

JS LEWIS LTD

Sustainable Design and Construction Statement  
incorporating Energy  
- Supporting Documentation on Energy

Enderby Place

Maritime View Ltd

November 2023

## SUPPORTING DOCUMENTS TO THE ENERGY STRATEGY (2023)

Be Green SAPs for TER and DER

Be Lean DER outputs from SAP

Be Lean BRUKL

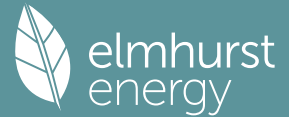
Be Green BRUKL

DH Communications

Technical document: example water source heat pumps for apartments

Technical document: example communal air source heat pumps for ambient loop

# Full SAP Calculation Printout



Property Reference	1A RE Ambient		Issued on Date	20/11/2023	
Assessment Reference	L23, 1a RE Ambient	Prop Type Ref	FF MT		
Property	FF MT				
SAP Rating	86 B	DER	3.78	TER	15.12
Environmental	97 A	% DER < TER			75.00
CO <sub>2</sub> Emissions (t/year)	0.19	DFEE	26.82	TFEE	30.44
Compliance Check	See BREL	% DFEE < TFEE			11.91
% DPER < TPER	51.46	DPER	40.43	TPER	83.29
Assessor Details	Mr. Jonathan Lewis			Assessor ID	AZ32-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	52.0000 (1b)	2.5000 (2b)	130.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.0000		130.0000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 130.0000 (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	2.5000	(17)
Infiltration rate	0.1250	(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) =	0.1062 (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	0.1355	0.1328	0.1302	0.1169	0.1142	0.1009	0.1009	0.0983	0.1062	0.1142	0.1195	0.1248 (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)												81.9000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2260	0.2233	0.2207	0.2074	0.2047	0.1914	0.1914	0.1888	0.1967	0.2047	0.2100	0.2153 (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
Window (Uw = 1.00)			15.4000	0.9615	14.8077		(27)
External Wall 1	39.0000	15.4000	23.6000	0.1800	4.2480		(29a)
Communal Corridor	17.0000		17.0000	0.1600	2.7200		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			56.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	21.7757	(33)
Party Floor 1			52.0000				(32d)
Party Ceiling 1			52.0000				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				9.0000	0.0560	0.5040	
E3 Sill				9.0000	0.0410	0.3690	
E4 Jamb				18.0000	0.0470	0.8460	
E7 Party floor between dwellings (in blocks of flats)				29.0000	0.0490	1.4210	

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E16 Corner (normal)	5.0000	0.0320	0.1600
E18 Party wall between dwellings	5.0000	0.0400	0.2000
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0310	-0.0775
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			3.4225 (36)
Total Thermal bridges			(36a) = 0.0000
Total fabric heat loss		(33) + (36) + (36a) =	25.1982 (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
	9.6941	9.5801	9.4662	8.8964	8.7824	8.2127	8.2127	8.0987	8.4406	8.7824	9.0103	9.2382
Heat transfer coeff	34.8923	34.7783	34.6643	34.0946	33.9806	33.4109	33.4109	33.2969	33.6388	33.9806	34.2085	34.4364
Average = Sum(39)m / 12 =												34.0661

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.6710	0.6688	0.6666	0.6557	0.6535	0.6425	0.6425	0.6403	0.6469	0.6535	0.6579	0.6622
HLP (average)												0.6551
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													1.7491 (42)
Hot water usage for mixer showers	60.2389	59.3336	58.0144	55.4905	53.6278	51.5507	50.3700	51.6792	53.1143	55.3445	57.9227	60.0081	(42a)
Hot water usage for baths	24.3680	24.0061	23.4965	22.5568	21.8532	21.0730	20.6516	21.1577	21.7087	22.5435	23.5025	24.2856	(42b)
Hot water usage for other uses	34.2550	33.0093	31.7637	30.5181	29.2724	28.0268	28.0268	29.2724	30.5181	31.7637	33.0093	34.2550	(42c)
Average daily hot water use (litres/day)													109.2721 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	118.8619	116.3491	113.2746	108.5654	104.7535	100.6505	99.0484	102.1093	105.3410	109.6517	114.4346	118.5487	
Energy conte	188.2482	165.6795	174.0989	148.6206	141.0183	123.7615	119.7904	126.4326	129.8960	148.7964	163.0331	185.6186	
Energy content (annual)													Total = Sum(45)m = 1814.9941
Distribution loss (46)m = 0.15 x (45)m	28.2372	24.8519	26.1148	22.2931	21.1528	18.5642	17.9686	18.9649	19.4844	22.3195	24.4550	27.8428	(46)
Water storage loss:													150.0000 (47)
Store volume													1.6000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.6000 (49)
Temperature factor from Table 2b													0.9600 (55)
Enter (49) or (54) in (55)													
Total storage loss	29.7600	26.8800	29.7600	28.8000	29.7600	28.8000	29.7600	29.7600	28.8000	29.7600	28.8000	29.7600	(56)
If cylinder contains dedicated solar storage	29.7600	26.8800	29.7600	28.8000	29.7600	28.8000	29.7600	29.7600	28.8000	29.7600	28.8000	29.7600	(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	241.2706	213.5707	227.1213	199.9326	194.0407	175.0735	172.8128	179.4550	181.2080	201.8188	214.3451	238.6410	(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	241.2706	213.5707	227.1213	199.9326	194.0407	175.0735	172.8128	179.4550	181.2080	201.8188	214.3451	238.6410	(64)
12Total per year (kWh/year)													2439.2901 (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	105.0104	93.4014	100.3058	90.4659	89.3065	82.2003	82.2482	84.4568	84.2400	91.8927	95.2581	104.1361	(65)

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

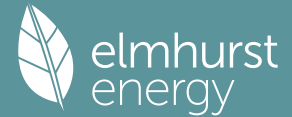
Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	76.8814	85.1187	76.8814	79.4441	76.8814	79.4441	76.8814	76.8814	79.4441	76.8814	79.4441	76.8814
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	152.4259	154.0076	150.0218	141.5364	130.8251	120.7580	114.0326	112.4509	116.4367	124.9221	135.6334	145.7005
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454
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)	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628
Water heating gains (Table 5)	141.1431	138.9902	134.8196	125.6471	120.0356	114.1671	110.5487	113.5171	117.0000	123.5117	132.3029	139.9679
Total internal gains	419.6864	427.3526	410.9589	395.8637	376.9782	363.6053	350.6987	352.0855	362.1169	374.5513	396.6165	411.7858

#### 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							
North	4.4000	10.6334	0.6300	0.7000	0.7700	14.2987 (74)						
South	2.1000	46.7521	0.6300	0.7000	0.7700	30.0049 (78)						
West	8.9000	19.6403	0.6300	0.7000	0.7700	53.4206 (80)						
Solar gains	97.7242	180.9679	281.1288	396.3277	481.8000	493.3950	469.5268	404.5025	321.3757	209.5304	119.8146	81.7776 (83)
Total gains	517.4107	608.3205	692.0877	792.1914	858.7782	857.0002	820.2256	756.5880	683.4926	584.0817	516.4310	493.5635 (84)

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

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Temperature during heating periods in the living area from Table 9, Th1 (C)												
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	41.3973	41.5329	41.6695	42.3658	42.5079	43.2328	43.2328	43.3807	42.9399	42.5079	42.2247	41.9452
alpha	3.7598	3.7689	3.7780	3.8244	3.8339	3.8822	3.8822	3.8920	3.8627	3.8339	3.8150	3.7963
util living area	0.8341	0.7564	0.6504	0.4993	0.3629	0.2487	0.1790	0.2021	0.3361	0.5669	0.7584	0.8493 (86)
MIT	20.2894	20.5303	20.7528	20.9194	20.9794	20.9965	20.9993	20.9988	20.9887	20.8944	20.6037	20.2480 (87)
Th 2	20.3665	20.3685	20.3704	20.3802	20.3821	20.3919	20.3919	20.3938	20.3880	20.3821	20.3782	20.3743 (88)
util rest of house	0.8203	0.7392	0.6298	0.4766	0.3398	0.2253	0.1544	0.1756	0.3072	0.5389	0.7387	0.8365 (89)
MIT 2	19.5451	19.8354	20.0987	20.2963	20.3624	20.3891	20.3914	20.3931	20.3783	20.2748	19.9369	19.5015 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	19.9172	20.1828	20.4257	20.6078	20.6709	20.6928	20.6953	20.6960	20.6835	20.5846	20.2703	19.8747 (92)
Temperature adjustment												
adjusted MIT	19.9172	20.1828	20.4257	20.6078	20.6709	20.6928	20.6953	20.6960	20.6835	20.5846	20.2703	19.8747 (93)

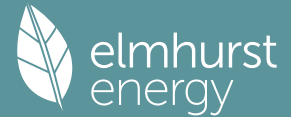
## 8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8099	0.7340	0.6316	0.4850	0.3506	0.2368	0.1667	0.1888	0.3212	0.5482	0.7351	0.8254 (94)
Useful gains	419.0323	446.4970	437.1327	384.2262	301.1035	202.9792	136.7201	142.8646	219.5275	320.1807	379.6435	407.3738 (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	544.9208	531.5105	482.7261	399.1732	304.8364	203.5650	136.8291	143.0420	221.4618	339.2825	450.5364	539.7817 (97)
Space heating kWh	93.6610	57.1291	33.9215	10.7618	2.7773	0.0000	0.0000	0.0000	0.0000	14.2118	51.0429	98.5114 (98a)
Space heating requirement - total per year (kWh/year)												
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)												
Space heating kWh	93.6610	57.1291	33.9215	10.7618	2.7773	0.0000	0.0000	0.0000	0.0000	14.2118	51.0429	98.5114 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												
Space heating per m2												
	(98c) / (4) =											
	6.9619 (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												1.0100 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	93.6610	57.1291	33.9215	10.7618	2.7773	0.0000	0.0000	0.0000	0.0000	14.2118	51.0429	98.5114 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.01	94.5977	57.7004	34.2607	10.8694	2.8050	0.0000	0.0000	0.0000	0.0000	14.3539	51.5533	99.4965
307a	94.5977	57.7004	34.2607	10.8694	2.8050	0.0000	0.0000	0.0000	0.0000	14.3539	51.5533	99.4965 (307)
Space heating requirement	94.5977	57.7004	34.2607	10.8694	2.8050	0.0000	0.0000	0.0000	0.0000	14.3539	51.5533	99.4965 (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	241.2706	213.5707	227.1213	199.9326	194.0407	175.0735	172.8128	179.4550	181.2080	201.8188	214.3451	238.6410 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.01	243.6833	215.7064	229.3925	201.9319	195.9811	176.8242	174.5410	181.2495	183.0201	203.8370	216.4885	241.0274
310a	243.6833	215.7064	229.3925	201.9319	195.9811	176.8242	174.5410	181.2495	183.0201	203.8370	216.4885	241.0274 (310)
Water heating fuel	243.6833	215.7064	229.3925	201.9319	195.9811	176.8242	174.5410	181.2495	183.0201	203.8370	216.4885	241.0274 (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	8.1090	7.3243	8.1090	7.8474	8.1090	7.8474	8.1090	8.1090	7.8474	8.1090	7.8474	8.1090 (315)
Lighting	14.8643	11.9247	10.7369	7.8663	6.0761	4.9643	5.5429	7.2048	9.3584	12.2787	13.8687	15.2774 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)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 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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												365.6370 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2463.6830 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												3.6564 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.6020)												
mechanical ventilation fans (SFP = 0.6020)												95.4772 (330a)
Total electricity for the above, kWh/year												95.4772 (331)
Electricity for lighting (calculated in Appendix L)												119.9634 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (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												3044.7607 (338)

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## 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			250.0000 (367)
Space and Water heating from Heat pump	1131.7280	0.1580	23.1090 (367)
Electrical energy for heat distribution (space & water)	3.6564	0.0000	4.0477 (372)
Overall CO2 factor for heat network			0.0587 (386)
Total CO2 associated with community systems			165.9554 (373)
Space and water heating			165.9554 (376)
Pumps, fans and electric keep-hot	95.4772	0.1387	13.2439 (378)
Energy for lighting	119.9634	0.1443	17.3144 (379)
Total CO2, kg/year			196.5137 (383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.7800 (384)

## 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			250.0000 (467a)
Space and Water heating from Heat pump	1131.7280	1.5849	231.7940 (467)
Electrical energy for heat distribution (space & water)	3.6564	0.0000	43.2623 (472)
Overall CO2 factor for heat network			0.6269 (486)
Total CO2 associated with community systems			1773.7541 (473)
Space and water heating			1773.7541 (476)
Pumps, fans and electric keep-hot	95.4772	1.5128	144.4379 (478)
Energy for lighting	119.9634	1.5338	184.0039 (479)
Total Primary energy kWh/year			2102.1959 (483)
Dwelling Primary energy Rate (DPER)			40.4300 (484)

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	52.0000 (1b)	x 2.5000 (2b)	= 130.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.0000		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	130.0000 (5)

### 2. Ventilation rate

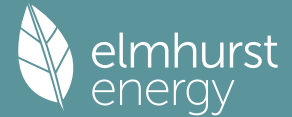
		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	2 * 10 =	20.0000 (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) =	20.0000 / (5) =	0.1538 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.4038	(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) =	0.3433 (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 infiltr rate	0.4377	0.4291	0.4205	0.3776	0.3690	0.3261	0.3261	0.3175	0.3433	0.3690	0.3862	0.4033 (22b)
Effective ac	0.5958	0.5921	0.5884	0.5713	0.5681	0.5532	0.5532	0.5504	0.5589	0.5681	0.5746	0.5813 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opening Type (Uw = 1.20)			12.9900	1.1450	14.8740		(27)
External Wall 1	39.0000	12.9900	26.0100	0.1800	4.6818		(29a)
Communal Corridor	17.0000		17.0000	0.1800	3.0600		(29a)
Total net area of external elements Aum(A, m2)			56.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	22.6158	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)
List of Thermal Bridges							

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K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	9.0000	0.0500	0.4500
E3 Sill	9.0000	0.0500	0.4500
E4 Jamb	18.0000	0.0500	0.9000
E7 Party floor between dwellings (in blocks of flats)	29.0000	0.0700	2.0300
E16 Corner (normal)	5.0000	0.0900	0.4500
E18 Party wall between dwellings	5.0000	0.0600	0.3000
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.3550 (36)  
 Point Thermal bridges 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 26.9708 (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	25.5588	25.3993	25.2429	24.5083	24.3709	23.7311	23.7311	23.6126	23.9775	24.3709	24.6489	24.9396 (38)
Average = Sum(39)m / 12 =	52.5297	52.3701	52.2137	51.4792	51.3417	50.7019	50.7019	50.5835	50.9484	51.3417	51.6198	51.9104 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0102	1.0071	1.0041	0.9900	0.9873	0.9750	0.9750	0.9728	0.9798	0.9873	0.9927	0.9983 (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												1.7491 (42)
Hot water usage for mixer showers												53.3405 (42a)
Hot water usage for baths												23.0714 (42b)
Hot water usage for other uses												32.5422 (42c)
Average daily hot water use (litres/day)												100.4145 (43)
Daily hot water use	109.2375	106.9057	104.0656	99.7460	96.2386	92.4676	91.0178	93.8456	96.8281	100.7870	105.1731	108.9541 (44)
Energy content (annual)	173.0055	152.2323	159.9449	136.5473	129.5556	113.6997	110.0781	116.2005	119.3987	136.7670	149.8384	170.5958 (45)
Distribution loss (46)m = 0.15 x (45)m												20.5151 (46)
Water storage loss:												150.0000 (47)
Store volume												1.3938 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.7527 (55)
Enter (49) or (54) in (55)												23.3325 (56)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (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	219.6004	194.3180	206.5398	181.6392	176.1505	158.7916	156.6730	162.7954	164.4906	183.3619	194.9303	217.1907 (62)
WWHRS	-24.4788	-21.6493	-22.6699	-18.7716	-17.4944	-14.9701	-14.0321	-14.9217	-15.4886	-18.2594	-20.6857	-24.0255 (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	195.1216	172.6687	183.8700	162.8676	158.6561	143.8215	142.6410	147.8737	149.0019	165.1025	174.2446	193.1652 (64)
12Total per year (kWh/year)												1989.0342 (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	94.8003	84.2858	90.4576	81.4755	80.3532	73.8786	73.8769	75.9126	75.7735	82.7510	85.8947	93.9990 (65)

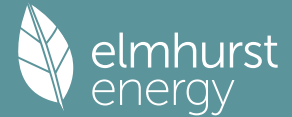
#### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	76.8814	85.1187	76.8814	79.4441	76.8814	79.4441	76.8814	76.8814	79.4441	76.8814	79.4441	76.8814 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	152.4259	154.0076	150.0218	141.5364	130.8251	120.7580	114.0326	112.4509	116.4367	124.9221	135.6334	145.7005 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628 (71)
Water heating gains (Table 5)	127.4197	125.4253	121.5828	113.1604	108.0016	102.6092	99.2969	102.0330	105.2410	111.2244	119.2983	126.3428 (72)
Total internal gains	408.9631	416.7877	400.7221	386.3769	367.9441	352.0474	339.4470	340.6014	350.3579	365.2640	386.6118	401.1607 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W					
North	3.7100	10.6334	0.6300	0.7000	0.7700	12.0564 (74)						
South	1.7700	46.7521	0.6300	0.7000	0.7700	25.2898 (78)						
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774 (80)						
Solar gains	82.4236	152.6396	237.1323	334.3136	406.4174	416.1997	396.0654	341.2117	271.0847	176.7342	101.0564	68.9730 (83)
Total gains	491.3867	569.4273	637.8543	720.6905	774.3615	768.2471	735.5123	681.8131	621.4426	541.9982	487.6683	470.1337 (84)

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## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	27.4977	27.5815	27.6641	28.0588	28.1339	28.4889	28.4889	28.5557	28.3511	28.1339	27.9824	27.8257
alpha	2.8332	2.8388	2.8443	2.8706	2.8756	2.8993	2.8993	2.9037	2.8901	2.8756	2.8655	2.8550
util living area	0.9045	0.8631	0.7995	0.6854	0.5471	0.4016	0.2966	0.3312	0.5125	0.7364	0.8633	0.9130 (86)
MIT	19.2164	19.5491	19.9793	20.4647	20.7762	20.9334	20.9794	20.9713	20.8624	20.4397	19.7703	19.1669 (87)
Th 2	20.0749	20.0774	20.0799	20.0917	20.0939	20.1042	20.1042	20.1061	20.1002	20.0939	20.0894	20.0848 (88)
util rest of house	0.8930	0.8476	0.7777	0.6539	0.5055	0.3507	0.2386	0.2702	0.4576	0.7014	0.8453	0.9024 (89)
MIT 2	18.0132	18.4246	18.9508	19.5330	19.8832	20.0527	20.0924	20.0888	19.9861	19.5219	18.7148	17.9584 (90)
Living area fraction									FLA = Living area / (4) =			0.5000 (91)
MIT	18.6148	18.9868	19.4651	19.9989	20.3297	20.4930	20.5359	20.5301	20.4242	19.9808	19.2426	18.5626 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6148	18.9868	19.4651	19.9989	20.3297	20.4930	20.5359	20.5301	20.4242	19.9808	19.2426	18.5626 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8709	0.8264	0.7615	0.6505	0.5166	0.3731	0.2668	0.2995	0.4779	0.6967	0.8259	0.8808 (94)
Useful gains	427.9563	470.5487	485.7018	468.8289	400.0638	286.6697	196.2247	204.1961	297.0077	377.6103	402.7529	414.1070 (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	751.9497	737.7294	676.9557	571.3603	443.0645	298.7876	199.5575	208.9140	322.2097	481.6257	626.7958	745.5711 (97)
Space heating kWh	241.0510	179.5454	142.2929	73.8226	31.9925	0.0000	0.0000	0.0000	0.0000	77.3874	161.3109	246.6093 (98a)
Space heating requirement - total per year (kWh/year)												1154.0120
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	241.0510	179.5454	142.2929	73.8226	31.9925	0.0000	0.0000	0.0000	0.0000	77.3874	161.3109	246.6093 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1154.0120
Space heating per m2										(98c) / (4) =		22.1925 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	241.0510	179.5454	142.2929	73.8226	31.9925	0.0000	0.0000	0.0000	0.0000	77.3874	161.3109	246.6093 (98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)
Space heating fuel (main heating system)	261.1604	194.5237	154.1635	79.9811	34.6614	0.0000	0.0000	0.0000	0.0000	83.8434	174.7680	267.1823 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	195.1216	172.6687	183.8700	162.8676	158.6561	143.8215	142.6410	147.8737	149.0019	165.1025	174.2446	193.1652 (64)
Efficiency of water heater	84.5350	84.1475	83.4917	82.4049	81.1807	79.8000	79.8000	79.8000	79.8000	82.4674	83.8872	79.8000 (216)
Fuel for water heating, kWh/month	230.8176	205.1977	220.2255	197.6431	195.4357	180.2274	178.7481	185.3054	186.7192	200.2033	207.7130	228.3043 (219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	15.9744	12.8153	11.5387	8.4538	6.5299	5.3350	5.9568	7.7429	10.0573	13.1957	14.9045	16.4184 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-2.9252	-4.6424	-7.5011	-9.5156	-11.2719	-10.9060	-10.7768	-9.6557	-7.8928	-5.7455	-3.3950	-2.4725 (233a)
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 (234a)
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 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-0.3851	-0.8539	-1.7829	-2.8107	-3.8518	-3.9192	-3.8711	-3.2126	-2.2734	-1.2602	-0.5262	-0.3013 (233b)
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 (234b)
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 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1250.2839 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												79.8000
Water heating fuel used												2416.5403 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												128.9228 (232)

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



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PV generation	-111.7491 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	3769.9979 (238)

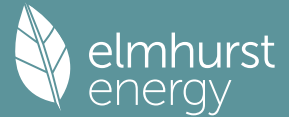
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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1250.2839	0.2100	262.5596 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2416.5403	0.2100	507.4735 (264)
Space and water heating			770.0331 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	128.9228	0.1443	18.6075 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-86.7005	0.1322	-11.4622
PV Unit electricity exported	-25.0487	0.1245	-3.1193
Total			-14.5815 (269)
Total CO2, kg/year			785.9884 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.1200 (273)

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 13a. Primary energy - Individual heating systems including micro-CHP  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1250.2839	1.1300	1412.8208 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2416.5403	1.1300	2730.6905 (278)
Space and water heating			4143.5114 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	128.9228	1.5338	197.7461 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-86.7005	1.4885	-129.0509
PV Unit electricity exported	-25.0487	0.4570	-11.4483
Total			-140.4992 (283)
Total Primary energy kWh/year			4330.8591 (286)
Target Primary Energy Rate (TPER)			83.2900 (287)

# Full SAP Calculation Printout



Property Reference	1B RE Ambient		Issued on Date	20/11/2023	
Assessment Reference	L23, 1b RE Ambient	Prop Type Ref	FF MT		
Property	FF MT				
SAP Rating	86 B	DER	3.52	TER	13.92
Environmental	98 A	% DER < TER			74.71
CO <sub>2</sub> Emissions (t/year)	0.18	DFEE	20.35	TFEE	24.44
Compliance Check	See BREL	% DFEE < TFEE			16.72
% DPER < TPER	50.70	DPER	37.90	TPER	76.86
Assessor Details	Mr. Jonathan Lewis			Assessor ID	AZ32-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	51.0000 (1b)	2.5000 (2b)	127.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	51.0000		127.5000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 127.5000 (5)

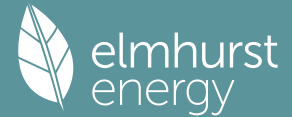
### 2. Ventilation rate

	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	2.5000	(17)
Infiltration rate	0.1250	(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) =	0.1062 (21)
Wind speed	Jan 5.1000, Feb 5.0000, Mar 4.9000, Apr 4.4000, May 4.3000, Jun 3.8000, Jul 3.8000, Aug 3.7000, Sep 4.0000, Oct 4.3000, Nov 4.5000, Dec 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	0.1355, 0.1328, 0.1302, 0.1169, 0.1142, 0.1009, 0.1009, 0.0983, 0.1062, 0.1142, 0.1195, 0.1248	(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) =		81.9000 (23c)
Effective ac	0.2260, 0.2233, 0.2207, 0.2074, 0.2047, 0.1914, 0.1914, 0.1888, 0.1967, 0.2047, 0.2100, 0.2153	(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
Window (Uw = 1.00)			11.8000	0.9615	11.3462		(27)
External Wall 1	16.5000	11.8000	4.7000	0.1800	0.8460		(29a)
Communal Corridor	16.5000		16.5000	0.1600	2.6400		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			33.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 14.8322		(33)
Party Floor 1			52.0000				(32d)
Party Ceiling 1			52.0000				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				6.0000	0.0560	0.3360	
E3 Sill				6.0000	0.0410	0.2460	
E4 Jamb				9.0000	0.0470	0.4230	
E7 Party floor between dwellings (in blocks of flats)				8.0000	0.0490	0.3920	

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E16 Corner (normal)	0.0000	0.0320	0.0000
E18 Party wall between dwellings	5.0000	0.0400	0.2000
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0310	-0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			1.5970 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	16.4292 (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	9.5076	9.3959	9.2841	8.7253	8.6135	8.0547	8.0547	7.9430	8.2783	8.6135	8.8371	9.0606 (38)
Average = Sum(39)m / 12 =	25.9368	25.8250	25.7133	25.1545	25.0427	24.4839	24.4839	24.3721	24.7074	25.0427	25.2662	25.4897 (39)
												25.1265

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.5086	0.5064	0.5042	0.4932	0.4910	0.4801	0.4801	0.4779	0.4845	0.4910	0.4954	0.4998 (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												1.7196 (42)	
Hot water usage for mixer showers													59.4538 (42a)
Hot water usage for baths													24.0625 (42b)
Hot water usage for other uses													33.9370 (42c)
Average daily hot water use (litres/day)													108.2624 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	117.7635	115.2740	112.2280	107.5622	103.7856	99.7205	98.1332	101.1657	104.3676	108.6385	113.3771	117.4532 (44)	
Energy content (annual)	186.5086	164.1486	172.4902	147.2473	139.7153	122.6179	118.6835	125.2643	128.6957	147.4214	161.5265	183.9034 (45)	
Distribution loss (46)m = 0.15 x (45)m													27.9763
Water storage loss:													24.6223
Store volume													25.8735
a) If manufacturer declared loss factor is known (kWh/day):													22.0871
Temperature factor from Table 2b													20.9573
Enter (49) or (54) in (55)													18.3927
Total storage loss													17.8025
If cylinder contains dedicated solar storage													18.7896
Primary loss													19.3044
Combi loss													22.1132
Total heat required for water heating calculated for each month													24.2290
WWHRS													27.5855 (46)
PV diverter													150.0000 (47)
Solar input													1.6000 (48)
FGHRS													0.6000 (49)
Output from w/h													0.9600 (55)
12Total per year (kWh/year)													2422.5188 (64)
Electric shower(s)													2423 (64)
Heat gains from water heating, kWh/month													0.0000 (64a)

#### 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	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785 (66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													75.5724 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													78.0915 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													112.0911 (69)
Pumps, fans													31.5979 (70)
Losses e.g. evaporation (negative values) (Table 5)													0.0000
Water heating gains (Table 5)													-68.7828 (71)
Total internal gains													140.3656 (72)
													414.5624 (73)

#### 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains	
West	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		
	11.8000	19.6403	0.6300	0.7000	0.7700	70.8274 (80)	
Solar gains	70.8274	138.5534	228.1777	332.7835	407.8387	417.4955	
Total gains	485.3898	560.6347	634.1119	723.8082	780.2558	776.7216	
							397.4727
							341.4232
							265.3801
							164.4052
							88.3134
							58.2450 (83)
							465.0322 (84)

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

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000 (85)
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Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	54.6200	54.8563	55.0948	56.3187	56.5701	57.8612	57.8612	58.1265	57.3377	56.5701	56.0696	55.5779
alpha	4.6413	4.6571	4.6730	4.7546	4.7713	4.8574	4.8574	4.8751	4.8225	4.7713	4.7380	4.7052
util living area	0.7729	0.6832	0.5667	0.4165	0.2978	0.2017	0.1448	0.1626	0.2732	0.4791	0.6779	0.7891 (86)
MIT	20.7019	20.8315	20.9304	20.9850	20.9974	20.9997	21.0000	20.9999	20.9988	20.9772	20.8671	20.6837 (87)
Th 2	20.5130	20.5150	20.5170	20.5270	20.5291	20.5391	20.5391	20.5411	20.5351	20.5291	20.5250	20.5210 (88)
util rest of house	0.7591	0.6678	0.5501	0.4008	0.2829	0.1872	0.1296	0.1464	0.2549	0.4587	0.6602	0.7759 (89)
MIT 2	20.1697	20.3243	20.4405	20.5114	20.5265	20.5389	20.5391	20.5411	20.5340	20.5058	20.3776	20.1554 (90)
Living area fraction										FLA = Living area / (4) =		0.4902 (91)
MIT	20.4306	20.5729	20.6807	20.7436	20.7573	20.7648	20.7650	20.7660	20.7618	20.7369	20.6175	20.4144 (92)
Temperature adjustment												0.0000
adjusted MIT	20.4306	20.5729	20.6807	20.7436	20.7573	20.7648	20.7650	20.7660	20.7618	20.7369	20.6175	20.4144 (93)

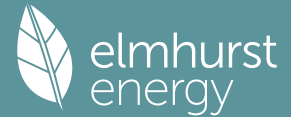
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7567	0.6696	0.5558	0.4080	0.2901	0.1943	0.1371	0.1544	0.2638	0.4677	0.6637	0.7728 (94)
Useful gains	367.3007	375.4289	352.4281	295.3281	226.3760	150.8956	101.9701	106.3991	164.3992	249.9829	318.6644	359.4000 (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	418.3753	404.7540	364.6313	297.9187	226.8193	150.9381	101.9757	106.4091	164.5965	253.8555	341.5368	413.3006 (97)
Space heating kWh	37.9995	19.7065	9.0792	1.8652	0.3299	0.0000	0.0000	0.0000	0.0000	2.8812	16.4681	40.1020 (98a)
Space heating requirement - total per year (kWh/year)												128.4316
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	37.9995	19.7065	9.0792	1.8652	0.3299	0.0000	0.0000	0.0000	0.0000	2.8812	16.4681	40.1020 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												128.4316
Space heating per m2										(98c) / (4) =		2.5183 (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												1.0100 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	37.9995	19.7065	9.0792	1.8652	0.3299	0.0000	0.0000	0.0000	0.0000	2.8812	16.4681	40.1020 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.01	38.3795	19.9035	9.1700	1.8838	0.3332	0.0000	0.0000	0.0000	0.0000	2.9100	16.6328	40.5030
307a												
Space heating requirement	38.3795	19.9035	9.1700	1.8838	0.3332	0.0000	0.0000	0.0000	0.0000	2.9100	16.6328	40.5030 (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	239.5310	212.0398	225.5126	198.5593	192.7377	173.9299	171.7059	178.2867	180.0077	200.4438	212.8385	236.9258 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.01	241.9263	214.1602	227.7677	200.5449	194.6651	175.6692	173.4230	180.0696	181.8077	202.4482	214.9669	239.2950
310a												
Water heating fuel	241.9263	214.1602	227.7677	200.5449	194.6651	175.6692	173.4230	180.0696	181.8077	202.4482	214.9669	239.2950 (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	7.9531	7.1834	7.9531	7.6965	7.9531	7.6965	7.9531	7.9531	7.9531	7.6965	7.6965	7.9531 (331)
Lighting	14.6112	11.7217	10.5541	7.7324	5.9727	4.8797	5.4485	7.0822	9.1990	12.0696	13.6326	15.0173 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)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 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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												129.7159 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2446.7440 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												1.2972 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.6020)												
mechanical ventilation fans (SFP = 0.6020)												93.6411 (330a)
Total electricity for the above, kWh/year												93.6411 (331)
Electricity for lighting (calculated in Appendix L)												117.9210 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (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												2788.0220 (338)

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## 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			250.0000 (367)
Space and Water heating from Heat pump	1030.5840	0.1593	8.2664 (367)
Electrical energy for heat distribution (space & water)	1.2972	0.0000	3.6526 (372)
Overall CO2 factor for heat network			0.0581 (386)
Total CO2 associated with community systems			149.7585 (373)
Space and water heating			149.7585 (376)
Pumps, fans and electric keep-hot	93.6411	0.1387	12.9892 (378)
Energy for lighting	117.9210	0.1443	17.0196 (379)
Total CO2, kg/year			179.7673 (383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.5200 (384)

## 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			250.0000 (467a)
Space and Water heating from Heat pump	1030.5840	1.5897	82.4816 (467)
Electrical energy for heat distribution (space & water)	1.2972	0.0000	39.2714 (472)
Overall CO2 factor for heat network			0.6249 (486)
Total CO2 associated with community systems			1610.1278 (473)
Space and water heating			1610.1278 (476)
Pumps, fans and electric keep-hot	93.6411	1.5128	141.6603 (478)
Energy for lighting	117.9210	1.5338	180.8711 (479)
Total Primary energy kWh/year			1932.6592 (483)
Dwelling Primary energy Rate (DPER)			37.9000 (484)

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	51.0000 (1b)	x 2.5000 (2b)	= 127.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	51.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	127.5000 (5)

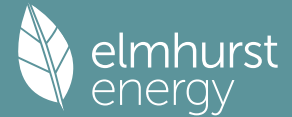
### 2. Ventilation rate

	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	2 * 10 =	20.0000 (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) =	20.0000 / (5) =	0.1569 (8)										
Pressure test	Yes											
Pressure Test Method	Blower Door											
Measured/design AP50	5.0000	(17)										
Infiltration rate	0.4069	(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) =	0.3458 (21)										
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 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	0.4409	0.4323	0.4236	0.3804	0.3718	0.3285	0.3285	0.3199	0.3458	0.3718	0.3891	0.4064 (22b)
Effective ac	0.5972	0.5934	0.5897	0.5724	0.5691	0.5540	0.5540	0.5512	0.5598	0.5691	0.5757	0.5826 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opening Type (Uw = 1.20)							
External Wall 1	16.5000	11.8000	11.8000	1.1450	13.5115		(27)
Communal Corridor	16.5000		16.5000	0.1800	0.8460		(29a)
Total net area of external elements Aum(A, m2)			33.0000		2.9700		(29a)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	17.3275		(31)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							(33)
List of Thermal Bridges							100.0000 (35)
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				6.0000	0.0500	0.3000	

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E3 Sill						6.0000	0.0500	0.3000				
E4 Jamb						9.0000	0.0500	0.4500				
E7 Party floor between dwellings (in blocks of flats)						8.0000	0.0700	0.5600				
E16 Corner (normal)						0.0000	0.0900	0.0000				
E18 Party wall between dwellings						5.0000	0.0600	0.3000				
E17 Corner (inverted - internal area greater than external area)						0.0000	-0.0900	-0.0000				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)												1.9100 (36)
Point Thermal bridges												0.0000
Total fabric heat loss												(33) + (36) + (36a) = 19.2375 (37)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7196 (42)

Hot water usage for mixer showers

53.0510	52.2538	51.0920	48.8692	47.2288	45.3995	44.3597	45.5127	46.7765	48.7407	51.0112	52.8478	52.8478 (42a)
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Hot water usage for baths

22.9369	22.5963	22.1166	21.2321	20.5698	19.8354	19.4388	19.9151	20.4338	21.2196	22.1223	22.8594	22.8594 (42b)
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Hot water usage for other uses

32.2401	31.0678	29.8954	28.7230	27.5507	26.3783	26.3783	27.5507	28.7230	29.8954	31.0678	32.2401	32.2401 (42c)
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------------

Average daily hot water use (litres/day)

99.4866	99.4866	99.4866	99.4866	99.4866	99.4866	99.4866	99.4866	99.4866	99.4866	99.4866	99.4866	99.4866 (43)
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Daily hot water use

108.2281	105.9178	103.1040	98.8243	95.3493	91.6132	90.1768	92.9784	95.9333	99.8556	104.2013	107.9473	107.9473 (44)
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Energy content (annual)

171.4068	150.8256	158.4670	135.2856	128.3585	112.6492	109.0610	115.1267	118.2954	135.5032	148.4538	169.0194	169.0194 (45)
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Distribution loss (46)m = 0.15 x (45)m

25.7110	22.6238	23.7701	20.2928	19.2538	16.8974	16.3591	17.2690	17.7443	20.3255	22.2681	25.3529	25.3529 (46)
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Water storage loss:

Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day):

Temperature factor from Table 2b 1.3938 (48)

Enter (49) or (54) in (55) 0.5400 (49)

Total storage loss 0.7527 (55)

23.3325 21.0745 23.3325 22.5798 23.3325 22.5798 23.3325 23.3325 22.5798 23.3325 22.5798 23.3325 23.3325 (56)

If cylinder contains dedicated solar storage

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325 (57)
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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 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 0.0000 (61)

Total heat required for water heating calculated for each month

218.0017	192.9113	205.0619	180.3774	174.9534	157.7410	155.6559	161.7216	163.3872	182.0981	193.5456	215.6143	215.6143 (62)
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WWHRS -24.2527 -21.4493 -22.4605 -18.5982 -17.3328 -14.8318 -13.9025 -14.7839 -15.3456 -18.0907 -20.4946 -23.8036 (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 -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 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 0.0000 (63d)

