-109.6419	-108.1091	-90.7710	-65.6625	-38.0005	-16.6435	-9.7994 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												201.5400 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2270.0700 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												2.0154 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												133.5877 (330a)
Total electricity for the above, kWh/year												133.5877 (331)
Electricity for lighting (calculated in Appendix L)												122.2970 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1260.8848 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												1466.6099 (338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	201.5400	4.4400	8.9484 (340a)
Space heating total			8.9484 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2270.0700	4.4400	100.7911 (342a)
Water heating total			100.7911 (342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (347a)
Pumps, fans and electric keep-hot	133.5877	16.4900	22.0286 (349)



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Energy for lighting	122.2970	16.4900	20.1668 (350)
Additional standing charges			92.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-539.8916	16.4900	-89.0281
PV Unit electricity exported	-720.9932	5.5900	-40.3035
Total			-129.3316 (352)
Total energy cost			114.6032 (355)

## 11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4206 (357)
SAP value		93.1820
SAP rating (Section 12)		93 (358)
SAP band		A

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			270.0000 (367)
Space and Water heating from Heat pump	915.4111	0.1584	11.8207 (367)
Electrical energy for heat distribution (space & water)	2.0154	0.0000	3.5135 (372)
Overall CO2 factor for heat network			0.0541 (386)
Total CO2 associated with community systems			133.6423 (373)
Space and water heating			133.6423 (376)
Pumps, fans and electric keep-hot	133.5877	0.1387	18.5303 (378)
Energy for lighting	122.2970	0.1443	17.6512 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-539.8916	0.1342	-72.4561
PV Unit electricity exported	-720.9932	0.1255	-90.4999
Total			-162.9561 (380)
Total CO2, kg/year			6.8678 (383)
CO2 emissions per m2			0.1300 (384)
EI value			99.9062 (384a)
EI rating			100 (385)
EI band			A

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	53.0900 (1b)	x 2.7500 (2b)	= 145.9975 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	53.0900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 145.9975 (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	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	3.0000 (17)																						
Infiltration rate	0.1500 (18)																						
Number of sides sheltered	2 (19)																						
Shelter factor	(20) = $1 - [0.075 \times (19)] =$	0.8500 (20)																					
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (21)																					
Wind speed																							
Jan	6.5000	Feb	6.2000	Mar	5.9000	Apr	5.2000	May	5.1000	Jun	4.7000	Jul	4.5000	Aug	4.5000	Sep	5.0000	Oct	5.7000	Nov	6.0000	Dec	6.0000 (22)
Wind factor	1.6250	1.5500	1.4750	1.3000	1.2750	1.1750	1.1250	1.1250	1.2500	1.4250	1.5000	1.5000	1.5000 (22a)										
Adj infilt rate	0.2072	0.1976	0.1881	0.1658	0.1626	0.1498	0.1434	0.1434	0.1594	0.1817	0.1913	0.1913 (22b)											
Balanced mechanical ventilation with heat recovery													0.5000 (23a)										
If mechanical ventilation													0.5000 (23b)										
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													81.0000 (23c)										
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =																							
Effective ac	0.3022	0.2926	0.2831	0.2607	0.2576	0.2448	0.2384	0.2384	0.2544	0.2767	0.2863	0.2863 (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						
Triple Glazing 1.0 (Uw = 1.00)			9.7600	0.9615	9.3846		(27)						
External Wall 1	41.9700	9.7600	32.2100	0.1500	4.8315		(29a)						
Total net area of external elements Aum(A, m2)			41.9700				(31)						
Fabric heat loss, W/K = Sum (A x U)					14.2161		(33)						
Party Floor 1			53.0900				(32d)						
Party Ceiling 1			53.0900				(32b)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)						
Thermal bridges (User defined value 0.050 * total exposed area)							2.0985 (36)						
Point Thermal bridges						(36a) =	0.0000						
Total fabric heat loss						(33) + (36) + (36a) =	16.3146 (37)						
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 14.5591	Feb 14.0984	Mar 13.6377	Apr 12.5627	May 12.4091	Jun 11.7949	Jul 11.4877	Aug 11.4877	Sep 12.2556	Oct 13.3306	Nov 13.7913	Dec 13.7913	(38)
Heat transfer coeff	30.8738	30.4130	29.9523	28.8773	28.7238	28.1095	27.8023	27.8023	28.5702	29.6452	30.1059	30.1059	(39)
Average = Sum(39)m / 12 =													29.2485
HLP	Jan 0.5815	Feb 0.5729	Mar 0.5642	Apr 0.5439	May 0.5410	Jun 0.5295	Jul 0.5237	Aug 0.5237	Sep 0.5381	Oct 0.5584	Nov 0.5671	Dec 0.5671	(40)
HLP (average)													0.5509
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy													1.7812 (42)
Hot water usage for mixer showers													
Hot water usage for baths	67.6058	66.5898	65.1093	62.2766	60.1862	57.8550	56.5299	57.9992	59.6098	62.1129	65.0063	67.3467	(42a)
Hot water usage for other uses	23.3814	23.0341	22.5451	21.6435	20.9684	20.2198	19.8154	20.3010	20.8297	21.6307	22.5509	23.3023	(42b)
Average daily hot water use (litres/day)	32.8714	31.6761	30.4808	29.2854	28.0901	26.8948	26.8948	28.0901	29.2854	30.4808	31.6761	32.8714	(42c)
Daily hot water use	123.8585	121.3000	118.1352	113.2056	109.2447	104.9696	103.2402	106.3903	109.7250	114.2244	119.2334	123.5205	(44)
Energy content (annual)	196.1617	172.7296	181.5694	154.9728	147.0644	129.0724	124.8600	131.7335	135.3019	155.0014	169.8698	193.4032	(45)
Distribution loss (46)m = 0.15 x (45)m	29.4242	25.9094	27.2354	23.2459	22.0597	19.3609	18.7290	19.7600	20.2953	23.2502	25.4805	29.0105	(46)
Water storage loss:													
Store volume													180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.2000 (48)
Temperature factor from Table 2b													0.6000 (49)
Enter (49) or (54) in (55)													0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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	241.7441	213.9008	227.1518	199.0848	192.6468	173.1844	170.4424	177.3159	179.4139	200.5838	213.9818	238.9856	(62)
WWHRS	-39.2544	-34.7170	-36.3536	-30.1022	-28.0542	-24.0062	-22.5019	-23.9286	-24.8377	-29.2809	-33.1717	-38.5275	(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	202.4896	179.1838	190.7982	168.9826	164.5926	149.1782	147.9405	153.3873	154.5762	171.3029	180.8101	200.4581	(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	101.6897	90.3695	96.8377	86.8181	85.3648	78.2062	77.9819	80.2673	80.2775	88.0039	91.7713	100.7725	(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	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	106.8728	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.3124	15.3767	12.5052	9.4672	7.0769	5.9746	6.4558	8.3914	11.2630	14.3009	16.6913	17.7936	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	231.7177	234.1222	228.0629	215.1634	198.8802	183.5762	173.3522	170.9477	177.0070	189.9064	206.1897	221.4937	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	47.4685	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	-71.2485	(71)
Water heating gains (Table 5)	136.6797	134.4785	130.1583	120.5806	114.7377	108.6197	104.8144	107.8862	111.4965	118.2848	127.4601	135.4469	(72)
Total internal gains	468.8025	467.0702	453.8191	428.3041	403.7875	381.2632	367.7151	370.3180	382.8592	405.5849	433.4339	457.8269	(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
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North	2.5600	11.7244	0.5500	0.7500	0.7700	8.5800 (74)
West	7.2000	21.7541	0.5500	0.7500	0.7700	44.7745 (80)

Solar gains	53.3545	98.5129	167.6321	251.2438	306.2914	325.9838	295.8753	252.7286	188.9608	114.2264	63.1696	41.2904 (83)
Total gains	522.1570	565.5831	621.4512	679.5479	710.0789	707.2470	663.5904	623.0466	571.8199	519.8113	496.6035	499.1174 (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	47.7662	48.4898	49.2356	51.0685	51.3415	52.4635	53.0431	53.0431	51.6175	49.7457	48.9845	48.9845
alpha	4.1844	4.2327	4.2824	4.4046	4.4228	4.4976	4.5362	4.5362	4.4412	4.3164	4.2656	4.2656
util living area	0.7841	0.7350	0.6454	0.5153	0.3924	0.2893	0.2385	0.2540	0.3717	0.5615	0.7108	0.7901 (86)
MIT	20.5955	20.7033	20.8400	20.9476	20.9861	20.9973	20.9991	20.9988	20.9916	20.9349	20.7862	20.6086 (87)
Th 2	20.4466	20.4545	20.4623	20.4807	20.4834	20.4939	20.4992	20.4992	20.4860	20.4676	20.4597	20.4597 (88)
util rest of house	0.7689	0.7184	0.6269	0.4960	0.3724	0.2695	0.2177	0.2318	0.3469	0.5364	0.6907	0.7751 (89)
MIT 2	19.9837	20.1183	20.2854	20.4251	20.4696	20.4915	20.4985	20.4982	20.4784	20.4010	20.2243	20.0116 (90)
Living area fraction									fLA = Living area / (4) =			0.5626 (91)
MIT	20.3279	20.4474	20.5974	20.7191	20.7602	20.7760	20.7801	20.7799	20.7671	20.7014	20.5404	20.3475 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3279	20.4474	20.5974	20.7191	20.7602	20.7760	20.7801	20.7799	20.7671	20.7014	20.5404	20.3475 (93)

## 8. Space heating requirement

Utilisation	0.7655	0.7182	0.6316	0.5049	0.3832	0.2806	0.2294	0.2442	0.3605	0.5475	0.6938	0.7718 (94)
Useful gains	399.7028	406.2013	392.5264	343.1123	272.0695	198.4277	152.2125	152.1603	206.1476	284.6039	344.5342	385.2381 (95)
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000 (96)
Heat loss rate W	473.2314	460.6793	422.2512	352.8538	274.6049	198.9039	152.3607	152.3538	207.6235	296.4931	383.5619	456.0295 (97)
Space heating kWh	54.7053	36.6092	22.1153	7.0139	1.8864	0.0000	0.0000	0.0000	0.0000	8.8455	28.0999	52.6688 (98a)
Space heating requirement - total per year (kWh/year)												211.9443
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	54.7053	36.6092	22.1153	7.0139	1.8864	0.0000	0.0000	0.0000	0.0000	8.8455	28.0999	52.6688 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												211.9443
Space heating per m2												(98c) / (4) = 3.9922 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	54.7053	36.6092	22.1153	7.0139	1.8864	0.0000	0.0000	0.0000	0.0000	8.8455	28.0999	52.6688 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	60.1758	40.2702	24.3268	7.7153	2.0750	0.0000	0.0000	0.0000	0.0000	9.7301	30.9099	57.9357
Space heating requirement	60.1758	40.2702	24.3268	7.7153	2.0750	0.0000	0.0000	0.0000	0.0000	9.7301	30.9099	57.9357 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	202.4896	179.1838	190.7982	168.9826	164.5926	149.1782	147.9405	153.3873	154.5762	171.3029	180.8101	200.4581 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	222.7386	197.1022	209.8780	185.8809	181.0519	164.0960	162.7345	168.7260	170.0338	188.4331	198.8911	220.5039
Water heating fuel	222.7386	197.1022	209.8780	185.8809	181.0519	164.0960	162.7345	168.7260	170.0338	188.4331	198.8911	220.5039 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	11.3458	10.2478	11.3458	10.9798	11.3458	10.9798	11.3458	11.3458	10.9798	11.3458	10.9798	11.3458 (331)
Lighting	15.1534	12.1567	10.9457	8.0193	6.1943	5.0608	5.6507	7.3450	9.5404	12.5175	14.1385	15.5746 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-26.0019	-35.5783	-52.7895	-60.4949	-65.1703	-62.0074	-60.0790	-56.5815	-49.4606	-40.4678	-27.6499	-21.3480 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-14.2240	-28.0090	-58.5923	-90.5796	-117.4966	-123.1949	-114.7786	-97.4825	-68.5926	-38.9309	-17.7311	-10.2629 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												233.1388 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2270.0700 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												2.3314 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												133.5877 (330a)
Total electricity for the above, kWh/year												133.5877 (331)
Electricity for lighting (calculated in Appendix L)												122.2970 (332)

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

PV generation	-1337.5038	(333)
Wind generation	0.0000	(334)
Hydro-electric generation (Appendix N)	0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(335)
Appendix Q - special features		
Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	1421.5897	(338)

## 10b. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Heat pump	233.1388	6.1900	14.4313	(340a)
Space heating total			14.4313	(340)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Heat pump	2270.0700	6.1900	140.5173	(342a)
Water heating total			140.5173	(342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(347a)
Pumps, fans and electric keep-hot	133.5877	25.1600	33.6107	(349)
Energy for lighting	122.2970	25.1600	30.7699	(350)
Additional standing charges			102.0000	(351)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-557.6289	25.1600	-140.2994	
PV Unit electricity exported	-779.8749	5.8100	-45.3107	
Total			-185.6102	(352)
Total energy cost			135.7191	(355)

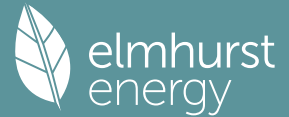
## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			270.0000	(367)
Space and Water heating from Heat pump	927.1144	0.1578	13.6242	(367)
Electrical energy for heat distribution (space & water)	2.3314	0.0000	3.5622	(372)
Overall CO2 factor for heat network			0.0541	(386)
Total CO2 associated with community systems			135.4945	(373)
Space and water heating			135.4945	(376)
Pumps, fans and electric keep-hot	133.5877	0.1387	18.5303	(378)
Energy for lighting	122.2970	0.1443	17.6512	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-557.6289	0.1343	-74.9003	
PV Unit electricity exported	-779.8749	0.1257	-97.9992	
Total			-172.8995	(380)
Total CO2, kg/year			-1.2235	(383)

## 13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Heat pump			270.0000	(467a)
Space and Water heating from Heat pump	927.1144	1.5841	136.7804	(467)
Electrical energy for heat distribution (space & water)	2.3314	0.0000	38.2050	(472)
Overall CO2 factor for heat network			0.5805	(486)
Total CO2 associated with community systems			1453.2048	(473)
Space and water heating			1453.2048	(476)
Pumps, fans and electric keep-hot	133.5877	1.5128	202.0915	(478)
Energy for lighting	122.2970	1.5338	187.5832	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-557.6289	1.4964	-834.4367	
PV Unit electricity exported	-779.8749	0.4613	-359.7271	
Total			-1194.1638	(480)
Total Primary energy kWh/year			648.7157	(483)

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Property Reference	Block B		Issued on Date	24/01/2024	
Assessment Reference	B-02.05 2b3P - proposed	Prop Type Ref	Block B		
Property					
SAP Rating	93 A	DER	0.22	TER	11.71
Environmental	100 A	% DER < TER			98.12
CO <sub>2</sub> Emissions (t/year)	0	DPER	11.21	TPER	62.47
Compliance Check	See BRWL	% DPER < TPER			82.06
Assessor Details	Mr. Oliver Fuller			Assessor ID	AW55-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	64.5000 (1b)	x 2.7500 (2b)	= 177.3750 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.5000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 177.3750 (5)

### 2. Ventilation rate

	m <sup>3</sup> 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)

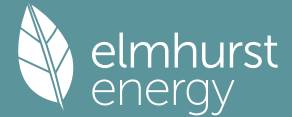
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	3.0000	(17)
Infiltration rate	0.1500	(18)
Number of sides sheltered	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (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) =												81.0000 (23c)
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
Triple Glazing 1.0 (Uw = 1.00)			11.2000	0.9615	10.7692		(27)					
External Wall 1	47.7400	11.2000	36.5400	0.1500	5.4810		(29a)					
Total net area of external elements Aum(A, m <sup>2</sup> )			47.7400				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	16.2502	(33)					
Party Floor 1			64.5000				(32d)					
Party Ceiling 1			64.5000				(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)					
Thermal bridges (User defined value 0.040 * total exposed area)							1.9096 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	18.1598 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	15.0761	14.8895	14.7029	13.7701	13.5835	12.6506	12.6506	12.4640	13.0238	13.5835	13.9566	14.3298 (38)
	33.2359	33.0494	32.8628	31.9299	31.7433	30.8104	30.8104	30.6239	31.1836	31.7433	32.1165	32.4896 (39)

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Average = Sum(39)m / 12 =

31.8833

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.5153	0.5124	0.5095	0.4950	0.4921	0.4777	0.4777	0.4748	0.4835	0.4921	0.4979	0.5037 (40)
HLP (average)												0.4943
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.1056 (42)
Hot water usage for mixer showers												74.4045 (42a)
Hot water usage for baths												25.7203 (42b)
Hot water usage for other uses												36.1934 (42c)
Average daily hot water use (litres/day)												125.3483 (43)
Daily hot water use	136.3182	133.5019	130.0185	124.5931	120.2337	115.5284	113.6253	117.0926	120.7629	125.7149	131.2277	135.9462 (44)
Energy content (annual)	215.8947	190.1050	199.8336	170.5617	161.8576	142.0556	137.4199	144.9851	148.9127	170.5939	186.9580	212.8589 (45)
Distribution loss (46)m = 0.15 x (45)m												2082.0367
Water storage loss:	32.3842	28.5157	29.9750	25.5843	24.2786	21.3083	20.6130	21.7478	22.3369	25.5891	28.0437	31.9288 (46)
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	261.4771	231.2762	245.4160	214.6737	207.4400	186.1676	183.0023	190.5675	193.0247	216.1763	231.0700	258.4413 (62)
WWHRS	-43.2020	-38.2082	-40.0095	-33.1294	-30.8754	-26.4203	-24.7648	-26.3349	-27.3355	-32.2255	-36.5076	-42.4020 (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	218.2751	193.0680	205.4066	181.5443	176.5646	159.7473	158.2375	164.2326	165.6892	183.9508	194.5624	216.0393 (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	108.2509	96.1469	102.9106	92.0014	90.2836	82.5231	82.1580	84.6735	84.8031	93.1884	97.4531	107.2415 (65)

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

Metabolic gains (Table 5), Watts	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.7515	18.4313	14.9893	11.3479	8.4827	7.1614	7.7382	10.0584	13.5004	17.1418	20.0070	21.3283 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	274.8314	277.6833	270.4966	255.1970	235.8841	217.7326	205.6063	202.7544	209.9411	225.2407	244.5536	262.7051 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239 (71)
Water heating gains (Table 5)	145.4985	143.0757	138.3207	127.7797	121.3489	114.6154	110.4275	113.8084	117.7820	125.2532	135.3516	144.1418 (72)
Total internal gains	532.9326	531.0414	515.6578	486.1758	457.5668	431.3606	415.6232	418.4724	433.0747	459.4869	491.7634	520.0263 (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						
North	4.0000	10.6334	0.5500	0.7500	0.7700	12.1588 (74)						
East	7.2000	19.6403	0.5500	0.7500	0.7700	40.4238 (76)						
Solar gains	52.5825	102.3135	169.7130	253.3526	318.2022	329.7393	312.2412	262.6080	198.9343	121.4915	65.4031	43.3787 (83)
Total gains	585.5151	633.3549	685.3708	739.5284	775.7691	761.1000	727.8644	681.0804	632.0090	580.9784	557.1665	563.4050 (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)												
tau	53.9075	54.2119	54.5196	56.1125	56.4423	58.1513	58.1513	58.5056	57.4554	56.4423	55.7865	55.1458
alpha	4.5938	4.6141	4.6346	4.7408	4.7628	4.8768	4.8768	4.9004	4.8304	4.7628	4.7191	4.6764
util living area	0.7986	0.7438	0.6501	0.5107	0.3782	0.2588	0.1862	0.2068	0.3392	0.5509	0.7233	0.8105 (86)
MIT	20.6456	20.7523	20.8743	20.9644	20.9925	20.9992	20.9999	20.9998	20.9968	20.9589	20.8227	20.6367 (87)
Th 2	20.5068	20.5095	20.5121	20.5254	20.5280	20.5413	20.5413	20.5440	20.5360	20.5280	20.5227	20.5174 (88)
util rest of house	0.7854	0.7288	0.6328	0.4922	0.3594	0.2403	0.1668	0.1863	0.3167	0.5286	0.7059	0.7979 (89)
MIT 2	20.0970	20.2268	20.3726	20.4877	20.5207	20.5406	20.5412	20.5439	20.5332	20.4856	20.3247	20.0960 (90)

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Living area fraction										FLA = Living area / (4) =	0.5730 (91)	
MIT	20.4114	20.5279	20.6601	20.7609	20.7910	20.8034	20.8041	20.8051	20.7988	20.7568	20.6101	20.4058 (92)
Temperature adjustment												0.0000
adjusted MIT	20.4114	20.5279	20.6601	20.7609	20.7910	20.8034	20.8041	20.8051	20.7988	20.7568	20.6101	20.4058 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.7827	0.7294	0.6381	0.5014	0.3699	0.2509	0.1779	0.1980	0.3295	0.5395	0.7092	0.7948	(94)
Useful gains	458.2881	461.9556	437.3504	370.8060	286.9411	190.9594	129.5052	134.8630	208.2271	313.4251	395.1219	447.8164	(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	535.4759	516.4931	465.3396	378.7160	288.5787	191.1289	129.5287	134.9017	208.8938	322.4112	433.8964	526.5218	(97)
Space heating kWh	57.4277	36.6492	20.8240	5.6952	1.2184	0.0000	0.0000	0.0000	0.0000	6.6856	27.9176	58.5568	(98a)
Space heating requirement - total per year (kWh/year)												214.9746	
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	57.4277	36.6492	20.8240	5.6952	1.2184	0.0000	0.0000	0.0000	0.0000	6.6856	27.9176	58.5568	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												214.9746	
Space heating per m2											(98c) / (4) =	3.3329	(99)

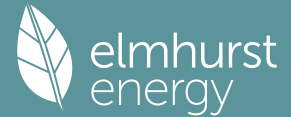
## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (301)
Fraction of space heat from community system													1.0000 (302)
Fraction of heat from community Heat pump-Space and Water													1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating													1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating													1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system													1.1000 (306)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating:													
Space heating requirement	57.4277	36.6492	20.8240	5.6952	1.2184	0.0000	0.0000	0.0000	0.0000	6.6856	27.9176	58.5568	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10	63.1705	40.3141	22.9064	6.2647	1.3402	0.0000	0.0000	0.0000	0.0000	7.3542	30.7094	64.4125	
307a	63.1705	40.3141	22.9064	6.2647	1.3402	0.0000	0.0000	0.0000	0.0000	7.3542	30.7094	64.4125	(307)
Space heating requirement	63.1705	40.3141	22.9064	6.2647	1.3402	0.0000	0.0000	0.0000	0.0000	7.3542	30.7094	64.4125	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)													0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating													
Annual water heating requirement	218.2751	193.0680	205.4066	181.5443	176.5646	159.7473	158.2375	164.2326	165.6892	183.9508	194.5624	216.0393	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10	240.1026	212.3747	225.9472	199.6987	194.2211	175.7221	174.0612	180.6558	182.2581	202.3459	214.0186	237.6432	
310a	240.1026	212.3747	225.9472	199.6987	194.2211	175.7221	174.0612	180.6558	182.2581	202.3459	214.0186	237.6432	
Water heating fuel	240.1026	212.3747	225.9472	199.6987	194.2211	175.7221	174.0612	180.6558	182.2581	202.3459	214.0186	237.6432	(310)
Cooling System Energy Efficiency Ratio	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	13.7842	12.4503	13.7842	13.3396	13.7842	13.3396	13.7842	13.7842	13.3396	13.7842	13.3396	13.7842	(331)
Lighting	18.1637	14.5716	13.1201	9.6123	7.4248	6.0662	6.7732	8.8041	11.4356	15.0041	16.9471	18.6685	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-24.9503	-36.1702	-53.5551	-62.0914	-68.5611	-64.6463	-63.8641	-59.4760	-51.9676	-42.1850	-27.7821	-21.4526	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)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	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)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	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-11.6128	-24.8431	-50.3577	-77.1722	-103.4873	-104.5047	-103.0516	-86.3590	-62.2504	-35.8125	-15.5871	-9.1445	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)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	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)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	(335b)
Annual totals kWh/year													
Space heating fuel - community heating													236.4721 (307)
Space heating fuel - secondary													0.0000 (309)
Water heating fuel - community heating													2439.0493 (310)
Efficiency of water heater													0.0000 (311)
Electricity used for heat distribution													2.3647 (313)
Space cooling fuel													0.0000 (321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)													
mechanical ventilation fans (SFP = 0.7500)													162.2981 (330a)
Total electricity for the above, kWh/year													162.2981 (331)
Electricity for lighting (calculated in Appendix L)													146.5913 (332)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-1260.8848 (333)
Wind generation													0.0000 (334)
Hydro-electric generation (Appendix N)													0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)													0.0000 (335)
Appendix Q - special features													
Energy saved or generated													-0.0000 (336)
Energy used													0.0000 (337)
Total delivered energy for all uses													1723.5260 (338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	236.4721	4.4400	10.4994 (340a)
Space heating total			10.4994 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2439.0493	4.4400	108.2938 (342a)
Water heating total			108.2938 (342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (347a)

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Pumps, fans and electric keep-hot	162.2981	16.4900	26.7630 (349)
Energy for lighting	146.5913	16.4900	24.1729 (350)
Additional standing charges			92.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-576.7018	16.4900	-95.0981
PV Unit electricity exported	-684.1829	5.5900	-38.2458
Total			-133.3440 (352)
Total energy cost			128.3851 (355)

## 11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4221 (357)
SAP value		93.1580
SAP rating (Section 12)		93 (358)
SAP band		A

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	891.8405	0.1584	12.4870 (367)
Electrical energy for heat distribution (space & water)	2.3647	0.0000	3.8079 (372)
Overall CO2 factor for heat network			0.0489 (386)
Total CO2 associated with community systems			130.7378 (373)
Space and water heating			130.7378 (376)
Pumps, fans and electric keep-hot	162.2981	0.1387	22.5128 (378)
Energy for lighting	146.5913	0.1443	21.1577 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-576.7018	0.1340	-77.2541
PV Unit electricity exported	-684.1829	0.1254	-85.7811
Total			-163.0352 (380)
Total CO2, kg/year			11.3731 (383)
CO2 emissions per m2			0.1800 (384)
EI value			99.8608 (384a)
EI rating			100 (385)
EI band			A

## SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	64.5000 (1b)	x 2.7500 (2b)	= 177.3750 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.5000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 177.3750 (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	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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.5000	6.2000	5.9000	5.2000	5.1000	4.7000	4.5000	4.5000	5.0000	5.7000	6.0000	6.0000 (22)
Wind factor	1.6250	1.5500	1.4750	1.3000	1.2750	1.1750	1.1250	1.1250	1.2500	1.4250	1.5000	1.5000 (22a)
Adj infilt rate	0.2072	0.1976	0.1881	0.1658	0.1626	0.1498	0.1434	0.1434	0.1594	0.1817	0.1913	0.1913 (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) =												81.0000 (23c)
Effective ac	0.3022	0.2926	0.2831	0.2607	0.2576	0.2448	0.2384	0.2384	0.2544	0.2767	0.2863	0.2863 (25)



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### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K						
Triple Glazing 1.0 (Uw = 1.00)			11.2000	0.9615	10.7692			(27)					
External Wall 1	47.7400	11.2000	36.5400	0.1500	5.4810			(29a)					
Total net area of external elements Aum(A, m <sup>2</sup> )			47.7400					(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	16.2502		(33)					
Party Floor 1			64.5000					(32d)					
Party Ceiling 1			64.5000					(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K								100.0000 (35)					
Thermal bridges (User defined value 0.040 * total exposed area)								1.9096 (36)					
Point Thermal bridges								0.0000 (36a) =					
Total fabric heat loss								(33) + (36) + (36a) = 18.1598 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	17.6882	17.1284	16.5687	15.2627	15.0761	14.3298	13.9566	13.9566	14.8895	16.1956	16.7553	16.7553	(38)
Average = Sum(39)m / 12 =	35.8480	35.2883	34.7285	33.4225	33.2359	32.4896	32.1165	32.1165	33.0494	34.3554	34.9151	34.9151	(39)
													33.8734
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	0.5558	0.5471	0.5384	0.5182	0.5153	0.5037	0.4979	0.4979	0.5124	0.5326	0.5413	0.5413	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	0.5252 (40)

### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy													2.1056 (42)
Hot water usage for mixer showers	74.4045	73.2863	71.6569	68.5394	66.2388	63.6731	62.2148	63.8319	65.6044	68.3592	71.5436	74.1194	(42a)
Hot water usage for baths	25.7203	25.3383	24.8004	23.8086	23.0659	22.2425	21.7976	22.3318	22.9134	23.7945	24.8068	25.6334	(42b)
Hot water usage for other uses	36.1934	34.8773	33.5612	32.2451	30.9289	29.6128	29.6128	30.9289	32.2451	33.5612	34.8773	36.1934	(42c)
Average daily hot water use (litres/day)													125.3483 (43)
Daily hot water use	136.3182	133.5019	130.0185	124.5931	120.2337	115.5284	113.6253	117.0926	120.7629	125.7149	131.2277	135.9462	(44)
Energy conte	215.8947	190.1050	199.8336	170.5617	161.8576	142.0556	137.4199	144.9851	148.9127	170.5939	186.9580	212.8589	(45)
Energy content (annual)													Total = Sum(45)m = 2082.0367
Distribution loss (46)m = 0.15 x (45)m	32.3842	28.5157	29.9750	25.5843	24.2786	21.3083	20.6130	21.7478	22.3369	25.5891	28.0437	31.9288	(46)
Water storage loss:													
Store volume													180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.2000 (48)
Temperature factor from Table 2b													0.6000 (49)
Enter (49) or (54) in (55)													0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	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	261.4771	231.2762	245.4160	214.6737	207.4400	186.1676	183.0023	190.5675	193.0247	216.1763	231.0700	258.4413	(62)
WWHRS	-43.2020	-38.2082	-40.0095	-33.1294	-30.8754	-26.4203	-24.7648	-26.3349	-27.3355	-32.2255	-36.5076	-42.4020	(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	218.2751	193.0680	205.4066	181.5443	176.5646	159.7473	158.2375	164.2326	165.6892	183.9508	194.5624	216.0393	(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	108.2509	96.1469	102.9106	92.0014	90.2836	82.5231	82.1580	84.6735	84.8031	93.1884	97.4531	107.2415	(65)

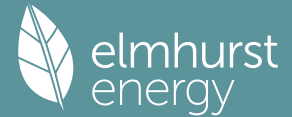
### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.7515	18.4313	14.9893	11.3479	8.4827	7.1614	7.7382	10.0584	13.5004	17.1418	20.0070	21.3283	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	274.8314	277.6833	270.4966	255.1970	235.8841	217.7326	205.6063	202.7544	209.9411	225.2407	244.5536	262.7051	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	(71)
Water heating gains (Table 5)	145.4985	143.0757	138.3207	127.7797	121.3489	114.6154	110.4275	113.8084	117.7820	125.2532	135.3516	144.1418	(72)
Total internal gains	532.9326	531.0414	515.6578	486.1758	457.5668	431.3606	415.6232	418.4724	433.0747	459.4869	491.7634	520.0263	(73)

### 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
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North	4.0000	11.7244	0.5500	0.7500	0.7700	13.4063 (74)
East	7.2000	21.7541	0.5500	0.7500	0.7700	44.7745 (76)

Solar gains	58.1808	107.2828	183.0270	276.3153	339.3172	362.4090	328.4281	278.8046	206.8295	124.4421	68.8385	45.0648 (83)
Total gains	591.1134	638.3242	698.6848	762.4911	796.8840	793.7696	744.0513	697.2770	639.9042	583.9290	560.6018	565.0911 (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	49.9795	50.7723	51.5906	53.6066	53.9075	55.1458	55.7865	55.7865	54.2119	52.1510	51.3149	51.3149
alpha	4.3320	4.3848	4.4394	4.5738	4.5938	4.6764	4.7191	4.7191	4.6141	4.4767	4.4210	4.4210
util living area	0.8000	0.7525	0.6642	0.5315	0.4047	0.2981	0.2458	0.2622	0.3844	0.5789	0.7281	0.8056 (86)
MIT	20.5992	20.7055	20.8415	20.9494	20.9871	20.9976	20.9992	20.9990	20.9922	20.9363	20.7888	20.6137 (87)
Th 2	20.4700	20.4778	20.4857	20.5042	20.5068	20.5174	20.5227	20.5227	20.5095	20.4910	20.4831	20.4831 (88)
util rest of house	0.7856	0.7367	0.6462	0.5126	0.3851	0.2785	0.2253	0.2403	0.3599	0.5543	0.7088	0.7914 (89)
MIT 2	20.0094	20.1428	20.3097	20.4503	20.4940	20.5153	20.5221	20.5219	20.5024	20.4255	20.2494	20.0390 (90)
Living area fraction	20.3474	20.4653	20.6144	20.7363	20.7766	20.7917	20.7955	20.7953	20.7831	20.7182	20.5585	20.5730 (91)
MIT	20.3474	20.4653	20.6144	20.7363	20.7766	20.7917	20.7955	20.7953	20.7831	20.7182	20.5585	20.3683 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3474	20.4653	20.6144	20.7363	20.7766	20.7917	20.7955	20.7953	20.7831	20.7182	20.5585	20.3683 (93)

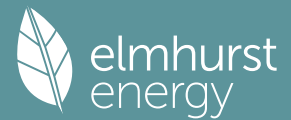
## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	462.3631	470.0180	454.6832	397.6407	315.4488	229.9025	176.3455	176.2881	239.0447	330.1473	398.9868	445.3765 (95)
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000 (96)
Heat loss rate W	550.1718	535.1555	490.1725	408.9690	318.2865	230.4058	176.4970	176.4897	240.7006	344.1801	445.4639	529.6025 (97)
Space heating kWh	65.3297	43.7724	26.4040	8.1563	2.1112	0.0000	0.0000	0.0000	0.0000	10.4404	33.4635	62.6641 (98a)
Space heating requirement - total per year (kWh/year)												252.3417
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	65.3297	43.7724	26.4040	8.1563	2.1112	0.0000	0.0000	0.0000	0.0000	10.4404	33.4635	62.6641 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												252.3417
Space heating per m2												(98c) / (4) = 3.9123 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	65.3297	43.7724	26.4040	8.1563	2.1112	0.0000	0.0000	0.0000	0.0000	10.4404	33.4635	62.6641 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10	71.8627	48.1497	29.0444	8.9720	2.3224	0.0000	0.0000	0.0000	0.0000	11.4844	36.8098	68.9305
307a	71.8627	48.1497	29.0444	8.9720	2.3224	0.0000	0.0000	0.0000	0.0000	11.4844	36.8098	68.9305 (307)
Space heating requirement	71.8627	48.1497	29.0444	8.9720	2.3224	0.0000	0.0000	0.0000	0.0000	11.4844	36.8098	68.9305 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	218.2751	193.0680	205.4066	181.5443	176.5646	159.7473	158.2375	164.2326	165.6892	183.9508	194.5624	216.0393 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10	240.1026	212.3747	225.9472	199.6987	194.2211	175.7221	174.0612	180.6558	182.2581	202.3459	214.0186	237.6432
310a	240.1026	212.3747	225.9472	199.6987	194.2211	175.7221	174.0612	180.6558	182.2581	202.3459	214.0186	237.6432 (310)
Water heating fuel	240.1026	212.3747	225.9472	199.6987	194.2211	175.7221	174.0612	180.6558	182.2581	202.3459	214.0186	237.6432 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	13.7842	12.4503	13.7842	13.3396	13.7842	13.3396	13.7842	13.3396	13.7842	13.3396	13.7842	13.3396 (331)
Lighting	18.1637	14.5716	13.1201	9.6123	7.4248	6.0662	6.7732	8.8041	11.4356	15.0041	16.9471	18.6685 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-26.9303	-37.2779	-56.0469	-65.0855	-70.7408	-67.6252	-65.3754	-61.2492	-52.9975	-42.7023	-28.7689	-22.0317 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-13.2956	-26.3094	-55.3348	-85.9890	-111.9261	-117.5771	-109.4821	-92.8148	-65.0557	-36.6963	-16.6121	-9.5793 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												277.5758 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2439.0493 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												2.7758 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												162.2981 (330a)
Total electricity for the above, kWh/year												162.2981 (331)