Output from w/h 193.7490 171.4620 182.6014 161.7793 157.6206 142.9092 141.7534 146.9378 148.0416 164.0073 173.0510 191.8107 (64)

Total per year (kWh/year) 1975.7233 (64)

Electric shower(s) 1976 (64)

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

Heat gains from water heating, kWh/month 94.2687 83.8181 89.9662 81.0559 79.9551 73.5293 73.5387 75.5556 75.4067 82.3307 85.4344 93.4749 (65)

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

Metabolic gains (Table 5), Watts

(66)m	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785 (66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

75.5724	83.6695	75.5724	78.0915	75.5724	78.0915	75.5724	78.0915	75.5724	78.0915	75.5724	78.0915	75.5724 (67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

149.8308	151.3856	147.4676	139.1267	128.5978	118.7021	112.0911	110.5364	114.4543	122.7953	133.3242	143.2199	143.2199 (68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979 (69)
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Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 0.0000 0.0000 0.0000 0.0000 3.0000 3.0000 3.0000 3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828 (71)
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Water heating gains (Table 5)

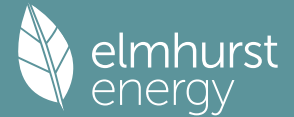
126.7052	124.7293	120.9223	112.5777	107.4666	102.1240	98.8423	101.5532	104.7315	110.6596	118.6588	125.6383	125.6383 (72)
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Total internal gains 403.9020 411.5779 395.7559 381.5894 363.4303 347.7112 335.2995 336.4555 346.0709 360.8208 381.8681 396.2241 (73)

6. Solar gains

[Jan]			Area	Solar flux	g	FF	Access	Gains				
			m2	Table 6a	W/m2	Specific data	factor	W				
						or Table 6b	Table 6d					
West			11.8000	19.6403	0.6300	0.7000	0.7700	70.8274 (80)				
Solar gains	70.8274	138.5534	228.1777	332.7835	407.8387	417.4955	397.4727	341.4232	265.3801	164.4052	88.3134	58.2450 (83)
Total gains	474.7294	550.1313	623.9336	714.3729	771.2690	765.2067	732.7722	677.8787	611.4510	525.2261	470.1815	454.4691 (84)

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## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	31.93019	32.0467	32.1599	32.7028	32.8064	33.2975	33.2975	33.3901	33.1066	32.8064	32.5975	32.3819
alpha	3.1288	3.1364	3.1440	3.1802	3.1871	3.2198	3.2198	3.2260	3.2071	3.1871	3.1732	3.1588
util living area	0.8939	0.8455	0.7675	0.6332	0.4873	0.3475	0.2531	0.2842	0.4575	0.6986	0.8457	0.9033 (86)
MIT	19.5982	19.9068	20.2904	20.6794	20.8851	20.9714	20.9922	20.9887	20.9305	20.6328	20.0795	19.5565 (87)
Th 2	20.1932	20.1958	20.1984	20.2107	20.2130	20.2238	20.2238	20.2258	20.2196	20.2130	20.2084	20.2035 (88)
util rest of house	0.8822	0.8300	0.7459	0.6040	0.4520	0.3076	0.2093	0.2376	0.4117	0.6654	0.8277	0.8926 (89)
MIT 2	18.5665	18.9466	19.4121	19.8757	20.1042	20.2012	20.2191	20.2187	20.1612	19.8368	19.1755	18.5224 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	19.0722	19.4173	19.8426	20.2697	20.4870	20.5787	20.5981	20.5961	20.5383	20.2270	19.6186	19.0293 (91)
Temperature adjustment												0.0000
adjusted MIT	19.0722	19.4173	19.8426	20.2697	20.4870	20.5787	20.5981	20.5961	20.5383	20.2270	19.6186	19.0293 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8634	0.8131	0.7356	0.6063	0.4645	0.3260	0.2305	0.2600	0.4307	0.6660	0.8126	0.8740 (94)
Useful gains	409.8949	447.3239	458.9430	433.0892	358.2554	249.4250	168.9146	176.2684	263.3390	349.8252	382.0878	397.2254 (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	655.3728	641.7570	587.7524	492.5278	379.4436	254.3687	170.1023	178.0325	275.5028	415.7202	544.0524	648.7648 (97)
Space heating kWh	182.6356	130.6591	95.8342	42.7958	15.7640	0.0000	0.0000	0.0000	0.0000	49.0259	116.6145	187.1453 (98a)
Space heating requirement - total per year (kWh/year)												820.4745
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	182.6356	130.6591	95.8342	42.7958	15.7640	0.0000	0.0000	0.0000	0.0000	49.0259	116.6145	187.1453 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												820.4745
Space heating per m <sup>2</sup>												16.0877 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	182.6356	130.6591	95.8342	42.7958	15.7640	0.0000	0.0000	0.0000	0.0000	49.0259	116.6145	187.1453 (98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)
Space heating fuel (main heating system)	197.8717	141.5591	103.8290	46.3660	17.0791	0.0000	0.0000	0.0000	0.0000	53.1158	126.3430	202.7577 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	193.7490	171.4620	182.6014	161.7793	157.6206	142.9092	141.7534	146.9378	148.0416	164.0073	173.0510	191.8107 (64)
Efficiency of water heater (217)m	83.9275	83.4581	82.6844	81.5286	80.5422	79.8000	79.8000	79.8000	79.8000	81.7057	83.1945	79.8000 (216)
Fuel for water heating, kWh/month	230.8528	205.4468	220.8416	198.4326	195.6994	179.0842	177.6359	184.1325	185.5158	200.7293	208.0077	228.3336 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	15.7025	12.5971	11.3423	8.3098	6.4188	5.2442	5.8554	7.6111	9.8860	12.9710	14.6507	16.1389 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-2.8697	-4.5546	-7.3599	-9.3376	-11.0620	-10.7035	-10.5768	-9.4761	-7.7453	-5.6373	-3.3306	-2.4255 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-0.3770	-0.8359	-1.7455	-2.7517	-3.7709	-3.8367	-3.7895	-3.1448	-2.2254	-1.2337	-0.5151	-0.2950 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												888.9214 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												79.8000
Water heating fuel used												2414.7121 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												126.7278 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-109.6001 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)

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Appendix Q - special features  
 Energy saved or generated  
 Energy used  
 Total delivered energy for all uses

-0.0000 (236)  
 0.0000 (237)  
 3406.7612 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	888.9214	0.2100	186.6735 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2414.7121	0.2100	507.0895 (264)
Space and water heating			693.7630 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	126.7278	0.1443	18.2907 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-85.0788	0.1322	-11.2477
PV Unit electricity exported	-24.5213	0.1245	-3.0536
Total			-14.3013 (269)
Total CO2, kg/year			709.6817 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.9200 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	888.9214	1.1300	1004.4812 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2414.7121	1.1300	2728.6247 (278)
Space and water heating			3733.1059 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	126.7278	1.5338	194.3794 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-85.0788	1.4885	-126.6365
PV Unit electricity exported	-24.5213	0.4570	-11.2073
Total			-137.8438 (283)
Total Primary energy kWh/year			3919.7422 (286)
Target Primary Energy Rate (TPER)			76.8600 (287)



# Full SAP Calculation Printout



Property Reference	1C RE Ambient		Issued on Date	20/11/2023	
Assessment Reference	L23, 1c RE Ambient	Prop Type Ref	FF MT		
Property	FF MT				
SAP Rating	87 B	DER	3.31	TER	12.91
Environmental	98 A	% DER < TER			74.36
CO <sub>2</sub> Emissions (t/year)	0.18	DFEE	18.39	TFEE	22.09
Compliance Check	See BREL	% DFEE < TFEE			16.78
% DPER < TPER	50.06	DPER	35.63	TPER	71.34
Assessor Details	Mr. Jonathan Lewis			Assessor ID	AZ32-0001
Client					

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	56.0000 (1b)	2.5000 (2b)	140.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.0000		140.0000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 140.0000 (5)

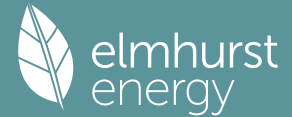
## 2. Ventilation rate

	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	2.5000	(17)
Infiltration rate	0.1250	(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) =	0.1062 (21)
Wind speed	Jan: 5.1000, Feb: 5.0000, Mar: 4.9000, Apr: 4.4000, May: 4.3000, Jun: 3.8000, Jul: 3.8000, Aug: 3.7000, Sep: 4.0000, Oct: 4.3000, Nov: 4.5000, Dec: 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	0.1355, 0.1328, 0.1302, 0.1169, 0.1142, 0.1009, 0.1009, 0.0983, 0.1062, 0.1142, 0.1195, 0.1248	(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) =		81.9000 (23c)
Effective ac	0.2260, 0.2233, 0.2207, 0.2074, 0.2047, 0.1914, 0.1914, 0.1888, 0.1967, 0.2047, 0.2100, 0.2153	(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
Window (Uw = 1.00)			11.8000	0.9615	11.3462		(27)
External Wall 1	16.0000	11.8000	4.2000	0.1800	0.7560		(29a)
Communal Corridor	11.0000		11.0000	0.1600	1.7600		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			27.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 13.8622		(33)
Party Floor 1			56.0000				(32d)
Party Ceiling 1			56.0000				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				6.0000	0.0560	0.3360	
E3 Sill				6.0000	0.0410	0.2460	
E4 Jamb				9.0000	0.0470	0.4230	
E7 Party floor between dwellings (in blocks of flats)				8.0000	0.0490	0.3920	

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E16 Corner (normal)	0.0000	0.0320	0.0000
E18 Party wall between dwellings	5.0000	0.0400	0.2000
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0310	-0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			1.5970 (36)
Total Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 15.4592 (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	10.4398	10.3170	10.1943	9.5807	9.4580	8.8444	8.8444	8.7217	9.0899	9.4580	9.7034	9.9489 (38)
Heat transfer coeff	25.8989	25.7762	25.6535	25.0399	24.9172	24.3036	24.3036	24.1808	24.5490	24.9172	25.1626	25.4080 (39)
Average = Sum(39)m / 12 =												25.0092

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.4625	0.4603	0.4581	0.4471	0.4449	0.4340	0.4340	0.4318	0.4384	0.4449	0.4493	0.4537 (40)
HLP (average)												0.4466
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													1.8666 (42)
Hot water usage for mixer showers													62.2164 (42a)
Hot water usage for baths													25.1746 (42b)
Hot water usage for other uses													35.5219 (42c)
Average daily hot water use (litres/day)													113.2947 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	123.2376	120.6322	117.4445	112.5618	108.6096	104.3555	102.6945	105.8682	109.2190	113.6884	118.6473	122.9129 (44)	
Energy conte	195.1782	171.7786	180.5078	154.0915	146.2094	128.3173	124.2001	131.0869	134.6779	154.2741	169.0348	192.4519 (45)	
Energy content (annual)													Total = Sum(45)m = 1881.8085
Distribution loss (46)m = 0.15 x (45)m	29.2767	25.7668	27.0762	23.1137	21.9314	19.2476	18.6300	19.6630	20.2017	23.1411	25.3552	28.8678 (46)	
Water storage loss:													150.0000 (47)
Store volume													1.6000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.6000 (49)
Temperature factor from Table 2b													0.9600 (55)
Enter (49) or (54) in (55)													
Total storage loss	29.7600	26.8800	29.7600	28.8000	29.7600	28.8000	29.7600	29.7600	28.8000	29.7600	28.8000	29.7600 (56)	
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	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	248.2006	219.6698	233.5302	205.4035	199.2318	179.6293	177.2225	184.1093	185.9899	207.2965	220.3468	245.4743 (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	248.2006	219.6698	233.5302	205.4035	199.2318	179.6293	177.2225	184.1093	185.9899	207.2965	220.3468	245.4743 (64)	
12Total per year (kWh/year)													Total per year (kWh/year) = Sum(64)m = 2506.1045 (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	107.3147	95.4293	102.4367	92.2850	91.0325	83.7151	83.7145	86.0043	85.8300	93.7141	97.2537	106.4082 (65)	

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

Metabolic gains (Table 5), Watts													
(66)m	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297 (66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	82.2990	91.1167	82.2990	85.0423	82.2990	85.0423	82.2990	82.2990	85.0423	82.2990	85.0423	82.2990 (67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	162.7587	164.4476	160.1916	151.1310	139.6936	128.9441	121.7627	120.0738	124.3298	133.3904	144.8278	155.5774 (68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330 (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)	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638 (71)	
Water heating gains (Table 5)	144.2402	142.0079	137.6838	128.1737	122.3556	116.2710	112.5194	115.5972	119.2083	125.9598	135.0746	143.0217 (72)	
Total internal gains	440.2968	448.5712	431.1733	415.3458	395.3471	381.2562	367.5801	368.9689	379.5794	392.6481	415.9436	431.8970 (73)	

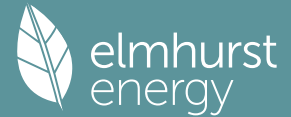
#### 6. Solar gains

[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						
West	11.8000	19.6403	0.6300	0.7000	0.7700	70.8274 (80)						
Solar gains	70.8274	138.5534	228.1777	332.7835	407.8387	417.4955	397.4727	341.4232	265.3801	164.4052	88.3134	58.2450 (83)
Total gains	511.1241	587.1246	659.3510	748.1294	803.1858	798.7517	765.0528	710.3921	644.9594	557.0533	504.2570	490.1420 (84)

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

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000 (85)
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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	60.0626	60.3485	60.6372	62.1231	62.4291	64.0052	64.0052	64.3301	63.3653	62.4291	61.8201	61.2230
alpha	5.0042	5.0232	5.0425	5.1415	5.1619	5.2670	5.2670	5.2887	5.2244	5.1619	5.1213	5.0815
util living area	0.7571	0.6654	0.5500	0.4027	0.2882	0.1947	0.1398	0.1566	0.2625	0.4604	0.6571	0.7729 (86)
MIT	20.7822	20.8837	20.9553	20.9916	20.9987	20.9999	21.0000	21.0000	20.9994	20.9870	20.9114	20.7696 (87)
Th 2	20.5553	20.5574	20.5594	20.5695	20.5715	20.5817	20.5817	20.5837	20.5776	20.5715	20.5675	20.5634 (88)
util rest of house	0.7437	0.6509	0.5349	0.3887	0.2750	0.1820	0.1265	0.1424	0.2464	0.4422	0.6405	0.7601 (89)
MIT 2	20.3046	20.4257	20.5102	20.5607	20.5703	20.5816	20.5817	20.5837	20.5771	20.5583	20.4693	20.2972 (90)
Living area fraction									FLA = Living area / (4) =			0.4464 (91)
MIT	20.5179	20.6302	20.7089	20.7531	20.7615	20.7683	20.7684	20.7695	20.7657	20.7497	20.6667	20.5081 (92)
Temperature adjustment												0.0000
adjusted MIT	20.5179	20.6302	20.7089	20.7531	20.7615	20.7683	20.7684	20.7695	20.7657	20.7497	20.6667	20.5081 (93)

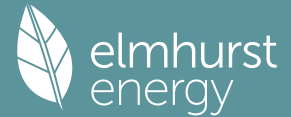
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7425	0.6533	0.5400	0.3947	0.2808	0.1877	0.1324	0.1487	0.2536	0.4498	0.6443	0.7584 (94)
Useful gains	379.5336	383.5733	356.0650	295.2514	225.5557	149.8946	101.3057	105.6556	163.5412	250.5395	324.9060	371.7177 (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	420.0247	405.4647	364.5071	296.8004	225.7878	149.9127	101.3077	105.6594	163.6356	252.9013	341.3727	414.3569 (97)
Space heating kWh	30.1254	14.7111	6.2810	1.1153	0.1727	0.0000	0.0000	0.0000	0.0000	1.7572	11.8560	31.7236 (98a)
Space heating requirement - total per year (kWh/year)												97.7422
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	30.1254	14.7111	6.2810	1.1153	0.1727	0.0000	0.0000	0.0000	0.0000	1.7572	11.8560	31.7236 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												97.7422
Space heating per m2												(98c) / (4) = 1.7454 (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												1.0100 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	30.1254	14.7111	6.2810	1.1153	0.1727	0.0000	0.0000	0.0000	0.0000	1.7572	11.8560	31.7236 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.01	30.4266	14.8582	6.3438	1.1265	0.1744	0.0000	0.0000	0.0000	0.0000	1.7747	11.9746	32.0408
307a	30.4266	14.8582	6.3438	1.1265	0.1744	0.0000	0.0000	0.0000	0.0000	1.7747	11.9746	32.0408 (307)
Space heating requirement	30.4266	14.8582	6.3438	1.1265	0.1744	0.0000	0.0000	0.0000	0.0000	1.7747	11.9746	32.0408 (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	248.2006	219.6698	233.5302	205.4035	199.2318	179.6293	177.2225	184.1093	185.9899	207.2965	220.3468	245.4743 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.01	250.6826	221.8665	235.8655	207.4576	201.2241	181.4255	178.9947	185.9504	187.8498	209.3695	222.5503	247.9290
310a	250.6826	221.8665	235.8655	207.4576	201.2241	181.4255	178.9947	185.9504	187.8498	209.3695	222.5503	247.9290 (310)
Water heating fuel	250.6826	221.8665	235.8655	207.4576	201.2241	181.4255	178.9947	185.9504	187.8498	209.3695	222.5503	247.9290 (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	8.7328	7.8877	8.7328	8.4511	8.7328	8.4511	8.7328	8.4511	8.7328	8.4511	8.7328	8.7328 (331)
Lighting	15.9117	12.7650	11.4935	8.4206	6.5043	5.3141	5.9335	7.7125	10.0178	13.1439	14.8460	16.3540 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)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 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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												98.7197 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2531.1655 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												0.9872 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.6020)												
mechanical ventilation fans (SFP = 0.6020)												102.8216 (330a)
Total electricity for the above, kWh/year												102.8216 (331)
Electricity for lighting (calculated in Appendix L)												128.4169 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (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												2861.1237 (338)

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## 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			250.0000 (367)
Space and Water heating from Heat pump	1051.9541	0.1597	6.3055 (367)
Electrical energy for heat distribution (space & water)	0.9872	0.0000	3.7231 (372)
Overall CO2 factor for heat network			0.0580 (386)
Total CO2 associated with community systems			152.6489 (373)
Space and water heating			152.6489 (376)
Pumps, fans and electric keep-hot	102.8216	0.1387	14.2626 (378)
Energy for lighting	128.4169	0.1443	18.5345 (379)
Total CO2, kg/year			185.4461 (383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.3100 (384)

## 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			250.0000 (467a)
Space and Water heating from Heat pump	1051.9541	1.5910	62.8246 (467)
Electrical energy for heat distribution (space & water)	0.9872	0.0000	40.0662 (472)
Overall CO2 factor for heat network			0.6246 (486)
Total CO2 associated with community systems			1642.7134 (473)
Space and water heating			1642.7134 (476)
Pumps, fans and electric keep-hot	102.8216	1.5128	155.5485 (478)
Energy for lighting	128.4169	1.5338	196.9701 (479)
Total Primary energy kWh/year			1995.2321 (483)
Dwelling Primary energy Rate (DPER)			35.6300 (484)

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	56.0000 (1b)	2.5000 (2b)	140.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	140.0000 (5)

### 2. Ventilation rate

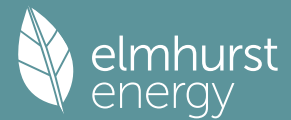
	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1429 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3929 (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) = 0.3339 (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	0.4258	0.4174	0.4091	0.3673	0.3590	0.3172	0.3172	0.3089	0.3339	0.3590	0.3757	0.3924 (22b)
Effective ac	0.5906	0.5871	0.5837	0.5675	0.5644	0.5503	0.5503	0.5477	0.5558	0.5644	0.5706	0.5770 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opening Type (Uw = 1.20)							(27)
External Wall 1	16.0000	11.8000	11.8000	1.1450	13.5115	0.7560	(29a)
Communal Corridor	11.0000		11.0000	0.1800	1.9800		(29a)
Total net area of external elements Aum(A, m2)			27.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	16.2475	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				6.0000	0.0500	0.3000	

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E3 Sill	6.0000	0.0500	0.3000	
E4 Jamb	9.0000	0.0500	0.4500	
E7 Party floor between dwellings (in blocks of flats)	8.0000	0.0700	0.5600	
E16 Corner (normal)	0.0000	0.0900	0.0000	
E18 Party wall between dwellings	5.0000	0.0600	0.3000	
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0900	-0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				1.9100 (36)
Point Thermal bridges				0.0000
Total fabric heat loss		(33) + (36) + (36a) =		18.1575 (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
	27.2874	27.1248	26.9654	26.2168	26.0767	25.4247	25.4247	25.3040	25.6758	26.0767	26.3600	26.6563 (38)
Heat transfer coeff	45.4448	45.2822	45.1228	44.3742	44.2342	43.5821	43.5821	43.4614	43.8333	44.2342	44.5175	44.8137 (39)
Average = Sum(39)m / 12 =												44.3735

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.8115	0.8086	0.8058	0.7924	0.7899	0.7783	0.7783	0.7761	0.7827	0.7899	0.7950	0.8002 (40)
HLP (average)												0.7924
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													1.8666 (42)
Hot water usage for mixer showers	55.5162	54.6819	53.4661	51.1400	49.4234	47.5091	46.4210	47.6275	48.9501	51.0055	53.3816	55.3035 (42a)	
Hot water usage for baths	23.9970	23.6406	23.1387	22.2134	21.5205	20.7522	20.3372	20.8355	21.3781	22.2003	23.1447	23.9159 (42b)	
Hot water usage for other uses	33.7458	32.5187	31.2915	30.0644	28.8373	27.6102	27.6102	28.8373	30.0644	31.2915	32.5187	33.7458 (42c)	
Average daily hot water use (litres/day)													104.1111 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	113.2590	110.8412	107.8964	103.4179	99.7812	95.8715	94.3684	97.3004	100.3927	104.4974	109.0450	112.9651 (44)	
Energy cont	179.3745	157.8363	165.8328	141.5739	134.3247	117.8852	114.1303	120.4782	123.7942	141.8019	155.3545	176.8761 (45)	
Energy content (annual)												1729.2628	
Distribution loss (46)m = 0.15 x (45)m	26.9062	23.6755	24.8749	21.2361	20.1487	17.6828	17.1196	18.0717	18.5691	21.2703	23.3032	26.5314 (46)	
Water storage loss:												150.0000 (47)	
Store volume												1.3938 (48)	
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)	
Temperature factor from Table 2b												0.7527 (55)	
Enter (49) or (54) in (55)													
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (56)	
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (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	225.9694	199.9221	212.4277	186.6657	180.9196	162.9770	160.7252	167.0731	168.8861	188.3968	200.4464	223.4710 (62)	
WWHRS	-25.3797	-22.4460	-23.5042	-19.4624	-18.1382	-15.5210	-14.5485	-15.4708	-16.0586	-18.9314	-21.4469	-24.9097 (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	200.5897	177.4761	188.9235	167.2034	162.7814	147.4560	146.1768	151.6022	152.8274	169.4655	178.9994	198.5613 (64)	
12Total per year (kWh/year)													2042.0628 (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	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	96.9180	86.1492	92.4153	83.1468	81.9389	75.2703	75.2243	77.3349	77.2351	84.4251	87.7289	96.0872 (65)	

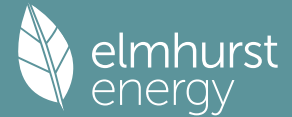
#### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	82.2990	91.1167	82.2990	85.0423	82.2990	85.0423	82.2990	82.2990	85.0423	82.2990	85.0423	82.2990 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	162.7587	164.4476	160.1916	151.1310	139.6936	128.9441	121.7627	120.0738	124.3298	133.3904	144.8278	155.5774 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638 (71)
Water heating gains (Table 5)	130.2661	128.1982	124.2142	115.4816	110.1329	104.5421	101.1079	103.9448	107.2709	113.4745	121.8456	129.1495 (72)
Total internal gains	429.3227	437.7614	420.7036	405.6538	386.1244	369.5273	356.1685	357.3165	367.6420	383.1629	405.7147	421.0248 (73)

#### 6. Solar gains

[Jan]			Area	Solar flux	g	FF	Access	Gains
			m2	Table 6a	or Table 6b	Specific data	factor	W
				W/m2		or Table 6c	Table 6d	
West			11.8000	19.6403	0.6300	0.7000	0.7700	70.8274 (80)
Solar gains	70.8274	138.5534	228.1777	332.7835	407.8387	417.4955	397.4727	341.4232
Total gains	500.1500	576.3148	648.8813	738.4374	793.9631	787.0228	753.6412	698.7397
								265.3801
								633.0220
								164.4052
								88.3134
								547.5681
								494.0281
								58.2450 (83)
								479.2697 (84)

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## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	34.2296	34.3525	34.4738	35.0554	35.1664	35.6925	35.6925	35.7917	35.4880	35.1664	34.9426	34.7116
alpha	3.2820	3.2902	3.2983	3.3370	3.3444	3.3795	3.3795	3.3861	3.3659	3.3444	3.3295	3.3141
util living area	0.8957	0.8478	0.7705	0.6356	0.4888	0.3475	0.2526	0.2832	0.4562	0.6988	0.8470	0.9051 (86)
MIT	19.7174	20.0070	20.3620	20.7192	20.9030	20.9772	20.9941	20.9913	20.9429	20.6781	20.1681	19.6779 (87)
Th 2	20.2434	20.2459	20.2483	20.2599	20.2621	20.2722	20.2722	20.2741	20.2683	20.2621	20.2577	20.2531 (88)
util rest of house	0.8846	0.8329	0.7498	0.6077	0.4552	0.3098	0.2115	0.2395	0.4128	0.6671	0.8297	0.8949 (89)
MIT 2	18.7501	19.1072	19.5384	19.9650	20.1694	20.2539	20.2686	20.2686	20.2198	19.9304	19.3208	18.7085 (90)
Living area fraction									fLA = Living area / (4) =			0.4464 (91)
MIT	19.1819	19.5089	19.9061	20.3017	20.4969	20.5768	20.5925	20.5912	20.5426	20.2642	19.6991	19.1413 (92)
Temperature adjustment												0.0000
adjusted MIT	19.1819	19.5089	19.9061	20.3017	20.4969	20.5768	20.5925	20.5912	20.5426	20.2642	19.6991	19.1413 (93)

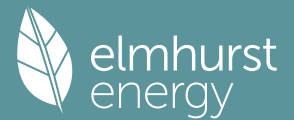
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8666	0.8168	0.7397	0.6094	0.4660	0.3257	0.2296	0.2587	0.4293	0.6672	0.8152	0.8771 (94)
Useful gains	433.4288	470.7065	480.0069	449.9805	369.9888	256.2961	173.0562	180.7327	271.7500	365.3177	402.7434	420.3783 (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	676.3065	661.5242	604.9189	505.9410	389.1232	260.4821	174.0021	182.1563	282.4003	427.4872	560.8791	669.5743 (97)
Space heating kWh	180.7010	128.2295	92.9345	40.2915	14.2359	0.0000	0.0000	0.0000	0.0000	46.2541	113.8577	185.4018 (98a)
Space heating requirement - total per year (kWh/year)												801.9061
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	180.7010	128.2295	92.9345	40.2915	14.2359	0.0000	0.0000	0.0000	0.0000	46.2541	113.8577	185.4018 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												801.9061
Space heating per m2										(98c) / (4) =		14.3198 (99)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	180.7010	128.2295	92.9345	40.2915	14.2359	0.0000	0.0000	0.0000	0.0000	46.2541	113.8577	185.4018 (98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)
Space heating fuel (main heating system)	195.7758	138.9268	100.6875	43.6528	15.4236	0.0000	0.0000	0.0000	0.0000	50.1128	123.3562	200.8686 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	200.5897	177.4761	188.9235	167.2034	162.7814	147.4560	146.1768	151.6022	152.8274	169.4655	178.9994	198.5613 (64)
Efficiency of water heater												79.8000 (216)
(217)m	83.8264	83.3431	82.5589	81.4020	80.4558	79.8000	79.8000	79.8000	79.8000	81.5727	83.0734	83.9063 (217)
Fuel for water heating, kWh/month	239.2919	212.9463	228.8348	205.4044	202.3241	184.7819	183.1789	189.9777	191.5131	207.7478	215.4714	236.6466 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	17.1001	13.7183	12.3518	9.0495	6.9901	5.7110	6.3766	8.2885	10.7660	14.1256	15.9548	17.5754 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-3.1474	-4.9934	-8.0654	-10.2275	-12.1109	-11.7156	-11.5762	-10.3737	-8.4825	-6.1778	-3.6521	-2.6604 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-0.4176	-0.9257	-1.9328	-3.0470	-4.1762	-4.2501	-4.1985	-3.4846	-2.4657	-1.3668	-0.5707	-0.3268 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												868.8040 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												79.8000
Water heating fuel used												2498.1190 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												138.0076 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-120.3452 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)

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Appendix Q - special features  
 Energy saved or generated  
 Energy used  
 Total delivered energy for all uses

-0.0000 (236)  
 0.0000 (237)  
 3470.5854 (238)

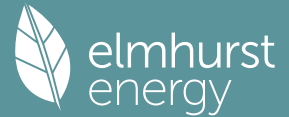
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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	868.8040	0.2100	182.4488 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2498.1190	0.2100	524.6050 (264)
Space and water heating			707.0538 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	138.0076	0.1443	19.9188 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-93.1828	0.1322	-12.3200
PV Unit electricity exported	-27.1624	0.1245	-3.3824
Total			-15.7024 (269)
Total CO2, kg/year			723.1995 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.9100 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	868.8040	1.1300	981.7485 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2498.1190	1.1300	2822.8744 (278)
Space and water heating			3804.6230 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	138.0076	1.5338	211.6807 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-93.1828	1.4885	-138.7025
PV Unit electricity exported	-27.1624	0.4570	-12.4139
Total			-151.1163 (283)
Total Primary energy kWh/year			3995.2881 (286)
Target Primary Energy Rate (TPER)			71.3400 (287)

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Property Reference	2B3P RE Ambient		Issued on Date	20/11/2023	
Assessment Reference	L23, 2B3P Re Ambient	Prop Type Ref	FF MT		
Property	FF MT				
SAP Rating	86 B	DER	3.68	TER	14.46
Environmental	97 A	% DER < TER			74.55
CO <sub>2</sub> Emissions (t/year)	0.2	DFEE	28.50	TFEE	30.42
Compliance Check	See BREL	% DFEE < TFEE			6.32
% DPER < TPER	50.66	DPER	39.28	TPER	79.62
Assessor Details	Mr. Jonathan Lewis			Assessor ID	AZ32-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	58.0000 (1b)	2.5000 (2b)	145.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.0000		145.0000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 145.0000 (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	2.5000	(17)
Infiltration rate	0.1250	(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) =	0.1062 (21)

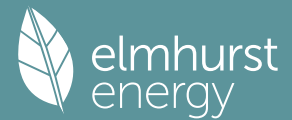
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.1355	0.1328	0.1302	0.1169	0.1142	0.1009	0.1009	0.0983	0.1062	0.1142	0.1195	0.1248 (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)												81.9000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2260	0.2233	0.2207	0.2074	0.2047	0.1914	0.1914	0.1888	0.1967	0.2047	0.2100	0.2153 (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
Window (Uw = 1.00)			19.8000	0.9615	19.0385		(27)
External Wall 1	46.0000	19.8000	26.2000	0.1800	4.7160		(29a)
Communal Corridor	14.0000		14.0000	0.1600	2.2400		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			60.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	25.9945	(33)
Party Floor 1			56.0000				(32d)
Party Ceiling 1			56.0000				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				12.0000	0.0560	0.6720	
E3 Sill				12.0000	0.0410	0.4920	
E4 Jamb				15.0000	0.0470	0.7050	
E7 Party floor between dwellings (in blocks of flats)				26.0000	0.0490	1.2740	



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E16 Corner (normal)	2.5000	0.0320	0.0800
E18 Party wall between dwellings	5.0000	0.0400	0.2000
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0310	-0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			3.4230 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss			(33) + (36) + (36a) = 29.4175 (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	10.8126	10.6855	10.5584	9.9229	9.7958	9.1603	9.1603	9.0332	9.4145	9.7958	10.0500	10.3042 (38)
Average = Sum(39)m / 12 =	40.2301	40.1030	39.9759	39.3404	39.2133	38.5777	38.5777	38.4506	38.8319	39.2133	39.4675	39.7217 (39)
HLP	0.6936	0.6914	0.6892	0.6783	0.6761	0.6651	0.6651	0.6629	0.6695	0.6761	0.6805	0.6849 (40)
HLP (average)												0.6777
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													1.9246 (42)
Hot water usage for mixer showers													63.3056 (42a)
Hot water usage for baths													25.6131 (42b)
Hot water usage for other uses													36.1467 (42c)
Average daily hot water use (litres/day)													115.2787 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	125.3958	122.7446	119.5011	114.5330	110.5115	106.1829	104.4929	107.7221	111.1317	115.6794	120.7251	125.0654 (44)	
Energy content (annual)	198.5963	174.7867	183.6687	156.7899	148.7697	130.5642	126.3751	133.3825	137.0365	156.9758	171.9950	195.8222 (45)	
Distribution loss (46)m = 0.15 x (45)m													1914.7627
Water storage loss:													150.0000 (47)
Store volume													1.6000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.6000 (49)
Temperature factor from Table 2b													0.9600 (55)
Enter (49) or (54) in (55)													
Total storage loss													29.7600 (56)
If cylinder contains dedicated solar storage													29.7600 (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	251.6187	222.6779	236.6911	208.1019	201.7921	181.8762	179.3975	186.4049	188.3485	209.9982	223.3070	248.8446 (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	251.6187	222.6779	236.6911	208.1019	201.7921	181.8762	179.3975	186.4049	188.3485	209.9982	223.3070	248.8446 (64)	
12Total per year (kWh/year)													2539.0587 (64)
Electric shower(s)													2539 (64)
Heat gains from water heating, kWh/month	108.4512	96.4296	103.4878	93.1822	91.8838	84.4622	84.4376	86.7676	86.6142	94.6124	98.2380	107.5288 (65)	

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

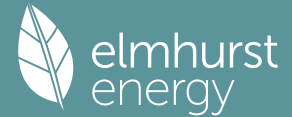
Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	84.6743	93.7465	84.6743	87.4967	84.6743	87.4967	84.6743	84.6743	87.4967	84.6743	87.4967	84.6743 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	167.8762	169.6182	165.2284	155.8829	144.0859	132.9984	125.5912	123.8492	128.2391	137.5845	149.3815	160.4691 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228 (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)	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823 (71)
Water heating gains (Table 5)	145.7677	143.4964	139.0965	129.4198	123.4998	117.3086	113.4914	116.6231	120.2975	127.1672	136.4416	144.5280 (72)
Total internal gains	450.1866	458.7295	440.8675	424.6678	404.1283	389.6721	375.6253	377.0150	387.9017	401.2944	425.1883	441.5397 (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	
North		8.0000	10.6334	0.6300	0.7000	0.7700	25.9976 (74)
East		11.8000	19.6403	0.6300	0.7000	0.7700	70.8274 (76)
Solar gains	96.8250	188.2362	312.6009	468.3888	590.5115	613.0521	580.0498
Total gains	547.0116	646.9656	753.4684	893.0566	994.6398	1002.7242	955.6751
							486.2748
							366.8841
							223.5461
							120.3848
							545.5731
							79.9179 (83)
							521.4576 (84)

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

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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	40.0474	40.1744	40.3021	40.9531	41.0859	41.7627	41.7627	41.9008	41.4893	41.0859	40.8213	40.5600
alpha	3.6698	3.6783	3.6868	3.7302	3.7391	3.7842	3.7842	3.7934	3.7660	3.7391	3.7214	3.7040
util living area	0.8584	0.7855	0.6739	0.5079	0.3611	0.2453	0.1774	0.2045	0.3503	0.5997	0.7904	0.8723 (86)
MIT	20.1552	20.4252	20.6993	20.9058	20.9770	20.9961	20.9991	20.9985	20.9851	20.8607	20.5071	20.1095 (87)
Th 2	20.3465	20.3484	20.3503	20.3601	20.3620	20.3717	20.3717	20.3737	20.3678	20.3620	20.3581	20.3542 (88)
util rest of house	0.8457	0.7689	0.6529	0.4845	0.3374	0.2215	0.1521	0.1768	0.3194	0.5705	0.7714	0.8606 (89)
MIT 2	19.3660	19.6936	20.0191	20.2622	20.3401	20.3686	20.3712	20.3727	20.3552	20.2199	19.8064	19.3166 (90)
Living area fraction									fLA = Living area / (4) =			0.4310 (91)
MIT	19.7062	20.0090	20.3123	20.5396	20.6146	20.6391	20.6419	20.6425	20.6267	20.4961	20.1084	19.6584 (92)
Temperature adjustment												0.0000
adjusted MIT	19.7062	20.0090	20.3123	20.5396	20.6146	20.6391	20.6419	20.6425	20.6267	20.4961	20.1084	19.6584 (93)

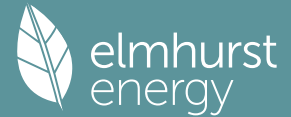
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8320	0.7598	0.6517	0.4911	0.3469	0.2316	0.1630	0.1887	0.3321	0.5768	0.7636	0.8466 (94)
Useful gains	455.1157	491.5367	491.0184	438.6210	344.9955	232.2582	155.7892	162.8878	250.6674	360.3921	416.6115	441.4462 (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	619.7910	605.9141	552.1572	457.9063	349.5720	232.9730	155.9260	163.1259	253.4456	388.0594	513.4101	614.0330 (97)
Space heating kWh	122.5184	76.8616	45.4873	13.8855	3.4049	0.0000	0.0000	0.0000	0.0000	20.5845	69.6950	128.4046 (98a)
Space heating requirement - total per year (kWh/year)												480.8418
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	122.5184	76.8616	45.4873	13.8855	3.4049	0.0000	0.0000	0.0000	0.0000	20.5845	69.6950	128.4046 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												480.8418
Space heating per m2												(98c) / (4) = 8.2904 (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												1.0100 (306)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating:												
Space heating requirement	122.5184	76.8616	45.4873	13.8855	3.4049	0.0000	0.0000	0.0000	0.0000	20.5845	69.6950	128.4046 (98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.01												
307a	123.7436	77.6302	45.9421	14.0243	3.4389	0.0000	0.0000	0.0000	0.0000	20.7903	70.3920	129.6886
Space heating requirement	123.7436	77.6302	45.9421	14.0243	3.4389	0.0000	0.0000	0.0000	0.0000	20.7903	70.3920	129.6886 (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	251.6187	222.6779	236.6911	208.1019	201.7921	181.8762	179.3975	186.4049	188.3485	209.9982	223.3070	248.8446 (64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.01												
310a	254.1348	224.9047	239.0580	210.1829	203.8100	183.6950	181.1914	188.2690	190.2319	212.0982	225.5401	251.3331
Water heating fuel	254.1348	224.9047	239.0580	210.1829	203.8100	183.6950	181.1914	188.2690	190.2319	212.0982	225.5401	251.3331 (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	9.0447	8.1694	9.0447	8.7529	9.0447	8.7529	9.0447	9.0447	8.7529	9.0447	8.7529	9.0447 (331)
Lighting	16.3710	13.1334	11.8252	8.6636	6.6920	5.4675	6.1047	7.9351	10.3069	13.5233	15.2745	16.8260 (332)
Electricity generated by PVs (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 (333a)
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)
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)
Electricity generated by PVs (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 (333b)
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)
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)
Annual totals kWh/year												
Space heating fuel - community heating												485.6502 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2564.4493 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												4.8565 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.6020)												
mechanical ventilation fans (SFP = 0.6020)												106.4938 (330a)
Total electricity for the above, kWh/year												106.4938 (331)
Electricity for lighting (calculated in Appendix L)												132.1232 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (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												3288.7165 (338)

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## 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			250.0000 (367)
Space and Water heating from Heat pump	1220.0398	0.1579	30.6702 (367)
Electrical energy for heat distribution (space & water)	4.8565	0.0000	4.3794 (372)
Overall CO2 factor for heat network			0.0589 (386)
Total CO2 associated with community systems			179.5548 (373)
Space and water heating			179.5548 (376)
Pumps, fans and electric keep-hot	106.4938	0.1387	14.7720 (378)
Energy for lighting	132.1232	0.1443	19.0695 (379)
Total CO2, kg/year			213.3962 (383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.6800 (384)

## 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			250.0000 (467a)
Space and Water heating from Heat pump	1220.0398	1.5844	307.7881 (467)
Electrical energy for heat distribution (space & water)	4.8565	0.0000	46.6974 (472)
Overall CO2 factor for heat network			0.6277 (486)
Total CO2 associated with community systems			1914.5917 (473)
Space and water heating			1914.5917 (476)
Pumps, fans and electric keep-hot	106.4938	1.5128	161.1038 (478)
Energy for lighting	132.1232	1.5338	202.6550 (479)
Total Primary energy kWh/year			2278.3505 (483)
Dwelling Primary energy Rate (DPER)			39.2800 (484)

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	58.0000 (1b)	2.5000 (2b)	145.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	145.0000 (5)

### 2. Ventilation rate

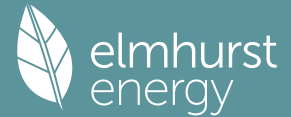
		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	2 * 10 =	20.0000 (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) =	20.0000 / (5) =	0.1379 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3879	(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) =	0.3297 (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	0.4204	0.4122	0.4039	0.3627	0.3545	0.3133	0.3133	0.3050	0.3297	0.3545	0.3710	0.3874 (22b)
Effective ac	0.5884	0.5849	0.5816	0.5658	0.5628	0.5491	0.5491	0.5465	0.5544	0.5628	0.5688	0.5751 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opening Type (Uw = 1.20)			14.5000	1.1450	16.6031		(27)
External Wall 1	46.0000	14.5000	31.5000	0.1800	5.6700		(29a)
Communal Corridor	14.0000		14.0000	0.1800	2.5200		(29a)
Total net area of external elements Aum(A, m2)			60.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	24.7931	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total

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E2 Other lintels (including other steel lintels)	12.0000	0.0500	0.6000	
E3 Sill	12.0000	0.0500	0.6000	
E4 Jamb	15.0000	0.0500	0.7500	
E7 Party floor between dwellings (in blocks of flats)	26.0000	0.0700	1.8200	
E16 Corner (normal)	2.5000	0.0900	0.2250	
E18 Party wall between dwellings	5.0000	0.0600	0.3000	
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0900	-0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				4.2950 (36)
Point Thermal bridges				0.0000 (36a) =
Total fabric heat loss				29.0881 (37) (33) + (36) + (36a) =

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	28.1538	27.9896	27.8287	27.0726	26.9312	26.2727	26.2727	26.1508	26.5264	26.9312	27.2173	27.5165 (38)
Average = Sum(39)m / 12 =	57.2419	57.0777	56.9167	56.1607	56.0192	55.3608	55.3608	55.2388	55.6144	56.0192	56.3054	56.6045 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9869	0.9841	0.9813	0.9683	0.9658	0.9545	0.9545	0.9524	0.9589	0.9658	0.9708	0.9759 (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 1.9246 (42)

Hot water usage for mixer showers

Hot water usage for mixer showers	56.4881	55.6392	54.4021	52.0353	50.2887	48.3408	47.2337	48.4613	49.8071	51.8985	54.3161	56.2716 (42a)
Hot water usage for baths	24.4149	24.0524	23.5417	22.6003	21.8953	21.1136	20.6914	21.1984	21.7505	22.5869	23.5478	24.3324 (42b)
Hot water usage for other uses	34.3394	33.0907	31.8420	30.5933	29.3446	28.0959	28.0959	29.3446	30.5933	31.8420	33.0907	34.3394 (42c)
Average daily hot water use (litres/day)												105.9343 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	115.2424	112.7822	109.7859	105.2289	101.5286	97.5503	96.0209	99.0043	102.1508	106.3274	110.9546	114.9435 (44)
Energy content (annual)	182.5158	160.6004	168.7368	144.0531	136.6770	119.9495	116.1290	122.5880	125.9622	144.2853	158.0752	179.9737 (45)
Distribution loss (46)m = 0.15 x (45)m	27.3774	24.0901	25.3105	21.6080	20.5015	17.9924	17.4193	18.3882	18.8943	21.6428	23.7113	26.9961 (46)
Water storage loss:												150.0000 (47)
Store volume												1.3938 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.7527 (55)
Enter (49) or (54) in (55)												
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (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	229.1107	202.6861	215.3317	189.1449	183.2719	165.0413	162.7239	169.1829	171.0540	190.8802	203.1670	226.5686 (62)
WWHRS	-25.8240	-22.8389	-23.9156	-19.8031	-18.4558	-15.7927	-14.8032	-15.7417	-16.3398	-19.2628	-21.8224	-25.3458 (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	203.2868	179.8472	191.4161	169.3418	164.8161	149.2486	147.9207	153.4412	154.7143	171.6174	181.3446	201.2228 (64)
Total per year (kWh/year)												2068.2176 (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	97.9624	87.0682	93.3809	83.9711	82.7210	75.9567	75.8888	78.0364	77.9559	85.2508	88.6335	97.1172 (65)

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

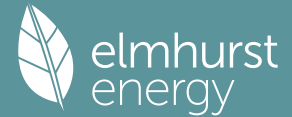
Metabolic gains (Table 5), Watts

(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	84.6743	93.7465	84.6743	87.4967	84.6743	87.4967	84.6743	84.6743	87.4967	84.6743	87.4967	84.6743 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	167.8762	169.6182	165.2284	155.8829	144.0859	132.9984	125.5912	123.8492	128.2391	137.5845	149.3815	160.4691 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823 (71)
Water heating gains (Table 5)	131.6699	129.5658	125.5120	116.6266	111.1842	105.4954	102.0011	104.8877	108.2721	114.5844	123.1020	130.5338 (72)
Total internal gains	439.0888	447.7989	430.2830	414.8746	394.8127	377.8589	364.1350	365.2795	375.8763	391.7116	414.8487	430.5455 (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		5.8600	10.6334	0.6300	0.7000	0.7700	19.0433 (74)
East		8.6400	19.6403	0.6300	0.7000	0.7700	51.8600 (76)
Solar gains	70.9033	137.8419	228.9125	342.9961	432.4287	448.9368	424.7686 (83)
Total gains	509.9921	585.6408	659.1955	757.8707	827.2414	826.7957	788.9035 (84)

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## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	28.1457	28.2266	28.3065	28.6875	28.7600	29.1020	29.1020	29.1663	28.9693	28.7600	28.6138	28.4626
alpha	2.8764	2.8818	2.8871	2.9125	2.9173	2.9401	2.9401	2.9444	2.9313	2.9173	2.9076	2.8975
util living area	0.9161	0.8801	0.8194	0.7025	0.5574	0.4075	0.3020	0.3415	0.5348	0.7622	0.8798	0.9235 (86)
MIT	19.1787	19.4948	19.9353	20.4480	20.7753	20.9345	20.9797	20.9708	20.8530	20.4020	19.7251	19.1319 (87)
Th 2	20.0942	20.0966	20.0989	20.1098	20.1119	20.1214	20.1214	20.1232	20.1178	20.1119	20.1078	20.1034 (88)
util rest of house	0.9058	0.8661	0.7990	0.6719	0.5163	0.3570	0.2440	0.2800	0.4797	0.7291	0.8635	0.9141 (89)
MIT 2	17.9800	18.3727	18.9140	19.5305	19.8992	20.0704	20.1097	20.1054	19.9945	19.4955	18.6740	17.9277 (90)
Living area fraction									fLA = Living area / (4) =			0.4310 (91)
MIT	18.4967	18.8563	19.3542	19.9259	20.2768	20.4428	20.4847	20.4784	20.3646	19.8862	19.1271	18.4468 (92)
Temperature adjustment												0.0000
adjusted MIT	18.4967	18.8563	19.3542	19.9259	20.2768	20.4428	20.4847	20.4784	20.3646	19.8862	19.1271	18.4468 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8833	0.8434	0.7801	0.6652	0.5242	0.3758	0.2682	0.3052	0.4956	0.7199	0.8423	0.8923 (94)
Useful gains	450.4858	493.9568	514.2285	504.1176	433.6161	310.6745	211.6157	220.1991	319.4482	399.8162	423.6887	436.3775 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	14.6000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	812.6454	796.5957	731.6178	619.2244	480.4667	323.4642	215.0619	225.2850	348.4002	520.2065	677.1902	806.4327 (97)
Space heating kWh	269.4468	203.3733	161.7376	82.8768	34.8568	0.0000	0.0000	0.0000	0.0000	89.5704	182.5211	275.3210 (98a)
Space heating requirement - total per year (kWh/year)												1299.7038
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	269.4468	203.3733	161.7376	82.8768	34.8568	0.0000	0.0000	0.0000	0.0000	89.5704	182.5211	275.3210 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1299.7038
Space heating per m2												(98c) / (4) = 22.4087 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	269.4468	203.3733	161.7376	82.8768	34.8568	0.0000	0.0000	0.0000	0.0000	89.5704	182.5211	275.3210 (98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)
Space heating fuel (main heating system)	291.9250	220.3395	175.2304	89.7907	37.7647	0.0000	0.0000	0.0000	0.0000	97.0426	197.7477	298.2893 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	203.2868	179.8472	191.4161	169.3418	164.8161	149.2486	147.9207	153.4412	154.7143	171.6174	181.3446	201.2228 (64)
Efficiency of water heater												79.8000 (216)
(217)m	84.6925	84.3362	83.6844	82.5491	81.2373	79.8000	79.8000	79.8000	79.8000	82.6735	84.0743	84.7633 (217)
Fuel for water heating, kWh/month	240.0292	213.2503	228.7358	205.1406	202.8822	187.0283	185.3643	192.2823	193.8775	207.5846	215.6957	237.3937 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	17.5936	14.1143	12.7083	9.3107	7.1918	5.8758	6.5606	8.5278	11.0767	14.5332	16.4153	18.0826 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-3.2584	-5.1686	-8.3470	-10.5826	-12.5294	-12.1194	-11.9749	-10.7318	-8.7766	-6.3936	-3.7805	-2.7543 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-0.4340	-0.9619	-2.0083	-3.1660	-4.3394	-4.4165	-4.3632	-3.6214	-2.5626	-1.4205	-0.5931	-0.3396 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1408.1298 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												79.8000
Water heating fuel used												2509.2646 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												141.9908 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-124.6433 (233)
Wind generation												0.0000 (234)

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Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	4020.7419 (238)

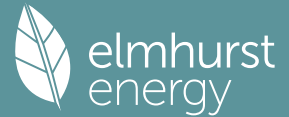
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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
 -----

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1408.1298	0.2100	295.7073 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2509.2646	0.2100	526.9456 (264)
Space and water heating			822.6528 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	141.9908	0.1443	20.4937 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-96.4170	0.1322	-12.7480
PV Unit electricity exported	-28.2262	0.1245	-3.5148
Total			-16.2628 (269)
Total CO2, kg/year			838.8130 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.4600 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1408.1298	1.1300	1591.1867 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2509.2646	1.1300	2835.4689 (278)
Space and water heating			4426.6557 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	141.9908	1.5338	217.7902 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-96.4170	1.4885	-143.5180
PV Unit electricity exported	-28.2262	0.4570	-12.8999
Total			-156.4179 (283)
Total Primary energy kWh/year			4618.1287 (286)
Target Primary Energy Rate (TPER)			79.6200 (287)

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Property Reference	3A RE Ambient		Issued on Date	20/11/2023	
Assessment Reference	L23, 3A RE Ambient	Prop Type Ref	FF MT		
Property	FF MT				
SAP Rating	88 B	DER	2.89	TER	11.94
Environmental	97 A	% DER < TER			75.80
CO <sub>2</sub> Emissions (t/year)	0.24	DFEE	23.93	TFEE	28.33
Compliance Check	See BREL	% DFEE < TFEE			15.51
% DPER < TPER	52.83	DPER	30.92	TPER	65.56
Assessor Details	Mr. Jonathan Lewis			Assessor ID	AZ32-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	87.0000 (1b)	2.5000 (2b)	217.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	217.5000 (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	2.5000	(17)
Infiltration rate	0.1250	(18)
Number of sides sheltered	2	(19)

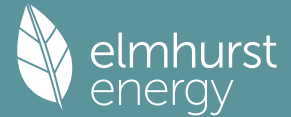
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1062 (21)

	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	0.1355	0.1328	0.1302	0.1169	0.1142	0.1009	0.1009	0.0983	0.1062	0.1142	0.1195	0.1248 (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)												81.9000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2260	0.2233	0.2207	0.2074	0.2047	0.1914	0.1914	0.1888	0.1967	0.2047	0.2100	0.2153 (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
Window (Uw = 1.00)			21.0000	0.9615	20.1923		(27)
External Wall 1	49.0000	21.0000	28.0000	0.1800	5.0400		(29a)
Communal Corridor	20.0000		20.0000	0.1600	3.2000		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			69.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	28.4323	(33)
Party Floor 1			87.0000				(32d)
Party Ceiling 1			87.0000				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				13.0000	0.0560	0.7280	
E3 Sill				13.0000	0.0410	0.5330	
E4 Jamb				17.0000	0.0470	0.7990	
E7 Party floor between dwellings (in blocks of flats)				34.0000	0.0490	1.6660	

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E16 Corner (normal)	2.5000	0.0320	0.0800	
E18 Party wall between dwellings	5.0000	0.0400	0.2000	
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0310	-0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				4.0060 (36)
Point Thermal bridges				0.0000
Total fabric heat loss				(33) + (36) + (36a) = 32.4383 (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	16.2189	16.0283	15.8376	14.8843	14.6937	13.7404	13.7404	13.5498	14.1217	14.6937	15.0750	15.4563 (38)
Average = Sum(39)m / 12 =	48.6572	48.4666	48.2759	47.3226	47.1320	46.1787	46.1787	45.9881	46.5600	47.1320	47.5133	47.8946 (39)
HLP	0.5593	0.5571	0.5549	0.5439	0.5417	0.5308	0.5308	0.5286	0.5352	0.5417	0.5461	0.5505 (40)
HLP (average)												0.5434
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													2.5824 (42)
Hot water usage for mixer showers	75.9577	74.8162	73.1528	69.9702	67.6216	65.0023	63.5136	65.1644	66.9740	69.7862	73.0371	75.6667	75.6667 (42a)
Hot water usage for baths	30.6928	30.2370	29.5951	28.4115	27.5253	26.5426	26.0118	26.6492	27.3432	28.3947	29.6027	30.5890	30.5890 (42b)
Hot water usage for other uses	43.2382	41.6659	40.0936	38.5213	36.9490	35.3767	35.3767	36.9490	38.5213	40.0936	41.6659	43.2382	43.2382 (42c)
Average daily hot water use (litres/day)													137.7949 (43)
Daily hot water use	149.8887	146.7190	142.8414	136.9030	132.0958	126.9216	124.9020	128.7625	132.8384	138.2745	144.3057	149.4939	149.4939 (44)
Energy conte	237.3870	208.9259	219.5420	187.4134	177.8263	156.0649	151.0582	159.4349	163.8031	187.6372	205.5899	234.0713	234.0713 (45)
Energy content (annual)													Total = Sum(45)m = 2288.7540
Distribution loss (46)m = 0.15 x (45)m	35.6080	31.3389	32.9313	28.1120	26.6740	23.4097	22.6587	23.9152	24.5705	28.1456	30.8385	35.1107	35.1107 (46)
Water storage loss:													150.0000 (47)
Store volume													1.6000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.6000 (49)
Temperature factor from Table 2b													0.9600 (55)
Enter (49) or (54) in (55)													0.9600 (55)
Total storage loss	29.7600	26.8800	29.7600	28.8000	29.7600	28.8000	29.7600	29.7600	28.8000	29.7600	28.8000	29.7600	29.7600 (56)
If cylinder contains dedicated solar storage	29.7600	26.8800	29.7600	28.8000	29.7600	28.8000	29.7600	29.7600	28.8000	29.7600	28.8000	29.7600	29.7600 (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	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	0.0000 (61)
Total heat required for water heating calculated for each month	290.4094	256.8171	272.5644	238.7254	230.8487	207.3769	204.0806	212.4573	215.1151	240.6596	256.9019	287.0937	287.0937 (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	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	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	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	0.0000 (63d)
Output from w/h	290.4094	256.8171	272.5644	238.7254	230.8487	207.3769	204.0806	212.4573	215.1151	240.6596	256.9019	287.0937	287.0937 (64)
12Total per year (kWh/year)													Total per year (kWh/year) = Sum(64)m = 2913.0500 (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	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	121.3491	107.7808	115.4156	103.3645	101.5452	92.9412	92.6448	95.4300	95.5141	104.8073	109.4082	120.2466	120.2466 (65)

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

Metabolic gains (Table 5), Watts													
(66)m	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	117.7482	130.3641	117.7482	121.6731	117.7482	121.6731	117.7482	117.7482	121.6731	117.7482	121.6731	117.7482	117.7482 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	233.4490	235.8715	229.7669	216.7711	200.3661	184.9478	174.6474	172.2249	178.3295	191.3253	207.7303	223.1486	223.1486 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120 (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	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956 (71)
Water heating gains (Table 5)	163.1036	160.3881	155.1285	143.5619	136.4855	129.0850	124.5225	128.2662	132.6585	140.8700	151.9559	161.6218	161.6218 (72)
Total internal gains	576.0367	588.3596	564.3795	543.7419	516.3356	497.4418	478.6540	479.9752	494.3970	511.6794	543.0952	564.2545	564.2545 (73)

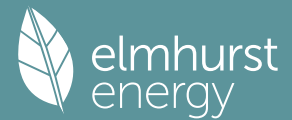
## 6. Solar gains

[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
North		9.0000	10.6334	0.6300	0.7000	0.7700	29.2473 (74)
West		12.0000	19.6403	0.6300	0.7000	0.7700	72.0278 (80)
Solar gains	101.2752	196.7949	327.0212	490.9799	620.2581	644.5729	609.6088
Total gains	677.3118	785.1544	891.4007	1034.7218	1136.5937	1142.0146	1088.2628
							510.1681
							384.0701
							233.7253
							745.4047
							668.9858
							83.6142 (83)
							647.8687 (84)

## 7. Mean internal temperature (heating season)



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	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	49.6672	49.8626	50.0595	51.0679	51.2744	52.3329	52.3329	52.5498	51.9043	51.2744	50.8630	50.4580		
alpha	4.3111	4.3242	4.3373	4.4045	4.4183	4.4889	4.4889	4.5033	4.4603	4.4183	4.3909	4.3639		
util living area	0.8775	0.8097	0.7037	0.5344	0.3821	0.2583	0.1866	0.2135	0.3631	0.6182	0.8092	0.8899	(86)	
MIT	20.3568	20.5734	20.7854	20.9416	20.9881	20.9985	20.9997	20.9995	20.9931	20.9128	20.6470	20.3252	(87)	
Th 2	20.4668	20.4688	20.4708	20.4807	20.4827	20.4927	20.4927	20.4947	20.4887	20.4827	20.4787	20.4747	(88)	
util rest of house	0.8670	0.7957	0.6857	0.5140	0.3615	0.2380	0.1651	0.1901	0.3368	0.5930	0.7931	0.8803	(89)	
MIT 2	19.7128	19.9774	20.2312	20.4190	20.4711	20.4914	20.4925	20.4944	20.4827	20.3922	20.0790	19.6806	(90)	
Living area fraction									fLA = Living area / (4) =				0.2874	(91)
MITA	19.8978	20.1486	20.3904	20.5692	20.6196	20.6371	20.6383	20.6395	20.6294	20.5418	20.2423	19.8659	(92)	
Temperature adjustment												0.0000		
adjusted MIT	19.8978	20.1486	20.3904	20.5692	20.6196	20.6371	20.6383	20.6395	20.6294	20.5418	20.2423	19.8659	(93)	

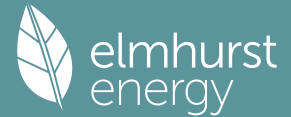
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8548	0.7868	0.6829	0.5175	0.3670	0.2438	0.1713	0.1968	0.3441	0.5960	0.7854	0.8680	(94)
Useful gains	578.9765	617.7696	608.7009	535.4499	417.1151	278.4111	186.4257	194.8634	302.2523	444.2314	525.4162	562.3363	(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	758.9473	739.0489	670.5722	552.2166	420.4008	278.7869	186.4820	194.9673	304.0072	468.5775	624.4320	750.3100	(97)
Space heating kWh	133.8982	81.4997	46.0322	12.0720	2.4446	0.0000	0.0000	0.0000	0.0000	18.1135	71.2914	139.8524	(98a)
Space heating requirement - total per year (kWh/year)												505.2041	
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	133.8982	81.4997	46.0322	12.0720	2.4446	0.0000	0.0000	0.0000	0.0000	18.1135	71.2914	139.8524	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												505.2041	
Space heating per m2										(98c) / (4) =		5.8069	(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													1.0100	(306)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating:														
Space heating requirement	133.8982	81.4997	46.0322	12.0720	2.4446	0.0000	0.0000	0.0000	0.0000	18.1135	71.2914	139.8524	(98)	
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.01														
307a	135.2372	82.3147	46.4925	12.1927	2.4690	0.0000	0.0000	0.0000	0.0000	18.2947	72.0043	141.2509		
Space heating requirement	135.2372	82.3147	46.4925	12.1927	2.4690	0.0000	0.0000	0.0000	0.0000	18.2947	72.0043	141.2509	(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	290.4094	256.8171	272.5644	238.7254	230.8487	207.3769	204.0806	212.4573	215.1151	240.6596	256.9019	287.0937	(64)	
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.01														
310a	293.3135	259.3853	275.2900	241.1126	233.1572	209.4507	206.1214	214.5819	217.2662	243.0662	259.4709	289.9646		
Water heating fuel	293.3135	259.3853	275.2900	241.1126	233.1572	209.4507	206.1214	214.5819	217.2662	243.0662	259.4709	289.9646	(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	13.5670	12.2541	13.5670	13.1294	13.5670	13.1294	13.5670	13.5670	13.1294	13.5670	13.1294	13.5670	(331)	
Lighting	22.7655	18.2633	16.4441	12.0477	9.3060	7.6031	8.4892	11.0346	14.3329	18.8055	21.2407	23.3982	(332)	
Electricity generated by PVs (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	(333a)	
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)	
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)	
Electricity generated by PVs (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	(333b)	
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)	
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)	
Annual totals kWh/year														
Space heating fuel - community heating													510.2561	(307)
Space heating fuel - secondary													0.0000	(309)
Water heating fuel - community heating													2942.1805	(310)
Efficiency of water heater													0.0000	(311)
Electricity used for heat distribution													5.1026	(313)
Space cooling fuel													0.0000	(321)
Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.6020)														
mechanical ventilation fans (SFP = 0.6020)													159.7407	(330a)
Total electricity for the above, kWh/year													159.7407	(331)
Electricity for lighting (calculated in Appendix L)													183.7308	(332)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													0.0000	(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													3795.9082	(338)

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## 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			250.0000 (367)
Space and Water heating from Heat pump	1380.9747	0.1583	32.3126 (367)
Electrical energy for heat distribution (space & water)	5.1026	0.0000	4.9552 (372)
Overall CO2 factor for heat network			0.0588 (386)
Total CO2 associated with community systems			203.1644 (373)
Space and water heating			203.1644 (376)
Pumps, fans and electric keep-hot	159.7407	0.1387	22.1580 (378)
Energy for lighting	183.7308	0.1443	26.5180 (379)
Total CO2, kg/year			251.8405 (383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.8900 (384)

## 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			250.0000 (467a)
Space and Water heating from Heat pump	1380.9747	1.5860	323.7073 (467)
Electrical energy for heat distribution (space & water)	5.1026	0.0000	52.8502 (472)
Overall CO2 factor for heat network			0.6276 (486)
Total CO2 associated with community systems			2166.8591 (473)
Space and water heating			2166.8591 (476)
Pumps, fans and electric keep-hot	159.7407	1.5128	241.6557 (478)
Energy for lighting	183.7308	1.5338	281.8124 (479)
Total Primary energy kWh/year			2690.3273 (483)
Dwelling Primary energy Rate (DPER)			30.9200 (484)

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	87.0000 (1b)	2.5000 (2b)	217.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	217.5000 (5)

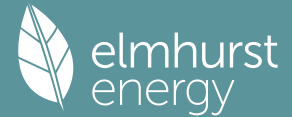
### 2. Ventilation rate

		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	3 * 10 =	30.0000 (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) =	30.0000 / (5) =	0.1379 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3879	(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) =	0.3297 (21)
Wind speed	Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 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	0.4204 0.4122 0.4039 0.3627 0.3545 0.3133 0.3133 0.3050 0.3297 0.3545 0.3710 0.3874	(22b)
Effective ac	0.5884 0.5849 0.5816 0.5658 0.5628 0.5491 0.5491 0.5465 0.5544 0.5628 0.5688 0.5751	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opening Type (Uw = 1.20)			21.0000	1.1450	24.0458		(27)
External Wall 1	49.0000	21.0000	28.0000	0.1800	5.0400		(29a)
Communal Corridor	20.0000		20.0000	0.1800	3.6000		(29a)
Total net area of external elements Aum(A, m2)			69.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =		32.6858 (33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total

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E2 Other lintels (including other steel lintels)	13.0000	0.0500	0.6500	
E3 Sill	13.0000	0.0500	0.6500	
E4 Jamb	17.0000	0.0500	0.8500	
E7 Party floor between dwellings (in blocks of flats)	34.0000	0.0700	2.3800	
E16 Corner (normal)	2.5000	0.0900	0.2250	
E18 Party wall between dwellings	5.0000	0.0600	0.3000	
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0900	-0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				5.0550 (36)
Point Thermal bridges				0.0000
Total fabric heat loss				(33) + (36) + (36a) = 37.7408 (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	42.2307	41.9844	41.7430	40.6090	40.3968	39.4091	39.4091	39.2262	39.7895	40.3968	40.8260	41.2747 (38)
Average = Sum(39)m / 12 =	79.9715	79.7252	79.4838	78.3498	78.1376	77.1499	77.1499	76.9670	77.5303	78.1376	78.5668	79.0155 (39)
												78.3487
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9192	0.9164	0.9136	0.9006	0.8981	0.8868	0.8868	0.8847	0.8912	0.8981	0.9031	0.9082 (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													2.5824 (42)
Hot water usage for mixer showers	67.5179	66.5033	65.0247	62.1958	60.1080	57.7799	56.4565	57.9239	59.5324	62.0322	64.9219	67.2593	(42a)
Hot water usage for baths	29.1581	28.7251	28.1153	26.9909	26.1490	25.2154	24.7112	25.3167	25.9760	26.9750	28.1225	29.0596	(42b)
Hot water usage for other uses	41.0763	39.5826	38.0889	36.5952	35.1015	33.6079	33.6079	35.1015	36.5952	38.0889	39.5826	41.0763	(42c)
Average daily hot water use (litres/day)													126.6255 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	137.7524	134.8110	131.2289	125.7819	121.3586	116.6032	114.7755	118.3421	122.1037	127.0961	132.6270	137.3951	(44)
Energy conte	218.1661	191.9690	201.6940	172.1891	163.3720	143.3772	138.8111	146.5323	150.5660	172.4682	188.9515	215.1275	(45)
Energy content (annual)													Total = Sum(45)m = 2103.2239
Distribution loss (46)m = 0.15 x (45)m	32.7249	28.7954	30.2541	25.8284	24.5058	21.5066	20.8217	21.9798	22.5849	25.8702	28.3427	32.2691	(46)
Water storage loss:													150.0000 (47)
Store volume													1.3938 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													0.7527 (55)
Enter (49) or (54) in (55)													
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(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	264.7610	234.0548	248.2889	217.2810	209.9669	188.4690	185.4060	193.1272	195.6579	219.0631	234.0433	261.7224	(62)
WWHRS	-30.8664	-27.2985	-28.5854	-23.6698	-22.0594	-18.8764	-17.6936	-18.8154	-19.5303	-23.0240	-26.0834	-30.2948	(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	233.8946	206.7563	219.7035	193.6111	187.9074	169.5926	167.7123	174.3118	176.1276	196.0390	207.9599	231.4276	(64)
													Total per year (kWh/year) = Sum(64)m = 2365.0438 (64)
													2365 (64)
12Total per year (kWh/year)													
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	109.8161	97.4983	104.3392	93.3264	91.5971	83.7464	83.4306	85.9979	86.1367	94.6216	98.8998	108.8058	(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	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	117.7482	130.3641	117.7482	121.6731	117.7482	121.6731	117.7482	117.7482	121.6731	117.7482	121.6731	117.7482	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	233.4490	235.8715	229.7669	216.7711	200.3661	184.9478	174.6474	172.2249	178.3295	191.3253	207.7303	223.1486	(68)
Pumps, fans	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	(69)
Losses e.g. evaporation (negative values) (Table 5)	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Water heating gains (Table 5)	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	(71)
Total internal gains	147.6023	145.0867	140.2408	129.6199	123.1144	116.3144	112.1379	115.5886	119.6343	127.1795	137.3609	146.2444	(72)
	563.5354	576.0581	552.4918	532.8000	505.9646	484.6712	466.2694	467.2976	481.3728	500.9890	531.5002	551.8771	(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		9.0000	10.6334	0.6300	0.7000	0.7700	29.2473 (74)						
West		12.0000	19.6403	0.6300	0.7000	0.7700	72.0278 (80)						
Solar gains	101.2752	196.7949	327.0212	490.9799	620.2581	644.5729	609.6088	510.1681	384.0701	233.7253	125.8906	83.6142	(83)
Total gains	664.8106	772.8530	879.5130	1023.7799	1126.2227	1129.2441	1075.8782	977.4657	865.4429	734.7142	657.3908	635.4913	(84)

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## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	30.2191	30.3125	30.4045	30.8446	30.9284	31.3243	31.3243	31.3987	31.1706	30.9284	30.7594	30.5847
alpha	3.0146	3.0208	3.0270	3.0563	3.0619	3.0883	3.0883	3.0932	3.0780	3.0619	3.0506	3.0390
util living area	0.9347	0.9012	0.8425	0.7238	0.5732	0.4175	0.3093	0.3521	0.5557	0.7904	0.9030	0.9414 (86)
MIT	19.1807	19.5027	19.9492	20.4688	20.7918	20.9424	20.9828	20.9744	20.8608	20.4044	19.7223	19.1346 (87)
Th 2	20.1512	20.1536	20.1559	20.1670	20.1691	20.1788	20.1788	20.1805	20.1750	20.1691	20.1649	20.1605 (88)
util rest of house	0.9265	0.8895	0.8244	0.6951	0.5338	0.3689	0.2538	0.2927	0.5026	0.7604	0.8895	0.9341 (89)
MIT 2	18.0208	18.4235	18.9753	19.6037	19.9695	20.1330	20.1685	20.1645	20.0560	19.5461	18.7120	17.9692 (90)
Living area fraction									fLA = Living area / (4) =			0.2874 (91)
MIT	18.3541	18.7336	19.2552	19.8523	20.2058	20.3656	20.4025	20.3972	20.2873	19.7928	19.0023	18.3041 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3541	18.7336	19.2552	19.8523	20.2058	20.3656	20.4025	20.3972	20.2873	19.7928	19.0023	18.3041 (93)

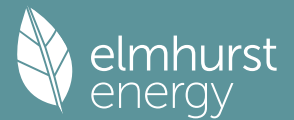
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9045	0.8656	0.8023	0.6835	0.5356	0.3802	0.2691	0.3087	0.5101	0.7452	0.8666	0.9130 (94)
Useful gains	601.3244	668.9987	705.6114	699.7734	603.2295	429.2948	289.4886	301.6996	441.4853	547.5299	569.7235	580.2308 (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	1123.9287	1102.8871	1013.8276	858.1116	664.6234	444.8156	293.3647	307.6538	479.7024	718.3002	935.1255	1114.4395 (97)
Space heating kWh	388.8176	291.5730	229.3128	114.0036	45.6771	0.0000	0.0000	0.0000	0.0000	127.0531	263.0894	397.4512 (98a)
Space heating requirement - total per year (kWh/year)												1856.9779
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	388.8176	291.5730	229.3128	114.0036	45.6771	0.0000	0.0000	0.0000	0.0000	127.0531	263.0894	397.4512 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1856.9779
Space heating per m2												(98c) / (4) = 21.3446 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	388.8176	291.5730	229.3128	114.0036	45.6771	0.0000	0.0000	0.0000	0.0000	127.0531	263.0894	397.4512 (98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)
Space heating fuel (main heating system)	421.2542	315.8971	248.4429	123.5142	49.4877	0.0000	0.0000	0.0000	0.0000	137.6523	285.0373	430.6081 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	233.8946	206.7563	219.7035	193.6111	187.9074	169.5926	167.7123	174.3118	176.1276	196.0390	207.9599	231.4276 (64)
Efficiency of water heater												79.8000 (216)
(217)m	85.1912	84.8305	84.1559	82.9144	81.4135	79.8000	79.8000	79.8000	79.8000	83.1125	84.5882	85.2613 (217)
Fuel for water heating, kWh/month	274.5526	243.7286	261.0671	233.5073	230.8061	212.5221	210.1658	218.4358	220.7113	235.8719	245.8496	271.4333 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	24.4658	19.6273	17.6722	12.9474	10.0010	8.1709	9.1232	11.8587	15.4033	20.2100	22.8271	25.1457 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-4.8556	-7.6837	-12.3782	-15.6515	-18.4885	-17.8637	-17.6463	-15.8325	-12.9763	-9.4849	-5.6264	-4.1061 (233a)
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 (234a)
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 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-0.6829	-1.5120	-3.1547	-4.9714	-6.8146	-6.9402	-6.8608	-5.6973	-4.0325	-2.2362	-0.9340	-0.5348 (233b)
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 (234b)
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 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												2011.8937 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												79.8000
Water heating fuel used												2858.6517 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												197.4526 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-186.9649 (233)
Wind generation												0.0000 (234)

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Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	4967.0331 (238)

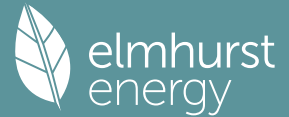
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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2011.8937	0.2100	422.4977 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2858.6517	0.2100	600.3168 (264)
Space and water heating			1022.8145 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	197.4526	0.1443	28.4985 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-142.5936	0.1323	-18.8609
PV Unit electricity exported	-44.3713	0.1245	-5.5250
Total			-24.3859 (269)
Total CO2, kg/year			1038.8564 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.9400 (273)