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Electricity for lighting (calculated in Appendix L)	146.5913 (332)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1337.5038 (333)
Wind generation	0.0000 (334)
Hydro-electric generation (Appendix N)	0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (335)
Appendix Q - special features	
Energy saved or generated	-0.0000 (336)
Energy used	0.0000 (337)
Total delivered energy for all uses	1688.0107 (338)

## 10b. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	277.5758	6.1900	17.1819 (340a)
Space heating total			17.1819 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2439.0493	6.1900	150.9772 (342a)
Water heating total			150.9772 (342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (347a)
Pumps, fans and electric keep-hot	162.2981	25.1600	40.8342 (349)
Energy for lighting	146.5913	25.1600	36.8824 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-596.8315	25.1600	-150.1628
PV Unit electricity exported	-740.6723	5.8100	-43.0331
Total			-193.1959 (352)
Total energy cost			154.6798 (355)

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	905.5417	0.1578	14.6022 (367)
Electrical energy for heat distribution (space & water)	2.7758	0.0000	3.8714 (372)
Overall CO2 factor for heat network			0.0489 (386)
Total CO2 associated with community systems			132.9165 (373)
Space and water heating			132.9165 (376)
Pumps, fans and electric keep-hot	162.2981	0.1387	22.5128 (378)
Energy for lighting	146.5913	0.1443	21.1577 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-596.8315	0.1341	-80.0144
PV Unit electricity exported	-740.6723	0.1255	-92.9652
Total			-172.9795 (380)
Total CO2, kg/year			3.6074 (383)

## 13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			300.0000 (467a)
Space and Water heating from Heat pump	905.5417	1.5842	146.5784 (467)
Electrical energy for heat distribution (space & water)	2.7758	0.0000	41.4827 (472)
Overall CO2 factor for heat network			0.5243 (486)
Total CO2 associated with community systems			1424.2404 (473)
Space and water heating			1424.2404 (476)
Pumps, fans and electric keep-hot	162.2981	1.5128	245.5246 (478)
Energy for lighting	146.5913	1.5338	224.8466 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-596.8315	1.4954	-892.5306
PV Unit electricity exported	-740.6723	0.4607	-341.2438
Total			-1233.7744 (480)
Total Primary energy kWh/year			660.8372 (483)

## SAP 10 EPC IMPROVEMENTS

### B-02.05 2b3P - proposed

Current energy efficiency rating:	A 93
Current environmental impact rating:	A 100

N Solar water heating	Not applicable
U Solar photovoltaic panels	Not applicable
V2 Wind turbine	Not applicable

Recommended measures: (none)	SAP change	Cost change	CO2 change
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Recommended measures (none)	Typical annual savings	Energy efficiency	Environmental impact
	Total Savings	£0	0.00 kg/m²

Potential energy efficiency rating:	A 93
Potential environmental impact rating:	A 100

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Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Wales):

	Current	Potential	Saving
Electricity	£78	£78	£0
Community scheme	£270	£270	£0
Space heating	£160	£160	£0
Water heating	£151	£151	£0
Lighting	£37	£37	£0
Generated (PV)	-£193	-£193	£0
Total cost of fuels	£155	£155	£0
Total cost of uses	£155	£155	£0
Delivered energy	26 kWh/m <sup>2</sup>	26 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.0 tonnes	0.0 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	0 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	10 kWh/m <sup>2</sup>	10 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	64.5000 (1b)	x 2.7500 (2b)	= 177.3750 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.5000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 177.3750 (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	0 * 10 =											0.0000 (7a)	
Number of passive vents	0 * 10 =											0.0000 (7b)	
Number of flueless gas fires	0 * 40 =											0.0000 (7c)	
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												3.0000 (17)	
Infiltration rate												0.1500 (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) =											0.1275 (21)	
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(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) =													81.0000 (23c)
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448	(25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K						
Triple Glazing 1.0 (Uw = 1.00)			11.2000	0.9615	10.7692		(27)						
External Wall 1	47.7400	11.2000	36.5400	0.1500	5.4810		(29a)						
Total net area of external elements Aum(A, m <sup>2</sup> )			47.7400				(31)						
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	16.2502	(33)						
Party Floor 1			64.5000				(32a)						
Party Ceiling 1			64.5000				(32b)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K								100.0000 (35)					
Thermal bridges (User defined value 0.040 * total exposed area)								1.9096 (36)					
Point Thermal bridges								0.0000 (36a)					
Total fabric heat loss								(33) + (36) + (36a) = 18.1598 (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	15.0761	14.8895	14.7029	13.7701	13.5835	12.6506	12.6506	12.4640	13.0238	13.5835	13.9566	14.3298	(38)
Heat transfer coeff	33.2359	33.0494	32.8628	31.9299	31.7433	30.8104	30.8104	30.6239	31.1836	31.7433	32.1165	32.4896	(39)
Average = Sum(39)m / 12 =													31.8833

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.5153	0.5124	0.5095	0.4950	0.4921	0.4777	0.4777	0.4748	0.4835	0.4921	0.4979	0.5037 (40)
HLP (average)												0.4943
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.1056 (42)
Hot water usage for mixer showers	74.4045	73.2863	71.6569	68.5394	66.2388	63.6731	62.2148	63.8319	65.6044	68.3592	71.5436	74.1194 (42a)
Hot water usage for baths	25.7203	25.3383	24.8004	23.8086	23.0659	22.2425	21.7976	22.3318	22.9134	23.7945	24.8068	25.6334 (42b)
Hot water usage for other uses	36.1934	34.8773	33.5612	32.2451	30.9289	29.6128	29.6128	30.9289	32.2451	33.5612	34.8773	36.1934 (42c)
Average daily hot water use (litres/day)												125.3483 (43)
Daily hot water use	136.3182	133.5019	130.0185	124.5931	120.2337	115.5284	113.6253	117.0926	120.7629	125.7149	131.2277	135.9462 (44)
Energy conte	215.8947	190.1050	199.8336	170.5617	161.8576	142.0556	137.4199	144.9851	148.9127	170.5939	186.9580	212.8589 (45)
Energy content (annual)												Total = Sum(45)m = 2082.0367
Distribution loss (46)m = 0.15 x (45)m	32.3842	28.5157	29.9750	25.5843	24.2786	21.3083	20.6130	21.7478	22.3369	25.5891	28.0437	31.9288 (46)
Water storage loss:												180.0000 (47)
Store volume												1.2000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.6000 (49)
Temperature factor from Table 2b												0.7200 (55)
Enter (49) or (54) in (55)												0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	261.4771	231.2762	245.4160	214.6737	207.4400	186.1676	183.0023	190.5675	193.0247	216.1763	231.0700	258.4413 (62)
WWHRS	-43.2020	-38.2082	-40.0095	-33.1294	-30.8754	-26.4203	-24.7648	-26.3349	-27.3355	-32.2255	-36.5076	-42.4020 (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	218.2751	193.0680	205.4066	181.5443	176.5646	159.7473	158.2375	164.2326	165.6892	183.9508	194.5624	216.0393 (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	108.2509	96.1469	102.9106	92.0014	90.2836	82.5231	82.1580	84.6735	84.8031	93.1884	97.4531	107.2415 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.7515	18.4313	14.9893	11.3479	8.4827	7.1614		7.7382	10.0584	13.5004	17.1418	20.0070 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	274.8314	277.6833	270.4966	255.1970	235.8841	217.7326	205.6063	202.7544	209.9411	225.2407	244.5536	262.7051 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239 (71)
Water heating gains (Table 5)	145.4985	143.0757	138.3207	127.7797	121.3489	114.6154	110.4275	113.8084	117.7820	125.2532	135.3516	144.1418 (72)
Total internal gains	532.9326	531.0414	515.6578	486.1758	457.5668	431.3606	415.6232	418.4724	433.0747	459.4869	491.7634	520.0263 (73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W						
North	4.0000	10.6334	0.5500	0.7500	0.7700	12.1588 (74)						
East	7.2000	19.6403	0.5500	0.7500	0.7700	40.4238 (76)						
Solar gains	52.5825	102.3135	169.7130	253.3526	318.2022	329.7393	312.2412	262.6080	198.9343	121.4915	65.4031	43.3787 (83)
Total gains	585.5151	633.3549	685.3708	739.5284	775.7691	761.1000	727.8644	681.0804	632.0090	580.9784	557.1665	563.4050 (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)												
tau	53.9075	54.2119	54.5196	56.1125	56.4423	58.1513	58.1513	58.5056	57.4554	56.4423	55.7865	55.1458
alpha	4.5938	4.6141	4.6346	4.7408	4.7628	4.8768	4.8768	4.9004	4.8304	4.7628	4.7191	4.6764
util living area	0.7986	0.7438	0.6501	0.5107	0.3782	0.2588	0.1862	0.2068	0.3392	0.5509	0.7233	0.8105 (86)
MIT	20.6456	20.7523	20.8743	20.9644	20.9925	20.9992	20.9999	20.9998	20.9968	20.9589	20.8227	20.6367 (87)
Th 2	20.5068	20.5095	20.5121	20.5254	20.5280	20.5413	20.5413	20.5440	20.5360	20.5280	20.5227	20.5174 (88)
util rest of house	0.7854	0.7288	0.6328	0.4922	0.3594	0.2403	0.1668	0.1863	0.3167	0.5286	0.7059	0.7979 (89)
MIT 2	20.0970	20.2268	20.3726	20.4877	20.5207	20.5406	20.5412	20.5439	20.5332	20.4856	20.3247	20.0960 (90)
Living area fraction												fLA = Living area / (4) = 0.5730 (91)

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MIT	20.4114	20.5279	20.6601	20.7609	20.7910	20.8034	20.8041	20.8051	20.7988	20.7568	20.6101	20.4058 (92)
Temperature adjustment												0.0000
adjusted MIT	20.4114	20.5279	20.6601	20.7609	20.7910	20.8034	20.8041	20.8051	20.7988	20.7568	20.6101	20.4058 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7827	0.7294	0.6381	0.5014	0.3699	0.2509	0.1779	0.1980	0.3295	0.5395	0.7092	0.7948 (94)
Useful gains	458.2881	461.9556	437.3504	370.8060	286.9411	190.9594	129.5052	134.8630	208.2271	313.4251	395.1219	447.8164 (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												
535.4759	516.4931	465.3396	378.7160	288.5787	191.1289	129.5287	134.9017	208.8938	322.4112	433.8964	526.5218 (97)	
Space heating kWh												
57.4277	36.6492	20.8240	5.6952	1.2184	0.0000	0.0000	0.0000	0.0000	6.6856	27.9176	58.5568 (98a)	
Space heating requirement - total per year (kWh/year)												214.9746
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												
57.4277	36.6492	20.8240	5.6952	1.2184	0.0000	0.0000	0.0000	0.0000	6.6856	27.9176	58.5568 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												214.9746
Space heating per m2										(98c) / (4) =		3.3329 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement												
57.4277	36.6492	20.8240	5.6952	1.2184	0.0000	0.0000	0.0000	0.0000	6.6856	27.9176	58.5568 (98)	
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	63.1705	40.3141	22.9064	6.2647	1.3402	0.0000	0.0000	0.0000	0.0000	7.3542	30.7094	64.4125
Space heating requirement												
63.1705	40.3141	22.9064	6.2647	1.3402	0.0000	0.0000	0.0000	0.0000	7.3542	30.7094	64.4125 (307)	
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)	
Water heating												
Annual water heating requirement												
218.2751	193.0680	205.4066	181.5443	176.5646	159.7473	158.2375	164.2326	165.6892	183.9508	194.5624	216.0393 (64)	
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	240.1026	212.3747	225.9472	199.6987	194.2211	175.7221	174.0612	180.6558	182.2581	202.3459	214.0186	237.6432
Water heating fuel												
240.1026	212.3747	225.9472	199.6987	194.2211	175.7221	174.0612	180.6558	182.2581	202.3459	214.0186	237.6432 (310)	
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)	
Pumps and Fa	13.7842	12.4503	13.7842	13.3396	13.7842	13.3396	13.7842	13.7842	13.3396	13.7842	13.3396	13.7842 (331)
Lighting	18.1637	14.5716	13.1201	9.6123	7.4248	6.0662	6.7732	8.8041	11.4356	15.0041	16.9471	18.6685 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-24.9503	-36.1702	-53.5551	-62.0914	-68.5611	-64.6463	-63.8641	-59.4760	-51.9676	-42.1850	-27.7821	-21.4526 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)	
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-11.6128	-24.8431	-50.3577	-77.1722	-103.4873	-104.5047	-103.0516	-86.3590	-62.2504	-35.8125	-15.5871	-9.1445 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)	
Annual totals kWh/year												
Space heating fuel - community heating												236.4721 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2439.0493 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												2.3647 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												162.2981 (330a)
Total electricity for the above, kWh/year												162.2981 (331)
Electricity for lighting (calculated in Appendix L)												146.5913 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1260.8848 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												1723.5260 (338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	236.4721	4.4400	10.4994 (340a)
Space heating total			10.4994 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2439.0493	4.4400	108.2938 (342a)
Water heating total			108.2938 (342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (347a)
Pumps, fans and electric keep-hot	162.2981	16.4900	26.7630 (349)

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Energy for lighting	146.5913	16.4900	24.1729 (350)
Additional standing charges			92.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-576.7018	16.4900	-95.0981
PV Unit electricity exported	-684.1829	5.5900	-38.2458
Total			-133.3440 (352)
Total energy cost			128.3851 (355)

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 11b. SAP rating - Community heating scheme  
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Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4221 (357)
SAP value		93.1580
SAP rating (Section 12)		93 (358)
SAP band		A

-----  
 12b. Carbon dioxide emissions - Community heating scheme  
 -----

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	891.8405	0.1584	12.4870 (367)
Electrical energy for heat distribution (space & water)	2.3647	0.0000	3.8079 (372)
Overall CO2 factor for heat network			0.0489 (386)
Total CO2 associated with community systems			130.7378 (373)
Space and water heating			130.7378 (376)
Pumps, fans and electric keep-hot	162.2981	0.1387	22.5128 (378)
Energy for lighting	146.5913	0.1443	21.1577 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-576.7018	0.1340	-77.2541
PV Unit electricity exported	-684.1829	0.1254	-85.7811
Total			-163.0352 (380)
Total CO2, kg/year			11.3731 (383)
CO2 emissions per m2			0.1800 (384)
EI value			99.8608 (384a)
EI rating			100 (385)
EI band			A

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING  
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 1. Overall dwelling characteristics  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	64.5000 (1b)	x 2.7500 (2b)	= 177.3750 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.5000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 177.3750 (5)

-----  
 2. Ventilation rate  
 -----

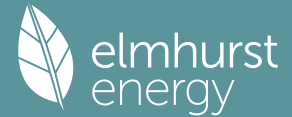
	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number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

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			3.0000 (17)
Infiltration rate			0.1500 (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) =	0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.5000	6.2000	5.9000	5.2000	5.1000	4.7000	4.5000	4.5000	5.0000	5.7000	6.0000	6.0000 (22)
Wind factor	1.6250	1.5500	1.4750	1.3000	1.2750	1.1750	1.1250	1.1250	1.2500	1.4250	1.5000	1.5000 (22a)
Adj infilt rate	0.2072	0.1976	0.1881	0.1658	0.1626	0.1498	0.1434	0.1434	0.1594	0.1817	0.1913	0.1913 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.3022	0.2926	0.2831	0.2607	0.2576	0.2448	0.2384	0.2384	0.2544	0.2767	0.2863	0.2863 (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						
Triple Glazing 1.0 (Uw = 1.00)			11.2000	0.9615	10.7692			(27)					
External Wall 1	47.7400	11.2000	36.5400	0.1500	5.4810			(29a)					
Total net area of external elements Aum(A, m2)			47.7400					(31)					
Fabric heat loss, W/K = Sum (A x U)								(33)					
Party Floor 1			64.5000					(32d)					
Party Ceiling 1			64.5000					(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)					
Thermal bridges (User defined value 0.040 * total exposed area)								1.9096 (36)					
Point Thermal bridges								(36a) = 0.0000					
Total fabric heat loss								(33) + (36) + (36a) = 18.1598 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	17.6882	17.1284	16.5687	15.2627	15.0761	14.3298	13.9566	13.9566	14.8895	16.1956	16.7553	16.7553	(38)
Average = Sum(39)m / 12 =	35.8480	35.2883	34.7285	33.4225	33.2359	32.4896	32.1165	32.1165	33.0494	34.3554	34.9151	34.9151	(39)
HLP	0.5558	0.5471	0.5384	0.5182	0.5153	0.5037	0.4979	0.4979	0.5124	0.5326	0.5413	0.5413	(40)
HLP (average)													0.5252
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy													2.1056 (42)
Hot water usage for mixer showers	74.4045	73.2863	71.6569	68.5394	66.2388	63.6731	62.2148	63.8319	65.6044	68.3592	71.5436	74.1194	(42a)
Hot water usage for baths	25.7203	25.3383	24.8004	23.8086	23.0659	22.2425	21.7976	22.3318	22.9134	23.7945	24.8068	25.6334	(42b)
Hot water usage for other uses	36.1934	34.8773	33.5612	32.2451	30.9289	29.6128	29.6128	30.9289	32.2451	33.5612	34.8773	36.1934	(42c)
Average daily hot water use (litres/day)													125.3483 (43)
Daily hot water use	136.3182	133.5019	130.0185	124.5931	120.2337	115.5284	113.6253	117.0926	120.7629	125.7149	131.2277	135.9462	(44)
Energy conte	215.8947	190.1050	199.8336	170.5617	161.8576	142.0556	137.4199	144.9851	148.9127	170.5939	186.9580	212.8589	(45)
Energy content (annual)													Total = Sum(45)m = 2082.0367
Distribution loss (46)m = 0.15 x (45)m	32.3842	28.5157	29.9750	25.5843	24.2786	21.3083	20.6130	21.7478	22.3369	25.5891	28.0437	31.9288	(46)
Water storage loss:													180.0000 (47)
Store volume													1.2000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.6000 (49)
Temperature factor from Table 2b													0.7200 (55)
Enter (49) or (54) in (55)													
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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	261.4771	231.2762	245.4160	214.6737	207.4400	186.1676	183.0023	190.5675	193.0247	216.1763	231.0700	258.4413	(62)
WWHRS	-43.2020	-38.2082	-40.0095	-33.1294	-30.8754	-26.4203	-24.7648	-26.3349	-27.3355	-32.2255	-36.5076	-42.4020	(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	218.2751	193.0680	205.4066	181.5443	176.5646	159.7473	158.2375	164.2326	165.6892	183.9508	194.5624	216.0393	(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	108.2509	96.1469	102.9106	92.0014	90.2836	82.5231	82.1580	84.6735	84.8031	93.1884	97.4531	107.2415	(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	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	126.3359	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.7515	18.4313	14.9893	11.3479	8.4827	7.1614	7.7382	10.0584	13.5004	17.1418	20.0070	21.3283	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	274.8314	277.6833	270.4966	255.1970	235.8841	217.7326	205.6063	202.7544	209.9411	225.2407	244.5536	262.7051	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	49.7392	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	-84.2239	(71)
Water heating gains (Table 5)	145.4985	143.0757	138.3207	127.7797	121.3489	114.6154	110.4275	113.8084	117.7820	125.2532	135.3516	144.1418	(72)
Total internal gains	532.9326	531.0414	515.6578	486.1758	457.5668	431.3606	415.6232	418.4724	433.0747	459.4869	491.7634	520.0263	(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
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North		4.0000	11.7244	0.5500	0.7500	0.7700	13.4063 (74)
East		7.2000	21.7541	0.5500	0.7500	0.7700	44.7745 (76)

Solar gains	58.1808	107.2828	183.0270	276.3153	339.3172	362.4090	328.4281	278.8046	206.8295	124.4421	68.8385	45.0648 (83)
Total gains	591.1134	638.3242	698.6848	762.4911	796.8840	793.7696	744.0513	697.2770	639.9042	583.9290	560.6018	565.0911 (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	49.9795	50.7723	51.5906	53.6066	53.9075	55.1458	55.7865	55.7865	54.2119	52.1510	51.3149	51.3149
alpha	4.3320	4.3848	4.4394	4.5738	4.5938	4.6764	4.7191	4.7191	4.6141	4.4767	4.4210	4.4210
util living area	0.8000	0.7525	0.6642	0.5315	0.4047	0.2981	0.2458	0.2622	0.3844	0.5789	0.7281	0.8056 (86)
MIT	20.5992	20.7055	20.8415	20.9494	20.9871	20.9976	20.9992	20.9990	20.9922	20.9363	20.7888	20.6137 (87)
Th 2	20.4700	20.4778	20.4857	20.5042	20.5068	20.5174	20.5227	20.5227	20.5095	20.4910	20.4831	20.4831 (88)
util rest of house	0.7856	0.7367	0.6462	0.5126	0.3851	0.2785	0.2253	0.2403	0.3599	0.5543	0.7088	0.7914 (89)
MIT 2	20.0094	20.1428	20.3097	20.4503	20.4940	20.5153	20.5221	20.5219	20.5024	20.4255	20.2494	20.0390 (90)
Living area fraction	20.3474	20.4653	20.6144	20.7363	20.7766	20.7917	20.7955	20.7953	20.7831	20.7182	20.5585	20.3683 (91)
MIT	20.3474	20.4653	20.6144	20.7363	20.7766	20.7917	20.7955	20.7953	20.7831	20.7182	20.5585	20.3683 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3474	20.4653	20.6144	20.7363	20.7766	20.7917	20.7955	20.7953	20.7831	20.7182	20.5585	20.3683 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7822	0.7363	0.6508	0.5215	0.3959	0.2896	0.2370	0.2528	0.3736	0.5654	0.7117	0.7881 (94)
Useful gains	462.3631	470.0180	454.6832	397.6407	315.4488	229.9025	176.3455	176.2881	239.0447	330.1473	398.9868	445.3765 (95)
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000 (96)
Heat loss rate W	550.1718	535.1555	490.1725	408.9690	318.2865	230.4058	176.4970	176.4897	240.7006	344.1801	445.4639	529.6025 (97)
Space heating kWh	65.3297	43.7724	26.4040	8.1563	2.1112	0.0000	0.0000	0.0000	0.0000	10.4404	33.4635	62.6641 (98a)
Space heating requirement - total per year (kWh/year)												252.3417
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	65.3297	43.7724	26.4040	8.1563	2.1112	0.0000	0.0000	0.0000	0.0000	10.4404	33.4635	62.6641 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												252.3417
Space heating per m2										(98c) / (4) =		3.9123 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (301)

Fraction of space heat from community system 1.0000 (302)

Fraction of heat from community Heat pump-Space and Water 1.0000 (303a)

Factor for control and charging method (Table 4c(3)) for space heating 1.0000 (305)

Factor for charging method (Table 4c(3)) for water heating 1.0000 (305a)

Distribution loss factor (Table 12c) for community heating system 1.1000 (306)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

Space heating:

Space heating requirement 65.3297 43.7724 26.4040 8.1563 2.1112 0.0000 0.0000 0.0000 0.0000 10.4404 33.4635 62.6641 (98)

Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10

307a 71.8627 48.1497 29.0444 8.9720 2.3224 0.0000 0.0000 0.0000 0.0000 11.4844 36.8098 68.9305

Space heating requirement 71.8627 48.1497 29.0444 8.9720 2.3224 0.0000 0.0000 0.0000 0.0000 11.4844 36.8098 68.9305 (307)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0.0000 (308)

Space heating fuel for secondary/supplementary system 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (309)

Water heating

Annual water heating requirement 218.2751 193.0680 205.4066 181.5443 176.5646 159.7473 158.2375 164.2326 165.6892 183.9508 194.5624 216.0393 (64)

Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10

310a 240.1026 212.3747 225.9472 199.6987 194.2211 175.7221 174.0612 180.6558 182.2581 202.3459 214.0186 237.6432

Water heating fuel 240.1026 212.3747 225.9472 199.6987 194.2211 175.7221 174.0612 180.6558 182.2581 202.3459 214.0186 237.6432 (310)

Cooling System Energy Efficiency Ratio

Space coolin 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (314)

Pumps and Fa 13.7842 12.4503 13.7842 13.3396 13.7842 13.3396 13.7842 13.7842 13.3396 13.7842 13.3396 13.7842 (315)

Lighting 18.1637 14.5716 13.1201 9.6123 7.4248 6.0662 6.7732 8.8041 11.4356 15.0041 16.9471 18.6685 (332)

Electricity generated by PVs (Appendix M) (negative quantity)

(333a)m -26.9303 -37.2779 -56.0469 -65.0855 -70.7408 -67.6252 -65.3754 -61.2492 -52.9975 -42.7023 -28.7689 -22.0317 (333a)

Electricity generated by wind turbines (Appendix M) (negative quantity)

(334a)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 (334a)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(335a)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 (335a)

Electricity generated by PVs (Appendix M) (negative quantity)

(333b)m -13.2956 -26.3094 -55.3348 -85.9890 -111.9261 -117.5771 -109.4821 -92.8148 -65.0557 -36.6963 -16.6121 -9.5793 (333b)

Electricity generated by wind turbines (Appendix M) (negative quantity)

(334b)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 (334b)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(335b)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 (335b)

Annual totals kWh/year

Space heating fuel - community heating 277.5758 (307)

Space heating fuel - secondary 0.0000 (309)

Water heating fuel - community heating 2439.0493 (310)

Efficiency of water heater 0.0000 (311)

Electricity used for heat distribution 2.7758 (313)

Space cooling fuel 0.0000 (321)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)

mechanical ventilation fans (SFP = 0.7500) 162.2981 (330a)

Total electricity for the above, kWh/year 162.2981 (331)

Electricity for lighting (calculated in Appendix L) 146.5913 (332)

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Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation		-1337.5038 (333)
Wind generation		0.0000 (334)
Hydro-electric generation (Appendix N)		0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)		0.0000 (335)
Appendix Q - special features		
Energy saved or generated		-0.0000 (336)
Energy used		0.0000 (337)
Total delivered energy for all uses		1688.0107 (338)

-----  
 10b. Fuel costs - using BEDF prices (535)  
 -----

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	277.5758	6.1900	17.1819 (340a)
Space heating total			17.1819 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2439.0493	6.1900	150.9772 (342a)
Water heating total			150.9772 (342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (347a)
Pumps, fans and electric keep-hot	162.2981	25.1600	40.8342 (349)
Energy for lighting	146.5913	25.1600	36.8824 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-596.8315	25.1600	-150.1628
PV Unit electricity exported	-740.6723	5.8100	-43.0331
Total			-193.1959 (352)
Total energy cost			154.6798 (355)

-----  
 12b. Carbon dioxide emissions - Community heating scheme  
 -----

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	905.5417	0.1578	14.6022 (367)
Electrical energy for heat distribution (space & water)	2.7758	0.0000	3.8714 (372)
Overall CO2 factor for heat network			0.0489 (386)
Total CO2 associated with community systems			132.9165 (373)
Space and water heating			132.9165 (376)
Pumps, fans and electric keep-hot	162.2981	0.1387	22.5128 (378)
Energy for lighting	146.5913	0.1443	21.1577 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-596.8315	0.1341	-80.0144
PV Unit electricity exported	-740.6723	0.1255	-92.9652
Total			-172.9795 (380)
Total CO2, kg/year			3.6074 (383)

-----  
 13b. Primary energy - Community heating scheme  
 -----

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			300.0000 (467a)
Space and Water heating from Heat pump	905.5417	1.5842	146.5784 (467)
Electrical energy for heat distribution (space & water)	2.7758	0.0000	41.4827 (472)
Overall CO2 factor for heat network			0.5243 (486)
Total CO2 associated with community systems			1424.2404 (473)
Space and water heating			1424.2404 (476)
Pumps, fans and electric keep-hot	162.2981	1.5128	245.5246 (478)
Energy for lighting	146.5913	1.5338	224.8466 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-596.8315	1.4954	-892.5306
PV Unit electricity exported	-740.6723	0.4607	-341.2438
Total			-1233.7744 (480)
Total Primary energy kWh/year			660.8372 (483)

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Property Reference	Block B		Issued on Date	24/01/2024	
Assessment Reference	B-03.02 2b3P - proposed	Prop Type Ref	Block B		
Property					
SAP Rating	93 A	DER	0.59	TER	12.85
Environmental	100 A	% DER < TER			95.41
CO <sub>2</sub> Emissions (t/year)	0.02	DPER	16.25	TPER	68.69
Compliance Check	See BRWL	% DPER < TPER			76.34
Assessor Details	Mr. Oliver Fuller			Assessor ID	AW55-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	58.3000 (1b)	x 2.7500 (2b)	= 160.3250 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 160.3250 (5)

### 2. Ventilation rate

	m <sup>3</sup> 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)

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		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (21)

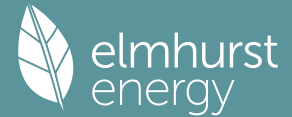
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Triple Glazing 1.0 (Uw = 1.00)			10.0800	0.9615	9.6923		(27)
External Wall 1	45.7000	10.0800	35.6200	0.1500	5.3430		(29a)
External Roof 1	58.3000		58.3000	0.1000	5.8300		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			104.0000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	20.8653		(33)
Party Floor 1			53.0900				(32d)
Party Ceiling 1			53.0900				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)							5.2000 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	26.0653 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	13.6269	13.4583	13.2896	12.4464	12.2778	11.4346	11.4346	11.2659	11.7719	12.2778	12.6151	12.9524 (38)
Heat transfer coeff												

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Average = Sum(39)m / 12 =	39.6922	39.5236	39.3549	38.5117	38.3431	37.4999	37.4999	37.3312	37.8372	38.3431	38.6804	39.0177 (39)
	38.4696											
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.6808	0.6779	0.6750	0.6606	0.6577	0.6432	0.6432	0.6403	0.6490	0.6577	0.6635	0.6693 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.9332 (42)
Hot water usage for mixer showers	70.7908	69.7270	68.1768	65.2107	63.0218	60.5807	59.1932	60.7317	62.4182	65.0392	68.0690	70.5196 (42a)	
Hot water usage for baths	24.4771	24.1136	23.6017	22.6578	21.9511	21.1674	20.7441	21.2524	21.8059	22.6445	23.6078	24.3944 (42b)	
Hot water usage for other uses	34.4277	33.1758	31.9239	30.6720	29.4201	28.1681	28.1681	29.4201	30.6720	31.9239	33.1758	34.4277 (42c)	
Average daily hot water use (litres/day)													119.2589 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	129.6957	127.0164	123.7024	118.5405	114.3929	109.9162	108.1054	111.4042	114.8961	119.6075	124.8525	129.3417 (44)	
Energy content (annual)	205.4063	180.8697	190.1259	162.2760	153.9948	135.1548	130.7442	137.9416	141.6783	162.3062	177.8753	202.5179 (45)	
Distribution loss (46)m = 0.15 x (45)m													1980.8911
Water storage loss:	30.8109	27.1305	28.5189	24.3414	23.0992	20.2732	19.6116	20.6912	21.2518	24.3459	26.6813	30.3777 (46)	
Store volume													180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.2000 (48)
Temperature factor from Table 2b													0.6000 (49)
Enter (49) or (54) in (55)													0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)	
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	250.9887	222.0409	235.7083	206.3880	199.5772	179.2668	176.3266	183.5240	185.7903	207.8886	221.9873	248.1003 (62)	
WWHRS	-41.1038	-36.3526	-38.0663	-31.5204	-29.3759	-25.1372	-23.5621	-25.0559	-26.0079	-30.6604	-34.7345	-40.3426 (63a)	
FV 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	209.8849	185.6883	197.6420	174.8676	170.2013	154.1297	152.7645	158.4681	159.7825	177.2282	187.2528	207.7576 (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)	
Heat gains from water heating, kWh/month	104.7635	93.0761	99.6828	89.2464	87.6692	80.2286	79.9383	82.3315	82.3976	90.4327	94.4331	103.8031 (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	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.0209	16.8942	13.7393	10.4015	7.7753	6.5642	7.0928	9.2195	12.3745	15.7122	18.3385	19.5495 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	251.7016	254.3134	247.7316	233.7196	216.0321	199.4082	188.3025	185.6906	192.2724	206.2844	223.9720	240.5958 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273 (71)
Water heating gains (Table 5)	140.8112	138.5061	133.9822	123.9533	117.8349	111.4286	107.4440	110.6606	114.4412	121.5494	131.1571	139.5203 (72)
Total internal gains	498.7295	496.9097	482.6490	455.2704	428.8382	404.5969	390.0353	392.7667	406.2840	430.7419	460.6635	486.8616 (73)

## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
South	7.2000	46.7521	0.5500	0.7500	0.7700	96.2256 (78)						
West	2.8800	19.6403	0.5500	0.7500	0.7700	16.1695 (80)						
Solar gains	112.3951	189.2237	252.8369	302.8583	329.5362	322.8426	313.0521	293.8401	270.2868	207.5113	134.2216	96.4448 (83)
Total gains	611.1246	686.1334	735.4859	758.1286	758.3744	727.4395	703.0874	686.6068	676.5709	638.2533	594.8851	583.3064 (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	40.8000	40.9741	41.1497	42.0507	42.2356	43.1853	43.1853	43.3804	42.8004	42.2356	41.8673	41.5054	
alpha	3.7200	3.7316	3.7433	3.8034	3.8157	3.8790	3.8790	3.8920	3.8534	3.8157	3.7912	3.7670	
util living area	0.8189	0.7580	0.6798	0.5735	0.4558	0.3269	0.2340	0.2493	0.3798	0.5813	0.7495	0.8337 (86)	
MIT	20.3217	20.5138	20.7041	20.8685	20.9540	20.9907	20.9981	20.9975	20.9825	20.8830	20.6139	20.2898 (87)	
Th 2	20.3578	20.3604	20.3629	20.3758	20.3784	20.3913	20.3913	20.3938	20.3861	20.3784	20.3732	20.3681 (88)	
util rest of house	0.8044	0.7408	0.6591	0.5492	0.4279	0.2966	0.2019	0.2167	0.3475	0.5529	0.7295	0.8200 (89)	

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MIT 2	19.5764	19.8088	20.0363	20.2375	20.3339	20.3836	20.3900	20.3922	20.3711	20.2592	19.9442	19.5467 (90)
Living area fraction									FLA = Living area / (4) =			0.6504 (91)
MIT	20.0612	20.2674	20.4707	20.6479	20.7373	20.7785	20.7855	20.7859	20.7688	20.6649	20.3798	20.0300 (92)
Temperature adjustment												0.0000
adjusted MIT	20.0612	20.2674	20.4707	20.6479	20.7373	20.7785	20.7855	20.7859	20.7688	20.6649	20.3798	20.0300 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7973	0.7381	0.6627	0.5599	0.4441	0.3159	0.2227	0.2378	0.3677	0.5662	0.7297	0.8122 (94)
Useful gains	487.2245	506.4690	487.4076	424.4801	336.8170	229.8194	156.5926	163.2600	248.7608	361.3688	434.0748	473.7685 (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												
625.5957	607.3734	549.8145	452.4330	346.5165	231.6926	156.9558	163.7312	252.3279	385.9212	513.6673	617.6513 (97)	
Space heating kWh												
102.9482	67.8078	46.4307	20.1261	7.2164	0.0000	0.0000	0.0000	0.0000	18.2669	57.3066	107.0488 (98a)	
Space heating requirement - total per year (kWh/year)												427.1514
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												
102.9482	67.8078	46.4307	20.1261	7.2164	0.0000	0.0000	0.0000	0.0000	18.2669	57.3066	107.0488 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												427.1514
Space heating per m2												7.3268 (99)
										(98c) / (4) =		