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 13a. Primary energy - Individual heating systems including micro-CHP  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2011.8937	1.1300	2273.4399 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2858.6517	1.1300	3230.2764 (278)
Space and water heating			5503.7163 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	197.4526	1.5338	302.8594 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-142.5936	1.4887	-212.2812
PV Unit electricity exported	-44.3713	0.4570	-20.2773
Total			-232.5585 (283)
Total Primary energy kWh/year			5704.1180 (286)
Target Primary Energy Rate (TPER)			65.5600 (287)

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Property Reference	1A EE Gas		Issued on Date	20/11/2023	
Assessment Reference	L23, 1a EE Gas	Prop Type Ref	FF MT		
Property	FF MT				
SAP Rating	86 B	DER	13.12	TER	15.53
Environmental	91 B	% DER < TER			15.52
CO <sub>2</sub> Emissions (t/year)	0.64	DFEE	26.82	TFEE	30.44
Compliance Check	See BREL	% DFEE < TFEE			11.91
% DPER < TPER	12.28	DPER	75.00	TPER	85.50
Assessor Details	Mr. Jonathan Lewis			Assessor ID	AZ32-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	52.0000 (1b)	2.5000 (2b)	130.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.0000		130.0000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 130.0000 (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	2.5000	(17)
Infiltration rate	0.1250	(18)
Number of sides sheltered	2	(19)

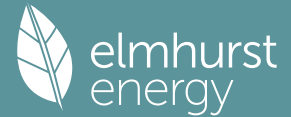
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1062 (21)

	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	0.1355	0.1328	0.1302	0.1169	0.1142	0.1009	0.1009	0.0983	0.1062	0.1142	0.1195	0.1248 (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)												81.9000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2260	0.2233	0.2207	0.2074	0.2047	0.1914	0.1914	0.1888	0.1967	0.2047	0.2100	0.2153 (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
Window (Uw = 1.00)			15.4000	0.9615	14.8077		(27)
External Wall 1	39.0000	15.4000	23.6000	0.1800	4.2480		(29a)
Communal Corridor	17.0000		17.0000	0.1600	2.7200		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			56.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	21.7757	(33)
Party Floor 1			52.0000				(32d)
Party Ceiling 1			52.0000				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				9.0000	0.0560	0.5040	
E3 Sill				9.0000	0.0410	0.3690	
E4 Jamb				18.0000	0.0470	0.8460	
E7 Party floor between dwellings (in blocks of flats)				29.0000	0.0490	1.4210	

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E16 Corner (normal)	5.0000	0.0320	0.1600	
E18 Party wall between dwellings	5.0000	0.0400	0.2000	
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0310	-0.0775	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				3.4225 (36)
Point Thermal bridges				0.0000 (36a) =
Total fabric heat loss				25.1982 (37) (33) + (36) + (36a) =

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	9.6941	9.5801	9.4662	8.8964	8.7824	8.2127	8.2127	8.0987	8.4406	8.7824	9.0103	9.2382 (38)
Average = Sum(39)m / 12 =	34.8923	34.7783	34.6643	34.0946	33.9806	33.4109	33.4109	33.2969	33.6388	33.9806	34.2085	34.4364 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.6710	0.6688	0.6666	0.6557	0.6535	0.6425	0.6425	0.6403	0.6469	0.6535	0.6579	0.6622 (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												1.7491 (42)
Hot water usage for mixer showers	60.2389	59.3336	58.0144	55.4905	53.6278	51.5507	50.3700	51.6792	53.1143	55.3445	57.9227	60.0081 (42a)
Hot water usage for baths	24.3680	24.0061	23.4965	22.5568	21.8532	21.0730	20.6516	21.1577	21.7087	22.5435	23.5025	24.2856 (42b)
Hot water usage for other uses	34.2550	33.0093	31.7637	30.5181	29.2724	28.0268	28.0268	29.2724	30.5181	31.7637	33.0093	34.2550 (42c)
Average daily hot water use (litres/day)												109.2721 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	118.8619	116.3491	113.2746	108.5654	104.7535	100.6505	99.0484	102.1093	105.3410	109.6517	114.4346	118.5487 (44)
Energy content (annual)	188.2482	165.6795	174.0989	148.6206	141.0183	123.7615	119.7904	126.4326	129.8960	148.7964	163.0331	185.6186 (45)
Distribution loss (46)m = 0.15 x (45)m	28.2372	24.8519	26.1148	22.2931	21.1528	18.5642	17.9686	18.9649	19.4844	22.3195	24.4550	27.8428 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	34.2208	30.9057	34.2095	33.0901	34.1831	33.0702	34.1652	34.1714	33.0751	34.1893	33.1016	34.2187 (61)
Total heat required for water heating calculated for each month	222.4690	196.5852	208.3084	181.7107	175.2014	156.8317	153.9556	160.6040	162.9711	182.9857	196.1347	219.8374 (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	222.4690	196.5852	208.3084	181.7107	175.2014	156.8317	153.9556	160.6040	162.9711	182.9857	196.1347	219.8374 (64)
12Total per year (kWh/year)												2217.5948 (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	71.1477	62.8149	66.4403	57.6889	55.4344	49.4183	48.3716	50.5817	51.4592	58.0221	62.4839	70.2729 (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	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535	87.4535 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	76.8814	85.1187	76.8814	79.4441	76.8814	79.4441	76.8814	76.8814	79.4441	76.8814	79.4441	76.8814 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	152.4259	154.0076	150.0218	141.5364	130.8251	120.7580	114.0326	112.4509	116.4367	124.9221	135.6334	145.7005 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628 (71)
Water heating gains (Table 5)	95.6287	93.4745	89.3014	80.1234	74.5086	68.6365	65.0156	67.9861	71.4711	77.9867	86.7832	94.4528 (72)
Total internal gains	377.1720	384.8369	368.4407	353.3400	334.4511	318.0747	305.1656	306.5545	316.5880	332.0263	354.0968	369.2707 (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	4.4000	10.6334	0.6300	0.7000	0.7700	14.2987 (74)
South	2.1000	46.7521	0.6300	0.7000	0.7700	30.0049 (78)
West	8.9000	19.6403	0.6300	0.7000	0.7700	53.4206 (80)

Solar gains	97.7242	180.9679	281.1288	396.3277	481.8000	493.3950	469.5268	404.5025	321.3757	209.5304	119.8146	81.7776 (83)
Total gains	474.8963	565.8048	649.5695	749.6677	816.2511	811.4696	774.6925	711.0569	637.9637	541.5567	473.9113	451.0483 (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

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tau	41.3973	41.5329	41.6695	42.3658	42.5079	43.2328	43.2328	43.3807	42.9399	42.5079	42.2247	41.9452
alpha	3.7598	3.7689	3.7780	3.8244	3.8339	3.8822	3.8822	3.8920	3.8627	3.8339	3.8150	3.7963
util living area	0.8622	0.7862	0.6797	0.5236	0.3809	0.2624	0.1895	0.2150	0.3591	0.6020	0.7936	0.8771 (86)
MIT	20.3071	20.5118	20.7025	20.8483	20.9012	20.9173	20.9198	20.9196	20.9094	20.8223	20.5667	20.2714 (87)
Th 2	20.3665	20.3685	20.3704	20.3802	20.3821	20.3919	20.3919	20.3938	20.3880	20.3821	20.3782	20.3743 (88)
util rest of house	0.8500	0.7699	0.6593	0.5004	0.3567	0.2378	0.1634	0.1868	0.3284	0.5735	0.7752	0.8658 (89)
MIT 2	19.5510	19.7999	20.0273	20.2025	20.2614	20.2873	20.2895	20.2914	20.2763	20.1794	19.8792	19.5141 (90)
Living area fraction									FLA = Living area / (4) = 0.5000 (91)			
MIT	19.9291	20.1559	20.3649	20.5254	20.5813	20.6023	20.6046	20.6055	20.5929	20.5008	20.2230	19.8927 (92)
Temperature adjustment												0.0000
adjusted MIT	19.9291	20.1559	20.3649	20.5254	20.5813	20.6023	20.6046	20.6055	20.5929	20.5008	20.2230	19.8927 (93)

## 8. Space heating requirement

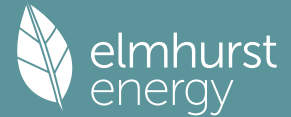
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8408	0.7642	0.6591	0.5059	0.3646	0.2463	0.1726	0.1966	0.3388	0.5791	0.7703	0.8564 (94)
Useful gains	399.2777	432.3783	428.1118	379.2456	297.5645	199.8779	133.6776	139.8283	216.1141	313.6075	365.0664	386.2753 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	545.3328	530.5737	480.6181	396.3623	301.7923	200.5426	133.7988	140.0300	218.4129	336.4362	448.9181	540.4016 (97)
Space heating kWh	108.6650	65.9873	39.0647	12.3240	3.1455	0.0000	0.0000	0.0000	0.0000	16.9845	60.3732	114.6700 (98a)
Space heating requirement - total per year (kWh/year)												421.2142
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	108.6650	65.9873	39.0647	12.3240	3.1455	0.0000	0.0000	0.0000	0.0000	16.9845	60.3732	114.6700 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												421.2142
Space heating per m2												(98c) / (4) = 8.1003 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												83.7000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	108.6650	65.9873	39.0647	12.3240	3.1455	0.0000	0.0000	0.0000	0.0000	16.9845	60.3732	114.6700 (98)
Space heating efficiency (main heating system 1)	83.7000	83.7000	83.7000	83.7000	83.7000	0.0000	0.0000	0.0000	0.0000	83.7000	83.7000	83.7000 (210)
Space heating fuel (main heating system)	129.8267	78.8379	46.6722	14.7240	3.7581	0.0000	0.0000	0.0000	0.0000	20.2921	72.1305	137.0012 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	222.4690	196.5852	208.3084	181.7107	175.2014	156.8317	153.9556	160.6040	162.9711	182.9857	196.1347	219.8374 (64)
Efficiency of water heater (217)m	87.5506	87.4211	87.2641	87.1060	87.0294	87.0000	87.0000	87.0000	87.0000	87.1419	87.3942	87.0000 (216)
Fuel for water heating, kWh/month	254.1032	224.8717	238.7103	208.6086	201.3128	180.2663	176.9605	184.6023	187.3231	209.9860	224.4252	251.0265 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	15.4131	13.9215	15.4131	14.9159	15.4131	14.9159	15.4131	15.4131	14.9159	15.4131	14.9159	15.4131 (231)
Lighting	14.8643	11.9247	10.7369	7.8663	6.0761	4.9643	5.5429	7.2048	9.3584	12.2787	13.8687	15.2774 (232)
Electricity generated by PVs (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 (233a)
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 (234a)
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 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												503.2428 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												87.0000
Water heating fuel used												2542.1964 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.6020)												
mechanical ventilation fans (SFP = 0.6020)												95.4772 (230a)
central heating pump												41.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												181.4772 (231)
Electricity for lighting (calculated in Appendix L)												119.9634 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												



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Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	3346.8798 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	503.2428	0.2100	105.6810 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2542.1964	0.2100	533.8613 (264)
Space and water heating			639.5422 (265)
Pumps, fans and electric keep-hot	181.4772	0.1387	25.1731 (267)
Energy for lighting	119.9634	0.1443	17.3144 (268)
Total CO2, kg/year			682.0298 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			13.1200 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	503.2428	1.1300	568.6643 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2542.1964	1.1300	2872.6820 (278)
Space and water heating			3441.3463 (279)
Pumps, fans and electric keep-hot	181.4772	1.5128	274.5387 (281)
Energy for lighting	119.9634	1.5338	184.0039 (282)
Total Primary energy kWh/year			3899.8889 (286)
Dwelling Primary energy Rate (DPER)			75.0000 (287)

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	52.0000 (1b)	x 2.5000 (2b)	= 130.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.0000		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	130.0000 (5)

### 2. Ventilation rate

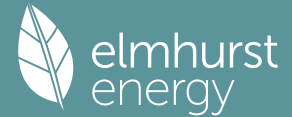
	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1538 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4038 (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) = 0.3433 (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	0.4377	0.4291	0.4205	0.3776	0.3690	0.3261	0.3261	0.3175	0.3433	0.3690	0.3862	0.4033 (22b)
Effective ac	0.5958	0.5921	0.5884	0.5713	0.5681	0.5532	0.5532	0.5504	0.5589	0.5681	0.5746	0.5813 (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
TER Opening Type (U <sub>w</sub> = 1.20)			12.9900	1.1450	14.8740		(27)
External Wall 1	39.0000	12.9900	26.0100	0.1800	4.6818		(29a)
Communal Corridor	17.0000		17.0000	0.1800	3.0600		(29a)
Total net area of external elements A <sub>um</sub> (A, m <sup>2</sup> )			56.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26) ... (30) + (32) =	22.6158	(33)
Thermal mass parameter (TMP = C <sub>m</sub> / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
List of Thermal Bridges							

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K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	9.0000	0.0500	0.4500
E3 Sill	9.0000	0.0500	0.4500
E4 Jamb	18.0000	0.0500	0.9000
E7 Party floor between dwellings (in blocks of flats)	29.0000	0.0700	2.0300
E16 Corner (normal)	5.0000	0.0900	0.4500
E18 Party wall between dwellings	5.0000	0.0600	0.3000
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			4.3550 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	26.9708 (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	25.5588	25.3993	25.2429	24.5083	24.3709	23.7311	23.7311	23.6126	23.9775	24.3709	24.6489	24.9396 (38)
Average = Sum(39)m / 12 =	52.5297	52.3701	52.2137	51.4792	51.3417	50.7019	50.7019	50.5835	50.9484	51.3417	51.6198	51.9104 (39)
HLP	1.0102	1.0071	1.0041	0.9900	0.9873	0.9750	0.9750	0.9728	0.9798	0.9873	0.9927	0.9983 (40)
HLP (average)												0.9900
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy 1.7491 (42)

Hot water usage for mixer showers 53.5457 52.7410 51.5684 49.3249 47.6692 45.8228 44.7733 45.9370 47.2127 49.1951 51.4869 53.3405 (42a)

Hot water usage for baths 23.1496 22.8058 22.3217 21.4290 20.7606 20.0194 19.6190 20.0998 20.6232 21.4163 22.3274 23.0714 (42b)

Hot water usage for other uses 32.5422 31.3589 30.1755 28.9922 27.8088 26.6255 26.6255 27.8088 28.9922 30.1755 31.3589 32.5422 (42c)

Average daily hot water use (litres/day) 100.4145 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	109.2375	106.9057	104.0656	99.7460	96.2386	92.4676	91.0178	93.8456	96.8281	100.7870	105.1731	108.9541 (44)
Energy content (annual)	173.0055	152.2323	159.9449	136.5473	129.5556	113.6997	110.0781	116.2005	119.3987	136.7670	149.8384	170.5958 (45)
Distribution loss (46)m = 0.15 x (45)m	25.9508	22.8348	23.9917	20.4821	19.4333	17.0550	16.5117	17.4301	17.9098	20.5151	22.4758	25.5894 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	50.9589	46.0274	50.9589	49.1898	49.0421	45.6005	46.3817	47.8227	47.7508	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	223.9644	198.2597	210.9038	185.7371	178.5977	159.3002	156.4598	164.0232	167.1496	187.7259	199.1535	221.5547 (62)
WWHRS	-24.4788	-21.6493	-22.6699	-18.7716	-17.4944	-14.9701	-14.0321	-14.9217	-15.4886	-18.2594	-20.6857	-24.0255 (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	199.4856	176.6104	188.2340	166.9656	161.1033	144.3301	142.4277	149.1015	151.6609	169.4665	178.4678	197.5292 (64)
12Total per year (kWh/year)												2025.3825 (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	70.2641	62.1241	65.9214	57.6994	55.3378	49.2053	48.1964	50.5923	51.6378	58.2148	62.1500	69.4628 (65)

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

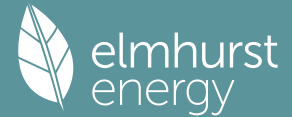
Metabolic gains (Table 5), Watts

(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	76.8814	85.1187	76.8814	79.4441	76.8814	79.4441	76.8814	76.8814	79.4441	76.8814	79.4441	76.8814 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	152.4259	154.0076	150.0218	141.5364	130.8251	120.7580	114.0326	112.4509	116.4367	124.9221	135.6334	145.7005 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454	31.7454 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628	-69.9628 (71)
Water heating gains (Table 5)	94.4410	92.4465	88.6041	80.1381	74.3787	68.3407	64.7801	68.0005	71.7191	78.2456	86.3195	93.3640 (72)
Total internal gains	375.9843	383.8089	367.7433	353.3547	334.3213	317.7789	304.9301	306.5688	316.8360	332.2852	353.6331	368.1820 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b g	Specific data or Table 6c FF	Access factor Table 6d	Gains W						
North	3.7100	10.6334	0.6300	0.7000	0.7700	12.0564 (74)						
South	1.7700	46.7521	0.6300	0.7000	0.7700	25.2898 (78)						
West	7.5100	19.6403	0.6300	0.7000	0.7700	45.0774 (80)						
Solar gains	82.4236	152.6396	237.1323	334.3136	406.4174	416.1997	396.0654	341.2117	271.0847	176.7342	101.0564	68.9730 (83)
Total gains	458.4080	536.4485	604.8756	687.6683	740.7387	733.9785	700.9955	647.7805	587.9207	509.0194	454.6895	437.1550 (84)

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## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	27.4977	27.5815	27.6641	28.0588	28.1339	28.4889	28.4889	28.5557	28.3511	28.1339	27.9824	27.8257
alpha	2.8332	2.8388	2.8443	2.8706	2.8756	2.8993	2.8993	2.9037	2.8901	2.8756	2.8655	2.8550
util living area	0.9172	0.8777	0.8163	0.7039	0.5653	0.4180	0.3103	0.3472	0.5351	0.7594	0.8804	0.9254 (86)
MIT	19.1175	19.4638	19.9124	20.4236	20.7560	20.9260	20.9768	20.9675	20.8459	20.3875	19.6843	19.0646 (87)
Th 2	20.0749	20.0774	20.0799	20.0917	20.0939	20.1042	20.1042	20.1061	20.1002	20.0939	20.0894	20.0848 (88)
util rest of house	0.9069	0.8633	0.7955	0.6729	0.5234	0.3656	0.2499	0.2837	0.4791	0.7257	0.8639	0.9160 (89)
MIT 2	17.8912	18.3212	18.8720	19.4876	19.8632	20.0467	20.0908	20.0864	19.9716	19.4644	18.6115	17.8319 (90)
Living area fraction									fLA = Living area / (4) =			0.5000 (91)
MIT	18.5043	18.8925	19.3922	19.9556	20.3096	20.4864	20.5338	20.5270	20.4087	19.9260	19.1479	18.4483 (92)
Temperature adjustment												0.0000
adjusted MIT	18.5043	18.8925	19.3922	19.9556	20.3096	20.4864	20.5338	20.5270	20.4087	19.9260	19.1479	18.4483 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8853	0.8416	0.7780	0.6680	0.5337	0.3883	0.2792	0.3140	0.4989	0.7189	0.8439	0.8951 (94)
Useful gains	405.8179	451.4906	470.6138	459.3610	395.3239	285.0126	195.6928	203.4123	293.2935	365.9161	383.6975	391.2771 (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	746.1480	732.7882	673.1499	569.1334	442.0313	298.4508	199.4515	208.7573	321.4201	478.8108	621.9091	739.6336 (97)
Space heating kWh	253.2056	189.0320	150.6869	79.0362	34.7503	0.0000	0.0000	0.0000	0.0000	83.9937	171.5124	259.1773 (98a)
Space heating requirement - total per year (kWh/year)												1221.3942
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	253.2056	189.0320	150.6869	79.0362	34.7503	0.0000	0.0000	0.0000	0.0000	83.9937	171.5124	259.1773 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1221.3942
Space heating per m2												(98c) / (4) = 23.4884 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.4000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	253.2056	189.0320	150.6869	79.0362	34.7503	0.0000	0.0000	0.0000	0.0000	83.9937	171.5124	259.1773 (98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000 (210)
Space heating fuel (main heating system)	274.0320	204.5801	163.0810	85.5370	37.6086	0.0000	0.0000	0.0000	0.0000	90.9022	185.6195	280.4949 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	199.4856	176.6104	188.2340	166.9656	161.1033	144.3301	142.4277	149.1015	151.6609	169.4665	178.4678	197.5292 (64)
Efficiency of water heater (217)m	84.8935	84.5274	83.9090	82.8758	81.7024	80.3000	80.3000	80.3000	80.3000	82.9595	84.2963	84.9644 (217)
Fuel for water heating, kWh/month	234.9834	208.9386	224.3312	201.4648	197.1832	179.7386	177.3695	185.6805	188.8679	204.2762	211.7149	232.4847 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	15.9744	12.8153	11.5387	8.4538	6.5299	5.3350	5.9568	7.7429	10.0573	13.1957	14.9045	16.4184 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-2.9252	-4.6424	-7.5011	-9.5156	-11.2719	-10.9060	-10.7768	-9.6557	-7.8928	-5.7455	-3.3950	-2.4725 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-0.3851	-0.8539	-1.7829	-2.8107	-3.8518	-3.9192	-3.8711	-3.2126	-2.2734	-1.2602	-0.5262	-0.3013 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1321.8552 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												80.3000
Water heating fuel used												2447.0335 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												128.9228 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-111.7491 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)

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Appendix Q - special features  
 Energy saved or generated  
 Energy used  
 Total delivered energy for all uses

-0.0000 (236)  
 0.0000 (237)  
 3872.0624 (238)

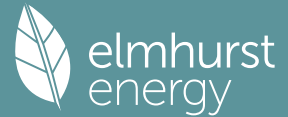
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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1321.8552	0.2100	277.5896 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2447.0335	0.2100	513.8770 (264)
Space and water heating			791.4666 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	128.9228	0.1443	18.6075 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-86.7005	0.1322	-11.4622
PV Unit electricity exported	-25.0487	0.1245	-3.1193
Total			-14.5815 (269)
Total CO2, kg/year			807.4219 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.5300 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1321.8552	1.1300	1493.6964 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2447.0335	1.1300	2765.1479 (278)
Space and water heating			4258.8443 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	128.9228	1.5338	197.7461 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-86.7005	1.4885	-129.0509
PV Unit electricity exported	-25.0487	0.4570	-11.4483
Total			-140.4992 (283)
Total Primary energy kWh/year			4446.1920 (286)
Target Primary Energy Rate (TPER)			85.5000 (287)

# Full SAP Calculation Printout



Property Reference	1B EE Gas		Issued on Date	20/11/2023	
Assessment Reference	L23, 1b EE Gas	Prop Type Ref	FF MT		
Property	FF MT				
SAP Rating	86 B	DER	12.02	TER	14.30
Environmental	92 A	% DER < TER		15.94	
CO <sub>2</sub> Emissions (t/year)	0.59	DFEE	20.35	TFEE	24.44
Compliance Check	See BREL	% DFEE < TFEE		16.72	
% DPER < TPER	12.37	DPER	69.15	TPER	78.91
Assessor Details	Mr. Jonathan Lewis			Assessor ID	AZ32-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	51.0000 (1b)	2.5000 (2b)	127.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	51.0000		127.5000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 127.5000 (5)

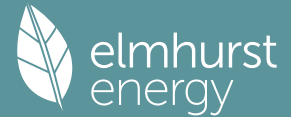
### 2. Ventilation rate

	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	2.5000	(17)
Infiltration rate	0.1250	(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) =	0.1062 (21)
Wind speed	Jan: 5.1000, Feb: 5.0000, Mar: 4.9000, Apr: 4.4000, May: 4.3000, Jun: 3.8000, Jul: 3.8000, Aug: 3.7000, Sep: 4.0000, Oct: 4.3000, Nov: 4.5000, Dec: 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	0.1355, 0.1328, 0.1302, 0.1169, 0.1142, 0.1009, 0.1009, 0.0983, 0.1062, 0.1142, 0.1195, 0.1248	(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) =		81.9000 (23c)
Effective ac	0.2260, 0.2233, 0.2207, 0.2074, 0.2047, 0.1914, 0.1914, 0.1888, 0.1967, 0.2047, 0.2100, 0.2153	(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
Window (Uw = 1.00)			11.8000	0.9615	11.3462		(27)
External Wall 1	16.5000	11.8000	4.7000	0.1800	0.8460		(29a)
Communal Corridor	16.5000		16.5000	0.1600	2.6400		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			33.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 14.8322		(33)
Party Floor 1			52.0000				(32d)
Party Ceiling 1			52.0000				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				6.0000	0.0560	0.3360	
E3 Sill				6.0000	0.0410	0.2460	
E4 Jamb				9.0000	0.0470	0.4230	
E7 Party floor between dwellings (in blocks of flats)				8.0000	0.0490	0.3920	

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E16 Corner (normal)	0.0000	0.0320	0.0000
E18 Party wall between dwellings	5.0000	0.0400	0.2000
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0310	-0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			1.5970 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss		(33) + (36) + (36a) =	16.4292 (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	9.5076	9.3959	9.2841	8.7253	8.6135	8.0547	8.0547	7.9430	8.2783	8.6135	8.8371	9.0606 (38)
Average = Sum(39)m / 12 =	25.9368	25.8250	25.7133	25.1545	25.0427	24.4839	24.4839	24.3721	24.7074	25.0427	25.2662	25.4897 (39)
												25.1265

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.5086	0.5064	0.5042	0.4932	0.4910	0.4801	0.4801	0.4779	0.4845	0.4910	0.4954	0.4998 (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												1.7196 (42)	
Hot water usage for mixer showers													59.4538 (42a)
Hot water usage for baths													24.0625 (42b)
Hot water usage for other uses													33.9370 (42c)
Average daily hot water use (litres/day)													108.2624 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	117.7635	115.2740	112.2280	107.5622	103.7856	99.7205	98.1332	101.1657	104.3676	108.6385	113.3771	117.4532 (44)	
Energy content (annual)	186.5086	164.1486	172.4902	147.2473	139.7153	122.6179	118.6835	125.2643	128.6957	147.4214	161.5265	183.9034 (45)	
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 1798.2228
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	34.2194	30.9044	34.2082	33.0890	34.1820	33.0690	34.1634	34.1705	33.0742	34.1882	33.1004	34.2174 (61)	
Total heat required for water heating calculated for each month	220.7281	195.0530	206.6984	180.3363	173.8973	155.6870	152.8470	159.4347	161.7698	181.6096	194.6269	218.1207 (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	220.7281	195.0530	206.6984	180.3363	173.8973	155.6870	152.8470	159.4347	161.7698	181.6096	194.6269	218.1207 (64)	
12Total per year (kWh/year)													Total per year (kWh/year) = Sum(64)m = 2200.8089 (64)
Electric shower(s)													2201 (64)
Heat gains from water heating, kWh/month	70.5690	62.3055	65.9051	57.2320	55.0008	49.0377	48.0031	50.1930	51.0598	57.5647	61.9827	69.7022 (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	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.5724	83.6695	75.5724	78.0915	75.5724	78.0915	75.5724	75.5724	78.0915	75.5724	78.0915	75.5724 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	149.8308	151.3856	147.4676	139.1267	128.5978	118.7021	112.0911	110.5364	114.4543	122.7953	133.3242	143.2199 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828 (71)
Water heating gains (Table 5)	94.8508	92.7165	88.5821	79.4888	73.9259	68.1079	64.5203	67.4637	70.9165	77.3719	86.0870	93.6858 (72)
Total internal gains	372.0476	379.5652	363.4156	348.5006	329.8896	313.6951	300.9775	302.3660	312.2559	327.5331	349.2963	364.2716 (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						
West		11.8000	19.6403	0.6300	0.7000	0.7700	70.8274 (80)					
Solar gains	70.8274	138.5534	228.1777	332.7835	407.8387	417.4955	397.4727	341.4232	265.3801	164.4052	88.3134	58.2450 (83)
Total gains	442.8749	518.1185	591.5933	681.2841	737.7283	731.1906	698.4502	643.7892	577.6359	491.9384	437.6097	422.5166 (84)

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

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.6200	54.8563	55.0948	56.3187	56.5701	57.8612	57.8612	58.1265	57.3377	56.5701	56.0696	55.5779	
alpha	4.6413	4.6571	4.6730	4.7546	4.7713	4.8574	4.8574	4.8751	4.8225	4.7713	4.7380	4.7052	

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util living area	0.8135	0.7226	0.6012	0.4413	0.3148	0.2142	0.1542	0.1741	0.2946	0.5171	0.7246	0.8302 (86)
MIT	20.6523	20.7738	20.8673	20.9206	20.9326	20.9360	20.9362	20.9364	20.9345	20.9116	20.8024	20.6344 (87)
Th 2	20.5130	20.5150	20.5170	20.5270	20.5291	20.5391	20.5391	20.5411	20.5351	20.5291	20.5250	20.5210 (88)
util rest of house												
MIT 2	0.8008	0.7074	0.5842	0.4249	0.2990	0.1988	0.1381	0.1568	0.2749	0.4956	0.7072	0.8183 (89)
Living area fraction	20.1015	20.2479	20.3587	20.4285	20.4433	20.4571	20.4573	20.4596	20.4516	20.4217	20.2934	20.0875 (90)
MIT	20.3715	20.5057	20.6080	20.6697	20.6832	20.6918	20.6921	20.6933	20.6883	20.6618	20.5429	20.3556 (92)
Temperature adjustment												0.0000
adjusted MIT	20.3715	20.5057	20.6080	20.6697	20.6832	20.6918	20.6921	20.6933	20.6883	20.6618	20.5429	20.3556 (93)

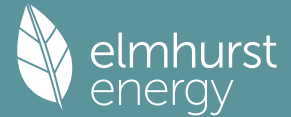
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7969	0.7071	0.5875	0.4299	0.3042	0.2039	0.1434	0.1625	0.2814	0.5017	0.7079	0.8140 (94)
Useful gains	352.9447	366.3850	347.5390	292.8507	224.4213	149.0995	100.1828	104.6250	162.5195	246.8175	309.7893	343.9133 (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												
416.8440	403.0170	362.7637	296.0604	224.9628	149.1521	100.1896	104.6375	162.7798	251.9758	339.6508	411.8019 (97)	
Space heating kWh	47.5411	24.6167	11.3271	2.3109	0.4029	0.0000	0.0000	0.0000	0.0000	3.8378	21.5003	50.5092 (98a)
Space heating requirement - total per year (kWh/year)												162.0460
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	47.5411	24.6167	11.3271	2.3109	0.4029	0.0000	0.0000	0.0000	0.0000	3.8378	21.5003	50.5092 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												162.0460
Space heating per m2										(98c) / (4) =		3.1774 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												83.7000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	47.5411	24.6167	11.3271	2.3109	0.4029	0.0000	0.0000	0.0000	0.0000	3.8378	21.5003	50.5092 (98)
Space heating efficiency (main heating system 1)	83.7000	83.7000	83.7000	83.7000	83.7000	0.0000	0.0000	0.0000	0.0000	83.7000	83.7000	83.7000 (210)
Space heating fuel (main heating system)	56.7994	29.4106	13.5330	2.7610	0.4813	0.0000	0.0000	0.0000	0.0000	4.5852	25.6873	60.3455 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	220.7281	195.0530	206.6984	180.3363	173.8973	155.6870	152.8470	159.4347	161.7698	181.6096	194.6269	218.1207 (64)
Efficiency of water heater (217)m	87.2965	87.1873	87.0867	87.0211	87.0039	87.0000	87.0000	87.0000	87.0000	87.0345	87.1662	87.0000 (216)
Fuel for water heating, kWh/month	252.8487	223.7174	237.3479	207.2328	199.8731	178.9505	175.6862	183.2583	185.9423	208.6638	223.2826	249.8100 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	15.2572	13.7807	15.2572	14.7650	15.2572	14.7650	15.2572	15.2572	14.7650	15.2572	14.7650	15.2572 (231)
Lighting	14.6112	11.7217	10.5541	7.7324	5.9727	4.8797	5.4485	7.0822	9.1990	12.0696	13.6326	15.0173 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												193.6033 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												87.0000
Water heating fuel used												2526.6137 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.6020)												
mechanical ventilation fans (SFP = 0.6020)												93.6411 (230a)
central heating pump												41.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												179.6411 (231)
Electricity for lighting (calculated in Appendix L)												117.9210 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)
Energy used												0.0000 (237)

# Full SAP Calculation Printout



Total delivered energy for all uses

3017.7791 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	193.6033	0.2100	40.6567 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2526.6137	0.2100	530.5889 (264)
Space and water heating			571.2456 (265)
Pumps, fans and electric keep-hot	179.6411	0.1387	24.9184 (267)
Energy for lighting	117.9210	0.1443	17.0196 (268)
Total CO2, kg/year			613.1837 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.0200 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	193.6033	1.1300	218.7717 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2526.6137	1.1300	2855.0735 (278)
Space and water heating			3073.8452 (279)
Pumps, fans and electric keep-hot	179.6411	1.5128	271.7611 (281)
Energy for lighting	117.9210	1.5338	180.8711 (282)
Total Primary energy kWh/year			3526.4774 (286)
Dwelling Primary energy Rate (DPER)			69.1500 (287)

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF TARGET EMISSIONS  
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-----  
 1. Overall dwelling characteristics  
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	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	51.0000 (1b)	x 2.5000 (2b)	= 127.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	51.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	127.5000 (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	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1569 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4069 (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) = 0.3458 (21)

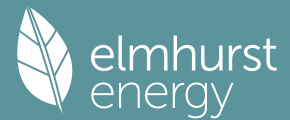
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4409	0.4323	0.4236	0.3804	0.3718	0.3285	0.3285	0.3199	0.3458	0.3718	0.3891	0.4064 (22b)
Effective ac	0.5972	0.5934	0.5897	0.5724	0.5691	0.5540	0.5540	0.5512	0.5598	0.5691	0.5757	0.5826 (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
TER Opening Type (Uw = 1.20)							(27)
External Wall 1	16.5000	11.8000	11.8000	1.1450	13.5115	0.8460	(29a)
Communal Corridor	16.5000		16.5000	0.1800	2.9700		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			33.0000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	17.3275		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				6.0000	0.0500	0.3000	



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E3 Sill	6.0000	0.0500	0.3000	
E4 Jamb	9.0000	0.0500	0.4500	
E7 Party floor between dwellings (in blocks of flats)	8.0000	0.0700	0.5600	
E16 Corner (normal)	0.0000	0.0900	0.0000	
E18 Party wall between dwellings	5.0000	0.0600	0.3000	
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0900	-0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				1.9100 (36)
Point Thermal bridges				0.0000
Total fabric heat loss		(33) + (36) + (36a) =		19.2375 (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	25.1277	24.9689	24.8132	24.0820	23.9452	23.3083	23.3083	23.1903	23.5536	23.9452	24.2219	24.5113 (38)
Average = Sum(39)m / 12 =	44.3652	44.2064	44.0507	43.3194	43.1826	42.5457	42.5457	42.4278	42.7910	43.1826	43.4594	43.7487 (39)
												43.3188
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8699	0.8668	0.8637	0.8494	0.8467	0.8342	0.8342	0.8319	0.8390	0.8467	0.8521	0.8578 (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													1.7196 (42)
Hot water usage for mixer showers	53.0510	52.2538	51.0920	48.8692	47.2288	45.3995	44.3597	45.5127	46.7765	48.7407	51.0112	52.8478 (42a)	
Hot water usage for baths	22.9369	22.5963	22.1166	21.2321	20.5698	19.8354	19.4388	19.9151	20.4338	21.2196	22.1223	22.8594 (42b)	
Hot water usage for other uses	32.2401	31.0678	29.8954	28.7230	27.5507	26.3783	26.3783	27.5507	28.7230	29.8954	31.0678	32.2401 (42c)	
Average daily hot water use (litres/day)													99.4866 (43)
Daily hot water use	108.2281	105.9178	103.1040	98.8243	95.3493	91.6132	90.1768	92.9784	95.9333	99.8556	104.2013	107.9473 (44)	
Energy conte	171.4068	150.8256	158.4670	135.2856	128.3585	112.6492	109.0610	115.1267	118.2954	135.5032	148.4538	169.0194 (45)	
Energy content (annual)													1652.4520
Distribution loss (46)m = 0.15 x (45)m	25.7110	22.6238	23.7701	20.2928	19.2538	16.8974	16.3591	17.2690	17.7443	20.3255	22.2681	25.3529 (46)	
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)	
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)	
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)	
Combi loss	50.9589	46.0274	50.9589	48.7353	48.5890	45.1791	45.9531	47.3808	47.3096	50.8853	49.3151	50.9589 (61)	
Total heat required for water heating calculated for each month	222.3657	196.8530	209.4259	184.0209	176.9474	157.8283	155.0141	162.5075	165.6050	186.3885	197.7689	219.9783 (62)	
WWHRS	-24.2527	-21.4493	-22.4605	-18.5982	-17.3328	-14.8318	-13.9025	-14.7839	-15.3456	-18.0907	-20.4946	-23.8036 (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	198.1130	175.4037	186.9654	165.4227	159.6146	142.9965	141.1116	147.7236	150.2594	168.2978	177.2743	196.1747 (64)	
12Total per year (kWh/year)													2009.3572 (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 =													2009 (64)
Heat gains from water heating, kWh/month	69.7325	61.6563	65.4300	57.1663	54.8264	48.7506	47.7510	50.1248	51.1606	57.7761	61.6897	68.9387 (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	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785	85.9785 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.5724	83.6695	75.5724	78.0915	75.5724	78.0915	75.5724	75.5724	78.0915	75.5724	78.0915	75.5724 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	149.8308	151.3856	147.4676	139.1267	128.5978	118.7021	112.0911	110.5364	114.4543	122.7953	133.3242	143.2199 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979	31.5979 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828	-68.7828 (71)
Water heating gains (Table 5)	93.7265	91.7505	87.9436	79.3976	73.6914	67.7092	64.1815	67.3721	71.0564	77.6561	85.6801	92.6595 (72)
Total internal gains	370.9233	378.5991	362.7771	348.4094	329.6552	313.2963	300.6386	302.2744	312.3958	327.8173	348.8893	363.2454 (73)