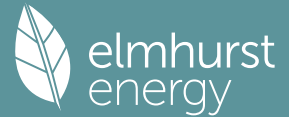
## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement												
102.9482	67.8078	46.4307	20.1261	7.2164	0.0000	0.0000	0.0000	0.0000	18.2669	57.3066	107.0488 (98)	
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	113.2430	74.5886	51.0738	22.1387	7.9380	0.0000	0.0000	0.0000	0.0000	20.0936	63.0372	117.7537
Space heating requirement												
113.2430	74.5886	51.0738	22.1387	7.9380	0.0000	0.0000	0.0000	0.0000	20.0936	63.0372	117.7537 (307)	
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)	
Water heating												
Annual water heating requirement												
209.8849	185.6883	197.6420	174.8676	170.2013	154.1297	152.7645	158.4681	159.7825	177.2282	187.2528	207.7576 (64)	
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	230.8734	204.2572	217.4062	192.3543	187.2214	169.5426	168.0409	174.3150	175.7607	194.9511	205.9781	228.5334
Water heating fuel												
230.8734	204.2572	217.4062	192.3543	187.2214	169.5426	168.0409	174.3150	175.7607	194.9511	205.9781	228.5334 (310)	
Cooling System Energy Efficiency Ratio												
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (314)	
Pumps and Fa	12.4592	11.2535	12.4592	12.0573	12.4592	12.0573	12.4592	12.4592	12.0573	12.4592	12.0573	12.4592 (331)
Lighting	16.6489	13.3563	12.0259	8.8107	6.8056	5.5603	6.2083	8.0698	10.4819	13.7528	15.5338	17.1116 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-24.5343	-35.3475	-52.0176	-59.9318	-65.8615	-61.9974	-61.2567	-57.2063	-50.2183	-41.0685	-27.2453	-21.1206 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)	
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-12.0288	-25.6659	-51.8952	-79.3318	-106.1870	-107.1536	-105.6589	-88.6287	-63.9998	-36.9290	-16.1239	-9.4765 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)	
Annual totals kWh/year												
Space heating fuel - community heating												469.8665 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2349.2343 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												4.6987 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												146.6974 (330a)
Total electricity for the above, kWh/year												146.6974 (331)
Electricity for lighting (calculated in Appendix L)												134.3659 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1260.8848 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												1839.2793 (338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	469.8665	4.4400	20.8621 (340a)
Space heating total			20.8621 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2349.2343	4.4400	104.3060 (342a)
Water heating total			104.3060 (342)

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Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (347a)
Pumps, fans and electric keep-hot	146.6974	16.4900	24.1904 (349)
Energy for lighting	134.3659	16.4900	22.1569 (350)
Additional standing charges			92.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-557.8057	16.4900	-91.9822
PV Unit electricity exported	-703.0790	5.5900	-39.3021
Total			-131.2843 (352)
Total energy cost			132.2311 (355)

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**11b. SAP rating - Community heating scheme**  
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Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4608 (357)
SAP value		92.5300
SAP rating (Section 12)		93 (358)
SAP band		A

-----  
**12b. Carbon dioxide emissions - Community heating scheme**  
 -----

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			270.0000 (367)
Space and Water heating from Heat pump			27.3577 (367)
Electrical energy for heat distribution (space & water)	1044.1114	0.1572	4.0449 (372)
Overall CO2 factor for heat network	4.6987	0.0000	0.0546 (386)
Total CO2 associated with community systems			153.8572 (373)
Space and water heating			153.8572 (376)
Pumps, fans and electric keep-hot	146.6974	0.1387	20.3487 (378)
Energy for lighting	134.3659	0.1443	19.3932 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-557.8057	0.1341	-74.7923
PV Unit electricity exported	-703.0790	0.1254	-88.2011
Total			-162.9933 (380)
Total CO2, kg/year			30.6058 (383)
CO2 emissions per m2			0.5200 (384)
EI value			99.6030 (384a)
EI rating			100 (385)
EI band			A

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY  
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-----  
**1. Overall dwelling characteristics**  
 -----

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	58.3000 (1b)	x 2.7500 (2b)	= 160.3250 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	160.3250 (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	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (21)
Wind speed	Jan 6.5000 Feb 6.2000 Mar 5.9000 Apr 5.2000 May 5.1000 Jun 4.7000 Jul 4.5000 Aug 4.5000 Sep 5.0000 Oct 5.7000 Nov 6.0000 Dec 6.0000 (22)	
Wind factor	1.6250 1.5500 1.4750 1.3000 1.2750 1.1750 1.1250 1.1250 1.2500 1.4250 1.5000 1.5000 (22a)	
Adj infilt rate	0.2072 0.1976 0.1881 0.1658 0.1626 0.1498 0.1434 0.1434 0.1594 0.1817 0.1913 0.1913 (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) =		81.0000 (23c)

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Effective ac 0.3022 0.2926 0.2831 0.2607 0.2576 0.2448 0.2384 0.2384 0.2544 0.2767 0.2863 0.2863 (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						
Triple Glazing 1.0 (Uw = 1.00)			10.0800	0.9615	9.6923			(27)					
External Wall 1	45.7000	10.0800	35.6200	0.1500	5.3430			(29a)					
External Roof 1	58.3000		58.3000	0.1000	5.8300			(30)					
Total net area of external elements Aum(A, m2)			104.0000					(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	20.8653		(33)					
Party Floor 1			53.0900					(32d)					
Party Ceiling 1			53.0900					(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)								5.2000 (36)					
Point Thermal bridges								(36a) = 0.0000					
Total fabric heat loss								(33) + (36) + (36a) = 26.0653 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 15.9879	Feb 15.4820	Mar 14.9761	Apr 13.7956	May 13.6269	Jun 12.9524	Jul 12.6151	Aug 12.6151	Sep 13.4583	Oct 14.6388	Nov 15.1447	Dec 15.1447	(38)
Heat transfer coeff	42.0532	41.5473	41.0414	39.8609	39.6922	39.0177	38.6804	38.6804	39.5236	40.7041	41.2100	41.2100	(39)
Average = Sum(39)m / 12 =													40.2684
HLP	Jan 0.7213	Feb 0.7126	Mar 0.7040	Apr 0.6837	May 0.6808	Jun 0.6693	Jul 0.6635	Aug 0.6635	Sep 0.6779	Oct 0.6982	Nov 0.7069	Dec 0.7069	(40)
HLP (average)													0.6907
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.9332 (42)
Hot water usage for mixer showers													
Hot water usage for baths	70.7908	69.7270	68.1768	65.2107	63.0218	60.5807	59.1932	60.7317	62.4182	65.0392	68.0690	70.5196	(42a)
Hot water usage for other uses	24.4771	24.1136	23.6017	22.6578	21.9511	21.1674	20.7441	21.2524	21.8059	22.6445	23.6078	24.3944	(42b)
Average daily hot water use (litres/day)	34.4277	33.1758	31.9239	30.6720	29.4201	28.1681	28.1681	29.4201	30.6720	31.9239	33.1758	34.4277	(42c)
Daily hot water use	129.6957	127.0164	123.7024	118.5405	114.3929	109.9162	108.1054	111.4042	114.8961	119.6075	124.8525	129.3417	(44)
Energy content (annual)	205.4063	180.8697	190.1259	162.2760	153.9948	135.1548	130.7442	137.9416	141.6783	162.3062	177.8753	202.5179	(45)
Distribution loss (46)m = 0.15 x (45)m	30.8109	27.1305	28.5189	24.3414	23.0992	20.2732	19.6116	20.6912	21.2518	24.3459	26.6813	30.3777	(46)
Water storage loss:													
Store volume													180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.2000 (48)
Temperature factor from Table 2b													0.6000 (49)
Enter (49) or (54) in (55)													0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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	250.9887	222.0409	235.7083	206.3880	199.5772	179.2668	176.3266	183.5240	185.7903	207.8886	221.9873	248.1003	(62)
WWHRS	-41.1038	-36.3526	-38.0663	-31.5204	-29.3759	-25.1372	-23.5621	-25.0559	-26.0079	-30.6604	-34.7345	-40.3426	(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	209.8849	185.6883	197.6420	174.8676	170.2013	154.1297	152.7645	158.4681	159.7825	177.2282	187.2528	207.7576	(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)
Heat gains from water heating, kWh/month	104.7635	93.0761	99.6828	89.2464	87.6692	80.2286	79.9383	82.3315	82.3976	90.4327	94.4331	103.8031	(65)

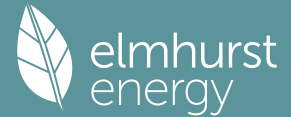
### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.0209	16.8942	13.7393	10.4015	7.7753	6.5642	7.0928	9.2195	12.3745	15.7122	18.3385	19.5495	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	251.7016	254.3134	247.7316	233.7196	216.0321	199.4082	188.3025	185.6906	192.2724	206.2844	223.9720	240.5958	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	(71)
Water heating gains (Table 5)	140.8112	138.5061	133.9822	123.9533	117.8349	111.4286	107.4440	110.6606	114.4412	121.5494	131.1571	139.5203	(72)
Total internal gains	498.7295	496.9097	482.6490	455.2704	428.8382	404.5969	390.0353	392.7667	406.2840	430.7419	460.6635	486.8616	(73)

### 6. Solar gains

[Jan] Area Solar flux g FF Access Gains

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	m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	factor Table 6d	W
South	7.2000	50.7747	0.5500	0.7500	0.7700	104.5049 (78)
West	2.8800	21.7541	0.5500	0.7500	0.7700	17.9098 (80)

Solar gains	122.4147	195.0182	267.8599	325.1529	347.0501	351.0741	325.5305	307.4880	276.1927	208.8184	138.9911	98.6784 (83)
Total gains	621.1442	691.9279	750.5089	780.4233	775.8882	755.6710	715.5658	700.2547	682.4767	639.5604	599.6546	585.5400 (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	38.5094	38.9783	39.4588	40.6274	40.8000	41.5054	41.8673	41.8673	40.9741	39.7858	39.2974	39.2974
alpha	3.5673	3.5986	3.6306	3.7085	3.7200	3.7670	3.7912	3.7912	3.7316	3.6524	3.6198	3.6198
util living area	0.8112	0.7589	0.6855	0.5887	0.4814	0.3709	0.3057	0.3121	0.4232	0.5994	0.7439	0.8231 (86)
MIT	20.3057	20.4756	20.6666	20.8381	20.9354	20.9809	20.9926	20.9920	20.9682	20.8510	20.5954	20.3009 (87)
Th 2	20.3220	20.3297	20.3373	20.3552	20.3578	20.3681	20.3732	20.3732	20.3604	20.3424	20.3348	20.3348 (88)
util rest of house	0.7951	0.7407	0.6644	0.5645	0.4532	0.3402	0.2728	0.2786	0.3896	0.5693	0.7217	0.8076 (89)
MIT 2	19.5290	19.7377	19.9696	20.1838	20.2944	20.3514	20.3675	20.3671	20.3320	20.1912	19.8906	19.5349 (90)
Living area fraction									FLA = Living area / (4) =			
MIT	20.0342	20.2177	20.4229	20.6094	20.7113	20.7609	20.7741	20.7736	20.7458	20.6204	20.3490	20.0332 (92)
Temperature adjustment												0.0000
adjusted MIT	20.0342	20.2177	20.4229	20.6094	20.7113	20.7609	20.7741	20.7736	20.7458	20.6204	20.3490	20.0332 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7879	0.7376	0.6672	0.5742	0.4688	0.3594	0.2938	0.3001	0.4099	0.5822	0.7222	0.8001 (94)
Useful gains	489.4067	510.3490	500.7427	448.0891	363.7740	271.5547	210.2608	210.1294	279.7652	372.3436	433.0835	468.4711 (95)
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000 (96)
Heat loss rate W	632.2367	619.7894	571.4162	482.6905	377.5256	275.4991	211.7391	211.7191	286.3796	403.8003	517.1446	611.2745 (97)
Space heating kWh	106.2655	73.5439	52.5811	24.9130	10.2312	0.0000	0.0000	0.0000	0.0000	23.4038	60.5240	106.2458 (98a)
Space heating requirement - total per year (kWh/year)												457.7082
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	106.2655	73.5439	52.5811	24.9130	10.2312	0.0000	0.0000	0.0000	0.0000	23.4038	60.5240	106.2458 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												457.7082
Space heating per m2										(98c) / (4) =		7.8509 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	106.2655	73.5439	52.5811	24.9130	10.2312	0.0000	0.0000	0.0000	0.0000	23.4038	60.5240	106.2458 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	116.8921	80.8983	57.8392	27.4043	11.2543	0.0000	0.0000	0.0000	0.0000	25.7441	66.5764	116.8703
Space heating requirement	116.8921	80.8983	57.8392	27.4043	11.2543	0.0000	0.0000	0.0000	0.0000	25.7441	66.5764	116.8703 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	209.8849	185.6883	197.6420	174.8676	170.2013	154.1297	152.7645	158.4681	159.7825	177.2282	187.2528	207.7576 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	230.8734	204.2572	217.4062	192.3543	187.2214	169.5426	168.0409	174.3150	175.7607	194.9511	205.9781	228.5334
Water heating fuel	230.8734	204.2572	217.4062	192.3543	187.2214	169.5426	168.0409	174.3150	175.7607	194.9511	205.9781	228.5334 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	12.4592	11.2535	12.4592	12.0573	12.4592	12.0573	12.4592	12.4592	12.0573	12.4592	12.0573	12.4592 (331)
Lighting	16.6489	13.3563	12.0259	8.8107	6.8056	5.5603	6.2083	8.0698	10.4819	13.7528	15.5338	17.1116 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-26.4590	-36.4121	-54.3807	-62.7274	-67.8706	-64.7257	-62.6436	-58.8467	-51.1836	-41.5619	-28.2002	-21.6850 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-13.7669	-27.1752	-57.0011	-88.3471	-114.7964	-120.4766	-112.2140	-95.2174	-66.8695	-37.8367	-17.1808	-9.9259 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												503.4790 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2349.2343 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												5.0348 (313)
Space cooling fuel												0.0000 (321)

Electricity for pumps and fans:  
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)



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mechanical ventilation fans (SFP = 0.7500) 146.6974 (330a)  
 Total electricity for the above, kWh/year 146.6974 (331)  
 Electricity for lighting (calculated in Appendix L) 134.3659 (332)

Energy saving/generation technologies (Appendices M ,N and Q)  
 PV generation -1337.5038 (333)  
 Wind generation 0.0000 (334)  
 Hydro-electric generation (Appendix N) 0.0000 (335a)  
 Electricity generated - Micro CHP (Appendix N) 0.0000 (335)  
 Appendix Q - special features  
 Energy saved or generated -0.0000 (336)  
 Energy used 0.0000 (337)  
 Total delivered energy for all uses 1796.2728 (338)

## 10b. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	503.4790	6.1900	31.1654 (340a)
Space heating total			31.1654 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2349.2343	6.1900	145.4176 (342a)
Water heating total			145.4176 (342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (347a)
Pumps, fans and electric keep-hot	146.6974	25.1600	36.9091 (349)
Energy for lighting	134.3659	25.1600	33.8065 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-576.6963	25.1600	-145.0968
PV Unit electricity exported	-760.8075	5.8100	-44.2029
Total			-189.2997 (352)
Total energy cost			159.9988 (355)

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			270.0000 (367)
Space and Water heating from Heat pump	1056.5605	0.1566	29.2056 (367)
Electrical energy for heat distribution (space & water)	5.0348	0.0000	4.0948 (372)
Overall CO2 factor for heat network			0.0546 (386)
Total CO2 associated with community systems			155.7549 (373)
Space and water heating			155.7549 (376)
Pumps, fans and electric keep-hot	146.6974	0.1387	20.3487 (378)
Energy for lighting	134.3659	0.1443	19.3932 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-576.6963	0.1342	-77.3890
PV Unit electricity exported	-760.8075	0.1256	-95.5481
Total			-172.9371 (380)
Total CO2, kg/year			22.5597 (383)

## 13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			270.0000 (467a)
Space and Water heating from Heat pump	1056.5605	1.5798	294.5900 (467)
Electrical energy for heat distribution (space & water)	5.0348	0.0000	43.6715 (472)
Overall CO2 factor for heat network			0.5823 (486)
Total CO2 associated with community systems			1661.1336 (473)
Space and water heating			1661.1336 (476)
Pumps, fans and electric keep-hot	146.6974	1.5128	221.9238 (478)
Energy for lighting	134.3659	1.5338	206.0949 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-576.6963	1.4959	-862.6973
PV Unit electricity exported	-760.8075	0.4610	-350.7275
Total			-1213.4248 (480)
Total Primary energy kWh/year			875.7275 (483)

## SAP 10 EPC IMPROVEMENTS

B-03.02 2b3P - proposed

Current energy efficiency rating: A 93  
 Current environmental impact rating: A 100

N Solar water heating Not applicable  
 U Solar photovoltaic panels Not applicable  
 V2 Wind turbine Not applicable

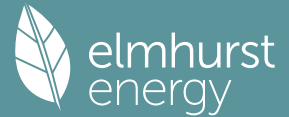
Recommended measures: (none) SAP change Cost change CO2 change

Recommended measures (none) Typical annual savings Energy Environmental efficiency impact

Total Savings £0 0.00 kg/m²

Potential energy efficiency rating: A 93

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Potential environmental impact rating:

A 100

Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)  
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Wales):

	Current	Potential	Saving
Electricity	£71	£71	£0
Community scheme	£279	£279	£0
Space heating	£170	£170	£0
Water heating	£145	£145	£0
Lighting	£34	£34	£0
Generated (PV)	-£189	-£189	£0
Total cost of fuels	£161	£161	£0
Total cost of uses	£160	£160	£0
Delivered energy	31 kWh/m <sup>2</sup>	31 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.0 tonnes	0.0 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	0 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	15 kWh/m <sup>2</sup>	15 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	58.3000 (1b)	x 2.7500 (2b)	= 160.3250 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 160.3250 (5)

## 2. Ventilation rate

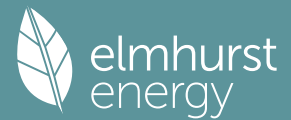
		m <sup>3</sup> per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (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)
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		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (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) =												81.0000 (23c)
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
Triple Glazing 1.0 (Uw = 1.00)			10.0800	0.9615	9.6923		(27)					
External Wall 1	45.7000	10.0800	35.6200	0.1500	5.3430		(29a)					
External Roof 1	58.3000		58.3000	0.1000	5.8300		(30)					
Total net area of external elements Aum(A, m <sup>2</sup> )			104.0000				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	20.8653	(33)					
Party Floor 1			53.0900				(32a)					
Party Ceiling 1			53.0900				(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)							5.2000 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	26.0653 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 13.6269	Feb 13.4583	Mar 13.2896	Apr 12.4464	May 12.2778	Jun 11.4346	Jul 11.4346	Aug 11.2659	Sep 11.7719	Oct 12.2778	Nov 12.6151	Dec 12.9524 (38)

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Heat transfer coeff	39.6922	39.5236	39.3549	38.5117	38.3431	37.4999	37.4999	37.3312	37.8372	38.3431	38.6804	39.0177 (39)
Average = Sum(39)m / 12 =												38.4696
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.6808	0.6779	0.6750	0.6606	0.6577	0.6432	0.6432	0.6403	0.6490	0.6577	0.6635	0.6693 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.9332 (42)
Hot water usage for mixer showers	70.7908	69.7270	68.1768	65.2107	63.0218	60.5807	59.1932	60.7317	62.4182	65.0392	68.0690	70.5196 (42a)
Hot water usage for baths	24.4771	24.1136	23.6017	22.6578	21.9511	21.1674	20.7441	21.2524	21.8059	22.6445	23.6078	24.3944 (42b)
Hot water usage for other uses	34.4277	33.1758	31.9239	30.6720	29.4201	28.1681	28.1681	29.4201	30.6720	31.9239	33.1758	34.4277 (42c)
Average daily hot water use (litres/day)												119.2589 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	129.6957	127.0164	123.7024	118.5405	114.3929	109.9162	108.1054	111.4042	114.8961	119.6075	124.8525	129.3417 (44)
Energy content (annual)	205.4063	180.8697	190.1259	162.2760	153.9948	135.1548	130.7442	137.9416	141.6783	162.3062	177.8753	202.5179 (45)
Distribution loss (46)m = 0.15 x (45)m												1980.8911
Water storage loss:	30.8109	27.1305	28.5189	24.3414	23.0992	20.2732	19.6116	20.6912	21.2518	24.3459	26.6813	30.3777 (46)
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	250.9887	222.0409	235.7083	206.3880	199.5772	179.2668	176.3266	183.5240	185.7903	207.8886	221.9873	248.1003 (62)
WWHRS	-41.1038	-36.3526	-38.0663	-31.5204	-29.3759	-25.1372	-23.5621	-25.0559	-26.0079	-30.6604	-34.7345	-40.3426 (63a)
FV 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	209.8849	185.6883	197.6420	174.8676	170.2013	154.1297	152.7645	158.4681	159.7825	177.2282	187.2528	207.7576 (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	104.7635	93.0761	99.6828	89.2464	87.6692	80.2286	79.9383	82.3315	82.3976	90.4327	94.4331	103.8031 (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	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.0209	16.8942	13.7393	10.4015	7.7753	6.5642	7.0928	9.2195	12.3745	15.7122	18.3385	19.5495 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	251.7016	254.3134	247.7316	233.7196	216.0321	199.4082	188.3025	185.6906	192.2724	206.2844	223.9720	240.5958 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273 (71)
Water heating gains (Table 5)	140.8112	138.5061	133.9822	123.9533	117.8349	111.4286	107.4440	110.6606	114.4412	121.5494	131.1571	139.5203 (72)
Total internal gains	498.7295	496.9097	482.6490	455.2704	428.8382	404.5969	390.0353	392.7667	406.2840	430.7419	460.6635	486.8616 (73)

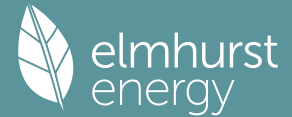
## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
South	7.2000	46.7521	0.5500	0.7500	0.7700	96.2256 (78)						
West	2.8800	19.6403	0.5500	0.7500	0.7700	16.1695 (80)						
Solar gains	112.3951	189.2237	252.8369	302.8583	329.5362	322.8426	313.0521	293.8401	270.2868	207.5113	134.2216	96.4448 (83)
Total gains	611.1246	686.1334	735.4859	758.1286	758.3744	727.4395	703.0874	686.6068	676.5709	638.2533	594.8851	583.3064 (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	40.8000	40.9741	41.1497	42.0507	42.2356	43.1853	43.1853	43.3804	42.8004	42.2356	41.8673	41.5054
alpha	3.7200	3.7316	3.7433	3.8034	3.8157	3.8790	3.8790	3.8920	3.8534	3.8157	3.7912	3.7670
util living area	0.8189	0.7580	0.6798	0.5735	0.4558	0.3269	0.2340	0.2493	0.3798	0.5813	0.7495	0.8337 (86)
MIT	20.3217	20.5138	20.7041	20.8685	20.9540	20.9907	20.9981	20.9975	20.9825	20.8830	20.6139	20.2898 (87)
Th 2	20.3578	20.3604	20.3629	20.3758	20.3784	20.3913	20.3913	20.3938	20.3861	20.3784	20.3732	20.3681 (88)
util rest of house												

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MIT 2	0.8044	0.7408	0.6591	0.5492	0.4279	0.2966	0.2019	0.2167	0.3475	0.5529	0.7295	0.8200 (89)
Living area fraction	19.5764	19.8088	20.0363	20.2375	20.3339	20.3836	20.3900	20.3922	20.3711	20.2592	19.9442	19.5467 (90)
MIT	20.0612	20.2674	20.4707	20.6479	20.7373	20.7785	20.7855	20.7859	20.7688	20.6649	20.3798	20.0300 (91)
Temperature adjustment												0.0000 (92)
adjusted MIT	20.0612	20.2674	20.4707	20.6479	20.7373	20.7785	20.7855	20.7859	20.7688	20.6649	20.3798	20.0300 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.7973	0.7381	0.6627	0.5599	0.4441	0.3159	0.2227	0.2378	0.3677	0.5662	0.7297	0.8122 (94)	
Useful gains	487.2245	506.4690	487.4076	424.4801	336.8170	229.8194	156.5926	163.2600	248.7608	361.3688	434.0748	473.7685 (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	625.5957	607.3734	549.8145	452.4330	346.5165	231.6926	156.9558	163.7312	252.3279	385.9212	513.6673	617.6513 (97)	
Space heating kWh	102.9482	67.8078	46.4307	20.1261	7.2164	0.0000	0.0000	0.0000	0.0000	18.2669	57.3066	107.0488 (98a)	
Space heating requirement - total per year (kWh/year)												427.1514	
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	102.9482	67.8078	46.4307	20.1261	7.2164	0.0000	0.0000	0.0000	0.0000	18.2669	57.3066	107.0488 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												427.1514	
Space heating per m2												(98c) / (4) = 7.3268 (99)	

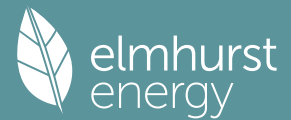
## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (301)
Fraction of space heat from community system													1.0000 (302)
Fraction of heat from community Heat pump-Space and Water													1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating													1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating													1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system													1.1000 (306)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating:													
Space heating requirement	102.9482	67.8078	46.4307	20.1261	7.2164	0.0000	0.0000	0.0000	0.0000	18.2669	57.3066	107.0488 (98)	
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10													
307a	113.2430	74.5886	51.0738	22.1387	7.9380	0.0000	0.0000	0.0000	0.0000	20.0936	63.0372	117.7537	
Space heating requirement	113.2430	74.5886	51.0738	22.1387	7.9380	0.0000	0.0000	0.0000	0.0000	20.0936	63.0372	117.7537 (307)	
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)													0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)	
Water heating													
Annual water heating requirement	209.8849	185.6883	197.6420	174.8676	170.2013	154.1297	152.7645	158.4681	159.7825	177.2282	187.2528	207.7576 (64)	
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10													
310a	230.8734	204.2572	217.4062	192.3543	187.2214	169.5426	168.0409	174.3150	175.7607	194.9511	205.9781	228.5334	
Water heating fuel	230.8734	204.2572	217.4062	192.3543	187.2214	169.5426	168.0409	174.3150	175.7607	194.9511	205.9781	228.5334	
Cooling System Energy Efficiency Ratio													
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (314)	
Pumps and Fa	12.4592	11.2535	12.4592	12.0573	12.4592	12.0573	12.4592	12.4592	12.0573	12.4592	12.0573	12.4592 (331)	
Lighting	16.6489	13.3563	12.0259	8.8107	6.8056	5.5603	6.2083	8.0698	10.4819	13.7528	15.5338	17.1116 (332)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-24.5343	-35.3475	-52.0176	-59.9318	-65.8615	-61.9974	-61.2567	-57.2063	-50.2183	-41.0685	-27.2453	-21.1206 (333a)	
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)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 (334a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)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 (335a)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-12.0288	-25.6659	-51.8952	-79.3318	-106.1870	-107.1536	-105.6589	-88.6287	-63.9998	-36.9290	-16.1239	-9.4765 (333b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)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 (334b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)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 (335b)	
Annual totals kWh/year													
Space heating fuel - community heating													469.8665 (307)
Space heating fuel - secondary													0.0000 (309)
Water heating fuel - community heating													2349.2343 (310)
Efficiency of water heater													0.0000 (311)
Electricity used for heat distribution													4.6987 (313)
Space cooling fuel													0.0000 (321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)													
mechanical ventilation fans (SFP = 0.7500)													146.6974 (330a)
Total electricity for the above, kWh/year													146.6974 (331)
Electricity for lighting (calculated in Appendix L)													134.3659 (332)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-1260.8848 (333)
Wind generation													0.0000 (334)
Hydro-electric generation (Appendix N)													0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)													0.0000 (335)
Appendix Q - special features													
Energy saved or generated													-0.0000 (336)
Energy used													0.0000 (337)
Total delivered energy for all uses													1839.2793 (338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Heat pump	469.8665	4.4400	20.8621	(340a)
Space heating total			20.8621	(340)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Heat pump	2349.2343	4.4400	104.3060	(342a)

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Water heating total			104.3060 (342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (347a)
Pumps, fans and electric keep-hot	146.6974	16.4900	24.1904 (349)
Energy for lighting	134.3659	16.4900	22.1569 (350)
Additional standing charges			92.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-557.8057	16.4900	-91.9822
PV Unit electricity exported	-703.0790	5.5900	-39.3021
Total			-131.2843 (352)
Total energy cost			132.2311 (355)

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**11b. SAP rating - Community heating scheme**  
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Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4608 (357)
SAP value		92.5300
SAP rating (Section 12)		93 (358)
SAP band		A

-----  
**12b. Carbon dioxide emissions - Community heating scheme**  
 -----

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			270.0000 (367)
Space and Water heating from Heat pump		0.1572	27.3577 (367)
Electrical energy for heat distribution (space & water)	1044.1114	0.0000	4.0449 (372)
Overall CO2 factor for heat network	4.6987		0.0546 (386)
Total CO2 associated with community systems			153.8572 (373)
Space and water heating			153.8572 (376)
Pumps, fans and electric keep-hot	146.6974	0.1387	20.3487 (378)
Energy for lighting	134.3659	0.1443	19.3932 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-557.8057	0.1341	-74.7923
PV Unit electricity exported	-703.0790	0.1254	-88.2011
Total			-162.9933 (380)
Total CO2, kg/year			30.6058 (383)
CO2 emissions per m2			0.5200 (384)
EI value			99.6030 (384a)
EI rating			100 (385)
EI band			A

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING  
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**1. Overall dwelling characteristics**  
 -----

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	58.3000 (1b)	x 2.7500 (2b)	= 160.3250 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.3000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	160.3250 (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	0 * 10 =	0.0000 (7a)										
Number of passive vents	0 * 10 =	0.0000 (7b)										
Number of flueless gas fires	0 * 40 =	0.0000 (7c)										
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		3.0000 (17)										
Infiltration rate		0.1500 (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) =	0.1275 (21)										
Wind speed	Jan 6.5000	Feb 6.2000	Mar 5.9000	Apr 5.2000	May 5.1000	Jun 4.7000	Jul 4.5000	Aug 4.5000	Sep 5.0000	Oct 5.7000	Nov 6.0000	Dec 6.0000 (22)
Wind factor	1.6250	1.5500	1.4750	1.3000	1.2750	1.1750	1.1250	1.1250	1.2500	1.4250	1.5000	1.5000 (22a)
Adj infilt rate	0.2072	0.1976	0.1881	0.1658	0.1626	0.1498	0.1434	0.1434	0.1594	0.1817	0.1913	0.1913 (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) =												81.0000 (23c)

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Effective ac 0.3022 0.2926 0.2831 0.2607 0.2576 0.2448 0.2384 0.2384 0.2544 0.2767 0.2863 0.2863 (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						
Triple Glazing 1.0 (Uw = 1.00)			10.0800	0.9615	9.6923			(27)					
External Wall 1	45.7000	10.0800	35.6200	0.1500	5.3430			(29a)					
External Roof 1	58.3000		58.3000	0.1000	5.8300			(30)					
Total net area of external elements Aum(A, m2)			104.0000					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	20.8653			(33)					
Party Floor 1			53.0900					(32d)					
Party Ceiling 1			53.0900					(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)								5.2000 (36)					
Point Thermal bridges						(36a) =	0.0000						
Total fabric heat loss						(33) + (36) + (36a) =	26.0653 (37)						
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 15.9879	Feb 15.4820	Mar 14.9761	Apr 13.7956	May 13.6269	Jun 12.9524	Jul 12.6151	Aug 12.6151	Sep 13.4583	Oct 14.6388	Nov 15.1447	Dec 15.1447	(38)
Heat transfer coeff	42.0532	41.5473	41.0414	39.8609	39.6922	39.0177	38.6804	38.6804	39.5236	40.7041	41.2100	41.2100	(39)
Average = Sum(39)m / 12 =												40.2684	
HLP	Jan 0.7213	Feb 0.7126	Mar 0.7040	Apr 0.6837	May 0.6808	Jun 0.6693	Jul 0.6635	Aug 0.6635	Sep 0.6779	Oct 0.6982	Nov 0.7069	Dec 0.7069	(40)
HLP (average)												0.6907	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

### 4. Water heating energy requirements (kWh/year)

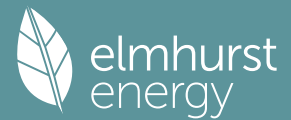
Assumed occupancy													1.9332 (42)
Hot water usage for mixer showers	70.7908	69.7270	68.1768	65.2107	63.0218	60.5807	59.1932	60.7317	62.4182	65.0392	68.0690	70.5196	(42a)
Hot water usage for baths	24.4771	24.1136	23.6017	22.6578	21.9511	21.1674	20.7441	21.2524	21.8059	22.6445	23.6078	24.3944	(42b)
Hot water usage for other uses	34.4277	33.1758	31.9239	30.6720	29.4201	28.1681	28.1681	29.4201	30.6720	31.9239	33.1758	34.4277	(42c)
Average daily hot water use (litres/day)													119.2589 (43)
Daily hot water use	Jan 129.6957	Feb 127.0164	Mar 123.7024	Apr 118.5405	May 114.3929	Jun 109.9162	Jul 108.1054	Aug 111.4042	Sep 114.8961	Oct 119.6075	Nov 124.8525	Dec 129.3417	(44)
Energy conte	205.4063	180.8697	190.1259	162.2760	153.9948	135.1548	130.7442	137.9416	141.6783	162.3062	177.8753	202.5179	(45)
Energy content (annual)										Total = Sum(45)m =		1980.8911	
Distribution loss (46)m = 0.15 x (45)m	30.8109	27.1305	28.5189	24.3414	23.0992	20.2732	19.6116	20.6912	21.2518	24.3459	26.6813	30.3777	(46)
Water storage loss:													180.0000 (47)
Store volume													1.2000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.6000 (49)
Temperature factor from Table 2b													0.7200 (55)
Enter (49) or (54) in (55)													
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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	250.9887	222.0409	235.7083	206.3880	199.5772	179.2668	176.3266	183.5240	185.7903	207.8886	221.9873	248.1003	(62)
WWHRS	-41.1038	-36.3526	-38.0663	-31.5204	-29.3759	-25.1372	-23.5621	-25.0559	-26.0079	-30.6604	-34.7345	-40.3426	(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	209.8849	185.6883	197.6420	174.8676	170.2013	154.1297	152.7645	158.4681	159.7825	177.2282	187.2528	207.7576	(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)
Heat gains from water heating, kWh/month	104.7635	93.0761	99.6828	89.2464	87.6692	80.2286	79.9383	82.3315	82.3976	90.4327	94.4331	103.8031	(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	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	115.9910	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.0209	16.8942	13.7393	10.4015	7.7753	6.5642	7.0928	9.2195	12.3745	15.7122	18.3385	19.5495	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	251.7016	254.3134	247.7316	233.7196	216.0321	199.4082	188.3025	185.6906	192.2724	206.2844	223.9720	240.5958	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	48.5323	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	-77.3273	(71)
Water heating gains (Table 5)	140.8112	138.5061	133.9822	123.9533	117.8349	111.4286	107.4440	110.6606	114.4412	121.5494	131.1571	139.5203	(72)
Total internal gains	498.7295	496.9097	482.6490	455.2704	428.8382	404.5969	390.0353	392.7667	406.2840	430.7419	460.6635	486.8616	(73)