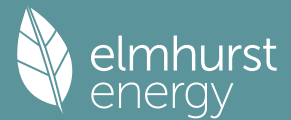
#### 6. Solar gains

[Jan]		Area	Solar flux	g	FF	Access	Gains					
West		m2	Table 6a	Specific data	Specific data	factor	W					
			W/m2	or Table 6b	or Table 6c	Table 6d						
		11.8000	19.6403	0.6300	0.7000	0.7700	70.8274 (80)					
Solar gains	70.8274	138.5534	228.1777	332.7835	407.8387	417.4955	397.4727	341.4232	265.3801	164.4052	88.3134	58.2450 (83)
Total gains	441.7506	517.1525	590.9548	681.1929	737.4939	730.7918	698.1114	643.6976	577.7759	492.2226	437.2027	421.4903 (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)	

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	31.9319	32.0467	32.1599	32.7028	32.8064	33.2975	33.2975	33.3901	33.1066	32.8064	32.5975	32.3819
alpha	3.1288	3.1364	3.1440	3.1802	3.1871	3.2198	3.2198	3.2260	3.2071	3.1871	3.1732	3.1588
util living area	0.9092	0.8630	0.7873	0.6537	0.5058	0.3627	0.2653	0.2987	0.4802	0.7252	0.8663	0.9183 (86)
MIT	19.4977	19.8234	20.2300	20.6479	20.8722	20.9676	20.9911	20.9869	20.9201	20.5883	19.9953	19.4521 (87)
Th 2	20.1932	20.1958	20.1984	20.2107	20.2130	20.2238	20.2238	20.2258	20.2196	20.2130	20.2084	20.2035 (88)
util rest of house	0.8988	0.8486	0.7665	0.6246	0.4697	0.3213	0.2195	0.2499	0.4329	0.6928	0.8498	0.9088 (89)
MIT 2	18.4428	18.8458	19.3416	19.8413	20.0915	20.1981	20.2184	20.2175	20.1521	19.7883	19.0748	18.3935 (90)
Living area fraction	18.9599	19.3250	19.7771	20.2367	20.4742	20.5753	20.5972	20.5947	20.5286	20.1805	19.5260	18.9124 (91)
Temperature adjustment	18.9599	19.3250	19.7771	20.2367	20.4742	20.5753	20.5972	20.5947	20.5286	20.1805	19.5260	18.9124 (92)
adjusted MIT	18.9599	19.3250	19.7771	20.2367	20.4742	20.5753	20.5972	20.5947	20.5286	20.1805	19.5260	18.9124 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8801	0.8310	0.7547	0.6256	0.4819	0.3402	0.2416	0.2733	0.4520	0.6914	0.8337	0.8906 (94)
Useful gains	388.7807	429.7344	446.0195	426.1428	355.3913	248.6240	168.6958	175.9263	261.1340	340.3370	364.5064	375.3632 (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	650.3896	637.6764	584.8660	491.0976	378.8929	254.2225	170.0626	177.9704	275.0868	413.7095	540.0273	643.6485 (97)
Space heating kWh	194.6370	139.7370	103.3018	46.7675	17.4852	0.0000	0.0000	0.0000	0.0000	54.5891	126.3750	199.6042 (98a)
Space heating requirement - total per year (kWh/year)												882.4969
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	194.6370	139.7370	103.3018	46.7675	17.4852	0.0000	0.0000	0.0000	0.0000	54.5891	126.3750	199.6042 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												882.4969
Space heating per m2										(98c) / (4) =		17.3039 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.4000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	194.6370	139.7370	103.3018	46.7675	17.4852	0.0000	0.0000	0.0000	0.0000	54.5891	126.3750	199.6042 (98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000 (210)
Space heating fuel (main heating system)	210.6461	151.2306	111.7985	50.6142	18.9233	0.0000	0.0000	0.0000	0.0000	59.0791	136.7695	216.0219 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	198.1130	175.4037	186.9654	165.4227	159.6146	142.9965	141.1116	147.7236	150.2594	168.2978	177.2743	196.1747 (64)
Efficiency of water heater (217)m	84.3435	83.8988	83.1631	82.0494	81.0743	80.3000	80.3000	80.3000	80.3000	82.2487	83.6686	84.4186 (217)
Fuel for water heating, kWh/month	234.8883	209.0657	224.8178	201.6135	196.8744	178.0778	175.7305	183.9647	187.1225	204.6206	211.8767	232.3832 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	15.7025	12.5971	11.3423	8.3098	6.4188	5.2442	5.8554	7.6111	9.8860	12.9710	14.6507	16.1389 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-2.8697	-4.5546	-7.3599	-9.3376	-11.0620	-10.7035	-10.5768	-9.4761	-7.7453	-5.6373	-3.3306	-2.4255 (233a)
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 (234a)
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 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-0.3770	-0.8359	-1.7455	-2.7517	-3.7709	-3.8367	-3.7895	-3.1448	-2.2254	-1.2337	-0.5151	-0.2950 (233b)
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 (234b)
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 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												955.0832 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												80.3000
Water heating fuel used												2441.0356 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												126.7278 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-109.6001 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)
Energy used												0.0000 (237)
Total delivered energy for all uses												3499.2466 (238)

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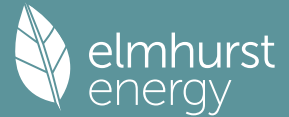
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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	955.0832	0.2100	200.5675 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2441.0356	0.2100	512.6175 (264)
Space and water heating			713.1850 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	126.7278	0.1443	18.2907 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-85.0788	0.1322	-11.2477
PV Unit electricity exported	-24.5213	0.1245	-3.0536
Total			-14.3013 (269)
Total CO2, kg/year			729.1037 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.3000 (273)

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 13a. Primary energy - Individual heating systems including micro-CHP  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	955.0832	1.1300	1079.2441 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2441.0356	1.1300	2758.3703 (278)
Space and water heating			3837.6143 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	126.7278	1.5338	194.3794 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-85.0788	1.4885	-126.6365
PV Unit electricity exported	-24.5213	0.4570	-11.2073
Total			-137.8438 (283)
Total Primary energy kWh/year			4024.2507 (286)
Target Primary Energy Rate (TPER)			78.9100 (287)

# Full SAP Calculation Printout



Property Reference	1C EE Gas		Issued on Date	20/11/2023	
Assessment Reference	L23, 1c EE Gas	Prop Type Ref	FF MT		
Property	FF MT				
SAP Rating	87 B	DER	11.20	TER	13.31
Environmental	92 A	% DER < TER		15.85	
CO <sub>2</sub> Emissions (t/year)	0.61	DFEE	18.39	TFEE	22.09
Compliance Check	See BREL	% DFEE < TFEE		16.78	
% DPER < TPER	12.11	DPER	64.58	TPER	73.48
Assessor Details	Mr. Jonathan Lewis			Assessor ID	AZ32-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	56.0000 (1b)	2.5000 (2b)	140.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.0000		140.0000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 140.0000 (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	2.5000	(17)
Infiltration rate	0.1250	(18)
Number of sides sheltered	2	(19)

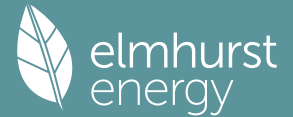
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1062 (21)

	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	0.1355	0.1328	0.1302	0.1169	0.1142	0.1009	0.1009	0.0983	0.1062	0.1142	0.1195	0.1248 (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)												81.9000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2260	0.2233	0.2207	0.2074	0.2047	0.1914	0.1914	0.1888	0.1967	0.2047	0.2100	0.2153 (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
Window (Uw = 1.00)			11.8000	0.9615	11.3462		(27)
External Wall 1	16.0000	11.8000	4.2000	0.1800	0.7560		(29a)
Communal Corridor	11.0000		11.0000	0.1600	1.7600		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			27.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	13.8622	(33)
Party Floor 1			56.0000				(32d)
Party Ceiling 1			56.0000				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				6.0000	0.0560	0.3360	
E3 Sill				6.0000	0.0410	0.2460	
E4 Jamb				9.0000	0.0470	0.4230	
E7 Party floor between dwellings (in blocks of flats)				8.0000	0.0490	0.3920	

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E16 Corner (normal)	0.0000	0.0320	0.0000	
E18 Party wall between dwellings	5.0000	0.0400	0.2000	
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0310	-0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				1.5970 (36)
Point Thermal bridges				0.0000
Total fabric heat loss			(36a) =	15.4592 (37)
			(33) + (36) + (36a) =	

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	10.4398	10.3170	10.1943	9.5807	9.4580	8.8444	8.8444	8.7217	9.0899	9.4580	9.7034	9.9489
Average = Sum(39)m / 12 =	25.8989	25.7762	25.6535	25.0399	24.9172	24.3036	24.3036	24.1808	24.5490	24.9172	25.1626	25.4080

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.4625	0.4603	0.4581	0.4471	0.4449	0.4340	0.4340	0.4318	0.4384	0.4449	0.4493	0.4537
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy												1.8666 (42)
Hot water usage for mixer showers												62.2164 (42a)
Hot water usage for baths												25.1746 (42b)
Hot water usage for other uses												35.5219 (42c)
Average daily hot water use (litres/day)												113.2947 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	123.2376	120.6322	117.4445	112.5618	108.6096	104.3555	102.6945	105.8682	109.2190	113.6884	118.6473	122.9129
Energy content (annual)	195.1782	171.7786	180.5078	154.0915	146.2094	128.3173	124.2001	131.0869	134.6779	154.2741	169.0348	192.4519
Distribution loss (46)m = 0.15 x (45)m												1881.8085
Water storage loss:												28.8678 (46)
Total storage loss												0.0000 (56)
If cylinder contains dedicated solar storage												0.0000 (57)
Primary loss												0.0000 (59)
Combi loss												34.2242 (61)
Total heat required for water heating calculated for each month												226.6761 (62)
WWHRs												0.0000 (63a)
PV diverter												0.0000 (63b)
Solar input												0.0000 (63c)
FGHRS												0.0000 (63d)
Output from w/h	229.4046	202.6891	214.7224	187.1860	180.3966	161.3911	158.3697	165.2620	167.7569	188.4678	202.1413	226.6761
12Total per year (kWh/year)												2284.4635 (64)
Electric shower(s)												2284 (64)
Heat gains from water heating, kWh/month	73.4534	64.8440	68.5725	59.5090	57.1614	50.9340	49.8389	52.1302	53.0501	59.8446	64.4807	72.5463

## 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	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	82.2990	91.1167	82.2990	85.0423	82.2990	85.0423	82.2990	82.2990	85.0423	82.2990	85.0423	82.2990
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	162.7587	164.4476	160.1916	151.1310	139.6936	128.9441	121.7627	120.0738	124.3298	133.3904	144.8278	155.5774
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000
Losses e.g. evaporation (negative values) (Table 5)	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638
Water heating gains (Table 5)	98.7276	96.4941	92.1673	82.6515	76.8299	70.7416	66.9878	70.0674	73.6808	80.4362	89.5565	97.5085
Total internal gains	397.7842	406.0573	388.6568	372.8236	352.8214	335.7269	322.0484	323.4391	334.0518	350.1246	373.4255	389.3837

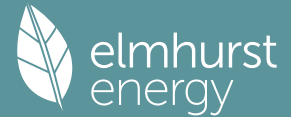
## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access factor	Gains						
West	m <sup>2</sup>	Table 6a	Specific data	Specific data	Table 6d	W						
		W/m <sup>2</sup>	or Table 6b	or Table 6c								
	11.8000	19.6403	0.6300	0.7000	0.7700	70.8274 (80)						
Solar gains	70.8274	138.5534	228.1777	332.7835	407.8387	417.4955	397.4727	341.4232	265.3801	164.4052	88.3134	58.2450
Total gains	468.6116	544.6107	616.8345	705.6072	760.6601	753.2223	719.5212	664.8623	599.4319	514.5298	461.7390	447.6287

## 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	60.0626	60.3485	60.6372	62.1231	62.4291	64.0052	64.0052	64.3301	63.3653	62.4291	61.8201	61.2230
alpha	5.0042	5.0232	5.0425	5.1415	5.1619	5.2670	5.2670	5.2887	5.2244	5.1619	5.1213	5.0815

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util living area	0.7984	0.7045	0.5834	0.4262	0.3042	0.2065	0.1486	0.1673	0.2823	0.4963	0.7033	0.8151 (86)
MIT	20.7287	20.8260	20.8951	20.9316	20.9387	20.9410	20.9411	20.9414	20.9401	20.9263	20.8492	20.7159 (87)
Th 2	20.5553	20.5574	20.5594	20.5695	20.5715	20.5817	20.5817	20.5837	20.5776	20.5715	20.5675	20.5634 (88)
util rest of house												
	0.7858	0.6901	0.5678	0.4115	0.2903	0.1930	0.1345	0.1522	0.2651	0.4770	0.6868	0.8032 (89)
MIT 2	20.2333	20.3504	20.4326	20.4836	20.4933	20.5061	20.5062	20.5085	20.5010	20.4805	20.3891	20.2256 (90)
Living area fraction									FLA = Living area / (4) =			0.4464 (91)
MIT	20.4545	20.5627	20.6391	20.6836	20.6921	20.7003	20.7004	20.7017	20.6970	20.6795	20.5945	20.4445 (92)
Temperature adjustment												0.0000
adjusted MIT	20.4545	20.5627	20.6391	20.6836	20.6921	20.7003	20.7004	20.7017	20.6970	20.6795	20.5945	20.4445 (93)

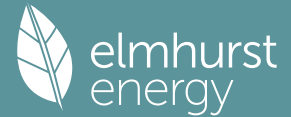
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.7829	0.6903	0.5707	0.4154	0.2942	0.1968	0.1385	0.1564	0.2700	0.4819	0.6878	0.7999	(94)
Useful gains	366.8841	375.9244	352.0119	293.1108	223.7707	148.2354	99.6507	104.0150	161.8231	247.9418	317.5938	358.0580	(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													
418.3834	403.7252	362.7159	295.0602	224.0584	148.2582	99.6533	104.0199	161.9500	251.1522	339.5574	412.7400	(97)	
Space heating kWh	38.3155	18.6821	7.9638	1.4036	0.2141	0.0000	0.0000	0.0000	0.0000	2.3885	15.8138	40.6834	(98a)
Space heating requirement - total per year (kWh/year)												125.4648	
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	38.3155	18.6821	7.9638	1.4036	0.2141	0.0000	0.0000	0.0000	0.0000	2.3885	15.8138	40.6834	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												125.4648	
Space heating per m2										(98c) / (4) =		2.2404	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													83.7000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	38.3155	18.6821	7.9638	1.4036	0.2141	0.0000	0.0000	0.0000	0.0000	2.3885	15.8138	40.6834	(98)
Space heating efficiency (main heating system 1)	83.7000	83.7000	83.7000	83.7000	83.7000	0.0000	0.0000	0.0000	0.0000	83.7000	83.7000	83.7000	(210)
Space heating fuel (main heating system)	45.7772	22.3203	9.5147	1.6769	0.2557	0.0000	0.0000	0.0000	0.0000	2.8537	18.8934	48.6062	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	229.4046	202.6891	214.7224	187.1860	180.3966	161.3911	158.3697	165.2620	167.7569	188.4678	202.1413	226.6761	(64)
Efficiency of water heater (217)m	87.2393	87.1409	87.0597	87.0124	87.0020	87.0000	87.0000	87.0000	87.0000	87.0209	87.1211	87.2545	(216)
Fuel for water heating, kWh/month	262.9602	232.5992	246.6382	215.1256	207.3477	185.5070	182.0342	189.9563	192.8240	216.5777	232.0232	259.7874	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	16.0369	14.4849	16.0369	15.5196	16.0369	15.5196	16.0369	16.0369	15.5196	16.0369	15.5196	16.0369	(231)
Lighting	15.9117	12.7650	11.4935	8.4206	6.5043	5.3141	5.9335	7.7125	10.0178	13.1439	14.8460	16.3540	(232)
Electricity generated by PVs (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	(233a)
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	(234a)
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	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1													149.8982 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													87.0000
Water heating fuel used													2623.3806 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.6020)													
mechanical ventilation fans (SFP = 0.6020)													102.8216 (230a)
central heating pump													41.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													188.8216 (231)
Electricity for lighting (calculated in Appendix L)													128.4169 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													0.0000 (233)
Wind generation													0.0000 (234)
Hydro-electric generation (Appendix N)													0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)													0.0000 (235)
Appendix Q - special features													
Energy saved or generated													-0.0000 (236)
Energy used													0.0000 (237)

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Total delivered energy for all uses

3090.5172 (238)

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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	149.8982	0.2100	31.4786 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2623.3806	0.2100	550.9099 (264)
Space and water heating			582.3885 (265)
Pumps, fans and electric keep-hot	188.8216	0.1387	26.1919 (267)
Energy for lighting	128.4169	0.1443	18.5345 (268)
Total CO2, kg/year			627.1149 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			11.2000 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	149.8982	1.1300	169.3849 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2623.3806	1.1300	2964.4200 (278)
Space and water heating			3133.8050 (279)
Pumps, fans and electric keep-hot	188.8216	1.5128	285.6493 (281)
Energy for lighting	128.4169	1.5338	196.9701 (282)
Total Primary energy kWh/year			3616.4244 (286)
Dwelling Primary energy Rate (DPER)			64.5800 (287)

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF TARGET EMISSIONS  
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-----  
 1. Overall dwelling characteristics  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	56.0000 (1b)	x 2.5000 (2b)	= 140.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	140.0000 (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	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1429 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3929 (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) = 0.3339 (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	0.4258	0.4174	0.4091	0.3673	0.3590	0.3172	0.3172	0.3089	0.3339	0.3590	0.3757	0.3924 (22b)
Effective ac	0.5906	0.5871	0.5837	0.5675	0.5644	0.5503	0.5503	0.5477	0.5558	0.5644	0.5706	0.5770 (25)

-----  
 3. Heat losses and heat loss parameter  
 -----

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opening Type (Uw = 1.20)			11.8000	1.1450	13.5115		(27)
External Wall 1	16.0000	11.8000	4.2000	0.1800	0.7560		(29a)
Communal Corridor	11.0000		11.0000	0.1800	1.9800		(29a)
Total net area of external elements Aum(A, m2)			27.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 16.2475		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				6.0000	0.0500	0.3000	

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E3 Sill	6.0000	0.0500	0.3000
E4 Jamb	9.0000	0.0500	0.4500
E7 Party floor between dwellings (in blocks of flats)	8.0000	0.0700	0.5600
E16 Corner (normal)	0.0000	0.0900	0.0000
E18 Party wall between dwellings	5.0000	0.0600	0.3000
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0900	-0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
 Point Thermal bridges (36a) = 1.9100 (36)  
 Total fabric heat loss (33) + (36) + (36a) = 18.1575 (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  
 27.2874    27.1248    26.9654    26.2168    26.0767    25.4247    25.4247    25.3040    25.6758    26.0767    26.3600    26.6563 (38)

Heat transfer coeff	45.4448	45.2822	45.1228	44.3742	44.2342	43.5821	43.5821	43.4614	43.8333	44.2342	44.5175	44.8137 (39)
Average = Sum(39)m / 12 =												44.3735

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8115	0.8086	0.8058	0.7924	0.7899	0.7783	0.7783	0.7761	0.7827	0.7899	0.7950	0.8002 (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												1.8666 (42)
Hot water usage for mixer showers												55.5162
Hot water usage for baths	55.5162	54.6819	53.4661	51.1400	49.4234	47.5091	46.4210	47.6275	48.9501	51.0055	53.3816	55.3035 (42a)
Hot water usage for other uses	23.9970	23.6406	23.1387	22.2134	21.5205	20.7522	20.3372	20.8355	21.3781	22.2003	23.1447	23.9159 (42b)
Average daily hot water use (litres/day)	33.7458	32.5187	31.2915	30.0644	28.8373	27.6102	27.6102	28.8373	30.0644	31.2915	32.5187	33.7458 (42c)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	113.2590	110.8412	107.8964	103.4179	99.7812	95.8715	94.3684	97.3004	100.3927	104.4974	109.0450	112.9651 (44)
Energy content (annual)	179.3745	157.8363	165.8328	141.5739	134.3247	117.8852	114.1303	120.4782	123.7942	141.8019	155.3545	176.8761 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1729.2628

Water storage loss:												26.9062
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage												0.0000
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.8474	47.2791	48.0891	49.5832	49.3151	50.9589	49.3151	50.9589 (59)
Total heat required for water heating calculated for each month	230.3334	203.8637	216.7917	190.8889	185.1722	165.1642	162.2194	170.0614	173.1093	192.7608	204.6696	227.8350 (62)
WWHRS	-25.3797	-22.4460	-23.5042	-19.4624	-18.1382	-15.5210	-14.5485	-15.4708	-16.0586	-18.9314	-21.4469	-24.9097 (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	204.9538	181.4177	193.2876	171.4266	167.0339	149.6432	147.6709	154.5905	157.0507	173.8295	183.2227	202.9253 (64)

12Total per year (kWh/year)  
 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  
 72.3818    63.9874    67.8791    59.4021    57.3748    51.0166    49.9706    52.4548    53.4904    59.8889    63.9841    71.5510 (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	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297	93.3297 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	82.2990	91.1167	82.2990	85.0423	82.2990	85.0423	82.2990	82.2990	85.0423	82.2990	85.0423	82.2990 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	162.7587	164.4476	160.1916	151.1310	139.6936	128.9441	121.7627	120.0738	124.3298	133.3904	144.8278	155.5774 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330	32.3330 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638	-74.6638 (71)
Water heating gains (Table 5)	97.2873	95.2194	91.2354	82.5029	77.1167	70.8564	67.1648	70.5038	74.2922	80.4958	88.8669	96.1707 (72)
Total internal gains	396.3439	404.7827	387.7249	372.6751	353.1082	335.8416	322.2254	323.8755	334.6632	350.1841	372.7359	388.0460 (73)

#### 6. Solar gains

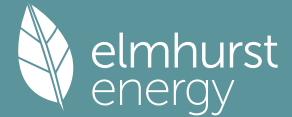
[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
West	11.8000	19.6403	0.6300	0.7000	0.7700	70.8274 (80)						
Solar gains	70.8274	138.5534	228.1777	332.7835	407.8387	417.4955	397.4727	341.4232	265.3801	164.4052	88.3134	58.2450 (83)
Total gains	467.1713	543.3360	615.9025	705.4586	760.9469	753.3371	719.6981	665.2986	600.0433	514.5894	461.0493	446.2910 (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)



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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	34.2296	34.3525	34.4738	35.0554	35.1664	35.6925	35.6925	35.7917	35.4880	35.1664	34.9426	34.7116
alpha	3.2820	3.2902	3.2983	3.3370	3.3444	3.3795	3.3795	3.3861	3.3659	3.3444	3.3295	3.3141
util living area	0.9106	0.8649	0.7900	0.6557	0.5065	0.3620	0.2642	0.2969	0.4778	0.7250	0.8671	0.9196 (86)
MIT	19.6241	19.9299	20.3065	20.6910	20.8920	20.9741	20.9932	20.9900	20.9343	20.6381	20.0907	19.5810 (87)
Th 2	20.2434	20.2459	20.2483	20.2599	20.2621	20.2722	20.2722	20.2741	20.2683	20.2621	20.2577	20.2531 (88)
util rest of house	0.9007	0.8511	0.7701	0.6279	0.4723	0.3230	0.2213	0.2513	0.4331	0.6939	0.8513	0.9106 (89)
MIT 2	18.6354	19.0140	19.4735	19.9341	20.1586	20.2514	20.2681	20.2676	20.2122	19.8868	19.2281	18.5888 (90)
Living area fraction	19.0768	19.4229	19.8454	20.2720	20.4860	20.5741	20.5918	20.5901	20.5346	20.2222	19.6131	19.0317 (91)
Temperature adjustment												0.0000
adjusted MIT	19.0768	19.4229	19.8454	20.2720	20.4860	20.5741	20.5918	20.5901	20.5346	20.2222	19.6131	19.0317 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8827	0.8341	0.7586	0.6284	0.4828	0.3393	0.2402	0.2712	0.4497	0.6922	0.8358	0.8931 (94)
Useful gains	412.3722	453.2233	467.2415	443.3217	367.3968	255.6173	172.8823	180.4578	269.8195	356.1786	385.3437	398.5630 (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	671.5284	657.6272	602.1801	504.6235	388.6430	260.3623	173.9715	182.1081	282.0495	425.6293	557.0539	664.6658 (97)
Space heating kWh	192.8122	137.3594	100.3943	44.1373	15.8072	0.0000	0.0000	0.0000	0.0000	51.6713	123.6313	197.9804 (98a)
Space heating requirement - total per year (kWh/year)												863.7936
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	192.8122	137.3594	100.3943	44.1373	15.8072	0.0000	0.0000	0.0000	0.0000	51.6713	123.6313	197.9804 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												863.7936
Space heating per m2												15.4249 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.4000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	192.8122	137.3594	100.3943	44.1373	15.8072	0.0000	0.0000	0.0000	0.0000	51.6713	123.6313	197.9804 (98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000 (210)
Space heating fuel (main heating system)	208.6712	148.6574	108.6519	47.7676	17.1073	0.0000	0.0000	0.0000	0.0000	55.9214	133.8002	214.2645 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	204.9538	181.4177	193.2876	171.4266	167.0339	149.6432	147.6709	154.5905	157.0507	173.8295	183.2227	202.9253 (64)
Efficiency of water heater (217)m	84.2507	83.7928	83.0463	81.9227	80.9772	80.3000	80.3000	80.3000	80.3000	82.1203	83.5567	84.3286 (217)
Fuel for water heating, kWh/month	243.2664	216.5075	232.7467	209.2541	206.2727	186.3552	183.8991	192.5162	195.5799	211.6766	219.2795	240.6365 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	17.1001	13.7183	12.3518	9.0495	6.9901	5.7110	6.3766	8.2885	10.7660	14.1256	15.9548	17.5754 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	(233a)m	-3.1474	-4.9934	-8.0654	-10.2275	-12.1109	-11.7156	-10.3737	-8.4825	-6.1778	-3.6521	-2.6604 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	(233b)m	-0.4176	-0.9257	-1.9328	-3.0470	-4.1762	-4.2501	-4.1985	-3.4846	-2.4657	-1.3668	-0.5707 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												934.8415 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												80.3000
Water heating fuel used												2537.9905 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												138.0076 (232)
Energy saving/generation technologies (Appendices M, N and Q)												
PV generation												-120.3452 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)
Energy used												0.0000 (237)
Total delivered energy for all uses												3576.4944 (238)

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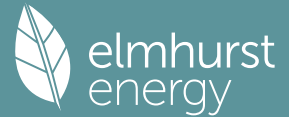
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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	934.8415	0.2100	196.3167 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2537.9905	0.2100	532.9780 (264)
Space and water heating			729.2947 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	138.0076	0.1443	19.9188 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-93.1828	0.1322	-12.3200
PV Unit electricity exported	-27.1624	0.1245	-3.3824
Total			-15.7024 (269)
Total CO2, kg/year			745.4404 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.3100 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	934.8415	1.1300	1056.3709 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2537.9905	1.1300	2867.9293 (278)
Space and water heating			3924.3002 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	138.0076	1.5338	211.6807 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-93.1828	1.4885	-138.7025
PV Unit electricity exported	-27.1624	0.4570	-12.4139
Total			-151.1163 (283)
Total Primary energy kWh/year			4114.9654 (286)
Target Primary Energy Rate (TPER)			73.4800 (287)

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Property Reference	2B3P EE Gas		Issued on Date	20/11/2023	
Assessment Reference	L23, 2B3P EE Gas	Prop Type Ref	FF MT		
Property	FF MT				
SAP Rating	86 B	DER	12.78	TER	14.89
Environmental	91 B	% DER < TER			14.17
CO <sub>2</sub> Emissions (t/year)	0.69	DFEE	28.50	TFEE	30.42
Compliance Check	See BREL	% DFEE < TFEE			6.32
% DPER < TPER	10.85	DPER	73.05	TPER	81.94
Assessor Details	Mr. Jonathan Lewis			Assessor ID	AZ32-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	58.0000 (1b)	2.5000 (2b)	145.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.0000		145.0000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 145.0000 (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		2.5000 (17)
Infiltration rate		0.1250 (18)
Number of sides sheltered		2 (19)

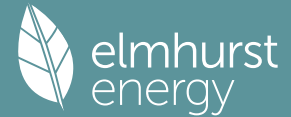
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1062 (21)

	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	0.1355	0.1328	0.1302	0.1169	0.1142	0.1009	0.1009	0.0983	0.1062	0.1142	0.1195	0.1248 (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)												81.9000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2260	0.2233	0.2207	0.2074	0.2047	0.1914	0.1914	0.1888	0.1967	0.2047	0.2100	0.2153 (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
Window (Uw = 1.00)			19.8000	0.9615	19.0385		(27)
External Wall 1	46.0000	19.8000	26.2000	0.1800	4.7160		(29a)
Communal Corridor	14.0000		14.0000	0.1600	2.2400		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			60.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	25.9945	(33)
Party Floor 1			56.0000				(32d)
Party Ceiling 1			56.0000				(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				12.0000	0.0560	0.6720	
E3 Sill				12.0000	0.0410	0.4920	
E4 Jamb				15.0000	0.0470	0.7050	
E7 Party floor between dwellings (in blocks of flats)				26.0000	0.0490	1.2740	

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E16 Corner (normal)	2.5000	0.0320	0.0800	
E18 Party wall between dwellings	5.0000	0.0400	0.2000	
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0310	-0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				3.4230 (36)
Point Thermal bridges				(36a) = 0.0000
Total fabric heat loss				(33) + (36) + (36a) = 29.4175 (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	10.8126	10.6855	10.5584	9.9229	9.7958	9.1603	9.1603	9.0332	9.4145	9.7958	10.0500	10.3042
Average = Sum(39)m / 12 =	40.2301	40.1030	39.9759	39.3404	39.2133	38.5777	38.5777	38.4506	38.8319	39.2133	39.4675	39.7217 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.6936	0.6914	0.6892	0.6783	0.6761	0.6651	0.6651	0.6629	0.6695	0.6761	0.6805	0.6849 (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													1.9246 (42)	
Hot water usage for mixer showers														63.3056 (42a)
Hot water usage for baths														25.6131 (42b)
Hot water usage for other uses														36.1467 (42c)
Average daily hot water use (litres/day)														115.2787 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	125.3958	122.7446	119.5011	114.5330	110.5115	106.1829	104.4929	107.7221	111.1317	115.6794	120.7251	125.0654 (44)	
Energy content (annual)	198.5963	174.7867	183.6687	156.7899	148.7697	130.5642	126.3751	133.3825	137.0365	156.9758	171.9950	195.8222 (45)	
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 1914.7627
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	34.2291	30.9129	34.2172	33.0966	34.1893	33.0757	34.1713	34.1769	33.0808	34.1958	33.1088	34.2269 (61)	
Total heat required for water heating calculated for each month	232.8254	205.6997	217.8859	189.8865	182.9589	163.6399	160.5464	167.5595	170.1173	191.1716	205.1038	230.0491 (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	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	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	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	0.0000 (63d)
Output from w/h	232.8254	205.6997	217.8859	189.8865	182.9589	163.6399	160.5464	167.5595	170.1173	191.1716	205.1038	230.0491 (64)	
12Total per year (kWh/year)													Total per year (kWh/year) = Sum(64)m = 2317.4441 (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	0.0000 (64a)
Heat gains from water heating, kWh/month	74.5905	65.8448	69.6241	60.4068	58.0132	51.6815	50.5625	52.8939	53.8348	60.7434	65.4656	73.6676 (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	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	84.6743	93.7465	84.6743	87.4967	84.6743	87.4967	84.6743	84.6743	87.4967	84.6743	87.4967	84.6743 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	167.8762	169.6182	165.2284	155.8829	144.0859	132.9984	125.5912	123.8492	128.2391	137.5845	149.3815	160.4691 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823 (71)
Water heating gains (Table 5)	100.2561	97.9834	93.5808	83.8983	77.9748	71.7799	67.9604	71.0940	74.7706	81.6444	90.9244	99.0156 (72)
Total internal gains	407.6749	416.2165	398.3519	382.1463	361.6033	344.1434	330.0943	331.4858	342.3748	358.7716	382.6710	399.0273 (73)

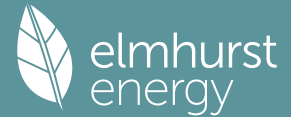
#### 6. Solar gains

[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						
North		8.0000	10.6334	0.6300	0.7000	0.7700	25.9976 (74)					
East		11.8000	19.6403	0.6300	0.7000	0.7700	70.8274 (76)					
Solar gains	96.8250	188.2362	312.6009	468.3888	590.5115	613.0521	580.0498	486.2748	366.8841	223.5461	120.3848	79.9179 (83)
Total gains	504.4999	604.4527	710.9527	850.5352	952.1148	957.1955	910.1441	817.7606	709.2589	582.3177	503.0559	478.9452 (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	
	40.0474	40.1744	40.3021	40.9531	41.0859	41.7627	41.7627	41.9008	41.4893	41.0859	40.8213	40.5600	

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alpha	3.6698	3.6783	3.6868	3.7302	3.7391	3.7842	3.7842	3.7934	3.7660	3.7391	3.7214	3.7040
util living area	0.8820	0.8114	0.7002	0.5295	0.3764	0.2568	0.1862	0.2158	0.3717	0.6324	0.8209	0.8954 (86)
MIT	20.2053	20.4296	20.6595	20.8363	20.8977	20.9150	20.9177	20.9174	20.9045	20.7926	20.4900	20.1671 (87)
Th 2	20.3465	20.3484	20.3503	20.3601	20.3620	20.3717	20.3717	20.3737	20.3678	20.3620	20.3581	20.3542 (88)
util rest of house	0.8707	0.7958	0.6795	0.5055	0.3518	0.2319	0.1597	0.1866	0.3391	0.6030	0.8034	0.8852 (89)
MIT 2	19.4096	19.6837	19.9588	20.1695	20.2373	20.2643	20.2667	20.2685	20.2511	20.1280	19.7705	19.3691 (90)
Living area fraction	19.7526	20.0052	20.2608	20.4569	20.5219	20.5448	20.5473	20.5482	FLA = Living area / (4) =			0.4310 (91)
MIT	19.7526	20.0052	20.2608	20.4569	20.5219	20.5448	20.5473	20.5482	20.5327	20.4145	20.0807	19.7131 (92)
Temperature adjustment												0.0000
adjusted MIT	19.7526	20.0052	20.2608	20.4569	20.5219	20.5448	20.5473	20.5482	20.5327	20.4145	20.0807	19.7131 (93)

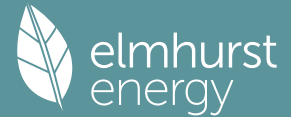
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8594	0.7871	0.6765	0.5092	0.3580	0.2388	0.1672	0.1947	0.3477	0.6055	0.7953	0.8739 (94)
Useful gains	433.5640	475.7633	480.9876	433.0788	340.8963	228.5546	152.1314	159.2389	246.5950	352.5830	400.0933	418.5296 (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	621.6580	605.7638	550.1001	454.6532	345.9368	229.3377	152.2776	159.4995	249.7957	384.8575	512.3137	616.2054 (97)
Space heating kWh	139.9419	87.3603	51.4197	15.5335	3.7501	0.0000	0.0000	0.0000	0.0000	24.0122	80.7987	147.0708 (98a)
Space heating requirement - total per year (kWh/year)												549.8871
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	139.9419	87.3603	51.4197	15.5335	3.7501	0.0000	0.0000	0.0000	0.0000	24.0122	80.7987	147.0708 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												549.8871
Space heating per m2										(98c) / (4) =		9.4808 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												83.7000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	139.9419	87.3603	51.4197	15.5335	3.7501	0.0000	0.0000	0.0000	0.0000	24.0122	80.7987	147.0708 (98)
Space heating efficiency (main heating system 1)	83.7000	83.7000	83.7000	83.7000	83.7000	0.0000	0.0000	0.0000	0.0000	83.7000	83.7000	83.7000 (210)
Space heating fuel (main heating system)	167.1946	104.3731	61.4333	18.5586	4.4804	0.0000	0.0000	0.0000	0.0000	28.6884	96.5337	175.7118 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	232.8254	205.6997	217.8859	189.8865	182.9589	163.6399	160.5464	167.5595	170.1173	191.1716	205.1038	230.0491 (64)
Efficiency of water heater (217)m	87.6305	87.4999	87.3195	87.1263	87.0335	87.0000	87.0000	87.0000	87.0000	87.1865	87.4738	87.6552 (217)
Fuel for water heating, kWh/month	265.6899	235.0856	249.5271	217.9441	210.2167	188.0918	184.5361	192.5971	195.5371	219.2676	234.4746	262.4479 (219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	16.3488	14.7666	16.3488	15.8214	16.3488	15.8214	16.3488	16.3488	15.8214	16.3488	15.8214	16.3488 (231)
Lighting	16.3710	13.1334	11.8252	8.6636	6.6920	5.4675	6.1047	7.9351	10.3069	13.5233	15.2745	16.8260 (232)
Electricity generated by PVs (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 (233a)
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 (234a)
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 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												656.9739 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												87.0000
Water heating fuel used												2655.4155 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.6020)												
mechanical ventilation fans (SFP = 0.6020)												106.4938 (230a)
central heating pump												41.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												192.4938 (231)
Electricity for lighting (calculated in Appendix L)												132.1232 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)

# Full SAP Calculation Printout



Energy used 0.0000 (237)  
 Total delivered energy for all uses 3637.0064 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	656.9739	0.2100	137.9645 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2655.4155	0.2100	557.6373 (264)
Space and water heating			695.6018 (265)
Pumps, fans and electric keep-hot	192.4938	0.1387	26.7013 (267)
Energy for lighting	132.1232	0.1443	19.0695 (268)
Total CO2, kg/year			741.3725 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.7800 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	656.9739	1.1300	742.3805 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2655.4155	1.1300	3000.6195 (278)
Space and water heating			3743.0000 (279)
Pumps, fans and electric keep-hot	192.4938	1.5128	291.2046 (281)
Energy for lighting	132.1232	1.5338	202.6550 (282)
Total Primary energy kWh/year			4236.8596 (286)
Dwelling Primary energy Rate (DPER)			73.0500 (287)

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF TARGET EMISSIONS  
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-----  
 1. Overall dwelling characteristics  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	58.0000 (1b)	x 2.5000 (2b)	= 145.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	145.0000 (5)

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 2. Ventilation rate  
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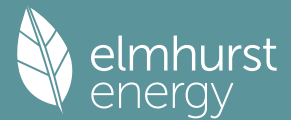
		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	2 * 10 =	20.0000 (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) =	20.0000 / (5) =	0.1379 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design APF50	5.0000	(17)
Infiltration rate	0.3879	(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) =	0.3297 (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	0.4204	0.4122	0.4039	0.3627	0.3545	0.3133	0.3133	0.3050	0.3297	0.3545	0.3710	0.3874 (22b)
Effective ac	0.5884	0.5849	0.5816	0.5658	0.5628	0.5491	0.5491	0.5465	0.5544	0.5628	0.5688	0.5751 (25)

-----  
 3. Heat losses and heat loss parameter  
 -----

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opening Type (Uw = 1.20)			14.5000	1.1450	16.6031		(27)
External Wall 1	46.0000	14.5000	31.5000	0.1800	5.6700		(29a)
Communal Corridor	14.0000		14.0000	0.1800	2.5200		(29a)
Total net area of external elements Aum (A, m2)			60.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	24.7931	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total

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E2 Other lintels (including other steel lintels)	12.0000	0.0500	0.6000	
E3 Sill	12.0000	0.0500	0.6000	
E4 Jamb	15.0000	0.0500	0.7500	
E7 Party floor between dwellings (in blocks of flats)	26.0000	0.0700	1.8200	
E16 Corner (normal)	2.5000	0.0900	0.2250	
E18 Party wall between dwellings	5.0000	0.0600	0.3000	
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0900	-0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				4.2950 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	29.0881 (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	28.1538	27.9896	27.8287	27.0726	26.9312	26.2727	26.2727	26.1508	26.5264	26.9312	27.2173	27.5165 (38)
Average = Sum(39)m / 12 =	57.2419	57.0777	56.9167	56.1607	56.0192	55.3608	55.3608	55.2388	55.6144	56.0192	56.3054	56.6045 (39)
												56.1600

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9869	0.9841	0.9813	0.9683	0.9658	0.9545	0.9545	0.9524	0.9589	0.9658	0.9708	0.9759 (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 1.9246 (42)

Hot water usage for mixer showers 56.4881 55.6392 54.4021 52.0353 50.2887 48.3408 47.2337 48.4613 49.8071 51.8985 54.3161 56.2716 (42a)

Hot water usage for baths 24.4149 24.0524 23.5417 22.6003 21.8953 21.1136 20.6914 21.1984 21.7505 22.5869 23.5478 24.3324 (42b)

Hot water usage for other uses 34.3394 33.0907 31.8420 30.5933 29.3446 28.0959 28.0959 29.3446 30.5933 31.8420 33.0907 34.3394 (42c)

Average daily hot water use (litres/day) 105.9343 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	115.2424	112.7822	109.7859	105.2289	101.5286	97.5503	96.0209	99.0043	102.1508	106.3274	110.9546	114.9435 (44)
Energy content (annual)	182.5158	160.6004	168.7368	144.0531	136.6770	119.9495	116.1290	122.5880	125.9622	144.2853	158.0752	179.9737 (45)
Distribution loss (46)m = 0.15 x (45)m	27.3774	24.0901	25.3105	21.6080	20.5015	17.9924	17.4193	18.3882	18.8943	21.6428	23.7113	26.9961 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	48.1070	48.9312	50.4515	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
WWHS	233.4747	206.6278	219.6957	193.3682	187.6359	168.0565	165.0602	173.0395	175.2773	195.2442	207.3903	230.9326 (62)
PV diverter	-25.8240	-22.8389	-23.9156	-19.8031	-18.4558	-15.7927	-14.8032	-15.7417	-16.3398	-19.2628	-21.8224	-25.3458 (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)
FGHS	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	207.6508	183.7888	195.7801	173.5651	169.1801	152.2638	150.2570	157.2979	158.9375	175.9814	185.5679	205.5868 (64)
12Total per year (kWh/year)												2115.8570 (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	73.4262	64.9065	68.8447	60.2264	58.1848	51.9100	50.8457	53.3734	54.2112	60.7146	64.8888	72.5810 (65)

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

Metabolic gains (Table 5), Watts

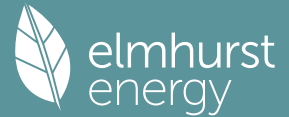
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279	96.2279 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	84.6743	93.7465	84.6743	87.4967	84.6743	87.4967	84.6743	84.6743	87.4967	84.6743	87.4967	84.6743 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	167.8762	169.6182	165.2284	155.8829	144.0859	132.9984	125.5912	123.8492	128.2391	137.5845	149.3815	160.4691 (68)
Pumps, fans	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228	32.6228 (69)
Losses e.g. evaporation (negative values) (Table 5)	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Water heating gains (Table 5)	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823	-76.9823 (71)
Total internal gains	98.6912	96.5870	92.5332	83.6478	78.2054	72.0972	68.3410	71.7384	75.2933	81.6056	90.1233	97.5551 (72)
	406.1100	414.8201	397.3042	381.8958	361.8339	344.4606	330.4748	332.1303	342.8975	358.7328	381.8700	397.5668 (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	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433 (74)
East	8.6400	19.6403	0.6300	0.7000	0.7700	51.8600 (76)
Solar gains	70.9033	137.8419	228.9125	342.9961	432.4287	448.9368
Total gains	477.0133	552.6620	626.2167	724.8919	794.2626	793.3975
						424.7686
						755.2434
						688.2253
						611.5614
						522.4316
						470.0256
						58.5226 (83)
						456.0894 (84)

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

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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	28.1457	28.2266	28.3065	28.6875	28.7600	29.1020	29.1020	29.1663	28.9693	28.7600	28.6138	28.4626
alpha	2.8764	2.8818	2.8871	2.9125	2.9173	2.9401	2.9401	2.9444	2.9313	2.9173	2.9076	2.8975
util living area	0.9272	0.8931	0.8348	0.7199	0.5743	0.4225	0.3146	0.3566	0.5565	0.7838	0.8950	0.9344 (86)
MIT	19.0860	19.4132	19.8703	20.4083	20.7566	20.9279	20.9774	20.9672	20.8365	20.3498	19.6431	19.0364 (87)
Th 2	20.0942	20.0966	20.0989	20.1098	20.1119	20.1214	20.1214	20.1232	20.1178	20.1119	20.1078	20.1034 (88)
util rest of house	0.9180	0.8802	0.8154	0.6898	0.5329	0.3706	0.2545	0.2928	0.5006	0.7520	0.8802	0.9260 (89)
MIT 2	17.8651	18.2731	18.8370	19.4864	19.8806	20.0651	20.1083	20.1031	19.9798	19.4374	18.5747	17.8091 (90)
Living area fraction	18.3914	18.7645	19.2824	19.8837	20.2582	20.4370	20.4829	20.4755	20.3491	19.8307	19.0352	18.3381 (91)
MIT	18.3914	18.7645	19.2824	19.8837	20.2582	20.4370	20.4829	20.4755	20.3491	19.8307	19.0352	18.3381 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3914	18.7645	19.2824	19.8837	20.2582	20.4370	20.4829	20.4755	20.3491	19.8307	19.0352	18.3381 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8963	0.8574	0.7955	0.6817	0.5399	0.3896	0.2795	0.3188	0.5158	0.7409	0.8588	0.9051 (94)
Useful gains	427.5383	473.8636	498.1720	494.1279	428.8491	309.0755	211.1111	219.4164	315.4319	387.0639	403.6431	412.7857 (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	806.6154	791.3551	727.5305	616.8545	479.4234	323.1386	214.9611	225.1281	347.5389	517.0960	672.0167	800.2810 (97)
Space heating kWh	282.0333	213.3542	170.6427	88.3632	37.6273	0.0000	0.0000	0.0000	0.0000	96.7439	193.2290	288.2965 (98a)
Space heating requirement - total per year (kWh/year)												1370.2901
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	282.0333	213.3542	170.6427	88.3632	37.6273	0.0000	0.0000	0.0000	0.0000	96.7439	193.2290	288.2965 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1370.2901
Space heating per m2												23.6257 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.4000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	282.0333	213.3542	170.6427	88.3632	37.6273	0.0000	0.0000	0.0000	0.0000	96.7439	193.2290	288.2965 (98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000 (210)
Space heating fuel (main heating system)	305.2309	230.9029	184.6782	95.6312	40.7222	0.0000	0.0000	0.0000	0.0000	104.7011	209.1222	312.0092 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	207.6508	183.7888	195.7801	173.5651	169.1801	152.2638	150.2570	157.2979	158.9375	175.9814	185.5679	205.5868 (64)
Efficiency of water heater (217)m	85.0380	84.7019	84.0882	83.0090	81.7387	80.3000	80.3000	80.3000	80.3000	83.1535	84.4683	85.1059 (217)
Fuel for water heating, kWh/month	244.1859	216.9830	232.8270	209.0918	206.9768	189.6186	187.1196	195.8877	197.9296	211.6344	219.6894	241.5660 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	17.5936	14.1143	12.7083	9.3107	7.1918	5.8758	6.5606	8.5278	11.0767	14.5332	16.4153	18.0826 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-3.2584	-5.1686	-8.3470	-10.5826	-12.5294	-12.1194	-11.9749	-10.7318	-8.7766	-6.3936	-3.7805	-2.7543 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-0.4340	-0.9619	-2.0083	-3.1660	-4.3394	-4.4165	-4.3632	-3.6214	-2.5626	-1.4205	-0.5931	-0.3396 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1482.9979 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												80.3000
Water heating fuel used												2553.5099 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												141.9908 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-124.6433 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)



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Energy used 0.0000 (237)  
 Total delivered energy for all uses 4139.8553 (238)

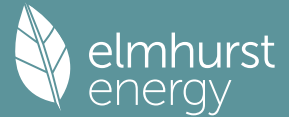
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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1482.9979	0.2100	311.4296 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2553.5099	0.2100	536.2371 (264)
Space and water heating			847.6666 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	141.9908	0.1443	20.4937 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-96.4170	0.1322	-12.7480
PV Unit electricity exported	-28.2262	0.1245	-3.5148
Total			-16.2628 (269)
Total CO2, kg/year			863.8268 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.8900 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1482.9979	1.1300	1675.7877 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2553.5099	1.1300	2885.4662 (278)
Space and water heating			4561.2539 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	141.9908	1.5338	217.7902 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-96.4170	1.4885	-143.5180
PV Unit electricity exported	-28.2262	0.4570	-12.8999
Total			-156.4179 (283)
Total Primary energy kWh/year			4752.7269 (286)
Target Primary Energy Rate (TPER)			81.9400 (287)

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Property Reference	3A EE Gas		Issued on Date	20/11/2023	
Assessment Reference	L23, 3A EE Gas	Prop Type Ref	FF MT		
Property	FF MT				
SAP Rating	88 B	DER	9.80	TER	12.25
Environmental	92 A	% DER < TER			20.00
CO <sub>2</sub> Emissions (t/year)	0.79	DFEE	23.93	TFEE	28.33
Compliance Check	See BREL	% DFEE < TFEE			15.51
% DPER < TPER	15.96	DPER	56.49	TPER	67.21
Assessor Details	Mr. Jonathan Lewis			Assessor ID	AZ32-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	87.0000 (1b)	x 2.5000 (2b)	= 217.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 217.5000 (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		2.5000 (17)
Infiltration rate		0.1250 (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) =	0.1062 (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	0.1355	0.1328	0.1302	0.1169	0.1142	0.1009	0.1009	0.0983	0.1062	0.1142	0.1195	0.1248 (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)												81.9000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.2260	0.2233	0.2207	0.2074	0.2047	0.1914	0.1914	0.1888	0.1967	0.2047	0.2100	0.2153 (25)

### 3. Heat losses and heat loss parameter

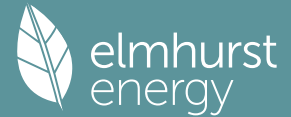
Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window (Uw = 1.00)			21.0000	0.9615	20.1923		(27)
External Wall 1	49.0000	21.0000	28.0000	0.1800	5.0400		(29a)
Communal Corridor	20.0000		20.0000	0.1600	3.2000		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			69.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	28.4323	(33)
Party Floor 1			87.0000				(32d)
Party Ceiling 1			87.0000				(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 100.0000 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	13.0000	0.0560	0.7280
E3 Sill	13.0000	0.0410	0.5330
E4 Jamb	17.0000	0.0470	0.7990
E7 Party floor between dwellings (in blocks of flats)	34.0000	0.0490	1.6660

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E16 Corner (normal)	2.5000	0.0320	0.0800	
E18 Party wall between dwellings	5.0000	0.0400	0.2000	
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0310	-0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				4.0060 (36)
Point Thermal bridges				0.0000
Total fabric heat loss		(33) + (36) + (36a) =		32.4383 (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	16.2189	16.0283	15.8376	14.8843	14.6937	13.7404	13.7404	13.5498	14.1217	14.6937	15.0750	15.4563 (38)
Average = Sum(39)m / 12 =	48.6572	48.4666	48.2759	47.3226	47.1320	46.1787	46.1787	45.9881	46.5600	47.1320	47.5133	47.8946 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.5593	0.5571	0.5549	0.5439	0.5417	0.5308	0.5308	0.5286	0.5352	0.5417	0.5461	0.5505 (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													2.5824 (42)
Hot water usage for mixer showers	75.9577	74.8162	73.1528	69.9702	67.6216	65.0023	63.5136	65.1644	66.9740	69.7862	73.0371	75.6667	(42a)
Hot water usage for baths	30.6928	30.2370	29.5951	28.4115	27.5253	26.5426	26.0118	26.6492	27.3432	28.3947	29.6027	30.5890	(42b)
Hot water usage for other uses	43.2382	41.6659	40.0936	38.5213	36.9490	35.3767	35.3767	36.9490	38.5213	40.0936	41.6659	43.2382	(42c)
Average daily hot water use (litres/day)													137.7949 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	149.8887	146.7190	142.8414	136.9030	132.0958	126.9216	124.9020	128.7625	132.8384	138.2745	144.3057	149.4939 (44)	
Energy content (annual)	237.3870	208.9259	219.5420	187.4134	177.8263	156.0649	151.0582	159.4349	163.8031	187.6372	205.5899	234.0713 (45)	
Distribution loss (46)m = 0.15 x (45)m	35.6080	31.3389	32.9313	28.1120	26.6740	23.4097	22.6587	23.9152	24.5705	28.1456	30.8385	35.1107 (46)	
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	34.2601	30.9403	34.2459	33.1211	34.2125	33.0961	34.1911	34.1978	33.1022	34.2203	33.1357	34.2575	(59)
Total heat required for water heating calculated for each month	271.6471	239.8662	253.7878	220.5345	212.0388	189.1610	185.2493	193.6327	196.9053	221.8575	238.7256	268.3288 (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	271.6471	239.8662	253.7878	220.5345	212.0388	189.1610	185.2493	193.6327	196.9053	221.8575	238.7256	268.3288 (64)	
12Total per year (kWh/year)													2691.7346 (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	0.0000 (64a)
Heat gains from water heating, kWh/month	87.4962	77.2029	81.5592	70.5952	67.6804	60.1656	58.7746	61.5616	62.7401	70.9445	76.6426	86.3931 (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	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195	129.1195 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	117.7482	130.3641	117.7482	121.6731	117.7482	121.6731	117.7482	117.7482	121.6731	117.7482	121.6731	117.7482 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	233.4490	235.8715	229.7669	216.7711	200.3661	184.9478	174.6474	172.2249	178.3295	191.3253	207.7303	223.1486 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956 (71)
Water heating gains (Table 5)	117.6024	114.8853	109.6225	98.0489	90.9683	83.5633	78.9981	82.7440	87.1390	95.3554	106.4480	116.1197 (72)
Total internal gains	533.5355	545.8567	521.8735	501.2290	473.8185	451.9201	433.1296	434.4530	448.8775	469.1649	500.5873	521.7524 (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	9.0000	10.6334	0.6300	0.7000	0.7700	29.2473 (74)						
West	12.0000	19.6403	0.6300	0.7000	0.7700	72.0278 (80)						
Solar gains	101.2752	196.7949	327.0212	490.9799	620.2581	644.5729	609.6088	510.1681	384.0701	233.7253	125.8906	83.6142 (83)
Total gains	634.8107	742.6516	848.8947	992.2089	1094.0765	1096.4930	1042.7384	944.6211	832.9476	702.8901	626.4779	605.3666 (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	49.6672	49.8626	50.0595	51.0679	51.2744	52.3329	52.3329	52.5498	51.9043	51.2744	50.8630	50.4580	

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alpha	4.3111	4.3242	4.3373	4.4045	4.4183	4.4889	4.4889	4.5033	4.4603	4.4183	4.3909	4.3639
util living area	0.8967	0.8317	0.7271	0.5543	0.3964	0.2690	0.1948	0.2237	0.3823	0.6473	0.8353	0.9086 (86)
MIT	20.3904	20.5687	20.7455	20.8794	20.9197	20.9298	20.9309	20.9309	20.9243	20.8517	20.6248	20.3642 (87)
Th 2	20.4668	20.4688	20.4708	20.4807	20.4827	20.4927	20.4927	20.4947	20.4887	20.4827	20.4787	20.4747 (88)
util rest of house	0.8874	0.8186	0.7094	0.5335	0.3751	0.2478	0.1723	0.1992	0.3548	0.6220	0.8204	0.9001 (89)
MIT 2	19.7414	19.9607	20.1739	20.3372	20.3828	20.4031	20.4041	20.4062	20.3942	20.3112	20.0412	19.7160 (90)
Living area fraction	19.9279	20.1354	20.3382	20.4930	20.5371	20.5545	20.5555	20.5570	20.5465	20.4665	20.2089	19.9023 (92)
Temperature adjustment												0.0000
adjusted MIT	19.9279	20.1354	20.3382	20.4930	20.5371	20.5545	20.5555	20.5570	20.5465	20.4665	20.2089	19.9023 (93)

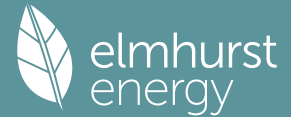
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8770	0.8098	0.7048	0.5340	0.3774	0.2504	0.1751	0.2023	0.3579	0.6212	0.8121	0.8900 (94)
Useful gains	556.7321	601.4312	598.2753	529.8080	412.8724	274.5553	182.5984	191.0581	298.1181	436.6356	508.7782	538.7555 (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	760.4092	738.4082	668.0494	548.6110	416.5092	274.9698	182.6589	191.1726	300.1494	465.0287	622.8451	752.0549 (97)
Space heating kWh	151.5357	92.0485	51.9119	13.5381	2.7058	0.0000	0.0000	0.0000	0.0000	21.1245	82.1281	158.6947 (98a)
Space heating requirement - total per year (kWh/year)												573.6874
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	151.5357	92.0485	51.9119	13.5381	2.7058	0.0000	0.0000	0.0000	0.0000	21.1245	82.1281	158.6947 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												573.6874
Space heating per m2										(98c) / (4) =		6.5941 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												83.7000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	151.5357	92.0485	51.9119	13.5381	2.7058	0.0000	0.0000	0.0000	0.0000	21.1245	82.1281	158.6947 (98)
Space heating efficiency (main heating system 1)	83.7000	83.7000	83.7000	83.7000	83.7000	0.0000	0.0000	0.0000	0.0000	83.7000	83.7000	83.7000 (210)
Space heating fuel (main heating system)	181.0462	109.9744	62.0214	16.1746	3.2327	0.0000	0.0000	0.0000	0.0000	25.2383	98.1220	189.5995 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	271.6471	239.8662	253.7878	220.5345	212.0388	189.1610	185.2493	193.6327	196.9053	221.8575	238.7256	268.3288 (64)
Efficiency of water heater (217)m	87.6012	87.4649	87.2841	87.0965	87.0210	87.0000	87.0000	87.0000	87.0000	87.1452	87.4289	87.6241 (217)
Fuel for water heating, kWh/month	310.0952	274.2428	290.7608	253.2069	243.6639	217.4264	212.9302	222.5663	226.3280	254.5838	273.0511	306.2271 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	20.8711	18.8513	20.8711	20.1979	20.8711	20.1979	20.8711	20.8711	20.1979	20.8711	20.1979	20.8711 (231)
Lighting	22.7655	18.2633	16.4441	12.0477	9.3060	7.6031	8.4892	11.0346	14.3329	18.8055	21.2407	23.3982 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												685.4091 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												87.0000
Water heating fuel used												3085.0825 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.6020)												
mechanical ventilation fans (SFP = 0.6020)												159.7407 (230a)
central heating pump												41.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												245.7407 (231)
Electricity for lighting (calculated in Appendix L)												183.7308 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)

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Energy used 0.0000 (237)  
 Total delivered energy for all uses 4199.9631 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	685.4091	0.2100	143.9359 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3085.0825	0.2100	647.8673 (264)
Space and water heating			791.8032 (265)
Pumps, fans and electric keep-hot	245.7407	0.1387	34.0873 (267)
Energy for lighting	183.7308	0.1443	26.5180 (268)
Total CO2, kg/year			852.4085 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			9.8000 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	685.4091	1.1300	774.5123 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3085.0825	1.1300	3486.1432 (278)
Space and water heating			4260.6555 (279)
Pumps, fans and electric keep-hot	245.7407	1.5128	371.7565 (281)
Energy for lighting	183.7308	1.5338	281.8124 (282)
Total Primary energy kWh/year			4914.2245 (286)
Dwelling Primary energy Rate (DPER)			56.4900 (287)

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF TARGET EMISSIONS  
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-----  
 1. Overall dwelling characteristics  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	87.0000 (1b)	x 2.5000 (2b)	= 217.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	217.5000 (5)

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 2. Ventilation rate  
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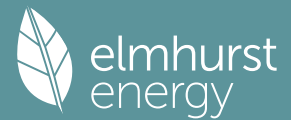
		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	3 * 10 =	30.0000 (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) =	30.0000 / (5) =	0.1379 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3879	(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) =	0.3297 (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												
Effective ac	0.4204	0.4122	0.4039	0.3627	0.3545	0.3133	0.3133	0.3050	0.3297	0.3545	0.3710	0.3874 (22b)
	0.5884	0.5849	0.5816	0.5658	0.5628	0.5491	0.5491	0.5465	0.5544	0.5628	0.5688	0.5751 (25)

-----  
 3. Heat losses and heat loss parameter  
 -----

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opening Type (Uw = 1.20)			21.0000	1.1450	24.0458		(27)
External Wall 1	49.0000	21.0000	28.0000	0.1800	5.0400		(29a)
Communal Corridor	20.0000		20.0000	0.1800	3.6000		(29a)
Total net area of external elements Aum (A, m2)			69.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	32.6858	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total

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E2 Other lintels (including other steel lintels)	13.0000	0.0500	0.6500	
E3 Sill	13.0000	0.0500	0.6500	
E4 Jamb	17.0000	0.0500	0.8500	
E7 Party floor between dwellings (in blocks of flats)	34.0000	0.0700	2.3800	
E16 Corner (normal)	2.5000	0.0900	0.2250	
E18 Party wall between dwellings	5.0000	0.0600	0.3000	
E17 Corner (inverted - internal area greater than external area)	0.0000	-0.0900	-0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				5.0550 (36)
Point Thermal bridges				0.0000
Total fabric heat loss		(33) + (36) + (36a) =		37.7408 (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	42.2307	41.9844	41.7430	40.6090	40.3968	39.4091	39.4091	39.2262	39.7895	40.3968	40.8260	41.2747 (38)
Average = Sum(39)m / 12 =	79.9715	79.7252	79.4838	78.3498	78.1376	77.1499	77.1499	76.9670	77.5303	78.1376	78.5668	79.0155 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9192	0.9164	0.9136	0.9006	0.8981	0.8868	0.8868	0.8847	0.8912	0.8981	0.9031	0.9082 (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 2.5824 (42)

Hot water usage for mixer showers 67.5179 66.5033 65.0247 62.1958 60.1080 57.7799 56.4565 57.9239 59.5324 62.0322 64.9219 67.2593 (42a)

Hot water usage for baths 29.1581 28.7251 28.1153 26.9909 26.1490 25.2154 24.7112 25.3167 25.9760 26.9750 28.1225 29.0596 (42b)

Hot water usage for other uses 41.0763 39.5826 38.0889 36.5952 35.1015 33.6079 33.6079 35.1015 36.5952 38.0889 39.5826 41.0763 (42c)

Average daily hot water use (litres/day) 126.6255 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	137.7524	134.8110	131.2289	125.7819	121.3586	116.6032	114.7755	118.3421	122.1037	127.0961	132.6270	137.3951 (44)
Energy content (annual)	218.1661	191.9690	201.6940	172.1891	163.3720	143.3772	138.8111	146.5323	150.5660	172.4682	188.9515	215.1275 (45)
Distribution loss (46)m = 0.15 x (45)m	32.7249	28.7954	30.2541	25.8284	24.5058	21.5066	20.8217	21.9798	22.5849	25.8702	28.3427	32.2691 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	269.1250	237.9964	252.6529	221.5042	214.3309	192.6922	189.7700	197.4912	199.8811	223.4271	238.2666	266.0864 (62)
WWHRS	-30.8664	-27.2985	-28.5854	-23.6698	-22.0594	-18.8764	-17.6936	-18.8154	-19.5303	-23.0240	-26.0834	-30.2948 (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	238.2586	210.6979	224.0675	197.8344	192.2714	173.8158	172.0763	178.6758	180.3508	200.4030	212.1831	235.7916 (64)
12Total per year (kWh/year)												2416.4264 (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	85.2799	75.3366	79.8030	69.5817	67.0609	60.0017	58.8944	61.4617	62.3920	70.0854	75.1551	84.2696 (65)

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

Metabolic gains (Table 5), Watts

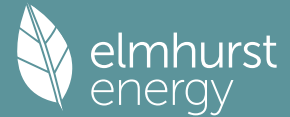
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	117.7482	130.3641	117.7482	121.6731	117.7482	121.6731	117.7482	117.7482	121.6731	117.7482	121.6731	117.7482 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	233.4490	235.8715	229.7669	216.7711	200.3661	184.9478	174.6474	172.2249	178.3295	191.3253	207.7303	223.1486 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120	35.9120 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956	-103.2956 (71)
Water heating gains (Table 5)	114.6236	112.1080	107.2621	96.6412	90.1356	83.3357	79.1592	82.6098	86.6555	94.2008	104.3821	113.2656 (72)
Total internal gains	530.5566	543.0794	519.5130	499.8213	472.9858	451.6925	433.2906	434.3188	448.3940	468.0102	498.5214	518.8983 (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
North	9.0000	10.6334	0.6300	0.7000	0.7700	29.2473 (74)
West	12.0000	19.6403	0.6300	0.7000	0.7700	72.0278 (80)
Solar gains	101.2752	196.7949	327.0212	490.9799	620.2581	644.5729
Total gains	631.8318	739.8742	846.5342	990.8011	1093.2439	1096.2653
						1042.8994
						510.1681
						384.0701
						233.7253
						125.8906
						83.6142 (83)
						602.5125 (84)

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

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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	30.2191	30.3125	30.4045	30.8446	30.9284	31.3243	31.3243	31.3987	31.1706	30.9284	30.7594	30.5847
alpha	3.0146	3.0208	3.0270	3.0563	3.0619	3.0883	3.0883	3.0932	3.0780	3.0619	3.0506	3.0390
util living area	0.9419	0.9100	0.8533	0.7366	0.5859	0.4285	0.3186	0.3634	0.5721	0.8060	0.9132	0.9484 (86)
MIT	19.1138	19.4435	19.9018	20.4402	20.7787	20.9380	20.9814	20.9720	20.8489	20.3657	19.6623	19.0658 (87)
Th 2	20.1512	20.1536	20.1559	20.1670	20.1691	20.1788	20.1788	20.1805	20.1750	20.1691	20.1649	20.1605 (88)
util rest of house	0.9345	0.8990	0.8360	0.7084	0.5463	0.3790	0.2615	0.3024	0.5186	0.7772	0.9008	0.9417 (89)
MIT 2	17.9374	18.3506	18.9186	19.5715	19.9564	20.1295	20.1676	20.1629	20.0452	19.5024	18.6387	17.8832 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	18.2754	18.6647	19.2011	19.8211	20.1927	20.3618	20.4015	20.3954	20.2762	19.7504	18.9328	18.2230 (92)
Temperature adjustment												0.0000
adjusted MIT	18.2754	18.6647	19.2011	19.8211	20.1927	20.3618	20.4015	20.3954	20.2762	19.7504	18.9328	18.2230 (93)

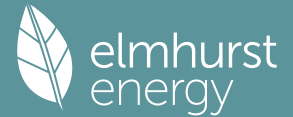
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9133	0.8754	0.8135	0.6958	0.5474	0.3903	0.2772	0.3187	0.5255	0.7608	0.8782	0.9217 (94)
Useful gains	577.0761	647.7202	688.6206	689.3784	598.4733	427.8366	289.0666	301.0032	437.4216	533.8926	548.3626	555.3244 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.6000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1117.6375	1097.3911	1009.5340	855.6689	663.5959	444.5228	293.2816	307.5162	478.8410	714.9931	929.6677	1108.0372 (97)
Space heating kWh	402.1776	302.1789	238.7596	119.7291	48.4512	0.0000	0.0000	0.0000	0.0000	134.7388	274.5396	411.2183 (98a)
Space heating requirement - total per year (kWh/year)												1931.7932
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	402.1776	302.1789	238.7596	119.7291	48.4512	0.0000	0.0000	0.0000	0.0000	134.7388	274.5396	411.2183 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1931.7932
Space heating per m2												(98c) / (4) = 22.2045 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												92.4000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	402.1776	302.1789	238.7596	119.7291	48.4512	0.0000	0.0000	0.0000	0.0000	134.7388	274.5396	411.2183 (98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000 (210)
Space heating fuel (main heating system)	435.2572	327.0334	258.3979	129.5769	52.4364	0.0000	0.0000	0.0000	0.0000	145.8212	297.1208	445.0415 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	238.2586	210.6979	224.0675	197.8344	192.2714	173.8158	172.0763	178.6758	180.3508	200.4030	212.1831	235.7916 (64)
Efficiency of water heater												80.3000 (216)
(217)m	85.4936	85.1534	84.5178	83.3396	81.8946	80.3000	80.3000	80.3000	80.3000	83.5494	84.9345	85.5606 (217)
Fuel for water heating, kWh/month	278.6857	247.4333	265.1127	237.3834	234.7793	216.4581	214.2918	222.5103	224.5963	239.8617	249.8197	275.5845 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	24.4658	19.6273	17.6722	12.9474	10.0010	8.1709	9.1232	11.8587	15.4033	20.2100	22.8271	25.1457 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-4.8556	-7.6837	-12.3782	-15.6515	-18.4885	-17.8637	-17.6463	-15.8325	-12.9763	-9.4849	-5.6264	-4.1061 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-0.6829	-1.5120	-3.1547	-4.9714	-6.8146	-6.9402	-6.8608	-5.6973	-4.0325	-2.2362	-0.9340	-0.5348 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												2090.6852 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												80.3000
Water heating fuel used												2906.5167 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												197.4526 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-186.9649 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)

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Energy used 0.0000 (237)  
 Total delivered energy for all uses 5093.6897 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2090.6852	0.2100	439.0439 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2906.5167	0.2100	610.3685 (264)
Space and water heating			1049.4124 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	197.4526	0.1443	28.4985 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-142.5936	0.1323	-18.8609
PV Unit electricity exported	-44.3713	0.1245	-5.5250
Total			-24.3859 (269)
Total CO2, kg/year			1065.4543 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.2500 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2090.6852	1.1300	2362.4743 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2906.5167	1.1300	3284.3639 (278)
Space and water heating			5646.8382 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	197.4526	1.5338	302.8594 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-142.5936	1.4887	-212.2812
PV Unit electricity exported	-44.3713	0.4570	-20.2773
Total			-232.5585 (283)
Total Primary energy kWh/year			5847.2400 (286)
Target Primary Energy Rate (TPER)			67.2100 (287)



## Project name

**Podium Level Unit**

As designed

Date: Tue Nov 21 07:32:37 2023

## Administrative information

## Building Details

Address: Telcon Tower, Enderby Place, London,

## Certifier details

Name:

Telephone number:

Address: , ,

## Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.4"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.4

BRUKL compliance check version: v6.1.b.0

Foundation area [m<sup>2</sup>]: 11.23The CO<sub>2</sub> emission and primary energy rates of the building must not exceed the targets

Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> annum	3.87
Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> annum	3.39
Target primary energy rate (TPER), kWh/m <sup>2</sup> annum	42.57
Building primary energy rate (BPER), kWh/m <sup>2</sup> annum	37.27
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER   BPER ≤ TPER

## The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U <sub>a-Limit</sub>	U <sub>a-Calc</sub>	U <sub>i-Calc</sub>	First surface with maximum value
Walls*	0.26	0.18	0.18	External Wall
Floors	0.18	0.12	0.12	Ground Floor
Pitched roofs	0.16	-	-	No pitched roofs in project
Flat roofs	0.18	-	-	No flat roofs in project
Windows** and roof windows	1.6	-	-	No windows or roof windows in project
Rooflights***	2.2	-	-	No rooflights in project
Personnel doors <sup>^</sup>	1.6	-	-	No personnel doors in project
Vehicle access & similar large doors	1.3	-	-	No vehicle access or similar large doors in project
High usage entrance doors	3	-	-	No high usage entrance doors in project

U<sub>a-Limit</sub> = Limiting area-weighted average U-values [W/(m<sup>2</sup>K)]U<sub>i-Calc</sub> = Calculated maximum individual element U-values [W/(m<sup>2</sup>K)]U<sub>a-Calc</sub> = Calculated area-weighted average U-values [W/(m<sup>2</sup>K)]

\* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

\*\* Display windows and similar glazing are excluded from the U-value check. \*\*\* Values for rooflights refer to the horizontal position.

<sup>^</sup> For fire doors, limiting U-value is 1.8 W/m<sup>2</sup>K

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m <sup>3</sup> /(h.m <sup>2</sup> ) at 50 Pa	8	3

## Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

### 1- System 1 (A1A2\_Sales 1)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
<b>This system</b>	3.5	-	-	0.6	0.95
<b>Standard value</b>	0.93*	N/A	N/A	2^	N/A
<b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>					YES
* Standard shown is for gas single boiler systems <=2 MW output and overall for multi-boiler systems. For single boiler systems >2 MW or any individual boiler in a multi-boiler system, limiting efficiency is 0.88.					
^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.					

### 1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
<b>This building</b>	2.5	0
<b>Standard value</b>	0.91	N/A

### Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]										HR efficiency	
	A	B	C	D	E	F	G	H	I	Zone	Standard	
<b>ID of system type</b>	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1			
<b>Standard value</b>	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1			
A1A2_Sales 1	-	-	-	-	-	-	-	0.3	-	-	N/A	

Zone name	General lighting and display lighting	General luminaire	Display light source	
		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m <sup>2</sup> ]
<b>Standard value</b>		95	80	0.3
A1A2_Sales 1		-	120	-

**The spaces in the building should have appropriate passive control measures to limit solar gains in summer**

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
A1A2_Sales 1	NO (-7%)	NO

## Regulation 25A: Consideration of high efficiency alternative energy systems

<b>Were alternative energy systems considered and analysed as part of the design process?</b>	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

# Technical Data Sheet (Actual vs. Notional Building)

## Building Global Parameters

	Actual	Notional
Floor area [m <sup>2</sup> ]	202	202
External area [m <sup>2</sup> ]	310	310
Weather	LON	LON
Infiltration [m <sup>3</sup> /hm <sup>2</sup> @ 50Pa]	3	3
Average conductance [W/K]	62	91
Average U-value [W/m <sup>2</sup> K]	0.2	0.29
Alpha value* [%]	21.76	6.76

\* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

## Building Use

% Area	Building Type
100	<b>Retail/Financial and Professional Services</b>
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

## Energy Consumption by End Use [kWh/m<sup>2</sup>]

	Actual	Notional
Heating	0.13	0.48
Cooling	3.7	3.58
Auxiliary	10.62	11.6
Lighting	10.29	12.76
Hot water	0.64	0.56
Equipment*	20.26	20.26
<b>TOTAL**</b>	<b>25.39</b>	<b>28.98</b>

\* Energy used by equipment does not count towards the total for consumption or calculating emissions.