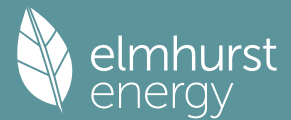
### 6. Solar gains

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[Jan]												Gains
	Area	Solar flux		g		FF		Access		Gains		
	m2	Table 6a		Specific data		Specific data		factor		W		
		W/m2		or Table 6b		or Table 6c		Table 6d				
South	7.2000	50.7747		0.5500		0.7500		0.7700		104.5049 (78)		
West	2.8800	21.7541		0.5500		0.7500		0.7700		17.9098 (80)		
-----												
Solar gains	122.4147	195.0182	267.8599	325.1529	347.0501	351.0741	325.5305	307.4880	276.1927	208.8184	138.9911	98.6784 (83)
Total gains	621.1442	691.9279	750.5089	780.4233	775.8882	755.6710	715.5658	700.2547	682.4767	639.5604	599.6546	585.5400 (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	38.5094	38.9783	39.4588	40.6274	40.8000	41.5054	41.8673	41.8673	40.9741	39.7858	39.2974	39.2974
alpha	3.5673	3.5986	3.6306	3.7085	3.7200	3.7670	3.7912	3.7912	3.7316	3.6524	3.6198	3.6198
util living area	0.8112	0.7589	0.6855	0.5887	0.4814	0.3709	0.3057	0.3121	0.4232	0.5994	0.7439	0.8231 (86)
MIT	20.3057	20.4756	20.6666	20.8381	20.9354	20.9809	20.9926	20.9920	20.9682	20.8510	20.5954	20.3009 (87)
Th 2	20.3220	20.3297	20.3373	20.3552	20.3578	20.3681	20.3732	20.3732	20.3604	20.3424	20.3348	20.3348 (88)
util rest of house	0.7951	0.7407	0.6644	0.5645	0.4532	0.3402	0.2728	0.2786	0.3896	0.5693	0.7217	0.8076 (89)
MIT 2	19.5290	19.7377	19.9696	20.1838	20.2944	20.3514	20.3675	20.3671	20.3320	20.1912	19.8906	19.5349 (90)
Living area fraction	20.0342	20.2177	20.4229	20.6094	20.7113	20.7609	20.7741	20.7736	20.7458	20.6204	20.3490	20.0332 (92)
Temperature adjustment												0.0000
adjusted MIT	20.0342	20.2177	20.4229	20.6094	20.7113	20.7609	20.7741	20.7736	20.7458	20.6204	20.3490	20.0332 (93)
-----												
8. Space heating requirement												
-----												
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	489.4067	510.3490	500.7427	448.0891	363.7740	271.5547	210.2608	210.1294	279.7652	372.3436	433.0835	468.4711 (95)
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000 (96)
Heat loss rate W	632.2367	619.7894	571.4162	482.6905	377.5256	275.4991	211.7391	211.7191	286.3796	403.8003	517.1446	611.2745 (97)
Space heating kWh	106.2655	73.5439	52.5811	24.9130	10.2312	0.0000	0.0000	0.0000	0.0000	23.4038	60.5240	106.2458 (98a)
Space heating requirement - total per year (kWh/year)												457.7082
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	106.2655	73.5439	52.5811	24.9130	10.2312	0.0000	0.0000	0.0000	0.0000	23.4038	60.5240	106.2458 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												457.7082
Space heating per m2												(98c) / (4) = 7.8509 (99)
-----												
9b. Energy requirements												
-----												
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	106.2655	73.5439	52.5811	24.9130	10.2312	0.0000	0.0000	0.0000	0.0000	23.4038	60.5240	106.2458 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	116.8921	80.8983	57.8392	27.4043	11.2543	0.0000	0.0000	0.0000	0.0000	25.7441	66.5764	116.8703
Space heating requirement	116.8921	80.8983	57.8392	27.4043	11.2543	0.0000	0.0000	0.0000	0.0000	25.7441	66.5764	116.8703 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	209.8849	185.6883	197.6420	174.8676	170.2013	154.1297	152.7645	158.4681	159.7825	177.2282	187.2528	207.7576 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	230.8734	204.2572	217.4062	192.3543	187.2214	169.5426	168.0409	174.3150	175.7607	194.9511	205.9781	228.5334
Water heating fuel	230.8734	204.2572	217.4062	192.3543	187.2214	169.5426	168.0409	174.3150	175.7607	194.9511	205.9781	228.5334 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	12.4592	11.2535	12.4592	12.0573	12.4592	12.0573	12.4592	12.0573	12.0573	12.4592	12.0573	12.4592 (331)
Lighting	16.6489	13.3563	12.0259	8.8107	6.8056	5.5603	6.2083	8.0698	10.4819	13.7528	15.5338	17.1116 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-26.4590	-36.4121	-54.3807	-62.7274	-67.8706	-64.7257	-62.6436	-58.8467	-51.1836	-41.5619	-28.2002	-21.6850 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-13.7669	-27.1752	-57.0011	-88.3471	-114.7964	-120.4766	-112.2140	-95.2174	-66.8695	-37.8367	-17.1808	-9.9259 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												503.4790 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2349.2343 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												5.0348 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												

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(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)	
mechanical ventilation fans (SFP = 0.7500)	146.6974 (330a)
Total electricity for the above, kWh/year	146.6974 (331)
Electricity for lighting (calculated in Appendix L)	134.3659 (332)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1337.5038 (333)
Wind generation	0.0000 (334)
Hydro-electric generation (Appendix N)	0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (335)
Appendix Q - special features	
Energy saved or generated	-0.0000 (336)
Energy used	0.0000 (337)
Total delivered energy for all uses	1796.2728 (338)

## 10b. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	503.4790	6.1900	31.1654 (340a)
Space heating total			31.1654 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2349.2343	6.1900	145.4176 (342a)
Water heating total			145.4176 (342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (347a)
Pumps, fans and electric keep-hot	146.6974	25.1600	36.9091 (349)
Energy for lighting	134.3659	25.1600	33.8065 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-576.6963	25.1600	-145.0968
PV Unit electricity exported	-760.8075	5.8100	-44.2029
Total			-189.2997 (352)
Total energy cost			159.9988 (355)

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			270.0000 (367)
Space and Water heating from Heat pump	1056.5605	0.1566	29.2056 (367)
Electrical energy for heat distribution (space & water)	5.0348	0.0000	4.0948 (372)
Overall CO2 factor for heat network			0.0546 (386)
Total CO2 associated with community systems			155.7549 (373)
Space and water heating			155.7549 (376)
Pumps, fans and electric keep-hot	146.6974	0.1387	20.3487 (378)
Energy for lighting	134.3659	0.1443	19.3932 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-576.6963	0.1342	-77.3890
PV Unit electricity exported	-760.8075	0.1256	-95.5481
Total			-172.9371 (380)
Total CO2, kg/year			22.5597 (383)

## 13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			270.0000 (467a)
Space and Water heating from Heat pump	1056.5605	1.5798	294.5900 (467)
Electrical energy for heat distribution (space & water)	5.0348	0.0000	43.6715 (472)
Overall CO2 factor for heat network			0.5823 (486)
Total CO2 associated with community systems			1661.1336 (473)
Space and water heating			1661.1336 (476)
Pumps, fans and electric keep-hot	146.6974	1.5128	221.9238 (478)
Energy for lighting	134.3659	1.5338	206.0949 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-576.6963	1.4959	-862.6973
PV Unit electricity exported	-760.8075	0.4610	-350.7275
Total			-1213.4248 (480)
Total Primary energy kWh/year			875.7275 (483)



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Property Reference	Block B		Issued on Date	24/01/2024	
Assessment Reference	B-03.04 2b3P - proposed	Prop Type Ref	Block B		
Property					
SAP Rating	92 A	DER	0.83	TER	12.93
Environmental	99 A	% DER < TER			93.58
CO <sub>2</sub> Emissions (t/year)	0.04	DPER	17.68	TPER	69.04
Compliance Check	See BRWL	% DPER < TPER			74.38
Assessor Details	Mr. Oliver Fuller			Assessor ID	AW55-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	63.5000 (1b)	2.7500 (2b)	174.6250 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	63.5000		174.6250 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 174.6250 (5)

### 2. Ventilation rate

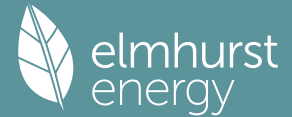
	Value	Reference
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
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)
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	3.0000	(17)
Infiltration rate	0.1500	(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) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
Triple Glazing 1.0 (Uw = 1.00)			11.2000	0.9615	10.7692		(27)					
External Wall 1	47.2100	11.2000	36.0100	0.1500	5.4015		(29a)					
External Roof 1	63.5000		63.5000	0.1000	6.3500		(30)					
Total net area of external elements Aum(A, m <sup>2</sup> )			110.7100				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	22.5207	(33)					
Party Floor 1			53.0900				(32d)					
Party Ceiling 1			53.0900				(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)							5.5355 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	28.0562 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 14.8424	Feb 14.6587	Mar 14.4750	Apr 13.5566	May 13.3729	Jun 12.4545	Jul 12.4545	Aug 12.2708	Sep 12.8218	Oct 13.3729	Nov 13.7403	Dec 14.1076 (38)
Heat transfer coeff												

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Average = Sum(39)m / 12 =	42.8986	42.7149	42.5312	41.6128	41.4291	40.5107	40.5107	40.3270	40.8781	41.4291	41.7965	42.1639 (39)
												41.5669
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.6756	0.6727	0.6698	0.6553	0.6524	0.6380	0.6380	0.6351	0.6437	0.6524	0.6582	0.6640 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.0787 (42)
Hot water usage for mixer showers	73.8400	72.7304	71.1134	68.0195	65.7363	63.1901	61.7429	63.3476	65.1068	67.8406	71.0009	73.5571 (42a)
Hot water usage for baths	25.5261	25.1470	24.6132	23.6289	22.8918	22.0745	21.6331	22.1632	22.7404	23.6149	24.6195	25.4398 (42b)
Hot water usage for other uses	35.9176	34.6115	33.3054	31.9994	30.6933	29.3872	29.3872	30.6933	31.9994	33.3054	34.6115	35.9176 (42c)
Average daily hot water use (litres/day)												124.3972 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	135.2838	132.4889	129.0320	123.6477	119.3214	114.6518	112.7631	116.2041	119.8465	124.7610	130.2320	134.9146 (44)
Energy content (annual)	214.2565	188.6625	198.3174	169.2675	160.6295	140.9778	136.3772	143.8849	147.7827	169.2994	185.5393	211.2437 (45)
Distribution loss (46)m = 0.15 x (45)m												2066.2385
Water storage loss:	32.1385	28.2994	29.7476	25.3901	24.0944	21.1467	20.4566	21.5827	22.1674	25.3949	27.8309	31.6866 (46)
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	259.8389	229.8337	243.8998	213.3795	206.2119	185.0898	181.9596	189.4673	191.8947	214.8818	229.6513	256.8261 (62)
WWHRS	-42.8743	-37.9184	-39.7059	-32.8781	-30.6412	-26.2199	-24.5770	-26.1351	-27.1281	-31.9811	-36.2307	-42.0803 (63a)
FV 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	216.9646	191.9153	204.1938	180.5014	175.5707	158.8699	157.3826	163.3322	164.7666	182.9008	193.4207	214.7457 (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)
Heat gains from water heating, kWh/month	107.7062	95.6672	102.4064	91.5711	89.8752	82.1647	81.8113	84.3077	84.4274	92.7580	96.9814	106.7044 (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	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.4136	18.1312	14.7452	11.1631	8.3445	7.0448	7.6122	9.8946	13.2805	16.8626	19.6812	20.9809 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.1641	273.9779	266.8871	251.7917	232.7365	214.8272	202.8627	200.0489	207.1397	222.2351	241.2903	259.1996 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467 (71)
Water heating gains (Table 5)	144.7664	142.3620	137.6431	127.1820	120.8000	114.1177	109.9615	113.3168	117.2602	124.6747	134.6964	143.4199 (72)
Total internal gains	527.4681	525.5951	510.3995	481.2609	453.0051	427.1137	411.5604	414.3843	428.8044	454.8965	486.7920	514.7245 (73)

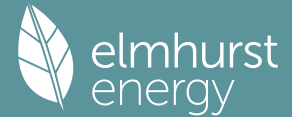
## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
North	4.0000	10.6334	0.5500	0.7500	0.7700	12.1588 (74)						
East	7.2000	19.6403	0.5500	0.7500	0.7700	40.4238 (76)						
Solar gains	52.5825	102.3135	169.7130	253.3526	318.2022	329.7393	312.2412	262.6080	198.9343	121.4915	65.4031	43.3787 (83)
Total gains	580.0506	627.9086	680.1125	734.6135	771.2073	756.8531	723.8017	676.9923	627.7387	576.3880	552.1951	558.1032 (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)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	41.1176	41.2945	41.4728	42.3881	42.5761	43.5413	43.5413	43.7396	43.1500	42.5761	42.2018	41.8341
util living area	3.7412	3.7530	3.7649	3.8259	3.8384	3.9028	3.9028	3.9160	3.8767	3.8384	3.8135	3.7889
	0.8634	0.8239	0.7498	0.6248	0.4815	0.3391	0.2455	0.2728	0.4380	0.6657	0.8119	0.8737 (86)
MIT	20.1715	20.3445	20.5889	20.8274	20.9460	20.9898	20.9978	20.9967	20.9722	20.8171	20.4865	20.1476 (87)
Th 2	20.3625	20.3650	20.3676	20.3805	20.3830	20.3960	20.3960	20.3985	20.3908	20.3830	20.3779	20.3727 (88)
util rest of house	0.8511	0.8092	0.7305	0.6002	0.4528	0.3080	0.2121	0.2375	0.4020	0.6371	0.7942	0.8622 (89)

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MIT 2	19.3991	19.6120	19.9081	20.1974	20.3306	20.3875	20.3945	20.3963	20.3666	20.1935	19.7997	19.3783 (90)
Living area fraction									FLA = Living area / (4) =			0.5496 (91)
MIT	19.8236	20.0146	20.2823	20.5436	20.6688	20.7185	20.7261	20.7263	20.6995	20.5362	20.1772	19.8011 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8236	20.0146	20.2823	20.5436	20.6688	20.7185	20.7261	20.7263	20.6995	20.5362	20.1772	19.8011 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8398	0.8004	0.7278	0.6068	0.4662	0.3247	0.2304	0.2568	0.4203	0.6444	0.7882	0.8508 (94)
Useful gains	487.1503	502.6055	495.0122	445.7601	359.5431	245.7191	166.7283	173.8248	263.8537	371.4402	435.2297	474.8161 (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												
Space heating	665.9412	645.6192	586.1764	484.5246	371.5695	247.8654	167.1503	174.4658	269.7734	411.6501	546.5798	657.8042 (97)
Space heating kWh	133.0204	96.1052	67.8262	27.9104	8.9476	0.0000	0.0000	0.0000	0.0000	29.9161	80.1721	136.1432 (98a)
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)
Space heating requirement - total per year (kWh/year)	133.0204	96.1052	67.8262	27.9104	8.9476	0.0000	0.0000	0.0000	0.0000	29.9161	80.1721	136.1432 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												580.0413 (99)
Space heating per m2										(98c) / (4) =		9.1345 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	133.0204	96.1052	67.8262	27.9104	8.9476	0.0000	0.0000	0.0000	0.0000	29.9161	80.1721	136.1432 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	146.3225	105.7157	74.6088	30.7015	9.8424	0.0000	0.0000	0.0000	0.0000	32.9078	88.1893	149.7575
Space heating requirement	146.3225	105.7157	74.6088	30.7015	9.8424	0.0000	0.0000	0.0000	0.0000	32.9078	88.1893	149.7575 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	216.9646	191.9153	204.1938	180.5014	175.5707	158.8699	157.3826	163.3322	164.7666	182.9008	193.4207	214.7457 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	238.6610	211.1068	224.6132	198.5516	193.1278	174.7569	173.1209	179.6654	181.2433	201.1909	212.7627	236.2203
Water heating fuel	238.6610	211.1068	224.6132	198.5516	193.1278	174.7569	173.1209	179.6654	181.2433	201.1909	212.7627	236.2203 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	13.5705	12.2572	13.5705	13.1328	13.5705	13.1328	13.5705	13.5705	13.1328	13.5705	13.1328	13.5705 (331)
Lighting	17.8679	14.3343	12.9064	9.4558	7.3039	5.9674	6.6629	8.6607	11.2494	14.7598	16.6711	18.3645 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-24.8862	-36.0434	-53.3179	-61.7582	-68.1445	-64.2374	-63.4611	-59.1247	-51.6966	-42.0122	-27.6992	-21.4014 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-11.6769	-24.9700	-50.5948	-77.5054	-103.9040	-104.9137	-103.4545	-86.7103	-62.5214	-35.9853	-15.6700	-9.1957 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												638.0454 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2425.0208 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												6.3805 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												159.7819 (330a)
Total electricity for the above, kWh/year												159.7819 (331)
Electricity for lighting (calculated in Appendix L)												144.2040 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1260.8848 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												2106.1673 (338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	638.0454	4.4400	28.3292 (340a)
Space heating total			28.3292 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2425.0208	4.4400	107.6709 (342a)
Water heating total			107.6709 (342)

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Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (347a)
Pumps, fans and electric keep-hot	159.7819	16.4900	26.3480 (349)
Energy for lighting	144.2040	16.4900	23.7792 (350)
Additional standing charges			92.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-573.7827	16.4900	-94.6168
PV Unit electricity exported	-687.1020	5.5900	-38.4090
Total			-133.0258 (352)
Total energy cost			145.1016 (355)

## 11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4814 (357)
SAP value		92.1958
SAP rating (Section 12)		92 (358)
SAP band		A

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			270.0000 (367)
Space and Water heating from Heat pump	1134.4690	0.1568	37.0638 (367)
Electrical energy for heat distribution (space & water)	6.3805	0.0000	4.4142 (372)
Overall CO2 factor for heat network			0.0548 (386)
Total CO2 associated with community systems			167.9020 (373)
Space and water heating			167.9020 (376)
Pumps, fans and electric keep-hot	159.7819	0.1387	22.1637 (378)
Energy for lighting	144.2040	0.1443	20.8131 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-573.7827	0.1340	-76.8738
PV Unit electricity exported	-687.1020	0.1254	-86.1548
Total			-163.0287 (380)
Total CO2, kg/year			47.8502 (383)
CO2 emissions per m2			0.7500 (384)
EI value			99.4090 (384a)
EI rating			99 (385)
EI band			A

## SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

### 1. Overall dwelling characteristics

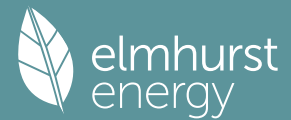
	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	63.5000 (1b)	x 2.7500 (2b)	= 174.6250 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	63.5000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	174.6250 (5)

### 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	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
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	3.0000 (17)
Infiltration rate	0.1500 (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) = 0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.5000	6.2000	5.9000	5.2000	5.1000	4.7000	4.5000	4.5000	5.0000	5.7000	6.0000	6.0000 (22)
Wind factor	1.6250	1.5500	1.4750	1.3000	1.2750	1.1750	1.1250	1.1250	1.2500	1.4250	1.5000	1.5000 (22a)
Adj infilt rate	0.2072	0.1976	0.1881	0.1658	0.1626	0.1498	0.1434	0.1434	0.1594	0.1817	0.1913	0.1913 (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) =												81.0000 (23c)

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Effective ac 0.3022 0.2926 0.2831 0.2607 0.2576 0.2448 0.2384 0.2384 0.2544 0.2767 0.2863 0.2863 (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						
Triple Glazing 1.0 (Uw = 1.00)			11.2000	0.9615	10.7692		(27)						
External Wall 1	47.2100	11.2000	36.0100	0.1500	5.4015		(29a)						
External Roof 1	63.5000		63.5000	0.1000	6.3500		(30)						
Total net area of external elements Aum(A, m2)			110.7100				(31)						
Fabric heat loss, W/K = Sum (A x U)					(26) ... (30) + (32) =	22.5207	(33)						
Party Floor 1			53.0900				(32d)						
Party Ceiling 1			53.0900				(32b)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)						
Thermal bridges (User defined value 0.050 * total exposed area)							5.5355 (36)						
Point Thermal bridges						(36a) =	0.0000						
Total fabric heat loss						(33) + (36) + (36a) =	28.0562 (37)						
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 17.4139	Feb 16.8629	Mar 16.3118	Apr 15.0260	May 14.8424	Jun 14.1076	Jul 13.7403	Aug 13.7403	Sep 14.6587	Oct 15.9445	Nov 16.4955	Dec 16.4955	(38)
Heat transfer coeff	45.4702	44.9191	44.3681	43.0823	42.8986	42.1639	41.7965	41.7965	42.7149	44.0007	44.5517	44.5517	(39)
Average = Sum(39)m / 12 =													43.5262
HLP	Jan 0.7161	Feb 0.7074	Mar 0.6987	Apr 0.6785	May 0.6756	Jun 0.6640	Jul 0.6582	Aug 0.6582	Sep 0.6727	Oct 0.6929	Nov 0.7016	Dec 0.7016	(40)
HLP (average)													0.6855
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.0787 (42)
Hot water usage for mixer showers													
Hot water usage for baths													
Hot water usage for other uses													
Average daily hot water use (litres/day)													
Daily hot water use	Jan 135.2838	Feb 132.4889	Mar 129.0320	Apr 123.6477	May 119.3214	Jun 114.6518	Jul 112.7631	Aug 116.2041	Sep 119.8465	Oct 124.7610	Nov 130.2320	Dec 134.9146	(44)
Energy content (annual)	214.2565	188.6625	198.3174	169.2675	160.6295	140.9778	136.3772	143.8849	147.7827	169.2994	185.5393	211.2437	(45)
Distribution loss (46)m = 0.15 x (45)m													
Water storage loss:													
Store volume													180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.2000 (48)
Temperature factor from Table 2b													0.6000 (49)
Enter (49) or (54) in (55)													0.7200 (55)
Total storage loss													
If cylinder contains dedicated solar storage													
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	(57)
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													
WWHRS	259.8389	229.8337	243.8998	213.3795	206.2119	185.0898	181.9596	189.4673	191.8947	214.8818	229.6513	256.8261	(62)
PV diverter	-42.8743	-37.9184	-39.7059	-32.8781	-30.6412	-26.2199	-24.5770	-26.1351	-27.1281	-31.9811	-36.2307	-42.0803	(63a)
Solar input	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
Output from w/h	216.9646	191.9153	204.1938	180.5014	175.5707	158.8699	157.3826	163.3322	164.7666	182.9008	193.4207	214.7457	(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)
Heat gains from water heating, kWh/month	107.7062	95.6672	102.4064	91.5711	89.8752	82.1647	81.8113	84.3077	84.4274	92.7580	96.9814	106.7044	(65)

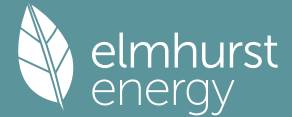
### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.4136	18.1312	14.7452	11.1631	8.3445	7.0448	7.6122	9.8946	13.2805	16.8626	19.6812	20.9809	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.1641	273.9779	266.8871	251.7917	232.7365	214.8272	202.8627	200.0489	207.1397	222.2351	241.2903	259.1996	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	(71)
Water heating gains (Table 5)	144.7664	142.3620	137.6431	127.1820	120.8000	114.1177	109.9615	113.3168	117.2602	124.6747	134.6964	143.4199	(72)
Total internal gains	527.4681	525.5951	510.3995	481.2609	453.0051	427.1137	411.5604	414.3843	428.8044	454.8965	486.7920	514.7245	(73)

### 6. Solar gains

[Jan] Area Solar flux g FF Access Gains

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	m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	factor Table 6d	W
North	4.0000	11.7244	0.5500	0.7500	0.7700	13.4063 (74)
East	7.2000	21.7541	0.5500	0.7500	0.7700	44.7745 (76)

Solar gains	58.1808	107.2828	183.0270	276.3153	339.3172	362.4090	328.4281	278.8046	206.8295	124.4421	68.8385	45.0648 (83)
Total gains	585.6488	632.8778	693.4265	757.5761	792.3223	789.5227	739.9885	693.1888	635.6340	579.3386	555.6305	559.7893 (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	38.7922	39.2681	39.7558	40.9423	41.1176	41.8341	42.2018	42.2018	41.2945	40.0878	39.5919	39.5919
alpha	3.5861	3.6179	3.6504	3.7295	3.7412	3.7889	3.8135	3.8135	3.7530	3.6725	3.6395	3.6395
util living area	0.8579	0.8237	0.7546	0.6390	0.5061	0.3831	0.3190	0.3398	0.4841	0.6810	0.8061	0.8641 (86)
MIT	20.1491	20.3024	20.5430	20.7910	20.9255	20.9793	20.9917	20.9896	20.9514	20.7761	20.4671	20.1628 (87)
Th 2	20.3267	20.3343	20.3420	20.3599	20.3625	20.3727	20.3779	20.3779	20.3650	20.3471	20.3394	20.3394 (88)
util rest of house	0.8443	0.8081	0.7350	0.6146	0.4773	0.3517	0.2851	0.3038	0.4474	0.6511	0.7866	0.8509 (89)
MIT 2	19.3449	19.5367	19.8316	20.1366	20.2889	20.3546	20.3715	20.3698	20.3212	20.1157	19.7461	19.3727 (90)
Living area fraction									FLA = Living area / (4) =			
MIT	19.7869	19.9575	20.2226	20.4963	20.6388	20.6980	20.7123	20.7105	20.6675	20.4787	20.1424	19.8069 (91)
Temperature adjustment												0.0000 (92)
adjusted MIT	19.7869	19.9575	20.2226	20.4963	20.6388	20.6980	20.7123	20.7105	20.6675	20.4787	20.1424	19.8069 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8325	0.7987	0.7313	0.6199	0.4899	0.3681	0.3034	0.3231	0.4651	0.6573	0.7804	0.8393 (94)
Useful gains	487.5245	505.4569	507.0768	469.6410	388.1483	290.5842	224.4994	224.0027	295.6023	380.8212	433.5888	469.8062 (95)
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000 (96)
Heat loss rate W	672.3634	658.4023	608.8440	516.8275	404.9096	295.0614	226.2162	226.1393	306.1609	430.2684	549.8743	650.7648 (97)
Space heating kWh	137.5202	102.7793	75.7148	33.9743	12.4704	0.0000	0.0000	0.0000	0.0000	36.7888	83.7256	134.6332 (98a)
Space heating requirement - total per year (kWh/year)												617.6066
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	137.5202	102.7793	75.7148	33.9743	12.4704	0.0000	0.0000	0.0000	0.0000	36.7888	83.7256	134.6332 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												617.6066
Space heating per m2												9.7261 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	137.5202	102.7793	75.7148	33.9743	12.4704	0.0000	0.0000	0.0000	0.0000	36.7888	83.7256	134.6332 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	151.2722	113.0573	83.2863	37.3717	13.7175	0.0000	0.0000	0.0000	0.0000	40.4676	92.0982	148.0965
Space heating requirement	151.2722	113.0573	83.2863	37.3717	13.7175	0.0000	0.0000	0.0000	0.0000	40.4676	92.0982	148.0965 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	216.9646	191.9153	204.1938	180.5014	175.5707	158.8699	157.3826	163.3322	164.7666	182.9008	193.4207	214.7457 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	238.6610	211.1068	224.6132	198.5516	193.1278	174.7569	173.1209	179.6654	181.2433	201.1909	212.7627	236.2203
Water heating fuel	238.6610	211.1068	224.6132	198.5516	193.1278	174.7569	173.1209	179.6654	181.2433	201.1909	212.7627	236.2203 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	13.5705	12.2572	13.5705	13.1328	13.5705	13.1328	13.5705	13.5705	13.1328	13.5705	13.1328	13.5705 (331)
Lighting	17.8679	14.3343	12.9064	9.4558	7.3039	5.9674	6.6629	8.6607	11.2494	14.7598	16.6711	18.3645 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-26.8576	-37.1443	-55.7898	-64.7214	-70.2976	-67.1772	-64.9531	-60.8772	-52.7164	-42.5257	-28.6811	-21.9782 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-13.3682	-26.4430	-55.5919	-86.3530	-112.3694	-118.0251	-109.9045	-93.1868	-65.3367	-36.8729	-16.7000	-9.6327 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												679.3672 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2425.0208 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												6.7937 (313)
Space cooling fuel												0.0000 (321)

Electricity for pumps and fans:  
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)

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mechanical ventilation fans (SFP = 0.7500) 159.7819 (330a)  
 Total electricity for the above, kWh/year 159.7819 (331)  
 Electricity for lighting (calculated in Appendix L) 144.2040 (332)

Energy saving/generation technologies (Appendices M ,N and Q)  
 PV generation -1337.5038 (333)  
 Wind generation 0.0000 (334)  
 Hydro-electric generation (Appendix N) 0.0000 (335a)  
 Electricity generated - Micro CHP (Appendix N) 0.0000 (335)  
 Appendix Q - special features  
 Energy saved or generated -0.0000 (336)  
 Energy used 0.0000 (337)  
 Total delivered energy for all uses 2070.8701 (338)

## 10b. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	679.3672	6.1900	42.0528 (340a)
Space heating total			42.0528 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2425.0208	6.1900	150.1088 (342a)
Water heating total			150.1088 (342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (347a)
Pumps, fans and electric keep-hot	159.7819	25.1600	40.2011 (349)
Energy for lighting	144.2040	25.1600	36.2817 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-593.7196	25.1600	-149.3799
PV Unit electricity exported	-743.7842	5.8100	-43.2139
Total			-192.5937 (352)
Total energy cost			178.0508 (355)

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			270.0000 (367)
Space and Water heating from Heat pump	1149.7733	0.1563	39.3312 (367)
Electrical energy for heat distribution (space & water)	6.7937	0.0000	4.4754 (372)
Overall CO2 factor for heat network			0.0548 (386)
Total CO2 associated with community systems			170.2307 (373)
Space and water heating			170.2307 (376)
Pumps, fans and electric keep-hot	159.7819	0.1387	22.1637 (378)
Energy for lighting	144.2040	0.1443	20.8131 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-593.7196	0.1341	-79.6087
PV Unit electricity exported	-743.7842	0.1255	-93.3643
Total			-172.9729 (380)
Total CO2, kg/year			40.2346 (383)

## 13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			270.0000 (467a)
Space and Water heating from Heat pump	1149.7733	1.5787	397.2247 (467)
Electrical energy for heat distribution (space & water)	6.7937	0.0000	47.5968 (472)
Overall CO2 factor for heat network			0.5832 (486)
Total CO2 associated with community systems			1810.4413 (473)
Space and water heating			1810.4413 (476)
Pumps, fans and electric keep-hot	159.7819	1.5128	241.7180 (478)
Energy for lighting	144.2040	1.5338	221.1849 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-593.7196	1.4955	-887.9201
PV Unit electricity exported	-743.7842	0.4608	-342.7091
Total			-1230.6292 (480)
Total Primary energy kWh/year			1042.7151 (483)

## SAP 10 EPC IMPROVEMENTS

B-03.04 2b3P - proposed

Current energy efficiency rating: A 92  
 Current environmental impact rating: A 99

N Solar water heating Not applicable  
 U Solar photovoltaic panels Not applicable  
 V2 Wind turbine Not applicable

Recommended measures: (none) SAP change Cost change CO2 change

Recommended measures (none) Typical annual savings Energy Environmental efficiency impact

Total Savings £0 0.00 kg/m²

Potential energy efficiency rating: A 92

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Potential environmental impact rating:

A 99

Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)  
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Wales):

	Current	Potential	Saving
Electricity	£76	£76	£0
Community scheme	£294	£294	£0
Space heating	£184	£184	£0
Water heating	£150	£150	£0
Lighting	£36	£36	£0
Generated (PV)	-£193	-£193	£0
Total cost of fuels	£177	£177	£0
Total cost of uses	£177	£177	£0
Delivered energy	33 kWh/m <sup>2</sup>	33 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.0 tonnes	0.0 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	1 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	16 kWh/m <sup>2</sup>	16 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	63.5000 (1b)	x 2.7500 (2b)	= 174.6250 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	63.5000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 174.6250 (5)

## 2. Ventilation rate

		Air changes 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)
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	3.0000	(17)
Infiltration rate	0.1500	(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) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (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) =												81.0000 (23c)
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
Triple Glazing 1.0 (Uw = 1.00)			11.2000	0.9615	10.7692		(27)					
External Wall 1	47.2100	11.2000	36.0100	0.1500	5.4015		(29a)					
External Roof 1	63.5000		63.5000	0.1000	6.3500		(30)					
Total net area of external elements Aum(A, m <sup>2</sup> )			110.7100				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	22.5207	(33)					
Party Floor 1			53.0900				(32a)					
Party Ceiling 1			53.0900				(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)							5.5355 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	28.0562 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 14.8424	Feb 14.6587	Mar 14.4750	Apr 13.5566	May 13.3729	Jun 12.4545	Jul 12.4545	Aug 12.2708	Sep 12.8218	Oct 13.3729	Nov 13.7403	Dec 14.1076 (38)



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Heat transfer coeff	42.8986	42.7149	42.5312	41.6128	41.4291	40.5107	40.5107	40.3270	40.8781	41.4291	41.7965	42.1639 (39)
Average = Sum(39)m / 12 =												41.5669
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.6756	0.6727	0.6698	0.6553	0.6524	0.6380	0.6380	0.6351	0.6437	0.6524	0.6582	0.6640 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.0787 (42)
Hot water usage for mixer showers												73.5571 (42a)
Hot water usage for baths												25.4398 (42b)
Hot water usage for other uses												35.9176 (42c)
Average daily hot water use (litres/day)												124.3972 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	135.2838	132.4889	129.0320	123.6477	119.3214	114.6518	112.7631	116.2041	119.8465	124.7610	130.2320	134.9146 (44)
Energy content (annual)	214.2565	188.6625	198.3174	169.2675	160.6295	140.9778	136.3772	143.8849	147.7827	169.2994	185.5393	211.2437 (45)
Distribution loss (46)m = 0.15 x (45)m												2066.2385
Water storage loss:												31.6866 (46)
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	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	259.8389	229.8337	243.8998	213.3795	206.2119	185.0898	181.9596	189.4673	191.8947	214.8818	229.6513	256.8261 (62)
WWHRS	-42.8743	-37.9184	-39.7059	-32.8781	-30.6412	-26.2199	-24.5770	-26.1351	-27.1281	-31.9811	-36.2307	-42.0803 (63a)
FV 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	216.9646	191.9153	204.1938	180.5014	175.5707	158.8699	157.3826	163.3322	164.7666	182.9008	193.4207	214.7457 (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	107.7062	95.6672	102.4064	91.5711	89.8752	82.1647	81.8113	84.3077	84.4274	92.7580	96.9814	106.7044 (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	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.4136	18.1312	14.7452	11.1631	8.3445	7.0448	7.6122	9.8946	13.2805	16.8626	19.6812	20.9809 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.1641	273.9779	266.8871	251.7917	232.7365	214.8272	202.8627	200.0489	207.1397	222.2351	241.2903	259.1996 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467 (71)
Water heating gains (Table 5)	144.7664	142.3620	137.6431	127.1820	120.8000	114.1177	109.9615	113.3168	117.2602	124.6747	134.6964	143.4199 (72)
Total internal gains	527.4681	525.5951	510.3995	481.2609	453.0051	427.1137	411.5604	414.3843	428.8044	454.8965	486.7920	514.7245 (73)

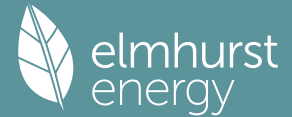
## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
North	4.0000	10.6334	0.5500	0.7500	0.7700	12.1588 (74)						
East	7.2000	19.6403	0.5500	0.7500	0.7700	40.4238 (76)						
Solar gains	52.5825	102.3135	169.7130	253.3526	318.2022	329.7393	312.2412	262.6080	198.9343	121.4915	65.4031	43.3787 (83)
Total gains	580.0506	627.9086	680.1125	734.6135	771.2073	756.8531	723.8017	676.9923	627.7387	576.3880	552.1951	558.1032 (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	41.1176	41.2945	41.4728	42.3881	42.5761	43.5413	43.5413	43.7396	43.1500	42.5761	42.2018	41.8341
alpha	3.7412	3.7530	3.7649	3.8259	3.8384	3.9028	3.9028	3.9160	3.8767	3.8384	3.8135	3.7889
util living area	0.8634	0.8239	0.7498	0.6248	0.4815	0.3391	0.2455	0.2728	0.4380	0.6657	0.8119	0.8737 (86)
MIT	20.1715	20.3445	20.5889	20.8274	20.9460	20.9898	20.9978	20.9967	20.9722	20.8171	20.4865	20.1476 (87)
Th 2	20.3625	20.3650	20.3676	20.3805	20.3830	20.3960	20.3960	20.3985	20.3908	20.3830	20.3779	20.3727 (88)
util rest of house												

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MIT 2	0.8511	0.8092	0.7305	0.6002	0.4528	0.3080	0.2121	0.2375	0.4020	0.6371	0.7942	0.8622 (89)
Living area fraction	19.3991	19.6120	19.9081	20.1974	20.3306	20.3875	20.3945	20.3963	20.3666	20.1935	19.7997	19.3783 (90)
MIT	19.8236	20.0146	20.2823	20.5436	20.6688	20.7185	20.7261	20.7263	20.6995	20.5362	20.1772	19.8011 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8236	20.0146	20.2823	20.5436	20.6688	20.7185	20.7261	20.7263	20.6995	20.5362	20.1772	19.8011 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8398	0.8004	0.7278	0.6068	0.4662	0.3247	0.2304	0.2568	0.4203	0.6444	0.7882	0.8508 (94)	
Useful gains	487.1503	502.6055	495.0122	445.7601	359.5431	245.7191	166.7283	173.8248	263.8537	371.4402	435.2297	474.8161 (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	665.9412	645.6192	586.1764	484.5246	371.5695	247.8654	167.1503	174.4658	269.7734	411.6501	546.5798	657.8042 (97)	
Space heating kWh	133.0204	96.1052	67.8262	27.9104	8.9476	0.0000	0.0000	0.0000	0.0000	29.9161	80.1721	136.1432 (98a)	
Space heating requirement - total per year (kWh/year)												580.0413	
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	133.0204	96.1052	67.8262	27.9104	8.9476	0.0000	0.0000	0.0000	0.0000	29.9161	80.1721	136.1432 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												580.0413	
Space heating per m2												9.1345 (99)	

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (301)
Fraction of space heat from community system													1.0000 (302)
Fraction of heat from community Heat pump-Space and Water													1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating													1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating													1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system													1.1000 (306)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	133.0204	96.1052	67.8262	27.9104	8.9476	0.0000	0.0000	0.0000	0.0000	29.9161	80.1721	136.1432 (98)	
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10	146.3225	105.7157	74.6088	30.7015	9.8424	0.0000	0.0000	0.0000	0.0000	32.9078	88.1893	149.7575	
307a													
Space heating requirement	146.3225	105.7157	74.6088	30.7015	9.8424	0.0000	0.0000	0.0000	0.0000	32.9078	88.1893	149.7575 (307)	
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)													0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)	
Water heating													
Annual water heating requirement	216.9646	191.9153	204.1938	180.5014	175.5707	158.8699	157.3826	163.3322	164.7666	182.9008	193.4207	214.7457 (64)	
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10	238.6610	211.1068	224.6132	198.5516	193.1278	174.7569	173.1209	179.6654	181.2433	201.1909	212.7627	236.2203	
310a													
Water heating fuel	238.6610	211.1068	224.6132	198.5516	193.1278	174.7569	173.1209	179.6654	181.2433	201.1909	212.7627	236.2203 (310)	
Cooling System Energy Efficiency Ratio													0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)	
Pumps and Fa	13.5705	12.2572	13.5705	13.1328	13.5705	13.1328	13.5705	13.5705	13.1328	13.5705	13.1328	13.5705 (331)	
Lighting	17.8679	14.3343	12.9064	9.4558	7.3039	5.9674	6.6629	8.6607	11.2494	14.7598	16.6711	18.3645 (332)	
Electricity generated by PVs (Appendix M) (negative quantity)	-24.8862	-36.0434	-53.3179	-61.7582	-68.1445	-64.2374	-63.4611	-59.1247	-51.6966	-42.0122	-27.6992	-21.4014 (333a)	
(333a)m													
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)	
(334a)m													
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)	
(335a)m													
Electricity generated by PVs (Appendix M) (negative quantity)	-11.6769	-24.9700	-50.5948	-77.5054	-103.9040	-104.9137	-103.4545	-86.7103	-62.5214	-35.9853	-15.6700	-9.1957 (333b)	
(333b)m													
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)	
(334b)m													
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)	
(335b)m													
Annual totals kWh/year													
Space heating fuel - community heating													638.0454 (307)
Space heating fuel - secondary													0.0000 (309)
Water heating fuel - community heating													2425.0208 (310)
Efficiency of water heater													0.0000 (311)
Electricity used for heat distribution													6.3805 (313)
Space cooling fuel													0.0000 (321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)													
mechanical ventilation fans (SFP = 0.7500)													159.7819 (330a)
Total electricity for the above, kWh/year													159.7819 (331)
Electricity for lighting (calculated in Appendix L)													144.2040 (332)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-1260.8848 (333)
Wind generation													0.0000 (334)
Hydro-electric generation (Appendix N)													0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)													0.0000 (335)
Appendix Q - special features													
Energy saved or generated													-0.0000 (336)
Energy used													0.0000 (337)
Total delivered energy for all uses													2106.1673 (338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Heat pump	638.0454	4.4400	28.3292	(340a)
Space heating total			28.3292	(340)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Heat pump	2425.0208	4.4400	107.6709	(342a)

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Water heating total			107.6709 (342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (347a)
Pumps, fans and electric keep-hot	159.7819	16.4900	26.3480 (349)
Energy for lighting	144.2040	16.4900	23.7792 (350)
Additional standing charges			92.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-573.7827	16.4900	-94.6168
PV Unit electricity exported	-687.1020	5.5900	-38.4090
Total			-133.0258 (352)
Total energy cost			145.1016 (355)

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 11b. SAP rating - Community heating scheme  
 -----

Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4814 (357)
SAP value		92.1958
SAP rating (Section 12)		92 (358)
SAP band		A

-----  
 12b. Carbon dioxide emissions - Community heating scheme  
 -----

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			270.0000 (367)
Space and Water heating from Heat pump		0.1568	37.0638 (367)
Electrical energy for heat distribution (space & water)	1134.4690	0.0000	4.4142 (372)
Overall CO2 factor for heat network	6.3805		0.0548 (386)
Total CO2 associated with community systems			167.9020 (373)
Space and water heating			167.9020 (376)
Pumps, fans and electric keep-hot	159.7819	0.1387	22.1637 (378)
Energy for lighting	144.2040	0.1443	20.8131 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-573.7827	0.1340	-76.8738
PV Unit electricity exported	-687.1020	0.1254	-86.1548
Total			-163.0287 (380)
Total CO2, kg/year			47.8502 (383)
CO2 emissions per m2			0.7500 (384)
EI value			99.4090 (384a)
EI rating			99 (385)
EI band			A

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING  
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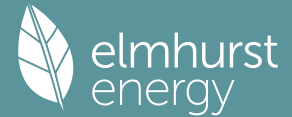
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 1. Overall dwelling characteristics  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	63.5000 (1b)	x 2.7500 (2b)	= 174.6250 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	63.5000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	174.6250 (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	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
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		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (21)
Wind speed	Jan 6.5000 Feb 6.2000 Mar 5.9000 Apr 5.2000 May 5.1000 Jun 4.7000 Jul 4.5000 Aug 4.5000 Sep 5.0000 Oct 5.7000 Nov 6.0000 Dec 6.0000 (22)	
Wind factor	1.6250 1.5500 1.4750 1.3000 1.2750 1.1750 1.1250 1.1250 1.2500 1.4250 1.5000 1.5000 (22a)	
Adj infilt rate	0.2072 0.1976 0.1881 0.1658 0.1626 0.1498 0.1434 0.1434 0.1594 0.1817 0.1913 0.1913 (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) =		81.0000 (23c)

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Effective ac 0.3022 0.2926 0.2831 0.2607 0.2576 0.2448 0.2384 0.2384 0.2544 0.2767 0.2863 0.2863 (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						
Triple Glazing 1.0 (Uw = 1.00)			11.2000	0.9615	10.7692			(27)					
External Wall 1	47.2100	11.2000	36.0100	0.1500	5.4015			(29a)					
External Roof 1	63.5000		63.5000	0.1000	6.3500			(30)					
Total net area of external elements Aum(A, m2)			110.7100					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	22.5207			(33)					
Party Floor 1			53.0900					(32d)					
Party Ceiling 1			53.0900					(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)					
Thermal bridges (User defined value 0.050 * total exposed area)								5.5355 (36)					
Point Thermal bridges						(36a) =	0.0000						
Total fabric heat loss						(33) + (36) + (36a) =	28.0562 (37)						
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 17.4139	Feb 16.8629	Mar 16.3118	Apr 15.0260	May 14.8424	Jun 14.1076	Jul 13.7403	Aug 13.7403	Sep 14.6587	Oct 15.9445	Nov 16.4955	Dec 16.4955	(38)
Heat transfer coeff	45.4702	44.9191	44.3681	43.0823	42.8986	42.1639	41.7965	41.7965	42.7149	44.0007	44.5517	44.5517	(39)
Average = Sum(39)m / 12 =													43.5262
HLP	Jan 0.7161	Feb 0.7074	Mar 0.6987	Apr 0.6785	May 0.6756	Jun 0.6640	Jul 0.6582	Aug 0.6582	Sep 0.6727	Oct 0.6929	Nov 0.7016	Dec 0.7016	(40)
HLP (average)													0.6855
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.0787 (42)	
Hot water usage for mixer showers														73.5571 (42a)
Hot water usage for baths	73.8400	72.7304	71.1134	68.0195	65.7363	63.1901	61.7429	63.3476	65.1068	67.8406	71.0009	73.5571		
Hot water usage for other uses	25.5261	25.1470	24.6132	23.6289	22.8918	22.0745	21.6331	22.1632	22.7404	23.6149	24.6195	25.4398	(42b)	
Average daily hot water use (litres/day)	35.9176	34.6115	33.3054	31.9994	30.6933	29.3872	29.3872	30.6933	31.9994	33.3054	34.6115	35.9176	(42c)	
Daily hot water use	135.2838	132.4889	129.0320	123.6477	119.3214	114.6518	112.7631	116.2041	119.8465	124.7610	130.2320	134.9146	(44)	
Energy conte	214.2565	188.6625	198.3174	169.2675	160.6295	140.9778	136.3772	143.8849	147.7827	169.2994	185.5393	211.2437	(45)	
Energy content (annual)													2066.2385	
Distribution loss (46)m = 0.15 x (45)m	32.1385	28.2994	29.7476	25.3901	24.0944	21.1467	20.4566	21.5827	22.1674	25.3949	27.8309	31.6866	(46)	
Water storage loss:													180.0000 (47)	
Store volume													1.2000 (48)	
a) If manufacturer declared loss factor is known (kWh/day):													0.6000 (49)	
Temperature factor from Table 2b													0.7200 (55)	
Enter (49) or (54) in (55)														
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)	
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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	259.8389	229.8337	243.8998	213.3795	206.2119	185.0898	181.9596	189.4673	191.8947	214.8818	229.6513	256.8261	(62)	
WWHRS	-42.8743	-37.9184	-39.7059	-32.8781	-30.6412	-26.2199	-24.5770	-26.1351	-27.1281	-31.9811	-36.2307	-42.0803	(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	216.9646	191.9153	204.1938	180.5014	175.5707	158.8699	157.3826	163.3322	164.7666	182.9008	193.4207	214.7457	(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	107.7062	95.6672	102.4064	91.5711	89.8752	82.1647	81.8113	84.3077	84.4274	92.7580	96.9814	106.7044	(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	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	124.7201	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.4136	18.1312	14.7452	11.1631	8.3445	7.0448	7.6122	9.8946	13.2805	16.8626	19.6812	20.9809	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	271.1641	273.9779	266.8871	251.7917	232.7365	214.8272	202.8627	200.0489	207.1397	222.2351	241.2903	259.1996	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	49.5507	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	-83.1467	(71)
Water heating gains (Table 5)	144.7664	142.3620	137.6431	127.1820	120.8000	114.1177	109.9615	113.3168	117.2602	124.6747	134.6964	143.4199	(72)
Total internal gains	527.4681	525.5951	510.3995	481.2609	453.0051	427.1137	411.5604	414.3843	428.8044	454.8965	486.7920	514.7245	(73)

### 6. Solar gains

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[Jan]	Area				Solar flux		g		FF		Access		Gains	
	m2				Table 6a		Specific data		Specific data		factor		W	
					W/m2		or Table 6b		or Table 6c		Table 6d			
North	4.0000				11.7244		0.5500		0.7500		0.7700		13.4063 (74)	
East	7.2000				21.7541		0.5500		0.7500		0.7700		44.7745 (76)	
Solar gains	58.1808	107.2828	183.0270	276.3153	339.3172	362.4090	328.4281	278.8046	206.8295	124.4421	68.8385	45.0648	(83)	
Total gains	585.6488	632.8778	693.4265	757.5761	792.3223	789.5227	739.9885	693.1888	635.6340	579.3386	555.6305	559.7893	(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	38.7922	39.2681	39.7558	40.9423	41.1176	41.8341	42.2018	42.2018	41.2945	40.0878	39.5919	39.5919		
alpha	3.5861	3.6179	3.6504	3.7295	3.7412	3.7889	3.8135	3.8135	3.7530	3.6725	3.6395	3.6395		
util living area	0.8579	0.8237	0.7546	0.6390	0.5061	0.3831	0.3190	0.3398	0.4841	0.6810	0.8061	0.8641	(86)	
MIT	20.1491	20.3024	20.5430	20.7910	20.9255	20.9793	20.9917	20.9896	20.9514	20.7761	20.4671	20.1628	(87)	
Th 2	20.3267	20.3343	20.3420	20.3599	20.3625	20.3727	20.3779	20.3779	20.3650	20.3471	20.3394	20.3394	(88)	
util rest of house	0.8443	0.8081	0.7350	0.6146	0.4773	0.3517	0.2851	0.3038	0.4474	0.6511	0.7866	0.8509	(89)	
MIT 2	19.3449	19.5367	19.8316	20.1366	20.2889	20.3546	20.3715	20.3698	20.3212	20.1157	19.7461	19.3727	(90)	
Living area fraction	FLA = Living area / (4) =												0.5496 (91)	
MIT	19.7869	19.9575	20.2226	20.4963	20.6388	20.6980	20.7123	20.7105	20.6675	20.4787	20.1424	19.8069	(92)	
Temperature adjustment													0.0000	
adjusted MIT	19.7869	19.9575	20.2226	20.4963	20.6388	20.6980	20.7123	20.7105	20.6675	20.4787	20.1424	19.8069	(93)	
8. Space heating requirement														
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	0.8325	0.7987	0.7313	0.6199	0.4899	0.3681	0.3034	0.3231	0.4651	0.6573	0.7804	0.8393	(94)	
Useful gains	487.5245	505.4569	507.0768	469.6410	388.1483	290.5842	224.4994	224.0027	295.6023	380.8212	433.5888	469.8062	(95)	
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000	(96)	
Heat loss rate W	672.3634	658.4023	608.8440	516.8275	404.9096	295.0614	226.2162	226.1393	306.1609	430.2684	549.8743	650.7648	(97)	
Space heating kWh	137.5202	102.7793	75.7148	33.9743	12.4704	0.0000	0.0000	0.0000	0.0000	36.7888	83.7256	134.6332	(98a)	
Space heating requirement - total per year (kWh/year)													617.6066	
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	137.5202	102.7793	75.7148	33.9743	12.4704	0.0000	0.0000	0.0000	0.0000	36.7888	83.7256	134.6332	(98c)	
Space heating requirement after solar contribution - total per year (kWh/year)													617.6066	
Space heating per m2													(98c) / (4) = 9.7261 (99)	
9b. Energy requirements														
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)		
Fraction of space heat from community system												1.0000 (302)		
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)		
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)		
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)		
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)		
Efficiency of secondary/supplementary heating system, %												0.0000 (208)		
Space heating:														
Space heating requirement												137.5202 102.7793 75.7148 33.9743 12.4704 0.0000 0.0000 0.0000 0.0000 36.7888 83.7256 134.6332 (98)		
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												151.2722 113.0573 83.2863 37.3717 13.7175 0.0000 0.0000 0.0000 0.0000 40.4676 92.0982 148.0965		
Space heating requirement												151.2722 113.0573 83.2863 37.3717 13.7175 0.0000 0.0000 0.0000 0.0000 40.4676 92.0982 148.0965 (307)		
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)		
Space heating fuel for secondary/supplementary system												0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (309)		
Water heating														
Annual water heating requirement												216.9646 191.9153 204.1938 180.5014 175.5707 158.8699 157.3826 163.3322 164.7666 182.9008 193.4207 214.7457 (64)		
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												238.6610 211.1068 224.6132 198.5516 193.1278 174.7569 173.1209 179.6654 181.2433 201.1909 212.7627 236.2203		
Water heating fuel												238.6610 211.1068 224.6132 198.5516 193.1278 174.7569 173.1209 179.6654 181.2433 201.1909 212.7627 236.2203 (310)		
Cooling System Energy Efficiency Ratio														
Space coolin												0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (314)		
Pumps and Fa												13.5705 12.2572 13.5705 13.1328 13.5705 13.1328 13.5705 13.5705 13.1328 13.5705 13.1328 13.5705 (331)		
Lighting												17.8679 14.3343 12.9064 9.4558 7.3039 5.9674 6.6629 8.6607 11.2494 14.7598 16.6711 18.3645 (332)		
Electricity generated by PVs (Appendix M) (negative quantity)												(333a)m -26.8576 -37.1443 -55.7898 -64.7214 -70.2976 -67.1772 -64.9531 -60.8772 -52.7164 -42.5257 -28.6811 -21.9782 (333a)		
Electricity generated by wind turbines (Appendix M) (negative quantity)												(334a)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 (334a)		
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												(335a)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 (335a)		
Electricity generated by PVs (Appendix M) (negative quantity)												(333b)m -13.3682 -26.4430 -55.5919 -86.3530 -112.3694 -118.0251 -109.9045 -93.1868 -65.3367 -36.8729 -16.7000 -9.6327 (333b)		
Electricity generated by wind turbines (Appendix M) (negative quantity)												(334b)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 (334b)		
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												(335b)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 (335b)		
Annual totals kWh/year														
Space heating fuel - community heating												679.3672 (307)		
Space heating fuel - secondary												0.0000 (309)		
Water heating fuel - community heating												2425.0208 (310)		
Efficiency of water heater												0.0000 (311)		
Electricity used for heat distribution												6.7937 (313)		
Space cooling fuel												0.0000 (321)		
Electricity for pumps and fans:														

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(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)	
mechanical ventilation fans (SFP = 0.7500)	159.7819 (330a)
Total electricity for the above, kWh/year	159.7819 (331)
Electricity for lighting (calculated in Appendix L)	144.2040 (332)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1337.5038 (333)
Wind generation	0.0000 (334)
Hydro-electric generation (Appendix N)	0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (335)
Appendix Q - special features	
Energy saved or generated	-0.0000 (336)
Energy used	0.0000 (337)
Total delivered energy for all uses	2070.8701 (338)

## 10b. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	679.3672	6.1900	42.0528 (340a)
Space heating total			42.0528 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2425.0208	6.1900	150.1088 (342a)
Water heating total			150.1088 (342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (347a)
Pumps, fans and electric keep-hot	159.7819	25.1600	40.2011 (349)
Energy for lighting	144.2040	25.1600	36.2817 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-593.7196	25.1600	-149.3799
PV Unit electricity exported	-743.7842	5.8100	-43.2139
Total			-192.5937 (352)
Total energy cost			178.0508 (355)

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			270.0000 (367)
Space and Water heating from Heat pump	1149.7733	0.1563	39.3312 (367)
Electrical energy for heat distribution (space & water)	6.7937	0.0000	4.4754 (372)
Overall CO2 factor for heat network			0.0548 (386)
Total CO2 associated with community systems			170.2307 (373)
Space and water heating			170.2307 (376)
Pumps, fans and electric keep-hot	159.7819	0.1387	22.1637 (378)
Energy for lighting	144.2040	0.1443	20.8131 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-593.7196	0.1341	-79.6087
PV Unit electricity exported	-743.7842	0.1255	-93.3643
Total			-172.9729 (380)
Total CO2, kg/year			40.2346 (383)

## 13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			270.0000 (467a)
Space and Water heating from Heat pump	1149.7733	1.5787	397.2247 (467)
Electrical energy for heat distribution (space & water)	6.7937	0.0000	47.5968 (472)
Overall CO2 factor for heat network			0.5832 (486)
Total CO2 associated with community systems			1810.4413 (473)
Space and water heating			1810.4413 (476)
Pumps, fans and electric keep-hot	159.7819	1.5128	241.7180 (478)
Energy for lighting	144.2040	1.5338	221.1849 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-593.7196	1.4955	-887.9201
PV Unit electricity exported	-743.7842	0.4608	-342.7091
Total			-1230.6292 (480)
Total Primary energy kWh/year			1042.7151 (483)

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Property Reference	Block B		Issued on Date	24/01/2024	
Assessment Reference	B-LG.01 1b2P - proposed	Prop Type Ref	Block B		
Property					
SAP Rating	92 A	DER	0.59	TER	13.08
Environmental	100 A	% DER < TER			95.49
CO <sub>2</sub> Emissions (t/year)	0.03	DPER	14.81	TPER	69.85
Compliance Check	See BRWL	% DPER < TPER			78.80
Assessor Details	Mr. Oliver Fuller			Assessor ID	AW55-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	65.5300 (1b)	2.7500 (2b)	180.2075 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	65.5300		180.2075 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 180.2075 (5)

### 2. Ventilation rate

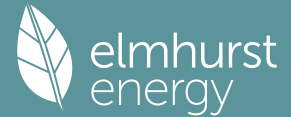
	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (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)
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	3.0000 (17)
Infiltration rate	0.1500 (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) = 0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
External Door			2.1300	1.0000	2.1300		(26)					
Triple Glazing 1.0 (Uw = 1.00)			9.9700	0.9615	9.5865		(27)					
Heat Loss Floor 1			65.5300	0.1000	6.5530		(28a)					
External Wall 1	65.8900	12.1000	53.7900	0.1500	8.0685		(29a)					
Total net area of external elements Aum(A, m <sup>2</sup> )			131.4200				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 26.3380		(33)					
Party Ceiling 1			54.2600				(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)					
Thermal bridges (User defined value 0.040 * total exposed area)							5.2568 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	31.5948 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	15.3168	15.1273	14.9377	13.9900	13.8004	12.8526	12.8526	12.6631	13.2317	13.8004	14.1795	14.5586 (38)

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Average = Sum(39)m / 12 =	46.9117	46.7221	46.5326	45.5848	45.3952	44.4475	44.4475	44.2579	44.8266	45.3952	45.7744	46.1535 (39)
	45.5374											
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.7159	0.7130	0.7101	0.6956	0.6927	0.6783	0.6783	0.6754	0.6841	0.6927	0.6985	0.7043 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.1329 (42)
Hot water usage for mixer showers	74.9771	73.8504	72.2085	69.0670	66.7486	64.1632	62.6937	64.3232	66.1094	68.8853	72.0943	74.6899 (42a)	
Hot water usage for baths	25.9173	25.5324	24.9904	23.9910	23.2426	22.4128	21.9646	22.5029	23.0889	23.9768	24.9968	25.8297 (42b)	
Hot water usage for other uses	36.4733	35.1470	33.8207	32.4944	31.1681	29.8418	29.8418	31.1681	32.4944	33.8207	35.1470	36.4733 (42c)	
Average daily hot water use (litres/day)													126.3134 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	137.3677	134.5298	131.0195	125.5523	121.1593	116.4178	114.5001	117.9941	121.6926	126.6828	132.2381	136.9928 (44)	
Energy content (annual)	217.5569	191.5686	201.3721	171.8748	163.1037	143.1493	138.4779	146.1013	150.0592	171.9074	188.3974	214.4977 (45)	
Distribution loss (46)m = 0.15 x (45)m													2098.0662
Water storage loss:	32.6335	28.7353	30.2058	25.7812	24.4656	21.4724	20.7717	21.9152	22.5089	25.7861	28.2596	32.1747 (46)	
Store volume													180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.2000 (48)
Temperature factor from Table 2b													0.6000 (49)
Enter (49) or (54) in (55)													0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)	
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	263.1393	232.7398	246.9545	215.9868	208.6861	187.2613	184.0603	194.6837	194.1712	217.4898	232.5094	260.0801 (62)	
WWHRS	-43.5345	-38.5023	-40.3174	-33.3844	-31.1131	-26.6237	-24.9554	-26.5376	-27.5459	-32.4735	-36.7886	-42.7284 (63a)	
FV 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	219.6048	194.2375	206.6371	182.6024	177.5731	160.6376	159.1048	165.1461	166.6253	185.0162	195.7208	217.3517 (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)	
Heat gains from water heating, kWh/month	108.8036	96.6335	103.4221	92.4380	90.6979	82.8867	82.5098	85.0446	85.1843	93.6251	97.9317	107.7864 (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	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.6156	19.1988	15.6135	11.8205	8.8359	7.4597	8.0604	10.4772	14.0625	17.8556	20.8401	22.2164 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	278.5797	281.4705	274.1858	258.6775	239.1012	220.7022	208.4105	205.5197	212.8044	228.3126	247.8890	266.2880 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169 (71)
Water heating gains (Table 5)	146.2414	143.7999	139.0083	128.3861	121.9058	115.1205	110.9003	114.3073	118.3115	125.8402	136.0163	144.8742 (72)
Total internal gains	539.0256	537.0581	521.3965	491.4730	462.4318	435.8712	419.9601	422.8931	437.7673	464.5974	497.3343	525.9675 (73)

## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
South	9.9700	46.7521	0.5500	0.7500	0.7700	133.2457 (78)						
Solar gains	133.2457	218.2221	277.9762	314.1735	327.3882	315.0666	307.8393	298.9546	290.3790	235.3730	157.9416	115.1365 (83)
Total gains	672.2713	755.2802	799.3727	805.6465	789.8200	750.9378	727.7994	721.8477	728.1463	699.9704	655.2759	641.1041 (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	38.8022	38.9596	39.1184	39.9317	40.0984	40.9535	40.9535	41.1289	40.6071	40.0984	39.7663	39.4397	
alpha	3.5868	3.5973	3.6079	3.6621	3.6732	3.7302	3.7302	3.7419	3.7071	3.6732	3.6511	3.6293	
util living area	0.8375	0.7809	0.7124	0.6196	0.5082	0.3725	0.2672	0.2803	0.4144	0.6130	0.7733	0.8516 (86)	
MIT	20.1927	20.4043	20.6135	20.8065	20.9231	20.9822	20.9960	20.9952	20.9719	20.8410	20.5221	20.1558 (87)	
Th 2	20.3268	20.3294	20.3319	20.3447	20.3473	20.3601	20.3601	20.3626	20.3549	20.3473	20.3421	20.3370 (88)	
util rest of house	0.8235	0.7639	0.6915	0.5940	0.4771	0.3369	0.2289	0.2420	0.3781	0.5833	0.7534	0.8385 (89)	
MIT 2	19.3950	19.6520	19.9039	20.1403	20.2726	20.3454	20.3575	20.3594	20.3308	20.1850	19.8098	19.3586 (90)	



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Living area fraction										FLA = Living area / (4) =	0.5335 (91)	
MIT	19.8206	20.0534	20.2825	20.4957	20.6196	20.6852	20.6982	20.6986	20.6728	20.5350	20.1898	19.7839 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8206	20.0534	20.2825	20.4957	20.6196	20.6852	20.6982	20.6986	20.6728	20.5350	20.1898	19.7839 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8120	0.7565	0.6899	0.6000	0.4902	0.3550	0.2492	0.2622	0.3961	0.5920	0.7486	0.8266	(94)
Useful gains	545.9150	571.3804	551.5080	483.4152	387.1709	266.6030	181.3734	189.2926	288.4192	414.3902	490.5208	529.9595	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	14.1000	11.6000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	728.0968	707.9986	641.3332	528.5876	404.9083	270.4699	182.1531	190.2480	294.6365	450.9996	599.1785	719.2505	(97)
Space heating kWh	135.5432	91.8075	66.8299	32.5241	13.1966	0.0000	0.0000	0.0000	0.0000	27.2374	78.2335	140.8325	(98a)
Space heating requirement - total per year (kWh/year)												586.2047	
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	135.5432	91.8075	66.8299	32.5241	13.1966	0.0000	0.0000	0.0000	0.0000	27.2374	78.2335	140.8325	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												586.2047	
Space heating per m2												8.9456	(99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (301)
Fraction of space heat from community system													1.0000 (302)
Fraction of heat from community Heat pump-Space and Water													1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating													1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating													1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system													1.1000 (306)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating:													
Space heating requirement	135.5432	91.8075	66.8299	32.5241	13.1966	0.0000	0.0000	0.0000	0.0000	27.2374	78.2335	140.8325	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10	149.0975	100.9882	73.5129	35.7765	14.5163	0.0000	0.0000	0.0000	0.0000	29.9611	86.0569	154.9157	
307a	149.0975	100.9882	73.5129	35.7765	14.5163	0.0000	0.0000	0.0000	0.0000	29.9611	86.0569	154.9157	(307)
Space heating requirement	149.0975	100.9882	73.5129	35.7765	14.5163	0.0000	0.0000	0.0000	0.0000	29.9611	86.0569	154.9157	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)													0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating													
Annual water heating requirement	219.6048	194.2375	206.6371	182.6024	177.5731	160.6376	159.1048	165.1461	166.6253	185.0162	195.7208	217.3517	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10	241.5652	213.6612	227.3008	200.8627	195.3304	176.7014	175.0153	181.6607	183.2879	203.5178	215.2928	239.0869	
310a	241.5652	213.6612	227.3008	200.8627	195.3304	176.7014	175.0153	181.6607	183.2879	203.5178	215.2928	239.0869	
Water heating fuel	241.5652	213.6612	227.3008	200.8627	195.3304	176.7014	175.0153	181.6607	183.2879	203.5178	215.2928	239.0869	
Cooling System Energy Efficiency Ratio													
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	14.0043	12.6491	14.0043	13.5526	14.0043	13.5526	14.0043	14.0043	13.5526	14.0043	13.5526	14.0043	(331)
Lighting	18.9200	15.1784	13.6664	10.0126	7.7340	6.3188	7.0552	9.1707	11.9118	15.6289	17.6528	19.4459	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-25.0233	-36.3130	-53.8177	-62.4544	-69.0091	-65.0837	-64.2982	-59.8614	-52.2714	-42.3819	-27.8773	-21.5114	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)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	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)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	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-11.5398	-24.7004	-50.0950	-76.8091	-103.0393	-104.0674	-102.6174	-85.9736	-61.9466	-35.6156	-15.4919	-9.0858	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)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	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)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	(335b)
Annual totals kWh/year													
Space heating fuel - community heating													644.8252 (307)
Space heating fuel - secondary													0.0000 (309)
Water heating fuel - community heating													2453.2832 (310)
Efficiency of water heater													0.0000 (311)
Electricity used for heat distribution													6.4483 (313)
Space cooling fuel													0.0000 (321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)													
mechanical ventilation fans (SFP = 0.7500)													164.8899 (330a)
Total electricity for the above, kWh/year													164.8899 (331)
Electricity for lighting (calculated in Appendix L)													152.6956 (332)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-1260.8848 (333)
Wind generation													0.0000 (334)
Hydro-electric generation (Appendix N)													0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)													0.0000 (335)
Appendix Q - special features													
Energy saved or generated													-0.0000 (336)
Energy used													0.0000 (337)
Total delivered energy for all uses													2154.8091 (338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Heat pump	644.8252	4.4400	28.6302	(340a)
Space heating total			28.6302	(340)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Heat pump	2453.2832	4.4400	108.9258	(342a)
Water heating total			108.9258	(342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(347a)

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Pumps, fans and electric keep-hot	164.8899	16.4900	27.1903 (349)
Energy for lighting	152.6956	16.4900	25.1795 (350)
Additional standing charges			92.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-579.9029	16.4900	-95.6260
PV Unit electricity exported	-680.9819	5.5900	-38.0669
Total			-133.6929 (352)
Total energy cost			148.2330 (355)

## 11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12):			0.3600 (356)
Energy cost factor (ECF)		$[(255) \times (256)] / [(4) + 45.0] =$	0.4828 (357)
SAP value			92.1738
SAP rating (Section 12)			92 (358)
SAP band			A

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	1032.7028	0.1567	33.6871 (367)
Electrical energy for heat distribution (space & water)	6.4483	0.0000	4.4640 (372)
Overall CO2 factor for heat network			0.0495 (386)
Total CO2 associated with community systems			153.2650 (373)
Space and water heating			153.2650 (376)
Pumps, fans and electric keep-hot	164.8899	0.1387	22.8723 (378)
Energy for lighting	152.6956	0.1443	22.0387 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-579.9029	0.1339	-77.6717
PV Unit electricity exported	-680.9819	0.1254	-85.3700
Total			-163.0416 (380)
Total CO2, kg/year			35.1343 (383)
CO2 emissions per m2			0.5400 (384)
EI value			99.5741 (384a)
EI rating			100 (385)
EI band			A

## SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

### 1. Overall dwelling characteristics

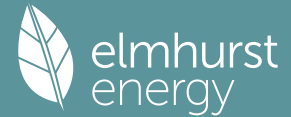
	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	65.5300 (1b)	x 2.7500 (2b)	= 180.2075 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	65.5300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	180.2075 (5)

### 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	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		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.5000	6.2000	5.9000	5.2000	5.1000	4.7000	4.5000	4.5000	5.0000	5.7000	6.0000	6.0000 (22)
Wind factor	1.6250	1.5500	1.4750	1.3000	1.2750	1.1750	1.1250	1.1250	1.2500	1.4250	1.5000	1.5000 (22a)
Adj infilt rate	0.2072	0.1976	0.1881	0.1658	0.1626	0.1498	0.1434	0.1434	0.1594	0.1817	0.1913	0.1913 (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) =												81.0000 (23c)
Effective ac	0.3022	0.2926	0.2831	0.2607	0.2576	0.2448	0.2384	0.2384	0.2544	0.2767	0.2863	0.2863 (25)

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### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K						
External Door			2.1300	1.0000	2.1300		(26)						
Triple Glazing 1.0 (Uw = 1.00)			9.9700	0.9615	9.5865		(27)						
Heat Loss Floor 1			65.5300	0.1000	6.5530		(28a)						
External Wall 1	65.8900	12.1000	53.7900	0.1500	8.0685		(29a)						
Total net area of external elements Aum(A, m <sup>2</sup> )			131.4200				(31)						
Fabric heat loss, W/K = Sum (A x U)					(26)... (30) + (32) =	26.3380	(33)						
Party Ceiling 1			54.2600				(32b)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)						
Thermal bridges (User defined value 0.040 * total exposed area)							5.2568 (36)						
Point Thermal bridges						(36a) =	0.0000						
Total fabric heat loss						(33) + (36) + (36a) =	31.5948 (37)						
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 17.9706	Feb 17.4020	Mar 16.8333	Apr 15.5064	May 15.3168	Jun 14.5586	Jul 14.1795	Aug 14.1795	Sep 15.1273	Oct 16.4542	Nov 17.0229	Dec 17.0229	(38)
Heat transfer coeff	49.5655	48.9968	48.4281	47.1012	46.9117	46.1535	45.7744	45.7744	46.7221	48.0490	48.6177	48.6177	(39)
Average = Sum(39)m / 12 =													47.5593
HLP	Jan 0.7564	Feb 0.7477	Mar 0.7390	Apr 0.7188	May 0.7159	Jun 0.7043	Jul 0.6985	Aug 0.6985	Sep 0.7130	Oct 0.7332	Nov 0.7419	Dec 0.7419	(40)
HLP (average)													0.7258
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.1329 (42)	
Hot water usage for mixer showers														
74.9771	73.8504	72.2085	69.0670	66.7486	64.1632	62.6937	64.3232	66.1094	68.8853	72.0943	74.6899	74.6899	(42a)	
Hot water usage for baths	25.9173	25.5324	24.9904	23.9910	23.2426	22.4128	21.9646	22.5029	23.0889	23.9768	24.9968	25.8297	(42b)	
Hot water usage for other uses	36.4733	35.1470	33.8207	32.4944	31.1681	29.8418	29.8418	31.1681	32.4944	33.8207	35.1470	36.4733	(42c)	
Average daily hot water use (litres/day)													126.3134 (43)	
Daily hot water use	Jan 137.3677	Feb 134.5298	Mar 131.0195	Apr 125.5523	May 121.1593	Jun 116.4178	Jul 114.5001	Aug 117.9941	Sep 121.6926	Oct 126.6828	Nov 132.2381	Dec 136.9928	(44)	
Energy conte	217.5569	191.5686	201.3721	171.8748	163.1037	143.1493	138.4779	146.1013	150.0592	171.9074	188.3974	214.4977	(45)	
Energy content (annual)										Total = Sum(45)m =			2098.0662	
Distribution loss (46)m = 0.15 x (45)m	32.6335	28.7353	30.2058	25.7812	24.4656	21.4724	20.7717	21.9152	22.5089	25.7861	28.2596	32.1747	(46)	
Water storage loss:														
Store volume													180.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):													1.2000 (48)	
Temperature factor from Table 2b													0.6000 (49)	
Enter (49) or (54) in (55)													0.7200 (55)	
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(56)	
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200	(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	263.1393	232.7398	246.9545	215.9868	208.6861	187.2613	184.0603	191.6837	194.1712	217.4898	232.5094	260.0801	(62)	
WWHRS	-43.5345	-38.5023	-40.3174	-33.3844	-31.1131	-26.6237	-24.9554	-26.5376	-27.5459	-32.4735	-36.7886	-42.7284	(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	219.6048	194.2375	206.6371	182.6024	177.5731	160.6376	159.1048	165.1461	166.6253	185.0162	195.7208	217.3517	(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	108.8036	96.6335	103.4221	92.4380	90.6979	82.8867	82.5098	85.0446	85.1843	93.6251	97.9317	107.7864	(65)	