\*\* Total is net of any electrical energy displaced by CHP generators, if applicable.

## Energy Production by Technology [kWh/m<sup>2</sup>]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>0</i>	<i>0</i>

## Energy & CO<sub>2</sub> Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m <sup>2</sup> ]	92.84	64.55
Primary energy [kWh/m <sup>2</sup> ]	37.27	42.57
Total emissions [kg/m <sup>2</sup> ]	3.39	3.87

## HVAC Systems Performance

System Type	Heat dem MJ/m <sup>2</sup>	Cool dem MJ/m <sup>2</sup>	Heat con kWh/m <sup>2</sup>	Cool con kWh/m <sup>2</sup>	Aux con kWh/m <sup>2</sup>	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity									
Actual	1.7	91.1	0.1	3.9	11.2	3.5	6.5	3.5	6.5
Notional	4.7	59.8	0.5	3.8	12.2	2.64	4.4	----	----

### Key to terms

Heat dem [MJ/m <sup>2</sup> ]	= Heating energy demand
Cool dem [MJ/m <sup>2</sup> ]	= Cooling energy demand
Heat con [kWh/m <sup>2</sup> ]	= Heating energy consumption
Cool con [kWh/m <sup>2</sup> ]	= Cooling energy consumption
Aux con [kWh/m <sup>2</sup> ]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

## Project name

**Podium Level Unit**

As designed

Date: Tue Nov 21 07:29:57 2023

## Administrative information

## Building Details

Address: Telcon Tower, Enderby Place, London,

## Certifier details

Name:

Telephone number:

Address: , ,

## Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.4"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.4

BRUKL compliance check version: v6.1.b.0

Foundation area [m<sup>2</sup>]: 11.23The CO<sub>2</sub> emission and primary energy rates of the building must not exceed the targets

Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> annum	3.87
Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> annum	2.35
Target primary energy rate (TPER), kWh/m <sup>2</sup> annum	42.57
Building primary energy rate (BPER), kWh/m <sup>2</sup> annum	25.23
Do the building's emission and primary energy rates exceed the targets?	BER =< TER   BPER =< TPER

## The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U <sub>a</sub> -Limit	U <sub>a</sub> -Calc	U <sub>i</sub> -Calc	First surface with maximum value
Walls*	0.26	0.18	0.18	External Wall
Floors	0.18	0.12	0.12	Ground Floor
Pitched roofs	0.16	-	-	No pitched roofs in project
Flat roofs	0.18	-	-	No flat roofs in project
Windows** and roof windows	1.6	-	-	No windows or roof windows in project
Rooflights***	2.2	-	-	No rooflights in project
Personnel doors <sup>^</sup>	1.6	-	-	No personnel doors in project
Vehicle access & similar large doors	1.3	-	-	No vehicle access or similar large doors in project
High usage entrance doors	3	-	-	No high usage entrance doors in project

U<sub>a</sub>-Limit = Limiting area-weighted average U-values [W/(m<sup>2</sup>K)]  
U<sub>a</sub>-Calc = Calculated area-weighted average U-values [W/(m<sup>2</sup>K)]  
U<sub>i</sub>-Calc = Calculated maximum individual element U-values [W/(m<sup>2</sup>K)]

\* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.  
\*\* Display windows and similar glazing are excluded from the U-value check. \*\*\* Values for rooflights refer to the horizontal position.  
<sup>^</sup> For fire doors, limiting U-value is 1.8 W/m<sup>2</sup>K  
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Whole building electric power factor achieved by power factor correction	>0.95

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<b>Standard value</b>	0.93*	N/A	N/A	2^	N/A
<b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>					YES
* Standard shown is for gas single boiler systems <=2 MW output and overall for multi-boiler systems. For single boiler systems >2 MW or any individual boiler in a multi-boiler system, limiting efficiency is 0.88.					
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Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES



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\* Energy used by equipment does not count towards the total for consumption or calculating emissions.

\*\* Total is net of any electrical energy displaced by CHP generators, if applicable.

## Energy Production by Technology [kWh/m<sup>2</sup>]

	Actual	Notional
Photovoltaic systems	8.25	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>8.25</i>	<i>0</i>

## Energy & CO<sub>2</sub> Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m <sup>2</sup> ]	92.84	64.55
Primary energy [kWh/m <sup>2</sup> ]	25.23	42.57
Total emissions [kg/m <sup>2</sup> ]	2.35	3.87

## HVAC Systems Performance

System Type	Heat dem MJ/m <sup>2</sup>	Cool dem MJ/m <sup>2</sup>	Heat con kWh/m <sup>2</sup>	Cool con kWh/m <sup>2</sup>	Aux con kWh/m <sup>2</sup>	Heat SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity									
Actual	1.7	91.1	0.1	3.9	11.2	3.5	6.5	3.5	6.5
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Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

**From:** Jonathan Lewis [REDACTED]  
**Subject:** Heat Network Connections Enquiry  
**Date:** 16 February 2021 at 11:00  
[REDACTED]@bellway.co.uk

---



[REDACTED]

Many thanks for your time on the phone just now.

Further to our call, I understand that the Bellway scheme River Gardens, just South of the Barratt scheme which in turn is directly South of our site, is nearing completion and that there is a site-specific heat network that has been engineered for the site's demands.

I'd be grateful if you could put me in touch with your technical manager so that I can understand a little more about the network.

With thanks

Johnny Lewis  
Director

JS Lewis Ltd  
2 Sully  
Bradford on Avon  
BA15 1FP



Registered Company No. 07066238  
VAT Registration No. 121 2714 62

**From:** Jonathan Lewis [REDACTED]  
**Subject:** Re: [EXT] Enderby Place - connecting to the existing District Heating network  
**Date:** 15 December 2020 at 14:35  
**To:** S [REDACTED]@eonenergy.com  
[REDACTED]@centroplan.co.uk



[REDACTED]

Thanks for your time on the phone last week and for the info you have already shared regarding heat tariffs etc. It was good to understand your position in more depth.

### Investment Proposal Request

Following up on our discussion, assumptions for you to use to work up an Investment Proposal below:

- Key dates - assume 2-3 yrs to be connection ready;
- Assume [REDACTED] mix assume as per Enderby Wharf;
- Assume Diversified [REDACTED] assuming cylinders in apartments [REDACTED]
- (Undiversified loads [REDACTED] or assuming cylinders in apartments);
- Assume contracting with CC for now and ownership 100pc within CC control;

### System Capacity

You were going to look at what excess capacity you might have - I think you estimated it as circa 90 units as things stand. Using the assumption at [REDACTED], I would need to know what the % heat provision split would be between gas boilers gas CHP (delivered kWh, not peak capacity in kW) once the energy centre had been enabled to supply both sites. This will allow me to assess the potential compliance issues (see below).

### Compliance Considerations

As discussed, the regulatory picture around DH is complex now - planning with GLA input is one consideration and for that we would need to prove that E.ON have an established strategy for decarbonising the heat network, and that it has been submitted to the GLA for approval. In reality, that would need to be done by E.ON asap if we are to use the SAP 2012 carbon factors on the basis of a connection to your system.

In addition to planning there would also be the Part L considerations. We would need to demonstrate compliance with Part L and therefore with the new SAP 10.1 factors - this is a far bigger risk for the site and makes your proposal difficult without any heat pump input into your network. There may be some kind of get-out clause in the new Part L for gas CHP but we haven't seen it yet so cannot rely upon that.

### Commercial Considerations

The IP should provide us with an indicative connection charge as far as I understand. The client would also need to be reassured that the commercial proposal for ongoing management and charging for occupants was appropriate. Part of this will be needing to go through the contracts required. Can you provide an example customer heat supply contract and an example contract that you would expect the developer/owner to sign to secure your interest in the site, and a list of any other agreements (adoption of pipe work/plant etc) that would need to be entered into?

### Alternative Option

Finally, as discussed, there may also be the option of a site-specific network fed by air source heat pumps and ancillary plant driven by compliance. Are you able to outline a separate proposal for maintenance and management of such a system, assuming no links to the Enderby Wharf system, based on the unit numbers provided?

Thanks again

Johnny Lewis  
Director

JS Lewis Ltd  
2 Sully  
Bradford on Avon  
BA15 1FP

[REDACTED]  
w. [www.jslewisltd.co.uk](http://www.jslewisltd.co.uk)

Registered Company No. 07066238  
VAT Registration No. 121 2714 62

On 7 Dec 2020, at 10: [REDACTED]

Thanks Luke.

**From:** Jonathan Lewis [REDACTED]  
**Subject:** Heat Network Enquiry - Morden Wharf  
**Date:** 20 November 2023 at 15:20  
**To:** [REDACTED]@amboll.co.uk

---



FAO Scott [REDACTED]

Dear Scott,

I note that you prepared the outline energy strategy for Morden Wharf on the Greenwich Peninsula. I am working on the adjacent Enderby Place site and am obliged by policy to enquire as to whether there would be the capacity to service our site with the proposed energy system you are anticipating for Morden Wharf. I would be grateful if you could confirm the following:

1. Whether your site has anticipated in its design a site-wide system only, or a system designed to service a wider catchment?
2. What opportunities and what barriers there might be to connecting the 2 sites from the outset?
3. Whether you can see an option in connecting the sites, both ambient loop solutions, to each other at some point in the future when a wider district network is available?

Many thanks in advance for your time.

Johnny Lewis  
Director

JS Lewis Ltd

Registered Company No. 07066238  
VAT Registration No. 121 2714 62

## Zeroth Apartment Heat Pump with integrated cylinder

### 4 and 6 KW Heating only models

The Zeroth Heat Pump comes in two sizes, 4kW and 6kW. The integrated cylinder is made from Stainless Steel with a Heat Pump mounted underneath, in a removable module. The outer casing is made from painted white steel formed around a rigid frame, with adjustable feet. The heat pump can produce heating or hot water very efficiently as it extracts energy from an energy loop at 25 degrees. The end user controls are mounted flush on the front and all pipework and cable entries are on the top of the unit, except for a drain hose (connected at the back) and the discharge which can be piped left or right, through the knockout.



Provides DHW and heating for new build dwellings

Compact unit with 550mm x 560mm footprint, ideal for integrated kitchen or cupboard installation

Stainless steel tank with no requirement for sacrificial anode.

Very quiet operation due to free swinging compressor base plate, inverter compressor, variable speed pumps, acoustic insulation and flexible pipework connections.

Use with an energy loop reduces overheating risk and improves building energy performance

Prewired and Pre-plumbed, simplifying the installation

Available with inbuilt source pump and 2 port valve or Cartridge PIC valve.

2 year manufacturers guarantee, which can be extended to 5 years.

		ZHP4H-180	ZHP6H-180
<b>Operating Limits</b>			
Heating water temperature (min/max)	°C	20/55	20/55
Energy loop temperature	°C	25	25
<b>Performance data / Flow rates</b>			
Heating output / CoP @ S25/W35	kW/CoP	4.0 / 9.3	6.4 / 8.4
Heating output / CoP @ S25/W55	kW/CoP	4.6 / 4.3	6.0 / 4.1
Heating output / CoP @ S20/W35	kW/CoP	4.2 / 8.0	6.2 / 7.2
Heating output / CoP @ S20/W55	kW/CoP	4.2 / 3.9	6.0 / 3.8
Heating output / CoP @ S15/W35	kW/CoP	4.1 / 6.5	6.2 / 6.0
Heating output / CoP @ S15/W55	kW/CoP	4.1 / 3.5	6.1 / 3.5
Nominal heating water flow rate	l/s	0.19	0.29
Available pump head @ nominal flow rate	kPa	54	35.5
<b>Source data / flow rates</b>			
Required capacity from loop @ S25/W35	kW	3.6	5.6
Nominal flow rate from loop	l/h	627	900
Maximum static pressure rating	Bar	10	10
<b>Dimensions, Weights and Filling quantities</b>			
Dimensions (w) x (d) x (h)	mm	550 x 560 x 2000	
Filled weight /weight without packaging (empty)	kg	353 / 178	
Loop / heating connections	mm	22 copper stub	
Drain discharge (19mm clear hose)	mm	1.5m length supplied loose	
Discharge (G3 T and P Valve)	mm	½" F BSP	
CWM inlet / DHW outlet connections	mm	22 copper stub	
IP rating		IPX4	
Expansion vessel (heating)	Litre	8	8
Refrigerant	Type/kg	R410A/1.05	R410A/1.05
Sound power level @ stand. rating condition	dB(A)	34	36
Noise rating	NR	35	35
<b>Electrical connections</b>			
Nominal Voltage/Phase/Frequency	V/P/Hz	230/1/50	230/1/50
Nominal power consumption @ S25/W35	kW	0.43	0.76
Maximum power consumption @ S25/W55	kW	1.06	1.46
Power Factor @ S25/W35	PF	0.98	0.98
Fuse protection (HP Module)	Rating	C 16A	
Immersion rating (cylinder)	kW	2.0	
Fuse protection (immersion)	Rating	B 10A	
Number of electrical supplies		2	
<b>Hot water cylinder</b>			
Type		Unvented	
Material / Insulation		Stainless Steel / EPS Foam	
T&P valve rating		7 Bar or 90°C	
Maximum water inlet pressure	bar	6	
Storage volume	L	172	
Mixed water at 40°C V40	L	709	
Declared ErP load profile		XXL	
Integrated electric immersion rating	kW	2.0	
Maximum temperature with immersion	°C	60	
Water regulations		G3 KIWA approval to EN12897	
T&P valve		Factory fitted	
Standing heat loss EN12897-2016 (KIWA)	kWh/24	1.97	
Standing heat loss EN15332-2007 (SAP)	kWh/24	1.63	
Cylinder heat up time (from 10 to 60°C)	hrs	2.75	2.0
Accessories Supplied Loose		Tundish, discharge pipework, 1.5m hose, adjustable feet	

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The Zeroth Heat Pump comes in two sizes, 4kW and 6kW. The integrated cylinder is made from Stainless Steel with a Heat Pump mounted underneath, in a removable module. The outer casing is made from painted white steel formed around a rigid frame, with adjustable feet. The heat pump can produce heating, cooling or hot water very efficiently as it extracts energy from an energy loop at 25 degrees. The end user controls are mounted flush on the front and all pipework and cable entries are on the top of the unit, except for a drain hose (connected at the back) and the discharge which can be piped left or right, through the knockout.



Provides DHW, heating and cooling for new build dwellings

Energy recovery features as standard by utilising simultaneous cooling and DHW

Compact unit with 550mm x 560mm footprint, ideal for integrated kitchen or cupboard installation

Stainless steel tank with no requirement for sacrificial anode.

Very quiet operation due to free swinging compressor base plate, inverter compressor, variable speed pumps, acoustic insulation and flexible pipework connections.

Use with an energy loop reduces overheating risk and improves building energy performance

Prewired and Pre-plumbed, simplifying the installation

Available with inbuilt source pump and 2 port valve or Cartridge PIC valve.

2 year manufacturers guarantee, which can be extended to 5 years.

		ZHP4C-180	ZHP6C-180
<b>Operating Limits</b>			
Heating water temperature (min/max)	°C	20/55	20/55
Cooling water temperature (min/max)	°C	8/25	8/25
Energy Loop Temperature	°C	25	25
<b>Performance data / Flow rates</b>			
Heating output / CoP @ S25/W35	kW/CoP	4.0 / 9.3	6.4 / 8.4
Heating output / CoP @ S25/W55	kW/CoP	4.6 / 4.3	6.0 / 4.1
Heating output / CoP @ S20/W35	kW/CoP	4.2 / 8.0	6.2 / 7.2
Heating output / CoP @ S20/W55	kW/CoP	4.2 / 3.9	6.0 / 3.8
Heating output / CoP @ S15/W35	kW/CoP	4.1 / 6.5	6.2 / 6.0
Heating output / CoP @ S15/W55	kW/CoP	4.1 / 3.5	6.1 / 3.5
Cooling output/EER @ S25/W10	kW/CoP	4.0 / 5.1	4.4 / 5.1
Nominal heating/cooling water flow rate	l/s	0.19	0.29
Available pump head @ nominal flow rate	kPa	54	35.5
<b>Source data / flow rates</b>			
Required capacity from loop (heat) @ S25/W35	kW	3.6	5.6
Required capacity from loop (cool) @ S25/W10	kW	4.8	5.3
Nominal flow rate from loop	l/h	627	900
Maximum static pressure rating	Bar	10	10
<b>Dimensions, Weights and Filling quantities</b>			
Dimensions (w) x (d) x (h)	mm	550 x 560 x 2000	
Filled weight / Weight without packaging (empty)	kg	353 / 178	
Loop / Heating & Cooling connections	mm	22 copper stub	
Drain discharge (19mm clear hose)	mm	1.5m length supplied loose	
Discharge (G3 T and P Valve)	mm	½" F BSP	
CWM inlet / DHW outlet connections	mm	22 copper stub	
IP rating		IPX4	
Expansion vessel (heating)	Litre	8	8
Refrigerant	Type/kg	R410A/1.05	R410A/1.05
Sound power level @ stand. rating condition	dB(A)	34	36
Noise rating	NR	35	35
<b>Electrical connections</b>			
Nominal Voltage / Phase / Frequency	V/P/Hz	230/1/50	230/1/50
Nominal power consumption @ S25/W35	kW	0.43	0.76
Maximum power consumption @ S25/W55	kW	1.06	1.46
Power Factor @ S25/W35	PF	0.98	0.98
Fuse protection (HP Module)	Rating	C 16A	
Immersion rating (cylinder)	kW	2.0	
Fuse protection (immersion)	Rating	B 10A	
Number of electrical supplies		2	
<b>Hot water cylinder</b>			
Type		Unvented	
Material /Insulation		Stainless Steel / EPS Foam	
T&P valve rating		7 Bar or 90°C	
Maximum water inlet pressure	bar	6	
Capacity	L	172	
Mixed water at 40°C V40	L	709	
Declared ErP load profile		XXL	
Integrated electric immersion		2.0	
Maximum temperature with immersion	°C	60	
Water regulations		G3 KIWA approval to EN12897	
T&P valve		Factory fitted	
Standing heat loss EN12897-2016 (KIWA)	kWh/24	1.97	
Standing heat loss EN15332-2007 (SAP)	kWh/24	1.63	
Cylinder heat up time (from 10 to 60°C)	hrs	2.75	2.0
Accessories Supplied Loose		Tundish, discharge pipework, 1.5m hose, adjustable feet	



*Changes for the Better*

HOT WATER HEAT PUMP

for a greener tomorrow



MODEL

# CAHV-P500YA-HPB(-BS)

Heating only air to water heat pump

## DATA BOOK

UK ver. 2



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------------------------------	----

# I | Product Specifications

## 1. Specifications

Model			CAHV-P500YA-HPB (-BS)
Power Source			3-phase 415v, 50Hz
Capacity *1 A7/W45		kW	45
	Power input	kW	12.9
	Current input (MAX)	A	19.94 (52.9)
	COP (kW / kW)		3.49
Capacity *2 A7/W35		kW	45
	Power input	kW	10.9
	Current input (MAX)	A	17.6 (52.9)
	COP (kW / kW)		4.13
Capacity *3 A-3/W35		kW	43
	Power input	kW	15.2
	Current input (MAX)	A	24.58 (52.9)
	COP (kW / kW)		2.8
Maximum current input *4			A
Water pressure drop *1			18kPa
Temp. range	Outlet water temp *5		25~70°C 77~158°F
	Outdoor temp *5	D.B	-20~40°C -4~104°F
Circulating water volume range			7.5 m³/h - 15.0m³/h
Sound Pressure level (measured in anechoic room) *1 at 1m *6			dB (A)
Sound Pressure level (measured in anechoic room) *1 at 10m *6			dB (A)
Diameter of water pipe	Inlet	mm (in)	38.1 (Rc 1 1/2") screw
	Outlet	mm (in)	38.1 (Rc 1 1/2") screw
External finish			Acrylic painted steel plate <MUNSELL 5Y 8/1 or similar>
External dimension H × W × D			mm in.
Net weight			kg (lb)
Accessories			Y strainer Rc 1 1/2
Design Pressure	R407C	MPa	3.85
	Water	MPa	1.0
Drawing	Wiring		KC94G268X01
	External		KC94G195X01
Heat exchanger	Water side		stainless steel plate and copper brazing
	Air side		Plate fin and copper tube
Compressor	Type		Inverter scroll hermetic compressor
	Manufacture		MITSUBISHI ELECTRIC CORPORATION
	Starting method		Inverter
	Motor output	kW	7.5 × 2
	Case heater	kW	0.045 × 2
	Lubricant		MEL32
	FAN		
Air flow rate	m³/min		185 × 2
	L/s		3,083 × 2
	cfm		6,532 × 2
External static press *7			0Pa, 60Pa (0mmH <sub>2</sub> O/6.1mmH <sub>2</sub> O)
Type × Quantity			Propeller fan × 2
Control, Driving mechanism			Inverter-control, Direct-driven by motor
Motor output			kW
HIC circuit (HIC:Heat inter-Changer)			Copper pipe
Protection	High pressure protection		High pres.Sensor & High pres.Switch at 3.85MPa
	Inverter circuit		Over-heat protection, Over current protection
	Compressor		Over-heat protection
	Fan motor		Thermal switch
Defrosting method			Auto-defrost mode (Reversed refrigerant circle)
Refrigerant	Type × original charge		R407C × 5.5(kg) × 2
	Control		LEV and HIC circuit

\*1 Under Normal heating conditions at outdoor temp. 7°CDB/6°CWB/ outlet water temp 45°C, inlet water temp 40°C.

\*2 Under Normal heating conditions at outdoor temp. 7°CDB/6°CWB/ outlet water temp 35°C, inlet water temp 30°C. as tested to BS EN14511. Power factor 86%.

\*3 Under Heating conditions at outdoor temp. -3°CDB/-2°CWB, outlet water temp 35°C.

\*4 MCB fuse size and all electrical work should be completed in line with IEE regulations.

\*6 Sound power level 70.7dB(A) tested to BS EN12102

\*7 Dip SW on the unit control board needs to be changed.

\* Due to continuing improvement, the above specifications may be subject to change without notice.

\* Please don't use the steel material for the water piping material.

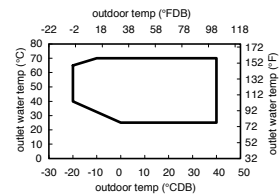
\* Please always make water circulate or pull out the circulation water completely when not using it.

\* Please do not use groundwater and well water.

\* Install the unit in an environment where the wet bulb temp. will not exceed 32°C.

\* The water circuit must use the closed circuit.

\*5



Outdoor temp -20°CDB/ Outlet water temp 40-65°C  
(Outdoor temp -4°FDB/ Outlet water temp 104°F-149°F)  
Outdoor temp -10°CDB/ Outlet water temp 33°C-70°C  
(Outdoor temp 14°FDB/ Outlet water temp 91°F-158°F)  
Outdoor temp 0°CDB/ Outlet water temp 25°C-70°C  
(Outdoor temp 32°FDB/ Outlet water temp 77°F-158°F)

Unit converter

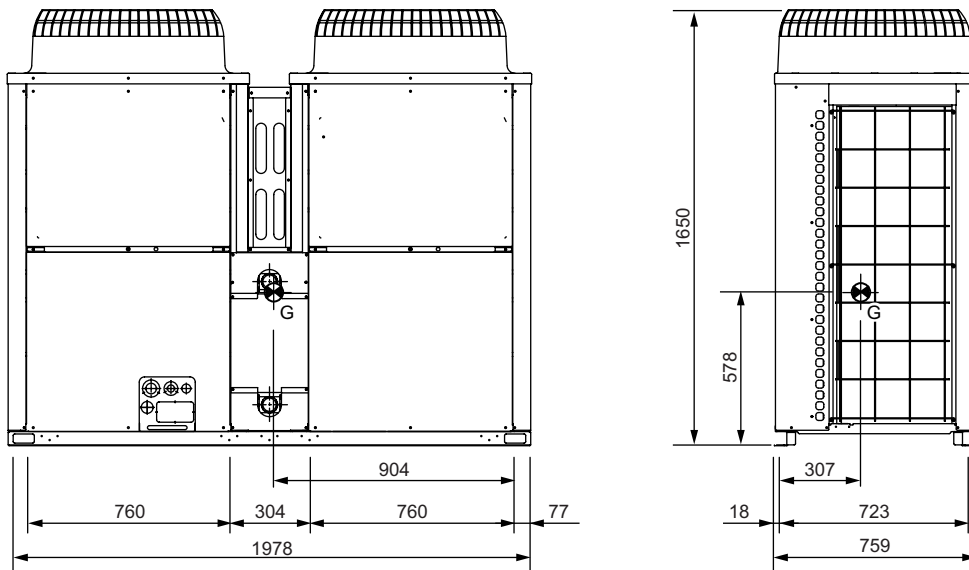
kcal = kW x 860  
BTU/h = kW x 3,412  
cfm = m³/min x 35.31  
lb = kg/0.4536



### 3. Center of Gravity

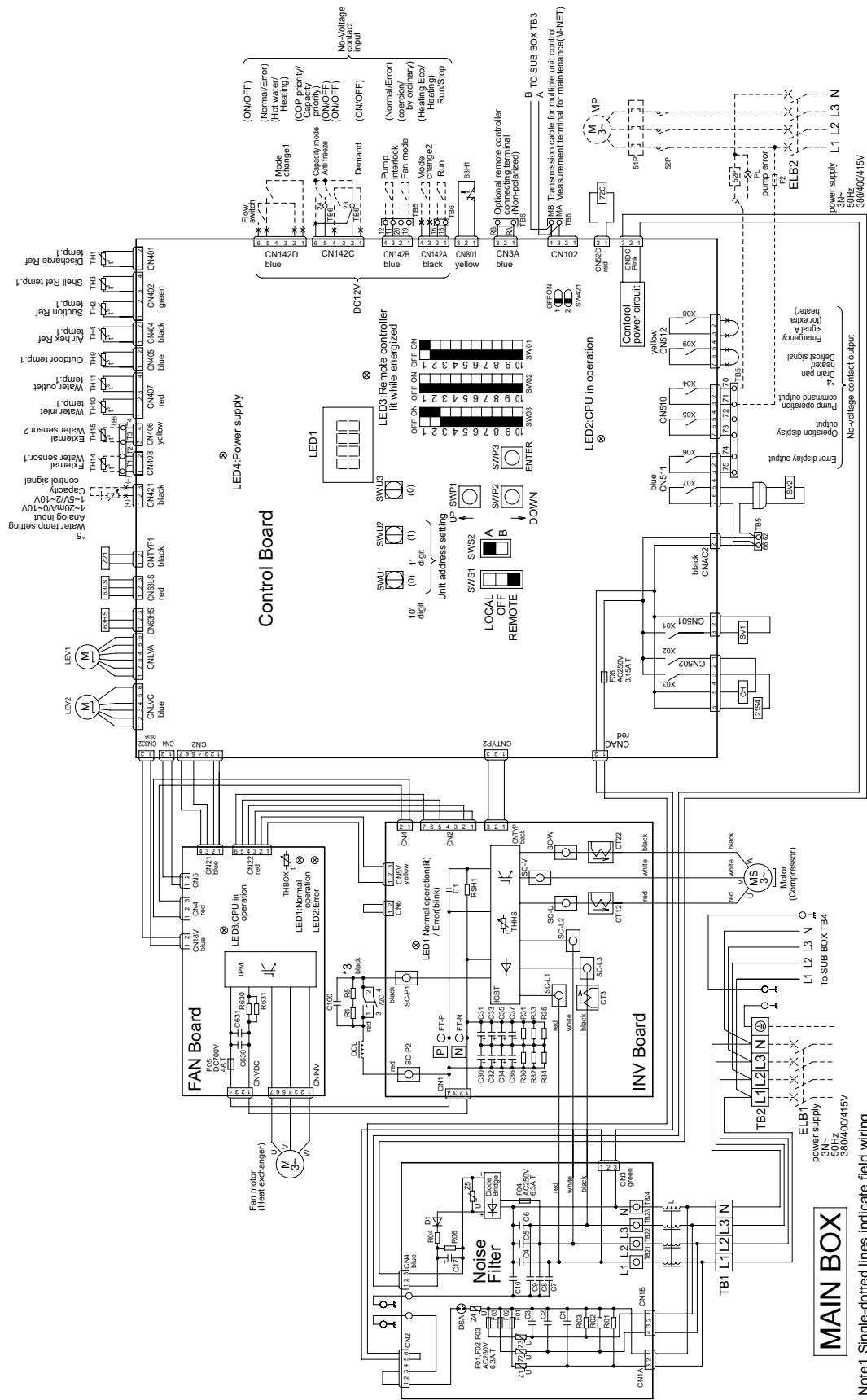
- CAHV-P500YA-HPB(-BS)

Unit: mm



## 4. Electrical Wiring Diagrams

- CAHV-P500YA-HPB(-BS)

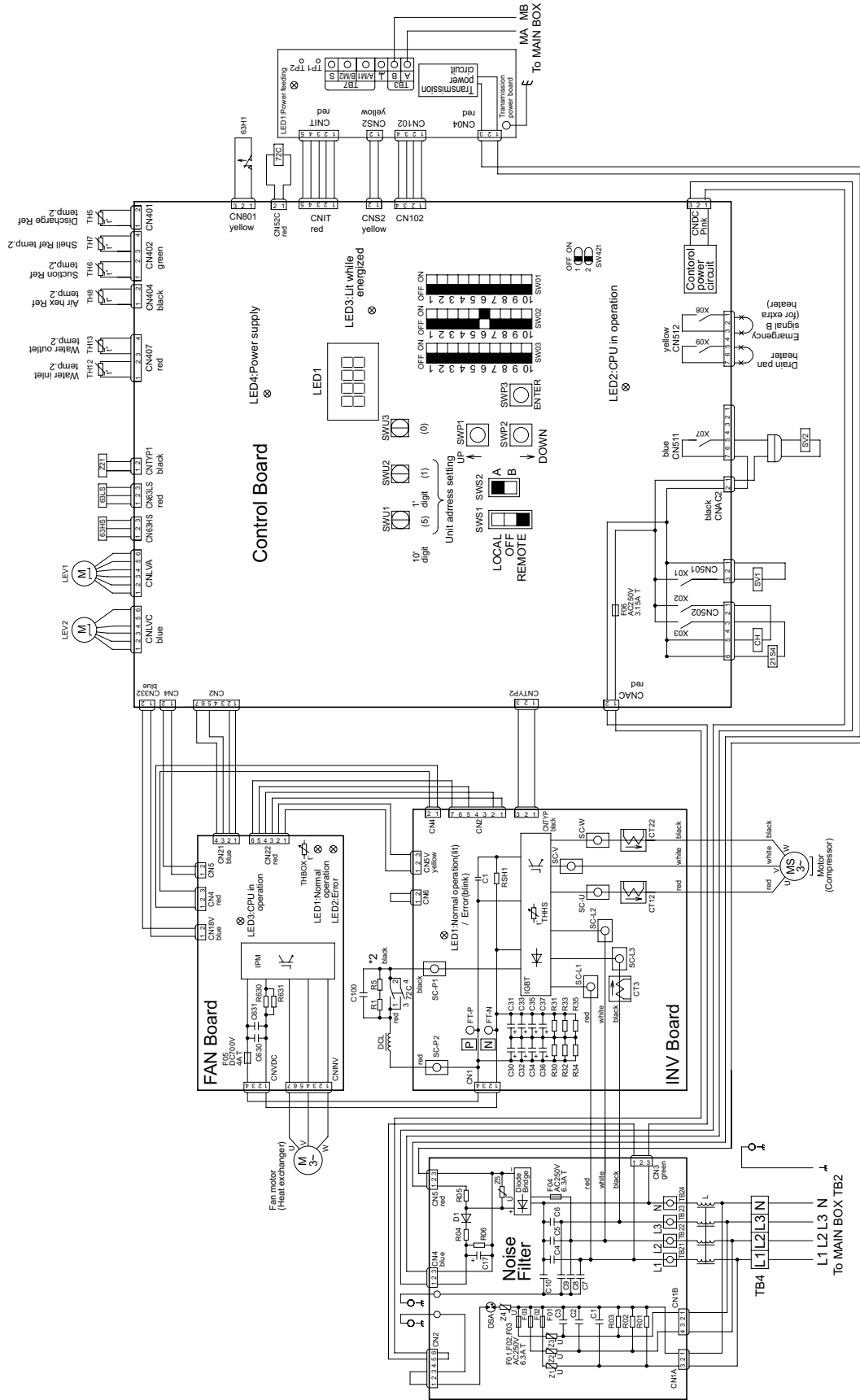


**Note 1:** Single-dotted lines indicate field wiring.  
**Note 2:** The symbols of the field connecting terminals are as follows.  
 ○: Terminal block    ×: Connection by cutting the short circuit wire  
**Note 3:** Fan terminals have a locking function.  
 Press the tab in the middle of the terminals to remove them.  
 Check that the terminals are securely locked in place after insertion.  
**Note 4:** Selects either Drain pan signal or Defrost signal by SW2 and SW3 settings. (Item code 1056)

**Note 5:** Selects either Water temperature setting input signal or Capacity control input signal by SW2 and SW3 settings. (Item code 1057)

Due to continuing improvement, the above specifications may be subject to change without notice.

• CAHV-P500YA-HPB(-BS)



**SUB BOX**

Note1: Single-dotted lines indicate field wiring.  
 Note2: Fanion terminals have a locking function.  
 Press the tab in the middle of the terminals to remove them.  
 Check that the terminals are securely locked in place after insertion.

Symbol explanation

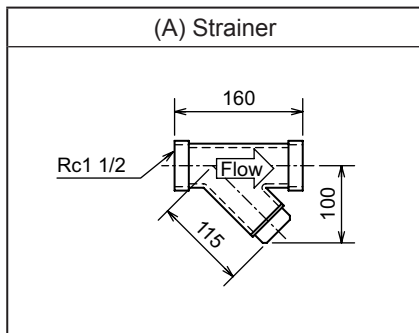
Symbol	explanation
CH	Crankcase heater (for heating the compressor)
CT12	
CT22	Ac current sensor
CT3	
C100	Capacitor (Electrolysis)
DCL	DC reactor
F01	
F02	
F03	
F04	Fuse
F05	
F06	
LEV1	Electronic expansion valve (Main circuit)
LEV2	Electronic expansion valve (Injection)
M	Fan motor
MS	Compressor motor
R1	Electrical resistance
R5	
SV1	Solenoid valve (Injection circuit)
SV2	Solenoid valve (Hot gas circuit)
THHS	IGBT temperature
Z21	Function setting connector
Z1S4	4-way valve
63HS	High pressure sensor
63H1	High pressure switch
63LS	Low pressure sensor
72C	Electromagnetic relay (Inverter main circuit)
TH1~4	
TH9~11	Thermistor
TH14	
TH6~8	Thermistor
TH12,13	
<ELB1,2,3>	Earth leakage breaker
<F2,3>	Fuse
<MP>	Pump motor
<S1P>	Overcurrent relay (Pump)
<S2P>	Electromagnetic contactor (Pump)

Note

- The broken lines indicate the optional parts, field-supplied parts, and field work.
- Make sure to connect a pump interlock contact.  
A short-circuit may cause abnormal stop or malfunctions.
- Operation signals can be received from the remote controller or through the dry contact. The temperature setting can be changed by a signal received through the dry contact or by using the schedule setting.
- Leave a space of at least 5 cm between the low voltage external wiring (no-voltage contact input and remote controller wiring) and wiring of 100V or greater. Do not place them in the same conduit tube or cable tray as this will damage the circuit board.
- When cable tray is used for the control cable wiring, use a separate cable tray for the following wiring.  
Using the same cable tray may cause malfunctions and damage to the unit.  
(a) Optional remote controller wiring  
(b) No-voltage contact input wiring  
(c) No-voltage contact output wiring  
(d) Remote water temperature setting
- Use a contact that takes 12VDC 5mA for no-voltage contact input.

## 5. Accessories

- CAHV-P500YA-HPB(-BS)

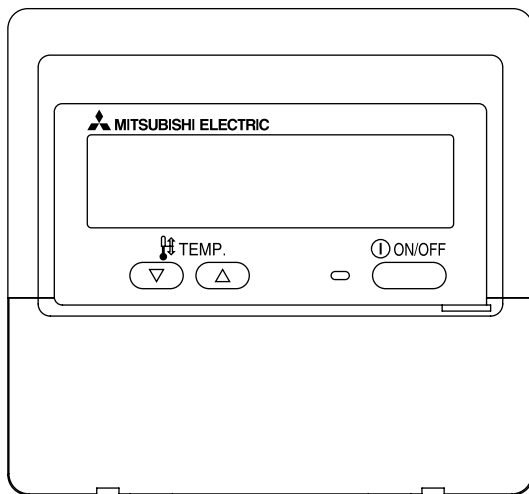


(A) Install the strainer at the water pipe inlet.