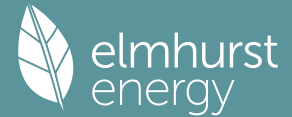
### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.6156	19.1988	15.6135	11.8205	8.8359	7.4597	8.0604	10.4772	14.0625	17.8556	20.8401	22.2164	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	278.5797	281.4705	274.1858	258.6775	239.1012	220.7022	208.4105	205.5197	212.8044	228.3126	247.8890	266.2880	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	(71)
Water heating gains (Table 5)	146.2414	143.7999	139.0083	128.3861	121.9058	115.1205	110.9003	114.3073	118.3115	125.8402	136.0163	144.8742	(72)
Total internal gains	539.0256	537.0581	521.3965	491.4730	462.4318	435.8712	419.9601	422.8931	437.7673	464.5974	497.3343	525.9675	(73)

### 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a	g Specific data	FF Specific data	Access factor	Gains W
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	W/m2		or Table 6b		or Table 6c		Table 6d						
South	9.9700	50.7747	0.5500	0.7500	0.7700	144.7103	(78)						
Solar gains	144.7103	224.1164	293.2212	335.7729	343.4367	341.4488	318.9417	311.4787	295.3821	235.9461	163.0571	117.4885	(83)
Total gains	683.7359	761.1744	814.6177	827.2459	805.8685	777.3200	738.9018	734.3718	733.1495	700.5435	660.3914	643.4560	(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	36.7247	37.1510	37.5872	38.6461	38.8022	39.4397	39.7663	39.7663	38.9596	37.8838	37.4406	37.4406	
alpha	3.4483	3.4767	3.5058	3.5764	3.5868	3.6293	3.6511	3.6511	3.5973	3.5256	3.4960	3.4960	
util living area	0.8289	0.7807	0.7171	0.6347	0.5351	0.4214	0.3480	0.3500	0.4598	0.6296	0.7663	0.8408	(86)
MIT	20.1845	20.3672	20.5717	20.7668	20.8954	20.9655	20.9860	20.9857	20.9512	20.8042	20.5082	20.1768	(87)
Th 2	20.2913	20.2989	20.3065	20.3243	20.3268	20.3370	20.3421	20.3421	20.3294	20.3116	20.3040	20.3040	(88)
util rest of house	0.8133	0.7628	0.6959	0.6094	0.5040	0.3858	0.3093	0.3111	0.4226	0.5983	0.7443	0.8259	(89)
MIT 2	19.3581	19.5830	19.8327	20.0762	20.2236	20.3068	20.3314	20.3311	20.2859	20.1123	19.7628	19.3603	(90)
Living area fraction	19.7990	20.0014	20.2270	20.4446	20.5820	20.6582	20.6806	20.6803	20.6408	20.4814	20.1605	0.5335	(91)
MIT	19.7990	20.0014	20.2270	20.4446	20.5820	20.6582	20.6806	20.6803	20.6408	20.4814	20.1605	19.7959	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7990	20.0014	20.2270	20.4446	20.5820	20.6582	20.6806	20.6803	20.6408	20.4814	20.1605	19.7959	(93)

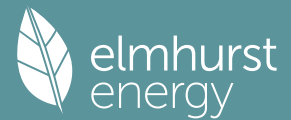
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8016	0.7547	0.6933	0.6140	0.5160	0.4032	0.3293	0.3312	0.4401	0.6062	0.7396	0.8140	(94)
Useful gains	548.0960	574.4836	564.8130	507.9004	415.7890	313.3952	243.3012	243.2315	322.6351	424.6771	488.4030	523.7656	(95)
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000	(96)
Heat loss rate W	733.5201	720.3212	664.7723	562.6061	440.1252	321.1445	246.2930	246.2817	333.6357	469.9868	600.9393	709.6205	(97)
Space heating kWh	137.9555	98.0029	74.3698	39.3881	18.1061	0.0000	0.0000	0.0000	0.0000	33.7104	81.0262	138.2761	(98a)
Space heating requirement - total per year (kWh/year)												620.8350	
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	137.9555	98.0029	74.3698	39.3881	18.1061	0.0000	0.0000	0.0000	0.0000	33.7104	81.0262	138.2761	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												620.8350	
Space heating per m2												9.4741	(99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)											
Fraction of space heat from community system	1.0000	(302)											
Fraction of heat from community Heat pump-Space and Water	1.0000	(303a)											
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)											
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)											
Distribution loss factor (Table 12c) for community heating system	1.1000	(306)											
Efficiency of secondary/supplementary heating system, %	0.0000	(208)											
Space heating:													
Space heating requirement	137.9555	98.0029	74.3698	39.3881	18.1061	0.0000	0.0000	0.0000	0.0000	33.7104	81.0262	138.2761	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10													
307a	151.7511	107.8032	81.8067	43.3269	19.9167	0.0000	0.0000	0.0000	0.0000	37.0815	89.1288	152.1037	
Space heating requirement	151.7511	107.8032	81.8067	43.3269	19.9167	0.0000	0.0000	0.0000	0.0000	37.0815	89.1288	152.1037	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating													
Annual water heating requirement	219.6048	194.2375	206.6371	182.6024	177.5731	160.6376	159.1048	165.1461	166.6253	185.0162	195.7208	217.3517	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10													
310a	241.5652	213.6612	227.3008	200.8627	195.3304	176.7014	175.0153	181.6607	183.2879	203.5178	215.2928	239.0869	
Water heating fuel	241.5652	213.6612	227.3008	200.8627	195.3304	176.7014	175.0153	181.6607	183.2879	203.5178	215.2928	239.0869	(310)
Cooling System Energy Efficiency Ratio	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	14.0043	12.6491	14.0043	13.5526	14.0043	13.5526	14.0043	14.0043	13.5526	14.0043	13.5526	14.0043	(331)
Lighting	18.9200	15.1784	13.6664	10.0126	7.7340	6.3188	7.0552	9.1707	11.9118	15.6289	17.6528	19.4459	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-27.0130	-37.4281	-56.3318	-65.4823	-71.2174	-68.1045	-65.8306	-61.6575	-53.3126	-42.9034	-28.8698	-22.0930	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)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	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)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	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-13.2128	-26.1592	-55.0500	-85.5922	-111.4495	-117.0978	-109.0269	-92.4066	-64.7406	-36.4952	-16.5112	-9.5179	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)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	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)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	(335b)
Annual totals kWh/year													
Space heating fuel - community heating												682.9185	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												2453.2832	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												6.8292	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)													
mechanical ventilation fans (SFP = 0.7500)												164.8899	(330a)
Total electricity for the above, kWh/year												164.8899	(331)

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Electricity for lighting (calculated in Appendix L)	152.6956 (332)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1337.5038 (333)
Wind generation	0.0000 (334)
Hydro-electric generation (Appendix N)	0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (335)
Appendix Q - special features	
Energy saved or generated	-0.0000 (336)
Energy used	0.0000 (337)
Total delivered energy for all uses	2116.2834 (338)

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**10b. Fuel costs - using BEDF prices (535)**  
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	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	682.9185	6.1900	42.2727 (340a)
Space heating total			42.2727 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2453.2832	6.1900	151.8582 (342a)
Water heating total			151.8582 (342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (347a)
Pumps, fans and electric keep-hot	164.8899	25.1600	41.4863 (349)
Energy for lighting	152.6956	25.1600	38.4182 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-600.2440	25.1600	-151.0214
PV Unit electricity exported	-737.2599	5.8100	-42.8348
Total			-193.8562 (352)
Total energy cost			182.1792 (355)

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**12b. Carbon dioxide emissions - Community heating scheme**  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	1045.4006	0.1561	35.5398 (367)
Electrical energy for heat distribution (space & water)	6.8292	0.0000	4.5196 (372)
Overall CO2 factor for heat network			0.0495 (386)
Total CO2 associated with community systems			155.1734 (373)
Space and water heating			155.1734 (376)
Pumps, fans and electric keep-hot	164.8899	0.1387	22.8723 (378)
Energy for lighting	152.6956	0.1443	22.0387 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-600.2440	0.1340	-80.4599
PV Unit electricity exported	-737.2599	0.1255	-92.5262
Total			-172.9861 (380)
Total CO2, kg/year			27.0982 (383)

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**13b. Primary energy - Community heating scheme**  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			300.0000 (467a)
Space and Water heating from Heat pump	1045.4006	1.5780	359.2075 (467)
Electrical energy for heat distribution (space & water)	6.8292	0.0000	48.0784 (472)
Overall CO2 factor for heat network			0.5263 (486)
Total CO2 associated with community systems			1650.6909 (473)
Space and water heating			1650.6909 (476)
Pumps, fans and electric keep-hot	164.8899	1.5128	249.4454 (478)
Energy for lighting	152.6956	1.5338	234.2097 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-600.2440	1.4954	-897.5890
PV Unit electricity exported	-737.2599	0.4607	-339.6318
Total			-1237.2208 (480)
Total Primary energy kWh/year			897.1251 (483)

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**SAP 10 EPC IMPROVEMENTS**  
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**B-LG.01 1b2P - proposed**

Current energy efficiency rating: A 92  
 Current environmental impact rating: A 100

N Solar water heating Not applicable  
 U Solar photovoltaic panels Not applicable  
 V2 Wind turbine Not applicable

Recommended measures: SAP change Cost change CO2 change  
 (none)

Recommended measures Typical annual savings Energy Environmental  
 (none) efficiency impact  
 Total Savings £0 0.00 kg/m²

Potential energy efficiency rating: A 92  
 Potential environmental impact rating: A 100

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Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Wales):

	Current	Potential	Saving
Electricity	£80	£80	£0
Community scheme	£296	£296	£0
Space heating	£186	£186	£0
Water heating	£152	£152	£0
Lighting	£38	£38	£0
Generated (PV)	-£194	-£194	£0
Total cost of fuels	£182	£182	£0
Total cost of uses	£182	£182	£0
Delivered energy	32 kWh/m <sup>2</sup>	32 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.0 tonnes	0.0 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	0 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	14 kWh/m <sup>2</sup>	14 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	65.5300 (1b)	x 2.7500 (2b)	= 180.2075 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	65.5300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 180.2075 (5)

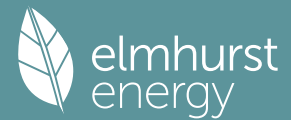
## 2. Ventilation rate

	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	0 * 10 =											0.0000 (7a)	
Number of passive vents	0 * 10 =											0.0000 (7b)	
Number of flueless gas fires	0 * 40 =											0.0000 (7c)	
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												3.0000 (17)	
Infiltration rate												0.1500 (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) =											0.1275 (21)	
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)
Balanced mechanical ventilation with heat recovery													0.5000 (23a)
If mechanical ventilation													0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448	(25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K						
External Door			2.1300	1.0000	2.1300		(26)						
Triple Glazing 1.0 (Uw = 1.00)			9.9700	0.9615	9.5865		(27)						
Heat Loss Floor 1			65.5300	0.1000	6.5530		(28a)						
External Wall 1	65.8900	12.1000	53.7900	0.1500	8.0685		(29a)						
Total net area of external elements Aum(A, m <sup>2</sup> )			131.4200				(31)						
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	26.3380	(33)						
Party Ceiling 1			54.2600				(32b)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K								100.0000 (35)					
Thermal bridges (User defined value 0.040 * total exposed area)								5.2568 (36)					
Point Thermal bridges								(36a) = 0.0000					
Total fabric heat loss								(33) + (36) + (36a) = 31.5948 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	15.3168	15.1273	14.9377	13.9900	13.8004	12.8526	12.8526	12.6631	13.2317	13.8004	14.1795	14.5586	(38)
Heat transfer coeff	46.9117	46.7221	46.5326	45.5848	45.3952	44.4475	44.4475	44.2579	44.8266	45.3952	45.7744	46.1535	(39)

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Average = Sum(39)m / 12 =

45.5374

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.7159	0.7130	0.7101	0.6956	0.6927	0.6783	0.6783	0.6754	0.6841	0.6927	0.6985	0.7043 (40)
HLP (average)												0.6949
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.1329 (42)
Hot water usage for mixer showers												74.6899 (42a)
Hot water usage for baths												25.8297 (42b)
Hot water usage for other uses												36.4733 (42c)
Average daily hot water use (litres/day)												126.3134 (43)
Daily hot water use	137.3677	134.5298	131.0195	125.5523	121.1593	116.4178	114.5001	117.9941	121.6926	126.6828	132.2381	136.9928 (44)
Energy conte	217.5569	191.5686	201.3721	171.8748	163.1037	143.1493	138.4779	146.1013	150.0592	171.9074	188.3974	214.4977 (45)
Energy content (annual)												2098.0662
Distribution loss (46)m = 0.15 x (45)m												32.6335
Water storage loss:												180.0000 (47)
Store volume												1.2000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.6000 (49)
Temperature factor from Table 2b												0.7200 (55)
Enter (49) or (54) in (55)												22.3200 (56)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	263.1393	232.7398	246.9545	215.9868	208.6861	187.2613	184.0603	191.6837	194.1712	217.4898	232.5094	260.0801 (62)
WWHRS	-43.5345	-38.5023	-40.3174	-33.3844	-31.1131	-26.6237	-24.9554	-26.5376	-27.5459	-32.4735	-36.7886	-42.7284 (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	219.6048	194.2375	206.6371	182.6024	177.5731	160.6376	159.1048	165.1461	166.6253	185.0162	195.7208	217.3517 (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	108.8036	96.6335	103.4221	92.4380	90.6979	82.8867	82.5098	85.0446	85.1843	93.6251	97.9317	107.7864 (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	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.6156	19.1988	15.6135	11.8205	8.8359	7.4597	8.0604	10.4772	14.0625	17.8556	20.8401	22.2164 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	278.5797	281.4705	274.1858	258.6775	239.1012	220.7022	208.4105	205.5197	212.8044	228.3126	247.8890	266.2880 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169 (71)
Water heating gains (Table 5)	146.2414	143.7999	139.0083	128.3861	121.9058	115.1205	110.9003	114.3073	118.3115	125.8402	136.0163	144.8742 (72)
Total internal gains	539.0256	537.0581	521.3965	491.4730	462.4318	435.8712	419.9601	422.8931	437.7673	464.5974	497.3343	525.9675 (73)

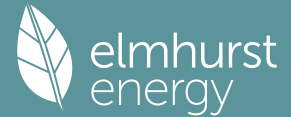
## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m <sup>2</sup>	Table 6a	Specific data	Specific data	factor	W						
		W/m <sup>2</sup>	or Table 6b	or Table 6c	Table 6d							
South	9.9700	46.7521	0.5500	0.7500	0.7700	133.2457 (78)						
Solar gains	133.2457	218.2221	277.9762	314.1735	327.3882	315.0666	307.8393	298.9546	290.3790	235.3730	157.9416	115.1365 (83)
Total gains	672.2713	755.2802	799.3727	805.6465	789.8200	750.9378	727.7994	721.8477	728.1463	699.9704	655.2759	641.1041 (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)												
tau	38.8022	38.9596	39.1184	39.9317	40.0984	40.9535	40.9535	41.1289	40.6071	40.0984	39.7663	39.4397
alpha	3.5868	3.5973	3.6079	3.6621	3.6732	3.7302	3.7302	3.7419	3.7071	3.6732	3.6511	3.6293
util living area	0.8375	0.7809	0.7124	0.6196	0.5082	0.3725	0.2672	0.2803	0.4144	0.6130	0.7733	0.8516 (86)
MIT	20.1927	20.4043	20.6135	20.8065	20.9231	20.9822	20.9960	20.9952	20.9719	20.8410	20.5221	20.1558 (87)
Th 2	20.3268	20.3294	20.3319	20.3447	20.3473	20.3601	20.3601	20.3626	20.3549	20.3473	20.3421	20.3370 (88)
util rest of house	0.8235	0.7639	0.6915	0.5940	0.4771	0.3369	0.2289	0.2420	0.3781	0.5833	0.7534	0.8385 (89)
MIT 2	19.3950	19.6520	19.9039	20.1403	20.2726	20.3454	20.3575	20.3594	20.3308	20.1850	19.8098	19.3586 (90)
Living area fraction												fLA = Living area / (4) = 0.5335 (91)

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MIT	19.8206	20.0534	20.2825	20.4957	20.6196	20.6852	20.6982	20.6986	20.6728	20.5350	20.1898	19.7839 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8206	20.0534	20.2825	20.4957	20.6196	20.6852	20.6982	20.6986	20.6728	20.5350	20.1898	19.7839 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8120	0.7565	0.6899	0.6000	0.4902	0.3550	0.2492	0.2622	0.3961	0.5920	0.7486	0.8266 (94)
Useful gains	545.9150	571.3804	551.5080	483.4152	387.1709	266.6030	181.3734	189.2926	288.4192	414.3902	490.5208	529.9595 (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												
Space heating	728.0968	707.9986	641.3332	528.5876	404.9083	270.4699	182.1531	190.2480	294.6365	450.9996	599.1785	719.2505 (97)
Space heating kWh	135.5432	91.8075	66.8299	32.5241	13.1966	0.0000	0.0000	0.0000	0.0000	27.2374	78.2335	140.8325 (98a)
Space heating requirement - total per year (kWh/year)												586.2047
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	135.5432	91.8075	66.8299	32.5241	13.1966	0.0000	0.0000	0.0000	0.0000	27.2374	78.2335	140.8325 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												586.2047
Space heating per m2										(98c) / (4) =		8.9456 (99)

## 9b. Energy requirements

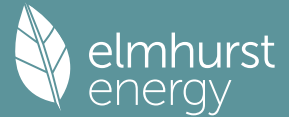
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	135.5432	91.8075	66.8299	32.5241	13.1966	0.0000	0.0000	0.0000	0.0000	27.2374	78.2335	140.8325 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	149.0975	100.9882	73.5129	35.7765	14.5163	0.0000	0.0000	0.0000	0.0000	29.9611	86.0569	154.9157
Space heating requirement	149.0975	100.9882	73.5129	35.7765	14.5163	0.0000	0.0000	0.0000	0.0000	29.9611	86.0569	154.9157 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	219.6048	194.2375	206.6371	182.6024	177.5731	160.6376	159.1048	165.1461	166.6253	185.0162	195.7208	217.3517 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	241.5652	213.6612	227.3008	200.8627	195.3304	176.7014	175.0153	181.6607	183.2879	203.5178	215.2928	239.0869
Water heating fuel	241.5652	213.6612	227.3008	200.8627	195.3304	176.7014	175.0153	181.6607	183.2879	203.5178	215.2928	239.0869 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	14.0043	12.6491	14.0043	13.5526	14.0043	13.5526	14.0043	14.0043	13.5526	14.0043	13.5526	14.0043 (331)
Lighting	18.9200	15.1784	13.6664	10.0126	7.7340	6.3188	7.0552	9.1707	11.9118	15.6289	17.6528	19.4459 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-25.0233	-36.3130	-53.8177	-62.4544	-69.0091	-65.0837	-64.2982	-59.8614	-52.2714	-42.3819	-27.8773	-21.5114 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-11.5398	-24.7004	-50.0950	-76.8091	-103.0393	-104.0674	-102.6174	-85.9736	-61.9466	-35.6156	-15.4919	-9.0858 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												644.8252 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2453.2832 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												6.4483 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												164.8899 (330a)
Total electricity for the above, kWh/year												164.8899 (331)
Electricity for lighting (calculated in Appendix L)												152.6956 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1260.8848 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												2154.8091 (338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	644.8252	4.4400	28.6302 (340a)
Space heating total			28.6302 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2453.2832	4.4400	108.9258 (342a)
Water heating total			108.9258 (342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (347a)
Pumps, fans and electric keep-hot	164.8899	16.4900	27.1903 (349)



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Energy for lighting	152.6956	16.4900	25.1795 (350)
Additional standing charges			92.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-579.9029	16.4900	-95.6260
PV Unit electricity exported	-680.9819	5.5900	-38.0669
Total			-133.6929 (352)
Total energy cost			148.2330 (355)

## 11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4828 (357)
SAP value		92.1738
SAP rating (Section 12)		92 (358)
SAP band		A

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	1032.7028	0.1567	33.6871 (367)
Electrical energy for heat distribution (space & water)	6.4483	0.0000	4.4640 (372)
Overall CO2 factor for heat network			0.0495 (386)
Total CO2 associated with community systems			153.2650 (373)
Space and water heating			153.2650 (376)
Pumps, fans and electric keep-hot	164.8899	0.1387	22.8723 (378)
Energy for lighting	152.6956	0.1443	22.0387 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-579.9029	0.1339	-77.6717
PV Unit electricity exported	-680.9819	0.1254	-85.3700
Total			-163.0416 (380)
Total CO2, kg/year			35.1343 (383)
CO2 emissions per m2			0.5400 (384)
EI value			99.5741 (384a)
EI rating			100 (385)
EI band			A

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	65.5300 (1b)	x 2.7500 (2b)	= 180.2075 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	65.5300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 180.2075 (5)

## 2. Ventilation rate

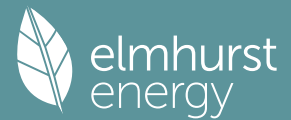
	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number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

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		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.5000	6.2000	5.9000	5.2000	5.1000	4.7000	4.5000	4.5000	5.0000	5.7000	6.0000	6.0000 (22)
Wind factor	1.6250	1.5500	1.4750	1.3000	1.2750	1.1750	1.1250	1.1250	1.2500	1.4250	1.5000	1.5000 (22a)
Adj infilt rate	0.2072	0.1976	0.1881	0.1658	0.1626	0.1498	0.1434	0.1434	0.1594	0.1817	0.1913	0.1913 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.3022	0.2926	0.2831	0.2607	0.2576	0.2448	0.2384	0.2384	0.2544	0.2767	0.2863	0.2863 (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					
External Door			2.1300	1.0000	2.1300		(26)					
Triple Glazing 1.0 (Uw = 1.00)			9.9700	0.9615	9.5865		(27)					
Heat Loss Floor 1			65.5300	0.1000	6.5530		(28a)					
External Wall 1	65.8900	12.1000	53.7900	0.1500	8.0685		(29a)					
Total net area of external elements Aum(A, m2)			131.4200				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	26.3380	(33)					
Party Ceiling 1			54.2600				(32b)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (User defined value 0.040 * total exposed area)							5.2568 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	31.5948 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	17.9706	17.4020	16.8333	15.5064	15.3168	14.5586	14.1795	14.1795	15.1273	16.4542	17.0229	17.0229
Average = Sum(39)m / 12 =	49.5655	48.9968	48.4281	47.1012	46.9117	46.1535	45.7744	45.7744	46.7221	48.0490	48.6177	48.6177
HLP	0.7564	0.7477	0.7390	0.7188	0.7159	0.7043	0.6985	0.6985	0.7130	0.7332	0.7419	0.7419
HLP (average)												0.7258
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.1329 (42)
Hot water usage for mixer showers	74.9771	73.8504	72.2085	69.0670	66.7486	64.1632	62.6937	64.3232	66.1094	68.8853	72.0943	74.6899 (42a)
Hot water usage for baths	25.9173	25.5324	24.9904	23.9910	23.2426	22.4128	21.9646	22.5029	23.0889	23.9768	24.9968	25.8297 (42b)
Hot water usage for other uses	36.4733	35.1470	33.8207	32.4944	31.1681	29.8418	29.8418	31.1681	32.4944	33.8207	35.1470	36.4733 (42c)
Average daily hot water use (litres/day)												126.3134 (43)
Daily hot water use	137.3677	134.5298	131.0195	125.5523	121.1593	116.4178	114.5001	117.9941	121.6926	126.6828	132.2381	136.9928 (44)
Energy conte	217.5569	191.5686	201.3721	171.8748	163.1037	143.1493	138.4779	146.1013	150.0592	171.9074	188.3974	214.4977 (45)
Energy content (annual)												Total = Sum(45)m = 2098.0662
Distribution loss (46)m = 0.15 x (45)m	32.6335	28.7353	30.2058	25.7812	24.4656	21.4724	20.7717	21.9152	22.5089	25.7861	28.2596	32.1747 (46)
Water storage loss:												
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	263.1393	232.7398	246.9545	215.9868	208.6861	187.2613	184.0603	191.6837	194.1712	217.4898	232.5094	260.0801 (62)
WWHRS	-43.5345	-38.5023	-40.3174	-33.3844	-31.1131	-26.6237	-24.9554	-26.5376	-27.5459	-32.4735	-36.7886	-42.7284 (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	219.6048	194.2375	206.6371	182.6024	177.5731	160.6376	159.1048	165.1461	166.6253	185.0162	195.7208	217.3517 (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	108.8036	96.6335	103.4221	92.4380	90.6979	82.8867	82.5098	85.0446	85.1843	93.6251	97.9317	107.7864 (65)

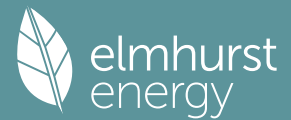
## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754	127.9754 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.6156	19.1988	15.6135	11.8205	8.8359	7.4597	8.0604	10.4772	14.0625	17.8556	20.8401	22.2164 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	278.5797	281.4705	274.1858	258.6775	239.1012	220.7022	208.4105	205.5197	212.8044	228.3126	247.8890	266.2880 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305	49.9305 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169	-85.3169 (71)
Water heating gains (Table 5)	146.2414	143.7999	139.0083	128.3861	121.9058	115.1205	110.9003	114.3073	118.3115	125.8402	136.0163	144.8742 (72)
Total internal gains	539.0256	537.0581	521.3965	491.4730	462.4318	435.8712	419.9601	422.8931	437.7673	464.5974	497.3343	525.9675 (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
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South	9.9700	50.7747	0.5500	0.7500	0.7700	144.7103 (78)						
Solar gains	144.7103	224.1164	293.2212	335.7729	343.4367	341.4488	318.9417	311.4787	295.3821	235.9461	163.0571	117.4885 (83)
Total gains	683.7359	761.1744	814.6177	827.2459	805.8685	777.3200	738.9018	734.3718	733.1495	700.5435	660.3914	643.4560 (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	36.7247	37.1510	37.5872	38.6461	38.8022	39.4397	39.7663	39.7663	38.9596	37.8838	37.4406	37.4406
alpha	3.4483	3.4767	3.5058	3.5764	3.5868	3.6293	3.6511	3.6511	3.5973	3.5256	3.4960	3.4960
util living area	0.8289	0.7807	0.7171	0.6347	0.5351	0.4214	0.3480	0.3500	0.4598	0.6296	0.7663	0.8408 (86)
MIT	20.1845	20.3672	20.5717	20.7668	20.8954	20.9655	20.9860	20.9857	20.9512	20.8042	20.5082	20.1768 (87)
Th 2	20.2913	20.2989	20.3065	20.3243	20.3268	20.3370	20.3421	20.3421	20.3294	20.3116	20.3040	20.3040 (88)
util rest of house	0.8133	0.7628	0.6959	0.6094	0.5040	0.3858	0.3093	0.3111	0.4226	0.5983	0.7443	0.8259 (89)
MIT 2	19.3581	19.5830	19.8327	20.0762	20.2236	20.3068	20.3314	20.3311	20.2859	20.1123	19.7628	19.3603 (90)
Living area fraction									fLA = Living area / (4) =			0.5335 (91)
MIT	19.7990	20.0014	20.2270	20.4446	20.5820	20.6582	20.6806	20.6803	20.6408	20.4814	20.1605	19.7959 (92)
Temperature adjustment												0.0000
adjusted MIT	19.7990	20.0014	20.2270	20.4446	20.5820	20.6582	20.6806	20.6803	20.6408	20.4814	20.1605	19.7959 (93)
8. Space heating requirement												
Utilisation	0.8016	0.7547	0.6933	0.6140	0.5160	0.4032	0.3293	0.3312	0.4401	0.6062	0.7396	0.8140 (94)
Useful gains	548.0960	574.4836	564.8130	507.9004	415.7890	313.3952	243.3012	243.2315	322.6351	424.6771	488.4030	523.7656 (95)
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000 (96)
Heat loss rate W	733.5201	720.3212	664.7723	562.6061	440.1252	321.1445	246.2930	246.2817	333.6357	469.9868	600.9393	709.6205 (97)
Space heating kWh	137.9555	98.0029	74.3698	39.3881	18.1061	0.0000	0.0000	0.0000	0.0000	33.7104	81.0262	138.2761 (98a)
Space heating requirement - total per year (kWh/year)												620.8350
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	137.9555	98.0029	74.3698	39.3881	18.1061	0.0000	0.0000	0.0000	0.0000	33.7104	81.0262	138.2761 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												620.8350
Space heating per m2										(98c) / (4) =		9.4741 (99)
9b. Energy requirements												
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	137.9555	98.0029	74.3698	39.3881	18.1061	0.0000	0.0000	0.0000	0.0000	33.7104	81.0262	138.2761 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	151.7511	107.8032	81.8067	43.3269	19.9167	0.0000	0.0000	0.0000	0.0000	37.0815	89.1288	152.1037
Space heating requirement	151.7511	107.8032	81.8067	43.3269	19.9167	0.0000	0.0000	0.0000	0.0000	37.0815	89.1288	152.1037 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	219.6048	194.2375	206.6371	182.6024	177.5731	160.6376	159.1048	165.1461	166.6253	185.0162	195.7208	217.3517 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	241.5652	213.6612	227.3008	200.8627	195.3304	176.7014	175.0153	181.6607	183.2879	203.5178	215.2928	239.0869
Water heating fuel	241.5652	213.6612	227.3008	200.8627	195.3304	176.7014	175.0153	181.6607	183.2879	203.5178	215.2928	239.0869 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	14.0043	12.6491	14.0043	13.5526	14.0043	13.5526	14.0043	14.0043	13.5526	14.0043	13.5526	14.0043 (331)
Lighting	18.9200	15.1784	13.6664	10.0126	7.7340	6.3188	7.0552	9.1707	11.9118	15.6289	17.6528	19.4459 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-27.0130	-37.4281	-56.3318	-65.4823	-71.2174	-68.1045	-65.8306	-61.6575	-53.3126	-42.9034	-28.8698	-22.0930 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-13.2128	-26.1592	-55.0500	-85.5922	-111.4495	-117.0978	-109.0269	-92.4066	-64.7406	-36.4952	-16.5112	-9.5179 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												682.9185 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2453.2832 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												6.8292 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												164.8899 (330a)
Total electricity for the above, kWh/year												164.8899 (331)
Electricity for lighting (calculated in Appendix L)												152.6956 (332)

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Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation		-1337.5038 (333)
Wind generation		0.0000 (334)
Hydro-electric generation (Appendix N)		0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)		0.0000 (335)
Appendix Q - special features		
Energy saved or generated		-0.0000 (336)
Energy used		0.0000 (337)
Total delivered energy for all uses		2116.2834 (338)

## 10b. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	682.9185	6.1900	42.2727 (340a)
Space heating total			42.2727 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2453.2832	6.1900	151.8582 (342a)
Water heating total			151.8582 (342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (347a)
Pumps, fans and electric keep-hot	164.8899	25.1600	41.4863 (349)
Energy for lighting	152.6956	25.1600	38.4182 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-600.2440	25.1600	-151.0214
PV Unit electricity exported	-737.2599	5.8100	-42.8348
Total			-193.8562 (352)
Total energy cost			182.1792 (355)

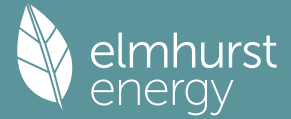
## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	1045.4006	0.1561	35.5398 (367)
Electrical energy for heat distribution (space & water)	6.8292	0.0000	4.5196 (372)
Overall CO2 factor for heat network			0.0495 (386)
Total CO2 associated with community systems			155.1734 (373)
Space and water heating			155.1734 (376)
Pumps, fans and electric keep-hot	164.8899	0.1387	22.8723 (378)
Energy for lighting	152.6956	0.1443	22.0387 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-600.2440	0.1340	-80.4599
PV Unit electricity exported	-737.2599	0.1255	-92.5262
Total			-172.9861 (380)
Total CO2, kg/year			27.0982 (383)

## 13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			300.0000 (467a)
Space and Water heating from Heat pump	1045.4006	1.5780	359.2075 (467)
Electrical energy for heat distribution (space & water)	6.8292	0.0000	48.0784 (472)
Overall CO2 factor for heat network			0.5263 (486)
Total CO2 associated with community systems			1650.6909 (473)
Space and water heating			1650.6909 (476)
Pumps, fans and electric keep-hot	164.8899	1.5128	249.4454 (478)
Energy for lighting	152.6956	1.5338	234.2097 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-600.2440	1.4954	-897.5890
PV Unit electricity exported	-737.2599	0.4607	-339.6318
Total			-1237.2208 (480)
Total Primary energy kWh/year			897.1251 (483)

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Property Reference	Block B		Issued on Date	24/01/2024	
Assessment Reference	B-LG.02 1b2P - proposed	Prop Type Ref	Block B		
Property					
SAP Rating	92 A	DER	0.23	TER	13.82
Environmental	100 A	% DER < TER			98.34
CO <sub>2</sub> Emissions (t/year)	0	DPER	13.50	TPER	74.09
Compliance Check	See BRWL	% DPER < TPER			81.78
Assessor Details	Mr. Oliver Fuller			Assessor ID	AW55-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	54.2600 (1b)	2.7500 (2b)	149.2150 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2600		149.2150 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 149.2150 (5)

### 2. Ventilation rate

	m <sup>3</sup> 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)

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		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
External Door			2.1300	1.0000	2.1300		(26)
Triple Glazing 1.0 (Uw = 1.00)			7.4100	0.9615	7.1250		(27)
Heat Loss Floor 1			54.2600	0.1000	5.4260		(28a)
External Wall 1	43.8400	9.5400	34.3000	0.1500	5.1450		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			98.1000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 19.8260		(33)
Party Ceiling 1			54.2600				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
Thermal bridges (User defined value 0.040 * total exposed area)							3.9240 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	23.7500 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	12.6826	12.5257	12.3687	11.5839	11.4270	10.6422	10.6422	10.4852	10.9561	11.4270	11.7409	12.0548 (38)

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Average = Sum(39)m / 12 =	36.4326	36.2757	36.1187	35.3339	35.1770	34.3922	34.3922	34.2352	34.7061	35.1770	35.4909	35.8048 (39)
												35.2947
HLP	0.6714	0.6686	0.6657	0.6512	0.6483	0.6338	0.6338	0.6309	0.6396	0.6483	0.6541	0.6599 (40)
HLP (average)												0.6505
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.8156 (42)
Hot water usage for mixer showers	68.3274	67.3006	65.8043	62.9414	60.8287	58.4726	57.1334	58.6183	60.2461	62.7759	65.7002	68.0656 (42a)
Hot water usage for baths	23.6296	23.2787	22.7845	21.8733	21.1910	20.4345	20.0258	20.5166	21.0509	21.8604	22.7904	23.5498 (42b)
Hot water usage for other uses	33.2240	32.0159	30.8077	29.5996	28.3914	27.1833	27.1833	28.3914	29.5996	30.8077	32.0159	33.2240 (42c)
Average daily hot water use (litres/day)												115.1077 (43)
Daily hot water use	125.1811	122.5952	119.3965	114.4143	110.4112	106.0904	104.3425	107.5263	110.8966	115.4440	120.5065	124.8394 (44)
Energy conte	198.2562	174.5739	183.5081	156.6275	148.6346	130.4505	126.1932	133.1401	136.7466	156.6565	171.6836	195.4683 (45)
Energy content (annual)												Total = Sum(45)m = 1911.9391
Distribution loss (46)m = 0.15 x (45)m	29.7384	26.1861	27.5262	23.4941	22.2952	19.5676	18.9290	19.9710	20.5120	23.4985	25.7525	29.3203 (46)
Water storage loss:												
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	243.8386	215.7451	229.0905	200.7395	194.2170	174.5625	171.7756	178.7225	180.8586	202.2389	215.7956	241.0507 (62)
WWHRS	-39.6735	-35.0875	-36.7416	-30.4235	-28.3536	-24.2624	-22.7421	-24.1840	-25.1028	-29.5935	-33.5258	-38.9388 (63a)
FV 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	204.1652	180.6576	192.3488	170.3160	165.8634	150.3001	149.0335	154.5385	155.7558	172.6454	182.2698	202.1120 (64)
												Total per year (kWh/year) = Sum(64)m = 2080.0058 (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	102.3861	90.9828	97.4823	87.3682	85.8869	78.6644	78.4252	80.7350	80.7578	88.5542	92.3744	101.4591 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.7699	16.6712	13.5580	10.2643	7.6726	6.4776	6.9992	9.0979	12.2112	15.5049	18.0965	19.2916 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.2336	238.6850	232.5076	219.3567	202.7561	187.1539	176.7306	174.2793	180.4566	193.6075	210.2081	225.8104 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258 (71)
Water heating gains (Table 5)	137.6158	135.3910	131.0247	121.3448	115.4394	109.2561	105.4102	108.5148	112.1637	119.0244	128.2978	136.3698 (72)
Total internal gains	476.6417	474.7697	461.1127	434.9882	409.8906	386.9100	373.1625	375.9144	388.8539	412.1593	440.6248	465.4942 (73)

## 6. Solar gains

[Jan]												
			Area	Solar flux	g	FF		Access		Gains		
			m2	Table 6a	Specific data	Specific data		factor		W		
				W/m2	or Table 6b	or Table 6c		Table 6d				
Southeast			7.4100	36.7938	0.5500	0.7500		0.7700		77.9382 (77)		
Solar gains	77.9382	132.7576	181.6447	225.0666	252.0934	250.2704	241.2874	221.1242	196.6828	146.7254	93.3520	66.6989 (83)
Total gains	554.5799	607.5273	642.7574	660.0549	661.9840	637.1804	614.4498	597.0386	585.5367	558.8847	533.9768	532.1930 (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)												
tau	41.3701	41.5491	41.7297	42.6565	42.8468	43.8245	43.8245	44.0255	43.4282	42.8468	42.4679	42.0955
alpha	3.7580	3.7699	3.7820	3.8438	3.8565	3.9216	3.9216	3.9350	3.8952	3.8565	3.8312	3.8064
util living area	0.8248	0.7745	0.7034	0.5988	0.4771	0.3419	0.2455	0.2627	0.4015	0.6040	0.7605	0.8374 (86)
MIT	20.3196	20.4880	20.6767	20.8532	20.9486	20.9897	20.9979	20.9972	20.9799	20.8714	20.6042	20.2945 (87)
Th 2	20.3661	20.3687	20.3713	20.3841	20.3867	20.3996	20.3996	20.4022	20.3945	20.3867	20.3816	20.3764 (88)
util rest of house	0.8106	0.7579	0.6832	0.5744	0.4487	0.3108	0.2123	0.2290	0.3680	0.5756	0.7409	0.8241 (89)
MIT 2	19.5811	19.7858	20.0128	20.2290	20.3368	20.3911	20.3982	20.4003	20.3771	20.2551	19.9405	19.5595 (90)

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Living area fraction										FLA = Living area / (4) =	0.6286 (91)	
MIT	20.0454	20.2272	20.4302	20.6214	20.7214	20.7674	20.7752	20.7755	20.7560	20.6425	20.3577	20.0215 (92)
Temperature adjustment												0.0000
adjusted MIT	20.0454	20.2272	20.4302	20.6214	20.7214	20.7674	20.7752	20.7755	20.7560	20.6425	20.3577	20.0215 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8030	0.7540	0.6852	0.5839	0.4643	0.3299	0.2331	0.2501	0.3881	0.5877	0.7401	0.8159	(94)
Useful gains	445.3075	458.0715	440.4056	385.4340	307.3695	210.2094	143.2256	149.3107	227.2301	328.4302	395.2191	434.2266	(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	573.6444	556.0054	503.1395	414.1622	317.3472	212.1120	143.5937	149.7977	231.0051	353.2662	470.5281	566.4874	(97)
Space heating kWh	95.4827	65.8116	46.6740	20.6843	7.4234	0.0000	0.0000	0.0000	0.0000	18.4780	54.2224	98.4020	(98a)
Space heating requirement - total per year (kWh/year)												407.1784	
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	95.4827	65.8116	46.6740	20.6843	7.4234	0.0000	0.0000	0.0000	0.0000	18.4780	54.2224	98.4020	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												407.1784	
Space heating per m2												7.5042	(99)

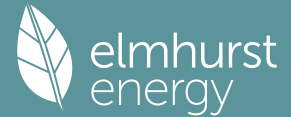
## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (301)
Fraction of space heat from community system													1.0000 (302)
Fraction of heat from community Heat pump-Space and Water													1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating													1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating													1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system													1.1000 (306)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating:													
Space heating requirement	95.4827	65.8116	46.6740	20.6843	7.4234	0.0000	0.0000	0.0000	0.0000	18.4780	54.2224	98.4020	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10	105.0309	72.3927	51.3414	22.7528	8.1657	0.0000	0.0000	0.0000	0.0000	20.3258	59.6447	108.2422	
Space heating requirement	105.0309	72.3927	51.3414	22.7528	8.1657	0.0000	0.0000	0.0000	0.0000	20.3258	59.6447	108.2422	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)													0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating													
Annual water heating requirement	204.1652	180.6576	192.3488	170.3160	165.8634	150.3001	149.0335	154.5385	155.7558	172.6454	182.2698	202.1120	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10	224.5817	198.7233	211.5837	187.3476	182.4497	165.3301	163.9368	169.9923	171.3314	189.9099	200.4968	222.3232	
Water heating fuel	224.5817	198.7233	211.5837	187.3476	182.4497	165.3301	163.9368	169.9923	171.3314	189.9099	200.4968	222.3232	(310)
Cooling System Energy Efficiency Ratio	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	11.5958	10.4737	11.5958	11.2218	11.5958	11.2218	11.5958	11.5958	11.2218	11.5958	11.2218	11.5958	(331)
Lighting	16.4292	13.1801	11.8672	8.6944	6.7158	5.4869	6.1264	7.9633	10.3436	13.5713	15.3288	16.8858	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-24.2472	-34.7787	-50.9510	-58.4287	-63.9779	-60.1479	-59.4431	-55.6386	-49.0187	-40.3049	-26.8775	-20.8922	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)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	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)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	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-12.3159	-26.2347	-52.9618	-80.8348	-108.0705	-109.0032	-107.4725	-90.1964	-65.1993	-37.6926	-16.4916	-9.7049	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)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	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)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	(335b)
Annual totals kWh/year													
Space heating fuel - community heating													447.8962 (307)
Space heating fuel - secondary													0.0000 (309)
Water heating fuel - community heating													2288.0064 (310)
Efficiency of water heater													0.0000 (311)
Electricity used for heat distribution													4.4790 (313)
Space cooling fuel													0.0000 (321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)													
mechanical ventilation fans (SFP = 0.7500)													136.5317 (330a)
Total electricity for the above, kWh/year													136.5317 (331)
Electricity for lighting (calculated in Appendix L)													132.5928 (332)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-1260.8848 (333)
Wind generation													0.0000 (334)
Hydro-electric generation (Appendix N)													0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)													0.0000 (335)
Appendix Q - special features													
Energy saved or generated													-0.0000 (336)
Energy used													0.0000 (337)
Total delivered energy for all uses													1744.1424 (338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Heat pump	447.8962	4.4400	19.8866	(340a)
Space heating total			19.8866	(340)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Heat pump	2288.0064	4.4400	101.5875	(342a)
Water heating total			101.5875	(342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(347a)

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Pumps, fans and electric keep-hot	136.5317	16.4900	22.5141 (349)
Energy for lighting	132.5928	16.4900	21.8646 (350)
Additional standing charges			92.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-544.7065	16.4900	-89.8221
PV Unit electricity exported	-716.1783	5.5900	-40.0344
Total			-129.8565 (352)
Total energy cost			127.9962 (355)

## 11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4642 (357)
SAP value		92.4750
SAP rating (Section 12)		92 (358)
SAP band		A

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	911.9675	0.1570	23.4346 (367)
Electrical energy for heat distribution (space & water)	4.4790	0.0000	3.9227 (372)
Overall CO2 factor for heat network			0.0492 (386)
Total CO2 associated with community systems			134.6802 (373)
Space and water heating			134.6802 (376)
Pumps, fans and electric keep-hot	136.5317	0.1387	18.9386 (378)
Energy for lighting	132.5928	0.1443	19.1372 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-544.7065	0.1342	-73.0859
PV Unit electricity exported	-716.1783	0.1255	-89.8782
Total			-162.9641 (380)
Total CO2, kg/year			9.7919 (383)
CO2 emissions per m2			0.1800 (384)
EI value			99.8678 (384a)
EI rating			100 (385)
EI band			A

## SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.2600 (1b)	x 2.7500 (2b)	= 149.2150 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.2150 (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	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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (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) =	0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.5000	6.2000	5.9000	5.2000	5.1000	4.7000	4.5000	4.5000	5.0000	5.7000	6.0000	6.0000 (22)
Wind factor	1.6250	1.5500	1.4750	1.3000	1.2750	1.1750	1.1250	1.1250	1.2500	1.4250	1.5000	1.5000 (22a)
Adj infilt rate	0.2072	0.1976	0.1881	0.1658	0.1626	0.1498	0.1434	0.1434	0.1594	0.1817	0.1913	0.1913 (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) =												81.0000 (23c)
Effective ac	0.3022	0.2926	0.2831	0.2607	0.2576	0.2448	0.2384	0.2384	0.2544	0.2767	0.2863	0.2863 (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						
External Door			2.1300	1.0000	2.1300		(26)						
Triple Glazing 1.0 (Uw = 1.00)			7.4100	0.9615	7.1250		(27)						
Heat Loss Floor 1			54.2600	0.1000	5.4260		(28a)						
External Wall 1	43.8400	9.5400	34.3000	0.1500	5.1450		(29a)						
Total net area of external elements Aum(A, m2)			98.1000				(31)						
Fabric heat loss, W/K = Sum (A x U)					(26)... (30) + (32) =	19.8260	(33)						
Party Ceiling 1			54.2600				(32b)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)						
Thermal bridges (User defined value 0.040 * total exposed area)							3.9240 (36)						
Point Thermal bridges						(36a) =	0.0000						
Total fabric heat loss						(33) + (36) + (36a) =	23.7500 (37)						
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 14.8800	Feb 14.4091	Mar 13.9383	Apr 12.8396	May 12.6826	Jun 12.0548	Jul 11.7409	Aug 11.7409	Sep 12.5257	Oct 13.6244	Nov 14.0952	Dec 14.0952	(38)
Heat transfer coeff	38.6300	38.1591	37.6883	36.5896	36.4326	35.8048	35.4909	35.4909	36.2757	37.3744	37.8452	37.8452	(39)
Average = Sum(39)m / 12 =													36.9689
HLP	Jan 0.7119	Feb 0.7033	Mar 0.6946	Apr 0.6743	May 0.6714	Jun 0.6599	Jul 0.6541	Aug 0.6541	Sep 0.6686	Oct 0.6888	Nov 0.6975	Dec 0.6975	(40)
HLP (average)													0.6813
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.8156 (42)
Hot water usage for mixer showers													68.0656 (42a)
Hot water usage for baths													23.5498 (42b)
Hot water usage for other uses													33.2240 (42c)
Average daily hot water use (litres/day)													115.1077 (43)
Daily hot water use	Jan 125.1811	Feb 122.5952	Mar 119.3965	Apr 114.4143	May 110.4112	Jun 106.0904	Jul 104.3425	Aug 107.5263	Sep 110.8966	Oct 115.4440	Nov 120.5065	Dec 124.8394	(44)
Energy conte	198.2562	174.5739	183.5081	156.6275	148.6346	130.4505	126.1932	133.1401	136.7466	156.6565	171.6836	195.4683	(45)
Energy content (annual)										Total = Sum(45)m =			1911.9391
Distribution loss (46)m = 0.15 x (45)m													29.3203 (46)
Water storage loss:													180.0000 (47)
Store volume													1.2000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.6000 (49)
Temperature factor from Table 2b													0.7200 (55)
Enter (49) or (54) in (55)													
Total storage loss													22.3200 (56)
If cylinder contains dedicated solar storage													22.3200 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	(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	243.8386	215.7451	229.0905	200.7395	194.2170	174.5625	171.7756	178.7225	180.8586	202.2389	215.7956	241.0507	(62)
WWHRS	-39.6735	-35.0875	-36.7416	-30.4235	-28.3536	-24.2624	-22.7421	-24.1840	-25.1028	-29.5935	-33.5258	-38.9388	(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	204.1652	180.6576	192.3488	170.3160	165.8634	150.3001	149.0335	154.5385	155.7558	172.6454	182.2698	202.1120	(64)
Electric shower(s)													2080.0058 (64)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Heat gains from water heating, kWh/month	102.3861	90.9828	97.4823	87.3682	85.8869	78.6644	78.4252	80.7350	80.7578	88.5542	92.3744	101.4591	(65)

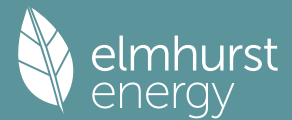
### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387	108.9387	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.7699	16.6712	13.5580	10.2643	7.6726	6.4776	6.9992	9.0979	12.2112	15.5049	18.0965	19.2916	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.2336	238.6850	232.5076	219.3567	202.7561	187.1539	176.7306	174.2793	180.4566	193.6075	210.2081	225.8104	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	(71)
Water heating gains (Table 5)	137.6158	135.3910	131.0247	121.3448	115.4394	109.2561	105.4102	108.5148	112.1637	119.0244	128.2978	136.3698	(72)
Total internal gains	476.6417	474.7697	461.1127	434.9882	409.8906	386.9100	373.1625	375.9144	388.8539	412.1593	440.6248	465.4942	(73)

### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a	g Specific data	FF Specific data	Access factor	Gains W
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					W/m2	or Table 6b	or Table 6c		Table 6d			
Southeast					7.4100	40.1192	0.5500	0.7500	0.7700		84.9822 (77)	
Solar gains	84.9822	137.0424	192.8877	242.3302	266.2465	272.8800	251.5963	232.0709	201.5057	147.9268	96.7910	68.3128 (83)
Total gains	561.6239	611.8121	654.0004	677.3184	676.1372	659.7900	624.7588	607.9853	590.3596	560.0861	537.4158	533.8069 (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	39.0169	39.4983	39.9918	41.1927	41.3701	42.0955	42.4679	42.4679	41.5491	40.3277	39.8260	39.8260
alpha	3.6011	3.6332	3.6661	3.7462	3.7580	3.8064	3.8312	3.8312	3.7699	3.6885	3.6551	3.6551
util living area	0.8185	0.7759	0.7103	0.6156	0.5043	0.3890	0.3209	0.3294	0.4471	0.6222	0.7556	0.8273 (86)
MIT	20.2982	20.4468	20.6343	20.8183	20.9276	20.9787	20.9917	20.9909	20.9634	20.8368	20.5834	20.3033 (87)
Th 2	20.3303	20.3380	20.3456	20.3636	20.3661	20.3764	20.3816	20.3816	20.3687	20.3507	20.3431	20.3431 (88)
util rest of house	0.8029	0.7584	0.6897	0.5914	0.4756	0.3574	0.2869	0.2946	0.4125	0.5922	0.7340	0.8121 (89)
MIT 2	19.5271	19.7111	19.9404	20.1701	20.2947	20.3577	20.3751	20.3745	20.3359	20.1842	19.8843	19.5449 (90)
Living area fraction	20.0118	20.1736	20.3766	20.5776	20.6926	20.7481	20.7627	20.7620	20.7304	20.5945	20.3238	20.0216 (92)
Temperature adjustment												0.0000
adjusted MIT	20.0118	20.1736	20.3766	20.5776	20.6926	20.7481	20.7627	20.7620	20.7304	20.5945	20.3238	20.0216 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7950	0.7538	0.6907	0.5997	0.4905	0.3763	0.3079	0.3161	0.4324	0.6037	0.7334	0.8042 (94)
Useful gains	446.5027	461.1937	451.7075	406.1889	331.6548	248.2981	192.3615	192.1899	255.2970	338.1008	394.1257	429.2852 (95)
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000 (96)
Heat loss rate W	579.9075	567.5633	522.9851	441.9140	345.8396	252.3552	193.8776	193.8516	262.2872	369.7992	473.9649	560.9280 (97)
Space heating kWh	99.2532	71.4804	53.0305	25.7221	10.5535	0.0000	0.0000	0.0000	0.0000	23.5836	57.4842	97.9422 (98a)
Space heating requirement - total per year (kWh/year)												439.0499
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	99.2532	71.4804	53.0305	25.7221	10.5535	0.0000	0.0000	0.0000	0.0000	23.5836	57.4842	97.9422 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												439.0499
Space heating per m2												8.0916 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	99.2532	71.4804	53.0305	25.7221	10.5535	0.0000	0.0000	0.0000	0.0000	23.5836	57.4842	97.9422 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	109.1786	78.6284	58.3336	28.2943	11.6089	0.0000	0.0000	0.0000	0.0000	25.9420	63.2326	107.7365
Space heating requirement	109.1786	78.6284	58.3336	28.2943	11.6089	0.0000	0.0000	0.0000	0.0000	25.9420	63.2326	107.7365 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	204.1652	180.6576	192.3488	170.3160	165.8634	150.3001	149.0335	154.5385	155.7558	172.6454	182.2698	202.1120 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	224.5817	198.7233	211.5837	187.3476	182.4497	165.3301	163.9368	169.9923	171.3314	189.9099	200.4968	222.3232
Water heating fuel	224.5817	198.7233	211.5837	187.3476	182.4497	165.3301	163.9368	169.9923	171.3314	189.9099	200.4968	222.3232 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	11.5958	10.4737	11.5958	11.2218	11.5958	11.2218	11.5958	11.5958	11.2218	11.5958	11.2218	11.5958 (331)
Lighting	16.4292	13.1801	11.8672	8.6944	6.7158	5.4869	6.1264	7.9633	10.3436	13.5713	15.3288	16.8858 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-26.1340	-35.8137	-53.2258	-61.0883	-65.8701	-62.7047	-60.7451	-57.1888	-49.9404	-40.7821	-27.8107	-21.4466 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-14.0919	-27.7736	-58.1559	-89.9861	-116.7968	-122.4976	-114.1125	-96.8753	-68.1127	-38.6165	-17.5704	-10.1643 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												482.9548 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2288.0064 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												4.8295 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												136.5317 (330a)
Total electricity for the above, kWh/year												136.5317 (331)

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Electricity for lighting (calculated in Appendix L)	132.5928 (332)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1337.5038 (333)
Wind generation	0.0000 (334)
Hydro-electric generation (Appendix N)	0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (335)
Appendix Q - special features	
Energy saved or generated	-0.0000 (336)
Energy used	0.0000 (337)
Total delivered energy for all uses	1702.5820 (338)

## 10b. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	482.9548	6.1900	29.8949 (340a)
Space heating total			29.8949 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2288.0064	6.1900	141.6276 (342a)
Water heating total			141.6276 (342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (347a)
Pumps, fans and electric keep-hot	136.5317	25.1600	34.3514 (349)
Energy for lighting	132.5928	25.1600	33.3604 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-562.7502	25.1600	-141.5879
PV Unit electricity exported	-774.7536	5.8100	-45.0132
Total			-186.6011 (352)
Total energy cost			154.6331 (355)

## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	923.6538	0.1564	25.1725 (367)
Electrical energy for heat distribution (space & water)	4.8295	0.0000	3.9749 (372)
Overall CO2 factor for heat network			0.0493 (386)
Total CO2 associated with community systems			136.4702 (373)
Space and water heating			136.4702 (376)
Pumps, fans and electric keep-hot	136.5317	0.1387	18.9386 (378)
Energy for lighting	132.5928	0.1443	19.1372 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-562.7502	0.1343	-75.5708
PV Unit electricity exported	-774.7536	0.1256	-97.3367
Total			-172.9075 (380)
Total CO2, kg/year			1.6386 (383)

## 13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			300.0000 (467a)
Space and Water heating from Heat pump	923.6538	1.5789	254.1738 (467)
Electrical energy for heat distribution (space & water)	4.8295	0.0000	42.4103 (472)
Overall CO2 factor for heat network			0.5255 (486)
Total CO2 associated with community systems			1456.0869 (473)
Space and water heating			1456.0869 (476)
Pumps, fans and electric keep-hot	136.5317	1.5128	206.5452 (478)
Energy for lighting	132.5928	1.5338	203.3753 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-562.7502	1.4963	-842.0349
PV Unit electricity exported	-774.7536	0.4612	-357.2945
Total			-1199.3294 (480)
Total Primary energy kWh/year			666.6780 (483)

## SAP 10 EPC IMPROVEMENTS

### B-LG.02 1b2P - proposed

Current energy efficiency rating:	A 92
Current environmental impact rating:	A 100

N Solar water heating	Not applicable
U Solar photovoltaic panels	Not applicable
V2 Wind turbine	Not applicable

Recommended measures: (none)	SAP change	Cost change	CO2 change
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Recommended measures (none)	Typical annual savings	Energy efficiency	Environmental impact
	Total Savings	£0	0.00 kg/m²

Potential energy efficiency rating:	A 92
Potential environmental impact rating:	A 100

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Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Wales):

	Current	Potential	Saving
Electricity	£68	£68	£0
Community scheme	£274	£274	£0
Space heating	£166	£166	£0
Water heating	£142	£142	£0
Lighting	£33	£33	£0
Generated (PV)	-£187	-£187	£0
Total cost of fuels	£155	£155	£0
Total cost of uses	£154	£154	£0
Delivered energy	31 kWh/m <sup>2</sup>	31 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.0 tonnes	0.0 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	0 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	12 kWh/m <sup>2</sup>	12 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	54.2600 (1b)	x 2.7500 (2b)	= 149.2150 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.2150 (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	0 * 10 =											0.0000 (7a)	
Number of passive vents	0 * 10 =											0.0000 (7b)	
Number of flueless gas fires	0 * 40 =											0.0000 (7c)	
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												3.0000 (17)	
Infiltration rate												0.1500 (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) =											0.1275 (21)	
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)
Balanced mechanical ventilation with heat recovery													0.5000 (23a)
If mechanical ventilation													0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													
Effective ac	0.2576	0.2544	0.2512	0.2352	0.2321	0.2161	0.2161	0.2129	0.2225	0.2321	0.2384	0.2448	(25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K						
External Door			2.1300	1.0000	2.1300		(26)						
Triple Glazing 1.0 (Uw = 1.00)			7.4100	0.9615	7.1250		(27)						
Heat Loss Floor 1			54.2600	0.1000	5.4260		(28a)						
External Wall 1	43.8400	9.5400	34.3000	0.1500	5.1450		(29a)						
Total net area of external elements Aum(A, m <sup>2</sup> )			98.1000				(31)						
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	19.8260	(33)						
Party Ceiling 1			54.2600				(32b)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K								100.0000 (35)					
Thermal bridges (User defined value 0.040 * total exposed area)								3.9240 (36)					
Point Thermal bridges								(36a) = 0.0000					
Total fabric heat loss								(33) + (36) + (36a) = 23.7500 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	12.6826	12.5257	12.3687	11.5839	11.4270	10.6422	10.6422	10.4852	10.9561	11.4270	11.7409	12.0548	(38)
Heat transfer coeff	36.4326	36.2757	36.1187	35.3339	35.1770	34.3922	34.3922	34.2352	34.7061	35.1770	35.4909	35.8048	(39)

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Average = Sum(39)m / 12 =

35.2947

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.6714	0.6686	0.6657	0.6512	0.6483	0.6338	0.6338	0.6309	0.6396	0.6483	0.6541	0.6599 (40)
HLP (average)												0.6505
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.8156 (42)
Hot water usage for mixer showers												68.0656 (42a)
Hot water usage for baths												23.5498 (42b)
Hot water usage for other uses												33.2240 (42c)
Average daily hot water use (litres/day)												115.1077 (43)
Daily hot water use												124.8394 (44)
Energy content (annual)												195.4683 (45)
Distribution loss (46)m = 0.15 x (45)m												1911.9391
Water storage loss:												29.3203 (46)
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.7200 (55)
Total storage loss												22.3200 (56)
If cylinder contains dedicated solar storage												22.3200 (57)
Primary loss												23.2624 (59)
Combi loss												0.0000 (61)
Total heat required for water heating calculated for each month												241.0507 (62)
WWHRS												-38.9388 (63a)
PV diverter												-0.0000 (63b)
Solar input												0.0000 (63c)
FGHRS												0.0000 (63d)
Output from w/h												202.1120 (64)
Electric shower(s)												0.0000 (64a)
Heat gains from water heating, kWh/month												101.4591 (65)

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

Metabolic gains (Table 5), Watts												108.9387 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												19.2916 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												225.8104 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												47.7095 (69)
Pumps, fans												0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												-72.6258 (71)
Water heating gains (Table 5)												136.3698 (72)
Total internal gains												465.4942 (73)

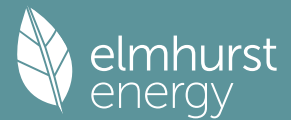
#### 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	Specific data or Table 6c	FF Access factor Table 6d	Gains W						
Southeast	7.4100	36.7938	0.5500	0.7500	0.7700	77.9382 (77)						
Solar gains	77.9382	132.7576	181.6447	225.0666	252.0934	250.2704	241.2874	221.1242	196.6828	146.7254	93.3520	66.6989 (83)
Total gains	554.5799	607.5273	642.7574	660.0549	661.9840	637.1804	614.4498	597.0386	585.5367	558.8847	533.9768	532.1930 (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)												
tau	41.3701	41.5491	41.7297	42.6565	42.8468	43.8245	43.8245	44.0255	43.4282	42.8468	42.4679	42.0955
alpha	3.7580	3.7699	3.7820	3.8438	3.8565	3.9216	3.9216	3.9350	3.8952	3.8565	3.8312	3.8064
util living area	0.8248	0.7745	0.7034	0.5988	0.4771	0.3419	0.2455	0.2627	0.4015	0.6040	0.7605	0.8374 (86)
MIT	20.3196	20.4880	20.6767	20.8532	20.9486	20.9897	20.9979	20.9972	20.9799	20.8714	20.6042	20.2945 (87)
Th 2	20.3661	20.3687	20.3713	20.3841	20.3867	20.3996	20.3996	20.4022	20.3945	20.3867	20.3816	20.3764 (88)
util rest of house	0.8106	0.7579	0.6832	0.5744	0.4487	0.3108	0.2123	0.2290	0.3680	0.5756	0.7409	0.8241 (89)
MIT 2	19.5811	19.7858	20.0128	20.2290	20.3368	20.3911	20.3982	20.4003	20.3771	20.2551	19.9405	19.5595 (90)
Living area fraction									fLA = Living area / (4) =			0.6286 (91)

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MIT	20.0454	20.2272	20.4302	20.6214	20.7214	20.7674	20.7752	20.7755	20.7560	20.6425	20.3577	20.0215 (92)
Temperature adjustment												0.0000
adjusted MIT	20.0454	20.2272	20.4302	20.6214	20.7214	20.7674	20.7752	20.7755	20.7560	20.6425	20.3577	20.0215 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8030	0.7540	0.6852	0.5839	0.4643	0.3299	0.2331	0.2501	0.3881	0.5877	0.7401	0.8159 (94)
Useful gains	445.3075	458.0715	440.4056	385.4340	307.3695	210.2094	143.2256	149.3107	227.2301	328.4302	395.2191	434.2266 (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												
Space heating kWh	573.6444	556.0054	503.1395	414.1622	317.3472	212.1120	143.5937	149.7977	231.0051	353.2662	470.5281	566.4874 (97)
Space heating requirement - total per year (kWh/year)	95.4827	65.8116	46.6740	20.6843	7.4234	0.0000	0.0000	0.0000	0.0000	18.4780	54.2224	98.4020 (98a)
Solar heating kWh												407.1784
Solar heating contribution - total per year (kWh/year)	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)
Space heating kWh	95.4827	65.8116	46.6740	20.6843	7.4234	0.0000	0.0000	0.0000	0.0000	18.4780	54.2224	98.4020 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												407.1784
Space heating per m2										(98c) / (4) =		7.5042 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	95.4827	65.8116	46.6740	20.6843	7.4234	0.0000	0.0000	0.0000	0.0000	18.4780	54.2224	98.4020 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10												
307a	105.0309	72.3927	51.3414	22.7528	8.1657	0.0000	0.0000	0.0000	0.0000	20.3258	59.6447	108.2422
Space heating requirement	105.0309	72.3927	51.3414	22.7528	8.1657	0.0000	0.0000	0.0000	0.0000	20.3258	59.6447	108.2422 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	204.1652	180.6576	192.3488	170.3160	165.8634	150.3001	149.0335	154.5385	155.7558	172.6454	182.2698	202.1120 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	224.5817	198.7233	211.5837	187.3476	182.4497	165.3301	163.9368	169.9923	171.3314	189.9099	200.4968	222.3232
Water heating fuel	224.5817	198.7233	211.5837	187.3476	182.4497	165.3301	163.9368	169.9923	171.3314	189.9099	200.4968	222.3232 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	11.5958	10.4737	11.5958	11.2218	11.5958	11.2218	11.5958	11.5958	11.2218	11.5958	11.2218	11.5958 (331)
Lighting	16.4292	13.1801	11.8672	8.6944	6.7158	5.4869	6.1264	7.9633	10.3436	13.5713	15.3288	16.8858 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-24.2472	-34.7787	-50.9510	-58.4287	-63.9779	-60.1479	-59.4431	-55.6386	-49.0187	-40.3049	-26.8775	-20.8922 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-12.3159	-26.2347	-52.9618	-80.8348	-108.0705	-109.0032	-107.4725	-90.1964	-65.1993	-37.6926	-16.4916	-9.7049 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												447.8962 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2288.0064 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												4.4790 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												136.5317 (330a)
Total electricity for the above, kWh/year												136.5317 (331)
Electricity for lighting (calculated in Appendix L)												132.5928 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1260.8848 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												1744.1424 (338)

## 10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	447.8962	4.4400	19.8866 (340a)
Space heating total			19.8866 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2288.0064	4.4400	101.5875 (342a)
Water heating total			101.5875 (342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (347a)
Pumps, fans and electric keep-hot	136.5317	16.4900	22.5141 (349)

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Energy for lighting	132.5928	16.4900	21.8646 (350)
Additional standing charges			92.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-544.7065	16.4900	-89.8221
PV Unit electricity exported	-716.1783	5.5900	-40.0344
Total			-129.8565 (352)
Total energy cost			127.9962 (355)

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**11b. SAP rating - Community heating scheme**  
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Energy cost deflator (Table 12):		0.3600 (356)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4642 (357)
SAP value		92.4750
SAP rating (Section 12)		92 (358)
SAP band		A

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**12b. Carbon dioxide emissions - Community heating scheme**  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	911.9675	0.1570	23.4346 (367)
Electrical energy for heat distribution (space & water)	4.4790	0.0000	3.9227 (372)
Overall CO2 factor for heat network			0.0492 (386)
Total CO2 associated with community systems			134.6802 (373)
Space and water heating			134.6802 (376)
Pumps, fans and electric keep-hot	136.5317	0.1387	18.9386 (378)
Energy for lighting	132.5928	0.1443	19.1372 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-544.7065	0.1342	-73.0859
PV Unit electricity exported	-716.1783	0.1255	-89.8782
Total			-162.9641 (380)
Total CO2, kg/year			9.7919 (383)
CO2 emissions per m2			0.1800 (384)
EI value			99.8678 (384a)
EI rating			100 (385)
EI band			A

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING  
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**1. Overall dwelling characteristics**  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.2600 (1b)	x 2.7500 (2b)	= 149.2150 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.2150 (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)

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			3.0000 (17)
Infiltration rate			0.1500 (18)
Number of sides sheltered			2 (19)

Shelter factor	(20) = $1 - [0.075 \times (19)] =$	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.5000	6.2000	5.9000	5.2000	5.1000	4.7000	4.5000	4.5000	5.0000	5.7000	6.0000	6.0000 (22)
Wind factor	1.6250	1.5500	1.4750	1.3000	1.2750	1.1750	1.1250	1.1250	1.2500	1.4250	1.5000	1.5000 (22a)
Adj infilt rate	0.2072	0.1976	0.1881	0.1658	0.1626	0.1498	0.1434	0.1434	0.1594	0.1817	0.1913	0.1913 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												81.0000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.3022	0.2926	0.2831	0.2607	0.2576	0.2448	0.2384	0.2384	0.2544	0.2767	0.2863	0.2863 (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					
External Door			2.1300	1.0000	2.1300							(26)
Triple Glazing 1.0 (Uw = 1.00)			7.4100	0.9615	7.1250							(27)
Heat Loss Floor 1			54.2600	0.1000	5.4260							(28a)
External Wall 1	43.8400	9.5400	34.3000	0.1500	5.1450							(29a)
Total net area of external elements Aum(A, m2)			98.1000									(31)
Fabric heat loss, W/K = Sum (A x U)												(33)
Party Ceiling 1			54.2600					19.8260				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K												100.0000 (35)
Thermal bridges (User defined value 0.040 * total exposed area)												3.9240 (36)
Point Thermal bridges												(36a) = 0.0000
Total fabric heat loss												(33) + (36) + (36a) = 23.7500 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	14.8800	14.4091	13.9383	12.8396	12.6826	12.0548	11.7409	11.7409	12.5257	13.6244	14.0952	14.0952 (38)
Average = Sum(39)m / 12 =	38.6300	38.1591	37.6883	36.5896	36.4326	35.8048	35.4909	35.4909	36.2757	37.3744	37.8452	37.8452 (39)
	38.6300	38.1591	37.6883	36.5896	36.4326	35.8048	35.4909	35.4909	36.2757	37.3744	37.8452	36.9689
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.7119	0.7033	0.6946	0.6743	0.6714	0.6599	0.6541	0.6541	0.6686	0.6888	0.6975	0.6975 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)												
Assumed occupancy												1.8156 (42)
Hot water usage for mixer showers												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for baths	68.3274	67.3006	65.8043	62.9414	60.8287	58.4726	57.1334	58.6183	60.2461	62.7759	65.7002	68.0656 (42a)
Hot water usage for other uses	23.6296	23.2787	22.7845	21.8733	21.1910	20.4345	20.0258	20.5166	21.0509	21.8604	22.7904	23.5498 (42b)
Average daily hot water use (litres/day)	33.2240	32.0159	30.8077	29.5996	28.3914	27.1833	27.1833	28.3914	29.5996	30.8077	32.0159	33.2240 (42c)
	33.2240	32.0159	30.8077	29.5996	28.3914	27.1833	27.1833	28.3914	29.5996	30.8077	32.0159	115.1077 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	125.1811	122.5952	119.3965	114.4143	110.4112	106.0904	104.3425	107.5263	110.8966	115.4440	120.5065	124.8394 (44)
Energy content (annual)	198.2562	174.5739	183.5081	156.6275	148.6346	130.4505	126.1932	133.1401	136.7466	156.6565	171.6836	195.4683 (45)
Distribution loss (46)m = 0.15 x (45)m	29.7384	26.1861	27.5262	23.4941	22.2952	19.5676	18.9290	19.9710	20.5120	23.4985	25.7525	29.3203 (46)
Water storage loss:												
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												0.7200 (55)
Total storage loss	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (56)
If cylinder contains dedicated solar storage	22.3200	20.1600	22.3200	21.6000	22.3200	21.6000	22.3200	22.3200	21.6000	22.3200	21.6000	22.3200 (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	243.8386	215.7451	229.0905	200.7395	194.2170	174.5625	171.7756	178.7225	180.8586	202.2389	215.7956	241.0507 (62)
WWHRS	-39.6735	-35.0875	-36.7416	-30.4235	-28.3536	-24.2624	-22.7421	-24.1840	-25.1028	-29.5935	-33.5258	-38.9388 (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	204.1652	180.6576	192.3488	170.3160	165.8634	150.3001	149.0335	154.5385	155.7558	172.6454	182.2698	202.1120 (64)
												Total per year (kWh/year) = Sum(64)m = 2080.0058 (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	102.3861	90.9828	97.4823	87.3682	85.8869	78.6644	78.4252	80.7350	80.7578	88.5542	92.3744	101.4591 (65)