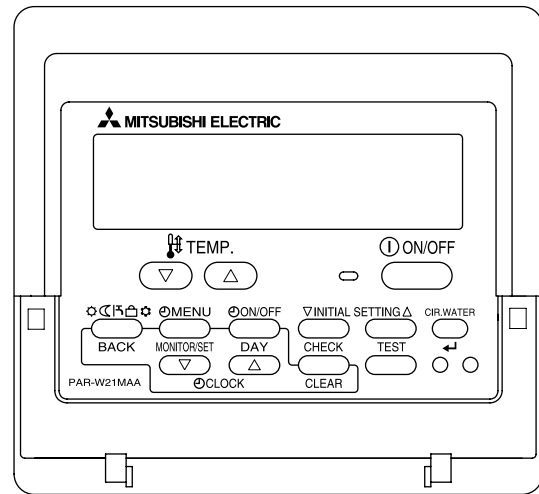
## 6. Optional parts

- (1) Remote controller PAR-W21MAA

Refer to Chapter VI "Controller", section 1. "PAR-W21MAA specifications".



Panel closed



Panel open



## (2) Representative-water temperature sensor TW-TH16

### (2)-1 Required parts for installing a representative-water temperature sensor

- Ⓐ Representative-water temperature sensor
  - Ⓑ Cable for connecting between the sensor and the unit\*
  - Ⓒ Cable terminal for connecting to the sensor and the unit terminal block\*  
(Terminals for M4 screws x 4)\*
- \* Ⓐ and Ⓑ are field-supplied.

#### Cable specifications

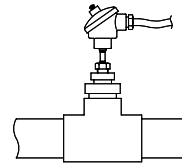
Size	2-core, 1.25 mm <sup>2</sup> or larger
Type	CVVS or CPEVS
Length	20m

### (2)-2 Installing a representative-water temperature sensor

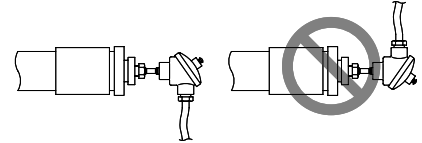
As shown in the figures at right, install the sensor at the merged part of water pipes or the load-side tank.

The sensor can be installed in either the vertical or the horizontal position.

When installing the sensor in the horizontal position, make sure to place the cable-access-hole side down.



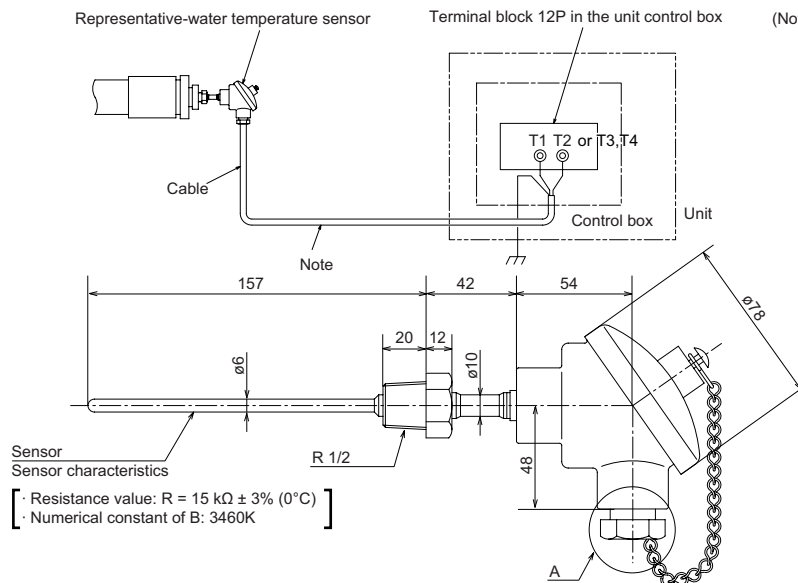
Vertical installation



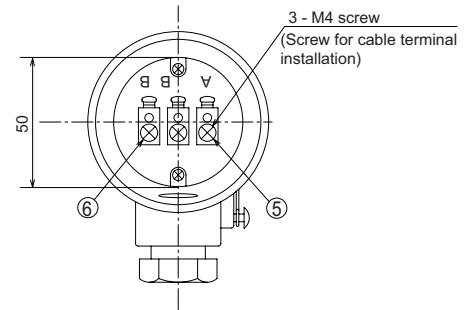
Horizontal installation

### (2)-3 Wiring for a representative-water temperature sensor

As shown in the figures below, connect the cable to the representative-water temperature sensor and the terminal block in the unit control box.



(Note) Install the sensor cable at least 5 cm away from the power cable to which 100 V or higher voltage is applied.



Terminal block on the sensor

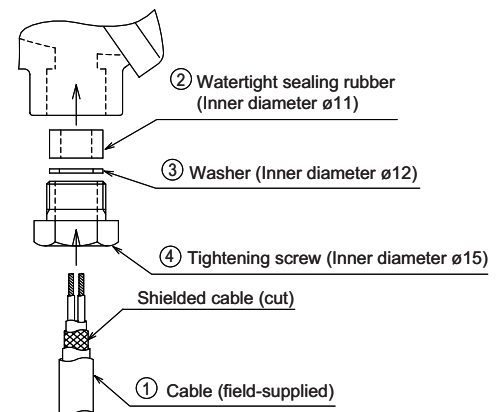
On the unit side, connect the sensor cable to the terminals T1 and T2 in the terminal block 12P in the unit control box.

Connect the shielded cable to the ground terminal.

On the sensor side, as shown in the figure at right, run the cable through ④, ③, and ②, attach the field-supplied terminals for M4 screws to the cable, and then connect the terminals to the screws ⑤ and ⑥ (terminal A and B).

Cut the shielded cable and leave it unconnected. (On the unit side, the shielded cable should be connected to the ground terminal already.)

Tighten the tightening screw ④, and caulk the gap between the tightening screw ④ and cable ① to prevent water leakage.



Enlarged view of area A: Cable installation

## II Product Data

### 1. Capacity tables

#### (1) Correction by temperature

##### • CAHV-P500YA-HPB(-BS)

##### (1)-1 Efficiency Priority Mode

##### • Capacity

		Intake air temperature °C															
		-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
Outlet water temperature °C	35	-	-	40.3	42.2	42.4	42.7	42.8	43.5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	45	32.0	37.4	40.6	42.4	42.6	42.9	43.0	43.5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	55	32.2	37.7	40.8	42.7	42.8	43.1	43.2	43.6	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	60	32.2	37.8	40.9	42.8	42.9	43.2	43.3	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	65	32.2	37.9	41.0	42.9	43.0	43.3	43.4	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	70	-	-	41.1	43.0	43.1	43.4	43.5	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

This table shows the capacity when the relative humidity is 85%.

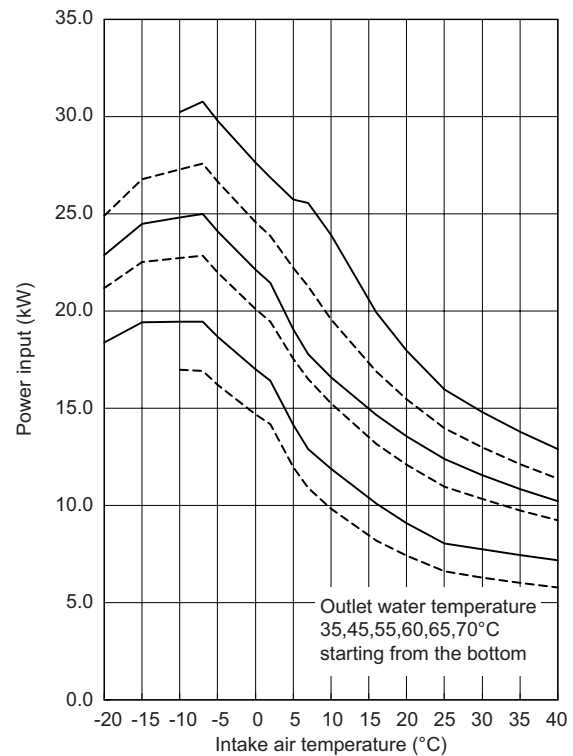
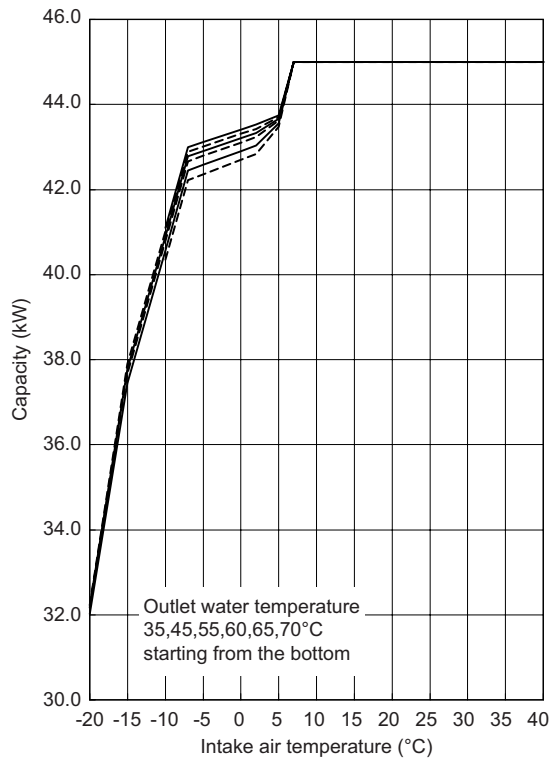
The intake wet-bulb temperature is fixed to 32°C when the intake dry-bulb temperature is 35°C or higher.

##### • Power input

		Intake air temperature °C															
		-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
Outlet water temperature °C	35	-	-	17.0	16.9	16.2	14.7	14.2	12.0	10.9	9.82	8.20	7.40	6.60	6.30	6.02	5.77
	45	18.4	19.4	19.4	19.5	18.7	17.0	16.4	14.2	12.9	11.9	10.1	9.08	8.05	7.73	7.44	7.17
	55	21.2	22.5	22.7	22.8	22.0	20.1	19.5	17.5	16.5	15.2	13.2	12.1	11.0	10.3	9.75	9.24
	60	22.9	24.5	24.8	25.0	24.1	22.1	21.4	19.1	17.8	16.6	14.7	13.6	12.4	11.6	10.8	10.2
	65	24.9	26.8	27.3	27.6	26.7	24.6	23.9	22.2	21.3	19.6	16.9	15.4	14.0	13.0	12.1	11.4
	70	-	-	30.2	30.8	29.8	27.6	26.9	25.7	25.6	23.9	19.9	18.0	16.0	14.8	13.8	12.9

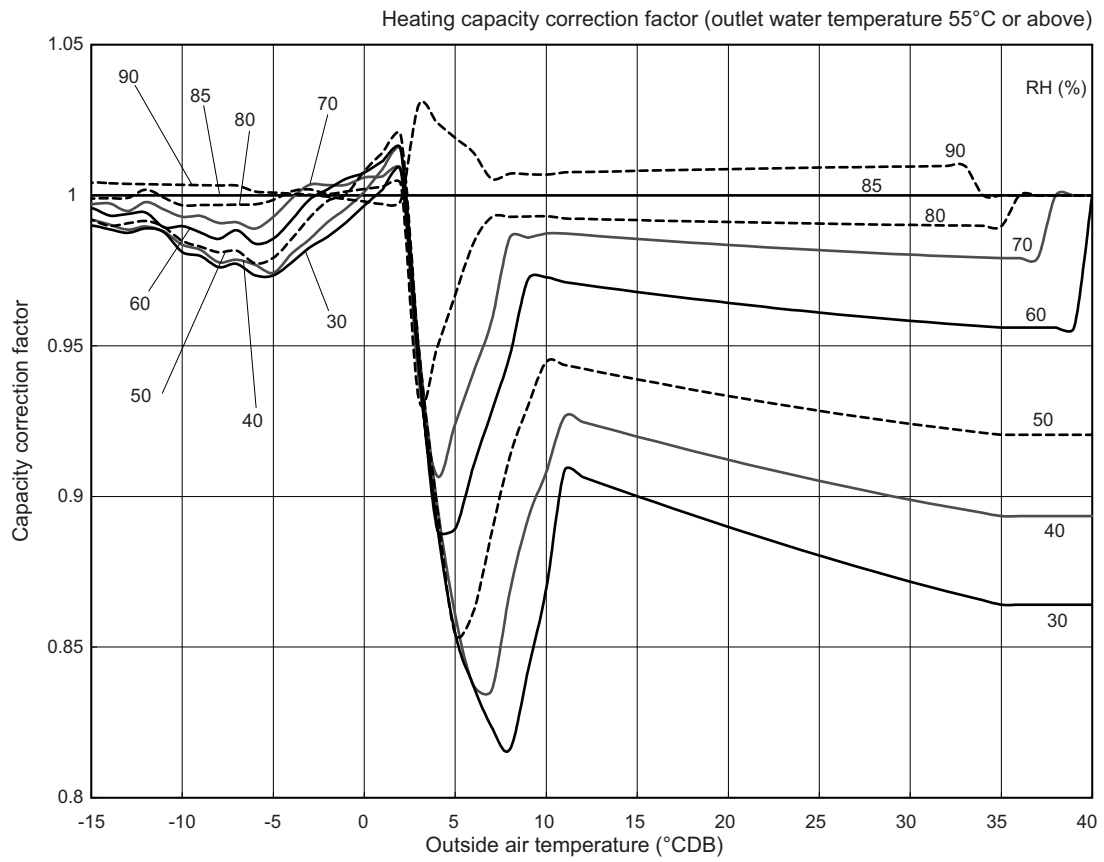
This table shows the power input when the relative humidity is 85%.

The intake wet-bulb temperature is fixed to 32°C when the intake dry-bulb temperature is 35°C or higher.



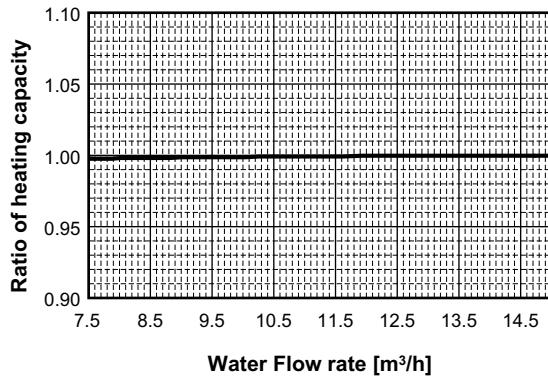
(2) Correction by relative humidity

• CAHV-P500YA-HPB(-BS)

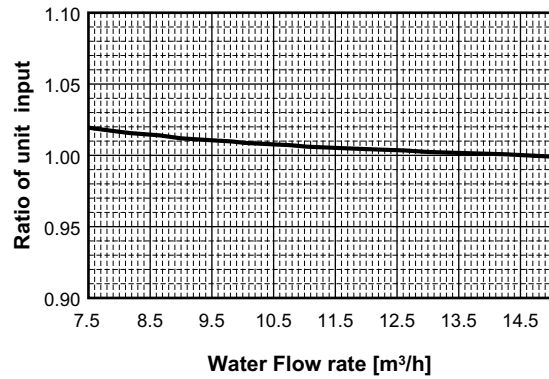


(3) Correction by water flow rate

- CAHV-P500YA-HPB(-BS)



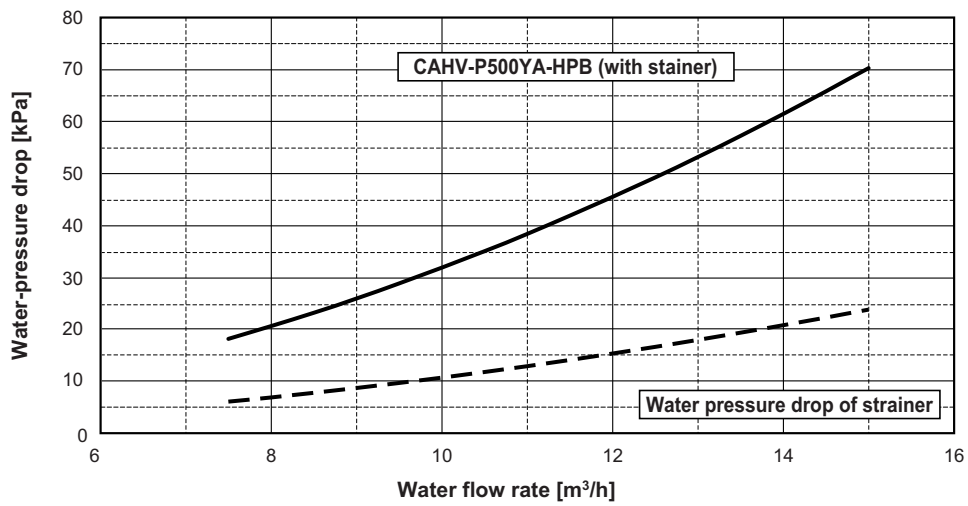
\*Conditions Outdoor temperature 0°C  
Intake water temperature 65°C  
Frequency of compressor 100Hz



\*Conditions Outdoor temperature 0°C  
Intake water temperature 50°C  
Frequency of compressor 100Hz

(4) Water pressure drop

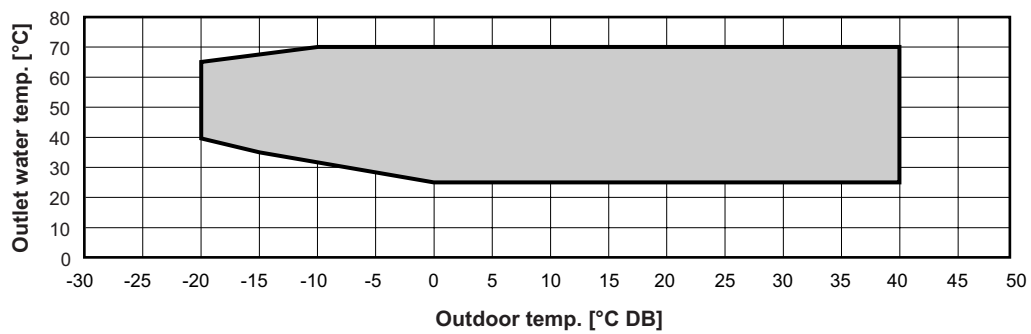
- CAHV-P500YA-HPB(-BS)



(5) Operation temperature range

- CAHV-P500YA-HPB(-BS)

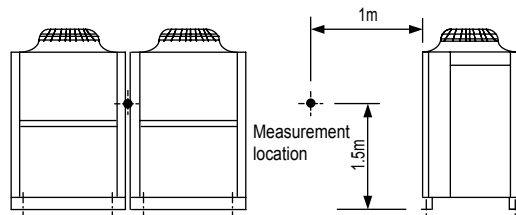
Heating



## 2. Sound pressure levels

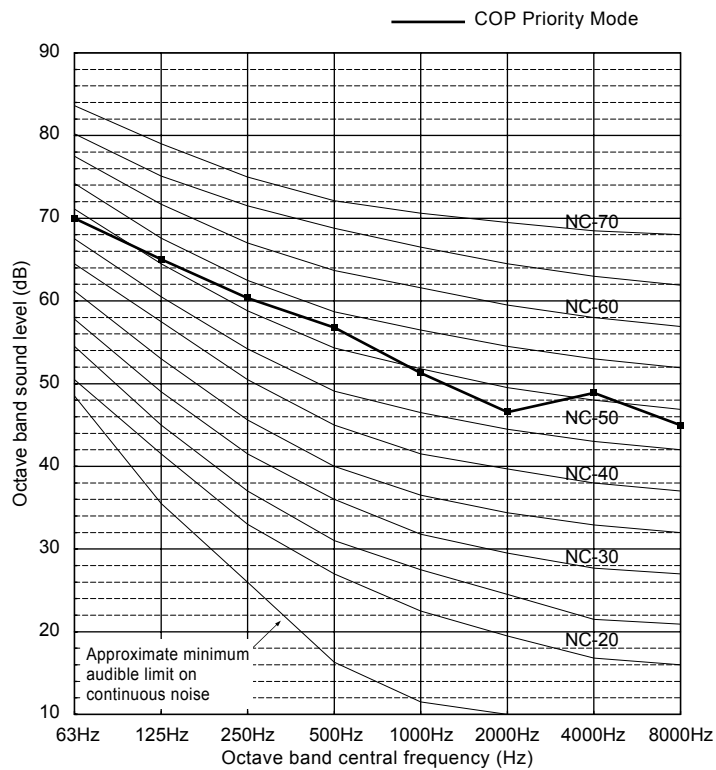
Measurement condition

- CAHV-P500YA-HPB(-BS)



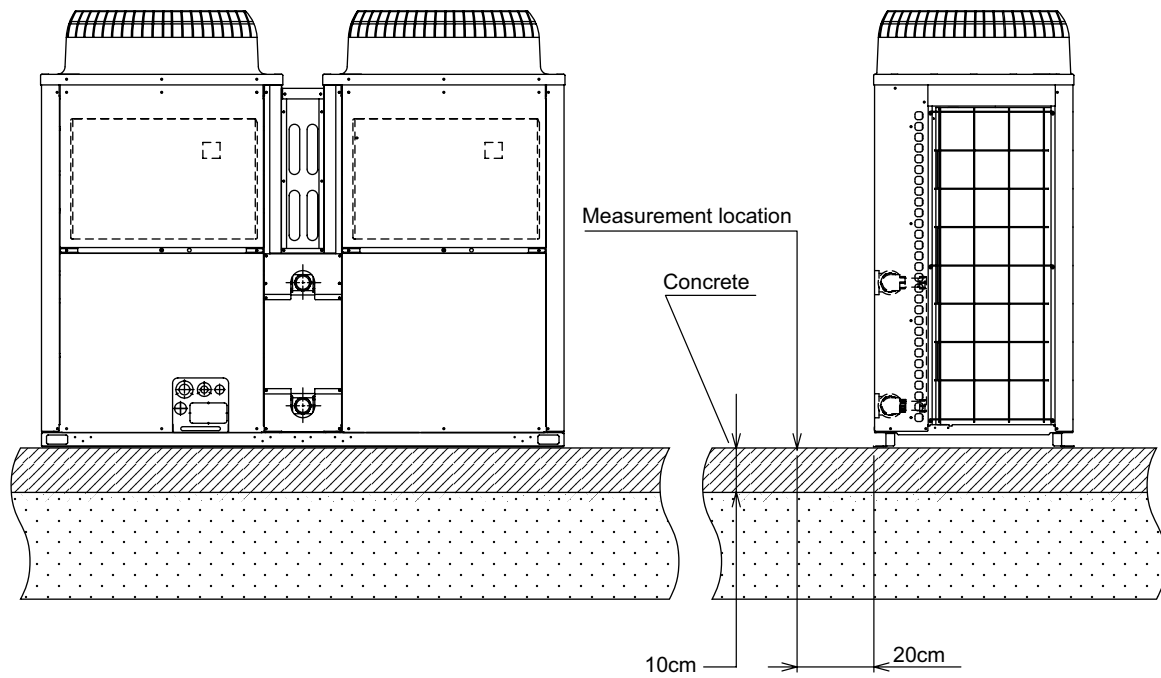
### Sound Pressure Level: 59.0 (COP Priority Mode)

Operation condition... Spring, Autumn: Outdoor temp.: 16°CDB/12°CWB, Inlet water temp.: 40°C, Outlet water temp.: 45°C  
 Winter: Outdoor temp.: 7°CDB/ 6 °CWB, Inlet water temp.: 65°C, Outlet water temp.: 70°C



### 3. Vibration levels

- CAHV-P500YA-HPB(-BS)



Model	Vibration Levels [dB]
CAHV-P500YA-HPB(-BS)	47 or less

# III | Installation

## 1. Selecting the Installation Site

### (1) Installation conditions

**Select the installation site in consultation with the client.**

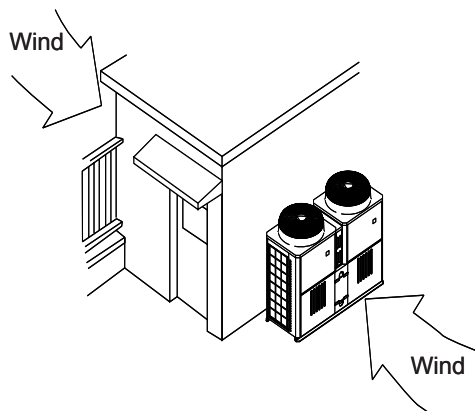
Select a site to install the outdoor unit that meets the following conditions:

- The unit will not be subject to heat from other heat sources.
- The noise from the unit will not be a problem.
- The unit will not be exposed to strong winds.
- Water from the unit can be drained properly.
- The space requirements (specified on page 17) are met.

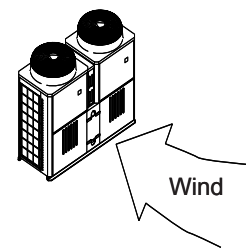
#### (1)-1. Providing protection against winds

Using the figures at right as a reference, provide adequate protection against winds.

A unit installed alone is vulnerable to strong winds. Select the installation site carefully to minimize the effect of winds. When installing a unit in a place where the wind always blows from the same direction, install the unit so that the outlet faces away from the direction of the wind.



- Install the outdoor unit in a place where it is not exposed to direct wind, such as behind a building.



- Install the outdoor unit so that the outlet/inlet faces away from the wind.

#### (1)-2. Cold Climate Installation

Observe the following when installing the units in areas where snow or strong winds prevail.

- Avoid direct exposure to rain, winds, and snow.
- When deciding the high of the unit stand for snow damage prevention, consider the snow accumulation.
- There is a possibility that an icicle may form under the unit stand. Consider this when installing the unit on the roof for this may injure person or the property.
- If the units are installed in the direct line of rain, winds, or snow, install the optional snow hood (on both the discharge and suction ducts). Use a snow net or snow fence as necessary to protect the unit.
- Install the unit on a base approximately twice as high as the expected snowfall.
- If the unit is continuously operated for a long time with the outside air temperature below the freezing point, install a heater at the base of the unit to prevent the water from freezing at the unit bottom.

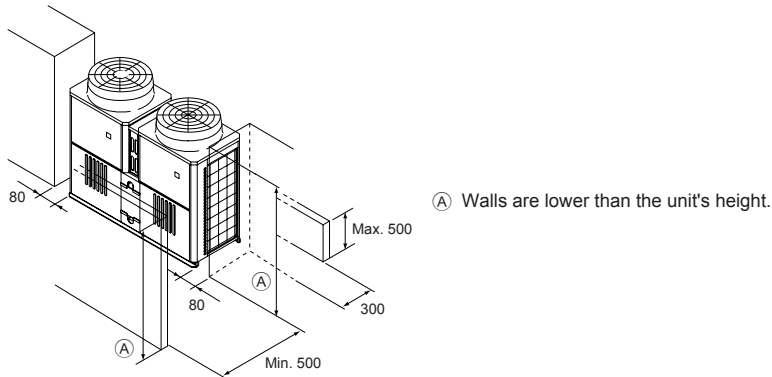
(2) Installation space requirements

(2)-1. Single unit installation

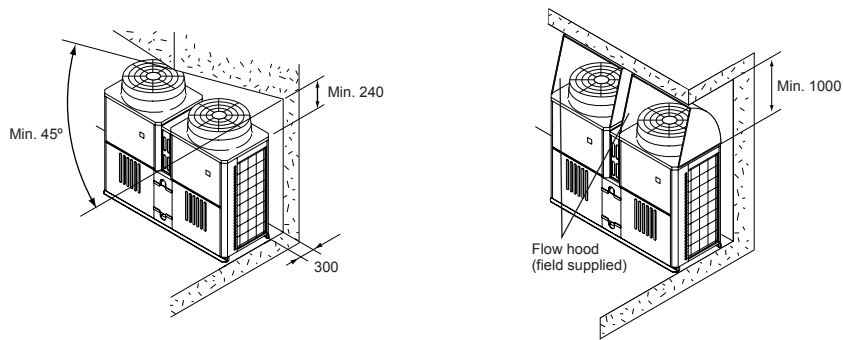
Secure enough space around the unit as shown in the figures below.

<Unit: mm>

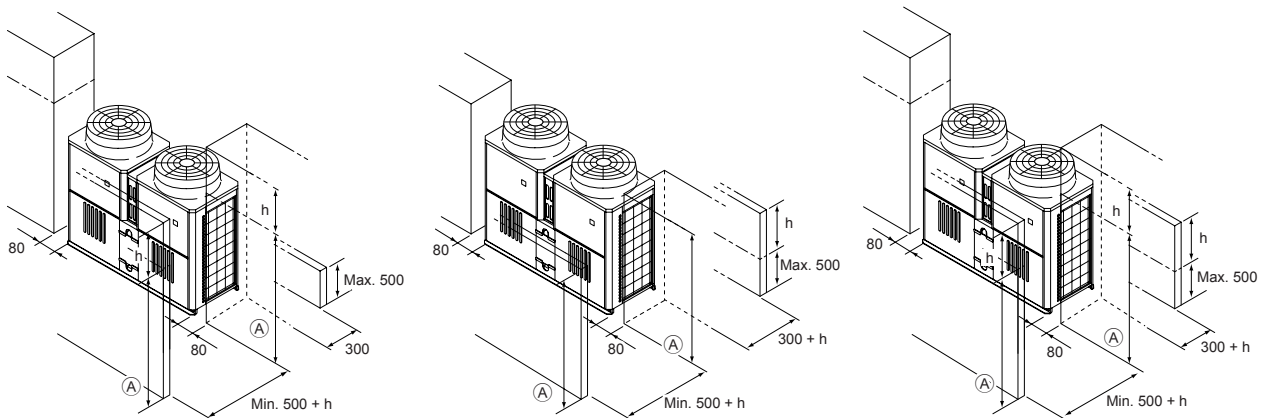
(2)-1-1. Walls around the unit do not exceed the height limit.



(2)-1-2. There is a wall above the unit.



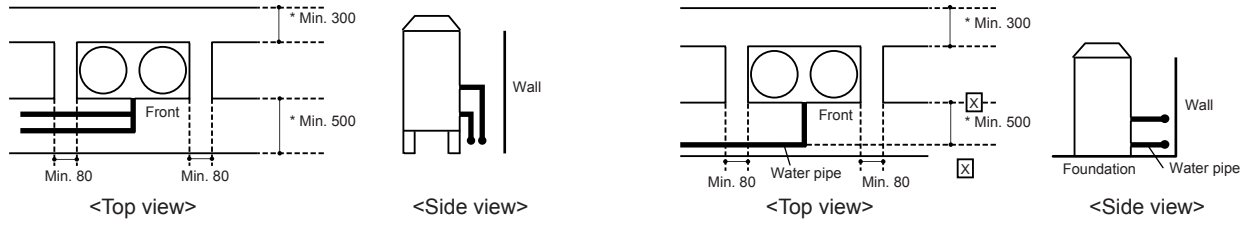
(2)-1-3. One or more of the walls around the unit are taller than the maximum allowable height <math>h</math>.



Ⓐ Walls are lower than the unit's height.



(2)-1-4. Water pipe installation



Leave a space of at least 500 between the unit and the water pipe if it is not possible to install the unit on a raised foundation. (SEE ☒ in the figure.)

(2)-2. Grouped and side-by-side installation

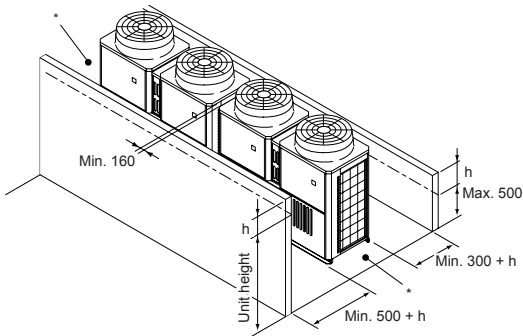
When multiple units are installed adjacent to each other, allow enough space for air circulation and a walk way between groups of units as shown in the figures below.

\* Leave both sides of each group of units open.

As with individual installation, if the wall height exceeds the height limit, widen the space in the front and the back of a given group of units by the amount that exceeds the limit (labeled <math>h</math> in the figure).

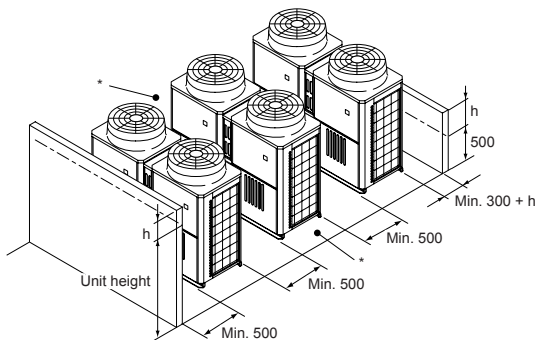
<Unit: mm>

(2)-2-1. Side-by-side installation

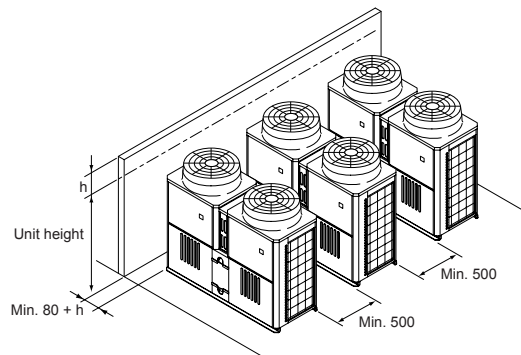


(2)-2-2. Face-to-face installation

- There are walls in the back and the front of a given group of units.

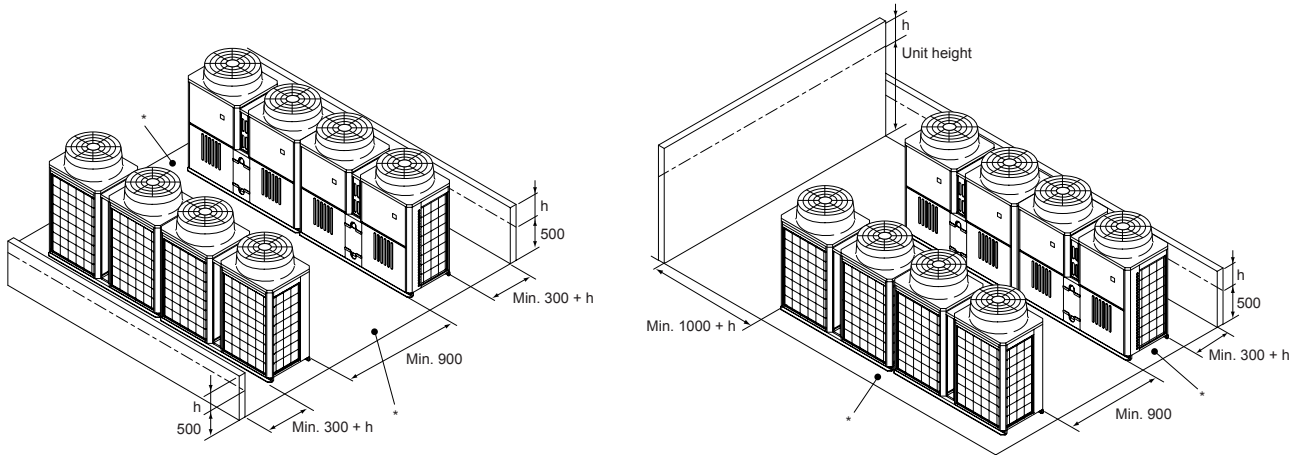


- There is a wall on one side.

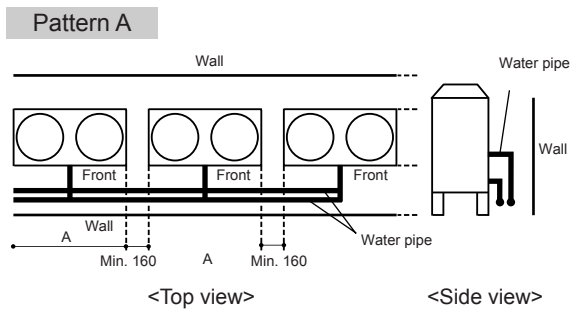


(2)-2-3. Combination of face-to-face and side-by-side installations

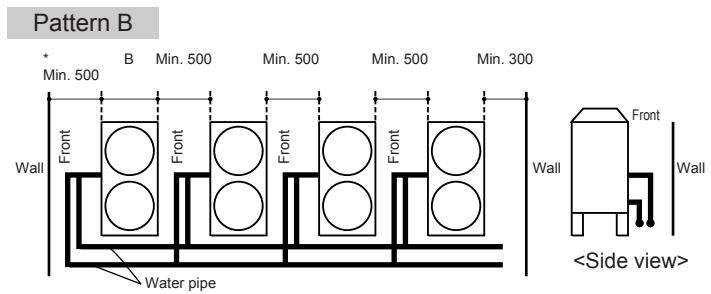
- There are walls in the back and the front of a given group of units.
- There is a wall on one side and either the front or the back of a given group of unit.



(2)-2-4. Water pipe installation



If the product width (labeled A in the figure) times the number of units that are installed side by side exceeds 6 m, leave a space of 1000 mm between each block. Each block is defined as a group of units that fit within 6 m.



If the product depth (labeled B in the figure) times the number of units that are installed in rows exceeds 6 m, leave a space of 1000 mm between each block. Each block is defined as a group of units that fit within 6 m.

(2)-3. Required airflow rate for the unit

Unit: m<sup>3</sup>/min

Model	Standard airflow rate	Minimum airflow rate	Allowable external static pressure (Unit: Pa)
CAHV-P500YA-HPB(-BS)	370	333	up to 60

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