5. Internal gains (see Table 5 and 5a)												
Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.7699	16.6712	13.5580	10.2643	7.6726	6.4776	6.9992	9.0979	12.2112	15.5049	18.0965	19.2916 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.2336	238.6850	232.5076	219.3567	202.7561	187.1539	176.7306	174.2793	180.4566	193.6075	210.2081	225.8104 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095	47.7095 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258	-72.6258 (71)
Water heating gains (Table 5)	137.6158	135.3910	131.0247	121.3448	115.4394	109.2561	105.4102	108.5148	112.1637	119.0244	128.2978	136.3698 (72)
Total internal gains	476.6417	474.7697	461.1127	434.9882	409.8906	386.9100	373.1625	375.9144	388.8539	412.1593	440.6248	465.4942 (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						



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-----  
 Southeast 7.4100 40.1192 0.5500 0.7500 0.7700 84.9822 (77)  
 -----

Solar gains 84.9822 137.0424 192.8877 242.3302 266.2465 272.8800 251.5963 232.0709 201.5057 147.9268 96.7910 68.3128 (83)  
 Total gains 561.6239 611.8121 654.0004 677.3184 676.1372 659.7900 624.7588 607.9853 590.3596 560.0861 537.4158 533.8069 (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	39.0169	39.4983	39.9918	41.1927	41.3701	42.0955	42.4679	42.4679	41.5491	40.3277	39.8260	39.8260
alpha	3.6011	3.6332	3.6661	3.7462	3.7580	3.8064	3.8312	3.8312	3.7699	3.6885	3.6551	3.6551
util living area	0.8185	0.7759	0.7103	0.6156	0.5043	0.3890	0.3209	0.3294	0.4471	0.6222	0.7556	0.8273 (86)
MIT	20.2982	20.4468	20.6343	20.8183	20.9276	20.9787	20.9917	20.9909	20.9634	20.8368	20.5834	20.3033 (87)
Th 2	20.3303	20.3380	20.3456	20.3636	20.3661	20.3764	20.3816	20.3816	20.3687	20.3507	20.3431	20.3431 (88)
util rest of house	0.8029	0.7584	0.6897	0.5914	0.4756	0.3574	0.2869	0.2946	0.4125	0.5922	0.7340	0.8121 (89)
MIT 2	19.5271	19.7111	19.9404	20.1701	20.2947	20.3577	20.3751	20.3745	20.3359	20.1842	19.8843	19.5449 (90)
Living area fraction									fLA = Living area / (4) =			0.6286 (91)
MIT	20.0118	20.1736	20.3766	20.5776	20.6926	20.7481	20.7627	20.7620	20.7304	20.5945	20.3238	20.0216 (92)
Temperature adjustment												0.0000
adjusted MIT	20.0118	20.1736	20.3766	20.5776	20.6926	20.7481	20.7627	20.7620	20.7304	20.5945	20.3238	20.0216 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7950	0.7538	0.6907	0.5997	0.4905	0.3763	0.3079	0.3161	0.4324	0.6037	0.7334	0.8042 (94)
Useful gains	446.5027	461.1937	451.7075	406.1889	331.6548	248.2981	192.3615	192.1899	255.2970	338.1008	394.1257	429.2852 (95)
Ext temp.	5.0000	5.3000	6.5000	8.5000	11.2000	13.7000	15.3000	15.3000	13.5000	10.7000	7.8000	5.2000 (96)
Heat loss rate W	579.9075	567.5633	522.9851	441.9140	345.8396	252.3552	193.8776	193.8516	262.2872	369.7992	473.9649	560.9280 (97)
Space heating kWh	99.2532	71.4804	53.0305	25.7221	10.5535	0.0000	0.0000	0.0000	0.0000	23.5836	57.4842	97.9422 (98a)
Space heating requirement - total per year (kWh/year)												439.0499
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	99.2532	71.4804	53.0305	25.7221	10.5535	0.0000	0.0000	0.0000	0.0000	23.5836	57.4842	97.9422 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												439.0499
Space heating per m2												(98c) / (4) = 8.0916 (99)

## 9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (301)
Fraction of space heat from community system												1.0000 (302)
Fraction of heat from community Heat pump-Space and Water												1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating												1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system												1.1000 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	99.2532	71.4804	53.0305	25.7221	10.5535	0.0000	0.0000	0.0000	0.0000	23.5836	57.4842	97.9422 (98)
Space heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
307a	109.1786	78.6284	58.3336	28.2943	11.6089	0.0000	0.0000	0.0000	0.0000	25.9420	63.2326	107.7365
Space heating requirement	109.1786	78.6284	58.3336	28.2943	11.6089	0.0000	0.0000	0.0000	0.0000	25.9420	63.2326	107.7365 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000 (308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement	204.1652	180.6576	192.3488	170.3160	165.8634	150.3001	149.0335	154.5385	155.7558	172.6454	182.2698	202.1120 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10												
310a	224.5817	198.7233	211.5837	187.3476	182.4497	165.3301	163.9368	169.9923	171.3314	189.9099	200.4968	222.3232
Water heating fuel	224.5817	198.7233	211.5837	187.3476	182.4497	165.3301	163.9368	169.9923	171.3314	189.9099	200.4968	222.3232 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	11.5958	10.4737	11.5958	11.2218	11.5958	11.2218	11.5958	11.2218	11.5958	11.2218	11.5958	11.5958 (331)
Lighting	16.4292	13.1801	11.8672	8.6944	6.7158	5.4869	6.1264	7.9633	10.2436	13.5713	15.3288	16.8858 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-26.1340	-35.8137	-53.2258	-61.0883	-65.8701	-62.7047	-60.7451	-57.1888	-49.9404	-40.7821	-27.8107	-21.4466 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)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 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)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 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-14.0919	-27.7736	-58.1559	-89.9861	-116.7968	-122.4976	-114.1125	-96.8753	-68.1127	-38.6165	-17.5704	-10.1643 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)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 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)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 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												482.9548 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2288.0064 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												4.8295 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7500)												
mechanical ventilation fans (SFP = 0.7500)												136.5317 (330a)
Total electricity for the above, kWh/year												136.5317 (331)
Electricity for lighting (calculated in Appendix L)												132.5928 (332)

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Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation		-1337.5038 (333)
Wind generation		0.0000 (334)
Hydro-electric generation (Appendix N)		0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)		0.0000 (335)
Appendix Q - special features		
Energy saved or generated		-0.0000 (336)
Energy used		0.0000 (337)
Total delivered energy for all uses		1702.5820 (338)

## 10b. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating from Heat pump	482.9548	6.1900	29.8949 (340a)
Space heating total			29.8949 (340)
Total CO2 associated with community systems			0.0000 (473)
Space heating - secondary	0.0000	0.0000	0.0000 (341)
Water heating from Heat pump	2288.0064	6.1900	141.6276 (342a)
Water heating total			141.6276 (342)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (347a)
Pumps, fans and electric keep-hot	136.5317	25.1600	34.3514 (349)
Energy for lighting	132.5928	25.1600	33.3604 (350)
Additional standing charges			102.0000 (351)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-562.7502	25.1600	-141.5879
PV Unit electricity exported	-774.7536	5.8100	-45.0132
Total			-186.6011 (352)
Total energy cost			154.6331 (355)

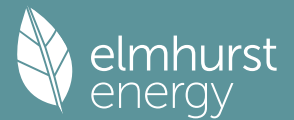
## 12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Heat pump			300.0000 (367)
Space and Water heating from Heat pump	923.6538	0.1564	25.1725 (367)
Electrical energy for heat distribution (space & water)	4.8295	0.0000	3.9749 (372)
Overall CO2 factor for heat network			0.0493 (386)
Total CO2 associated with community systems			136.4702 (373)
Space and water heating			136.4702 (376)
Pumps, fans and electric keep-hot	136.5317	0.1387	18.9386 (378)
Energy for lighting	132.5928	0.1443	19.1372 (379)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-562.7502	0.1343	-75.5708
PV Unit electricity exported	-774.7536	0.1256	-97.3367
Total			-172.9075 (380)
Total CO2, kg/year			1.6386 (383)

## 13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Heat pump			300.0000 (467a)
Space and Water heating from Heat pump	923.6538	1.5789	254.1738 (467)
Electrical energy for heat distribution (space & water)	4.8295	0.0000	42.4103 (472)
Overall CO2 factor for heat network			0.5255 (486)
Total CO2 associated with community systems			1456.0869 (473)
Space and water heating			1456.0869 (476)
Pumps, fans and electric keep-hot	136.5317	1.5128	206.5452 (478)
Energy for lighting	132.5928	1.5338	203.3753 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-562.7502	1.4963	-842.0349
PV Unit electricity exported	-774.7536	0.4612	-357.2945
Total			-1199.3294 (480)
Total Primary energy kWh/year			666.6780 (483)

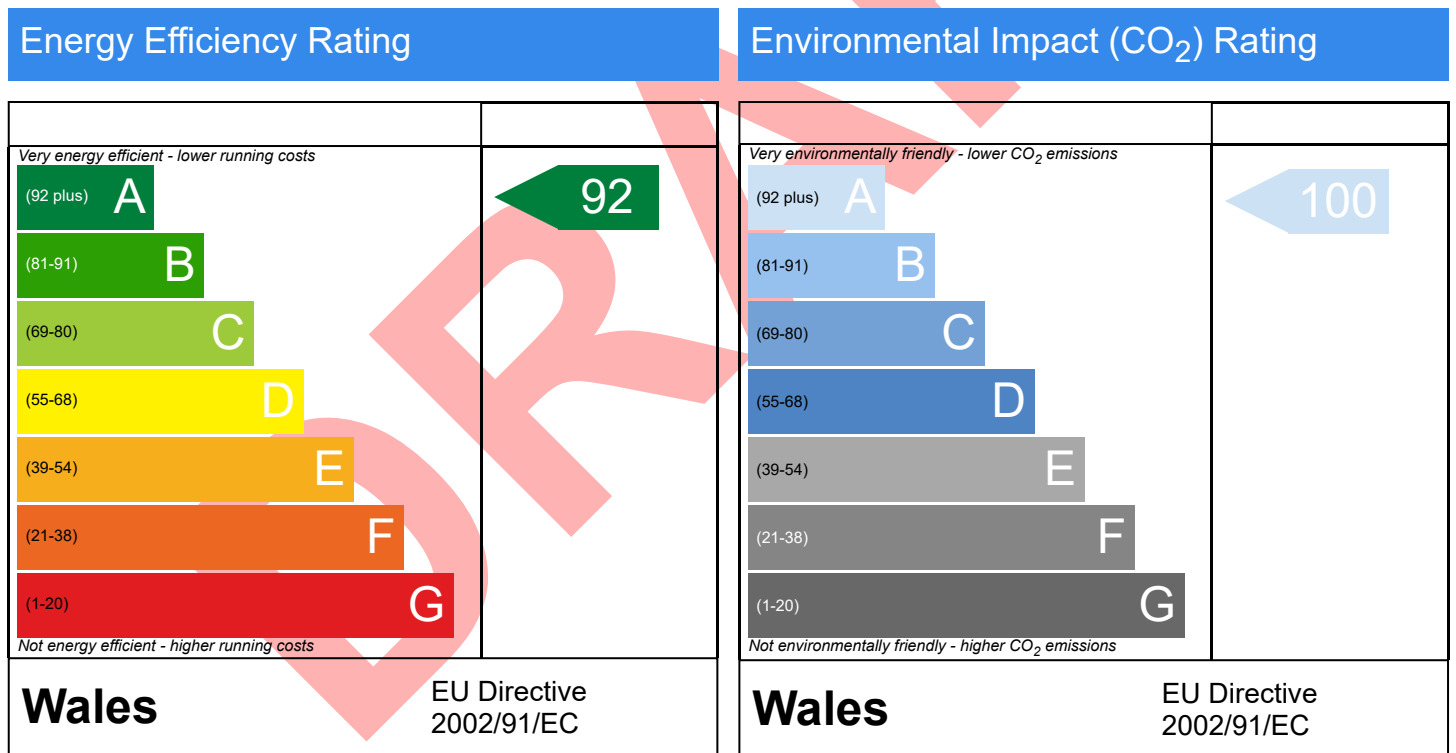
# Predicted Energy Assessment



Dwelling type: Flat, Detached  
 Date of assessment: 24/01/2024  
 Produced by: Oliver Fuller  
 Total floor area: 55.21 m<sup>2</sup>  
 DRRN:

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

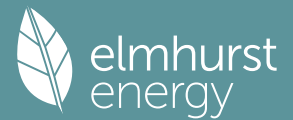
The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO<sub>2</sub>) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO<sub>2</sub>) emissions. The higher the rating the less impact it has on the environment.

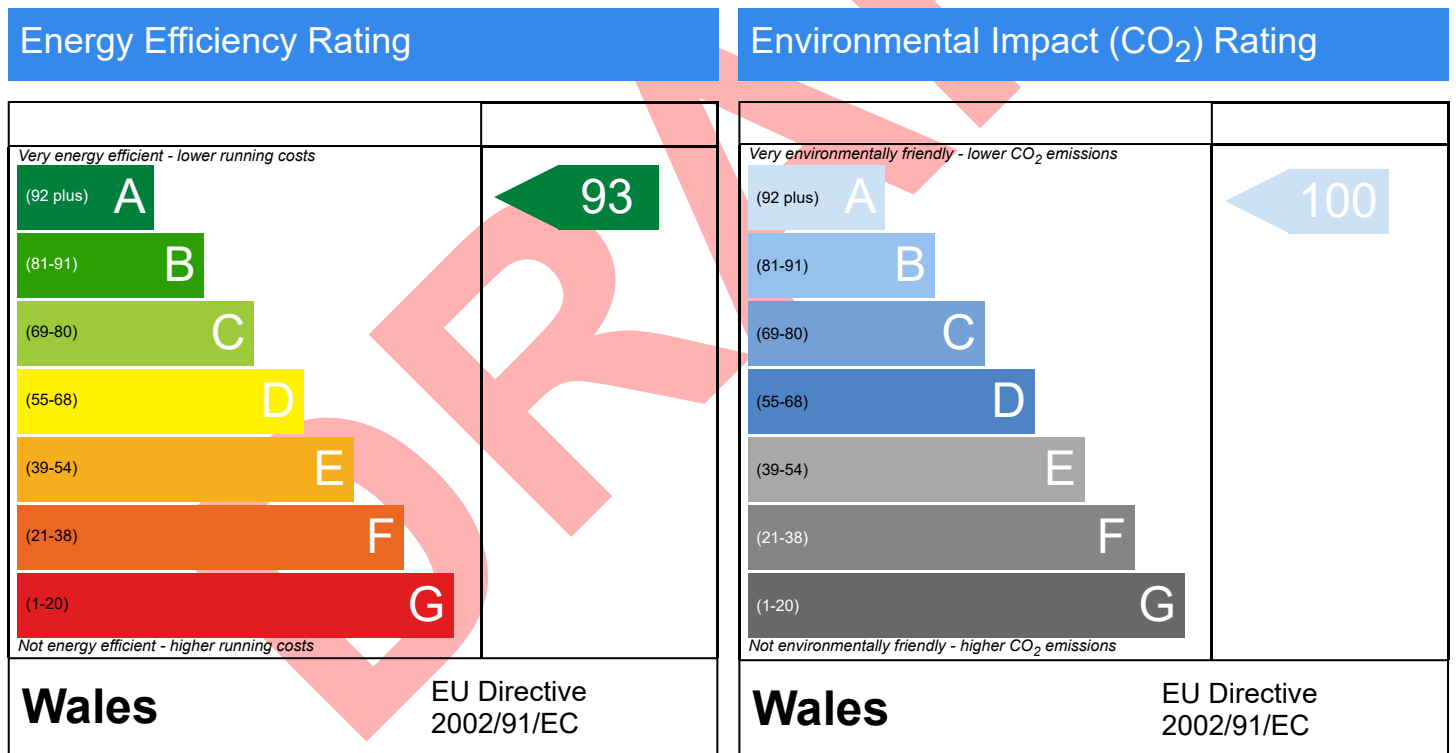
# Predicted Energy Assessment



Dwelling type: Flat, Detached  
 Date of assessment: 24/01/2024  
 Produced by: Oliver Fuller  
 Total floor area: 53.09 m<sup>2</sup>  
 DRRN:

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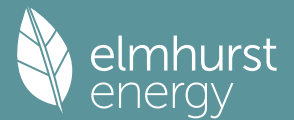
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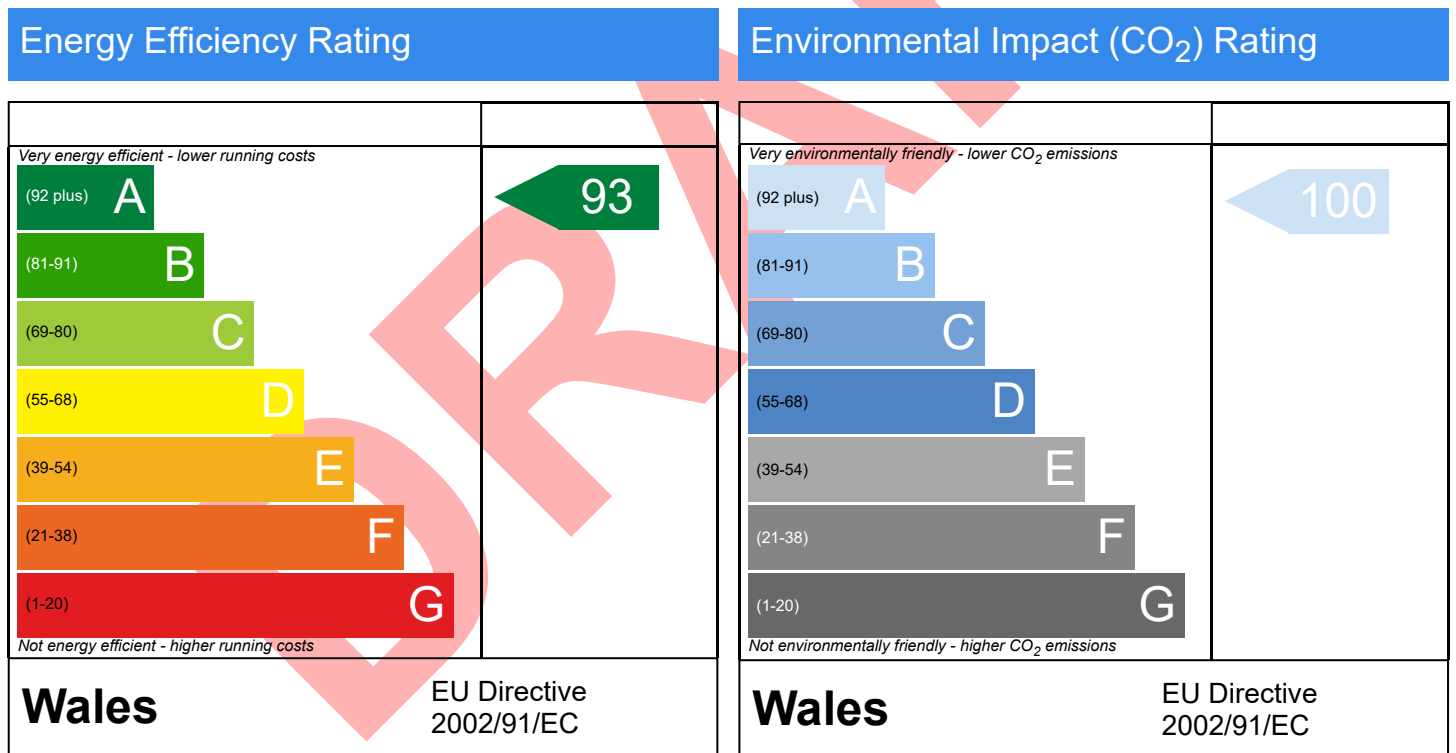
# Predicted Energy Assessment



Dwelling type: Flat, Detached  
 Date of assessment: 24/01/2024  
 Produced by: Oliver Fuller  
 Total floor area: 64.5 m<sup>2</sup>  
 DRRN:

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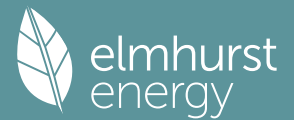
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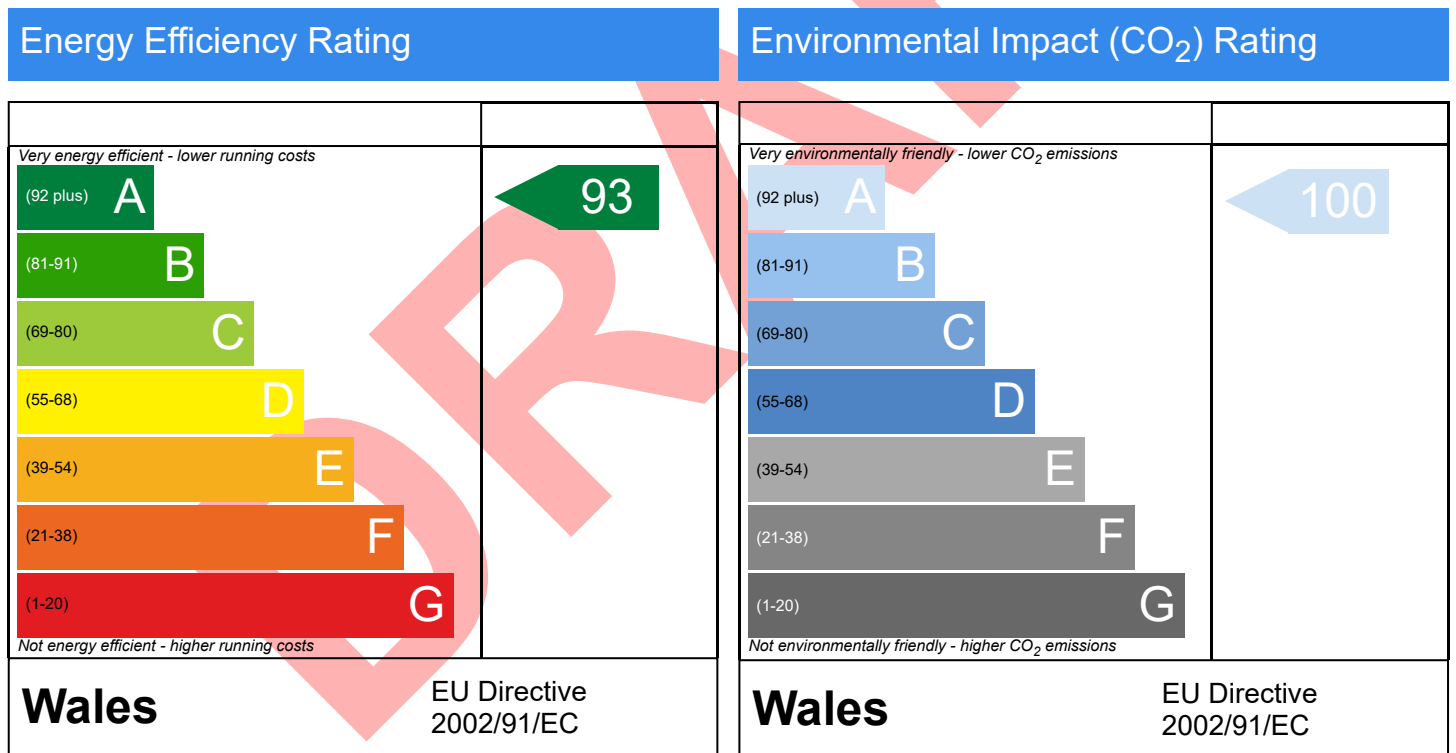
# Predicted Energy Assessment



Dwelling type: Flat, Detached  
 Date of assessment: 24/01/2024  
 Produced by: Oliver Fuller  
 Total floor area: 58.3 m<sup>2</sup>  
 DRRN:

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The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO<sub>2</sub>) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO<sub>2</sub>) emissions. The higher the rating the less impact it has on the environment.

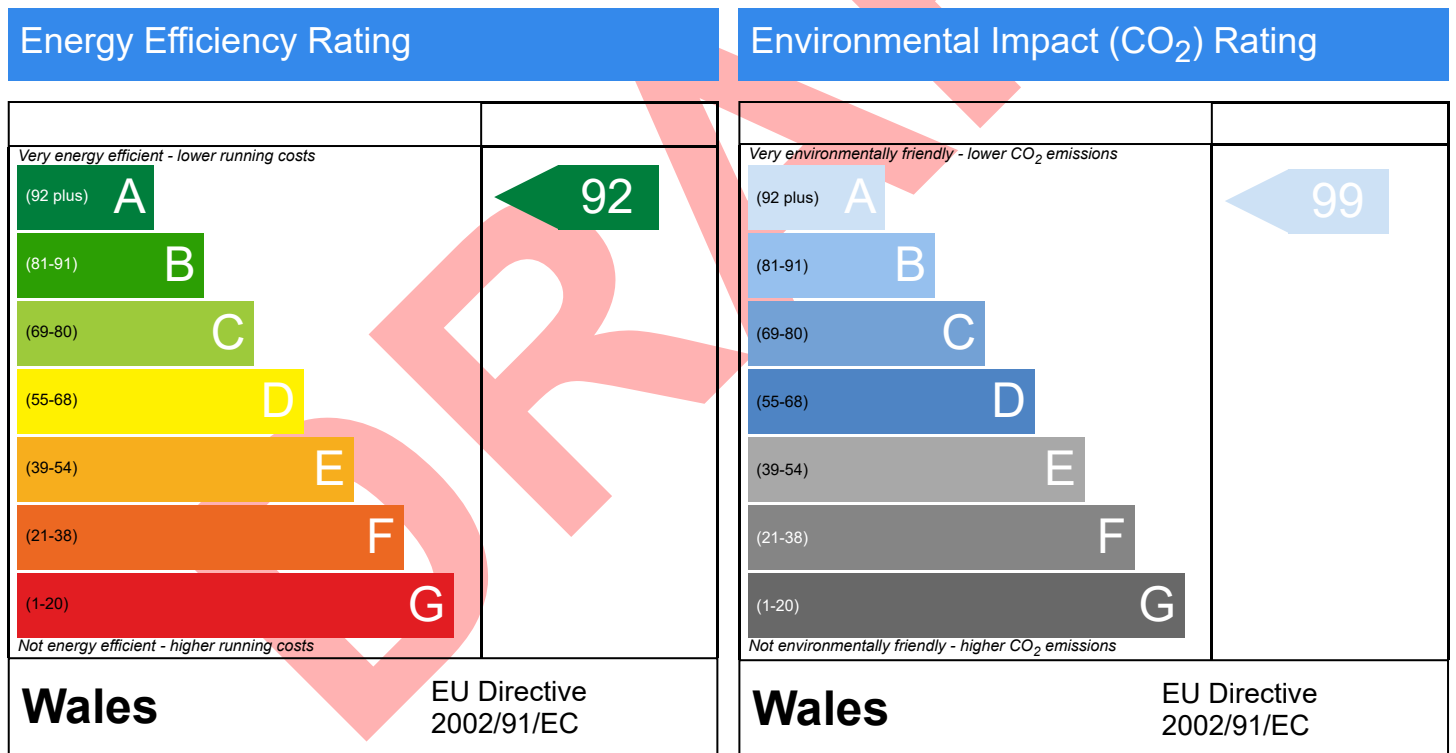
# Predicted Energy Assessment



Dwelling type: Flat, Detached  
 Date of assessment: 24/01/2024  
 Produced by: Oliver Fuller  
 Total floor area: 63.5 m<sup>2</sup>  
 DRRN:

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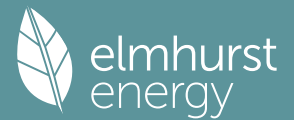
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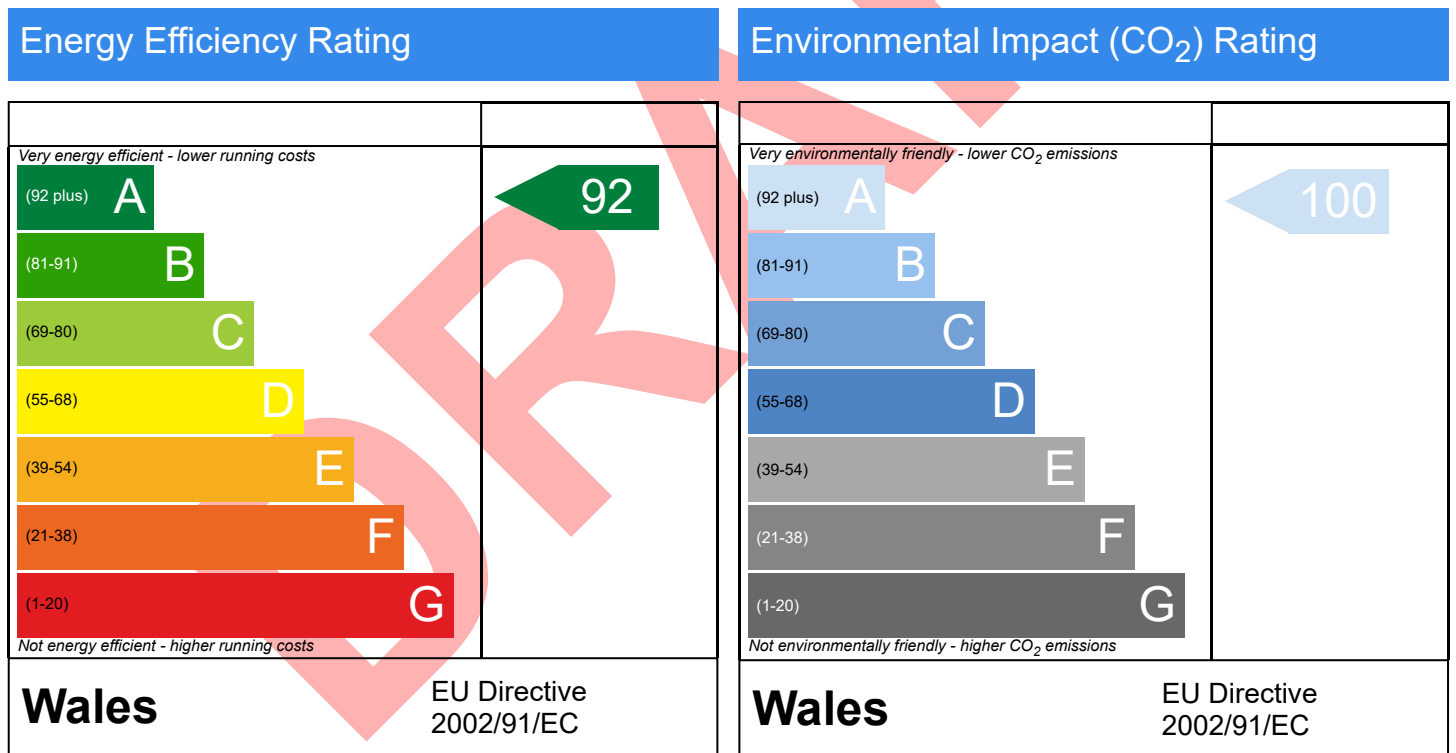
# Predicted Energy Assessment



Dwelling type: Flat, Detached  
 Date of assessment: 24/01/2024  
 Produced by: Oliver Fuller  
 Total floor area: 65.53 m<sup>2</sup>  
 DRRN:

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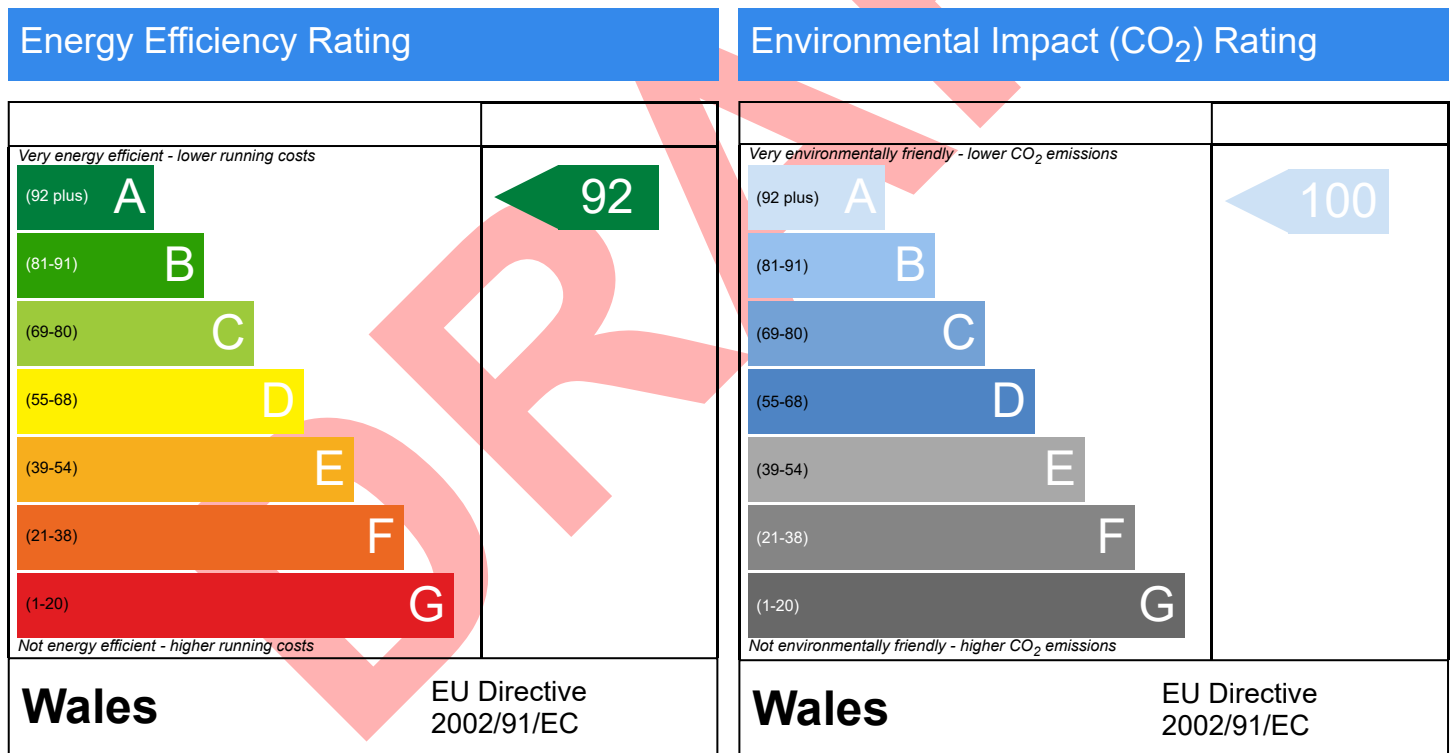
# Predicted Energy Assessment



Dwelling type: Flat, Detached  
 Date of assessment: 24/01/2024  
 Produced by: Oliver Fuller  
 Total floor area: 54.26 m<sup>2</sup>  
 DRRN:

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The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO<sub>2</sub>) emissions.



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