SAP WORKSHEET

Dwelling Reference: OPP-089359
Dwelling Type: New Dwelling Design Stage
05
UB9 6JY

1. Overall dwelling dimensions

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground Floor	111.98(1a)	x	2.65	(2a) =	296.75	(3a)
Total floor area TFA					111.98	(4)
Dwelling volume					296.75	(5)

2. Ventilation Rate

Chimneys/Flues	0	x	80 =	0	(6a)
Open chimneys	0	x	20 =	0	(6b)
Chimneys / flues attached to closed fire	0	x	10 =	0	(6c)
Flues attached to solid fuel boiler	0	x	20 =	0	(6d)
Flues attached to other heater	0	x	35 =	0	(6e)
Number of blocked chimneys	0	x	20 =	0	(6f)
Number of intermittent extract fans	1	x	10 =	10	(7a)
Number of passive vents	0	x	10 =	0	(7b)
Number of flueless gas fires	0	x	40 =	0	(7c)

	Air changes per hour		
Number of storeys in the dwelling (ns)	0.03	0.03	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc	0	0	(9)
Additional infiltration	0	0	(10)
Structural infiltration	0	0	(11)
Suspended wooden ground floor	0	0	(12)
No draught lobby	0	0	(13)
Percentage of windows and doors draught proofed	0	0	(14)
Window infiltration	0	0	(15)
Infiltration rate	0	0	(16)
Air permeability value, AP50, (m³/h/m²)	15	15	(17)
Air permeability value, AP4, (m³/h/m²)	0	0	(17a)
Air permeability value)	0.78	0.78	(18)
Number of sides on which dwelling is sheltered	0	0	(19)
Shelter factor		1	(20)
Infiltration rate incorporating shelter factor		0.78	(21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Monthly average wind speed from Table U2													
5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Wind Factor													
1.28	1.25	1.23	1.1	1.08	0.95	0.95	0.93	1	1.08	1.13	1.18	13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)													
1	0.98	0.96	0.86	0.84	0.74	0.74	0.72	0.78	0.84	0.88	0.92	10.29	(22b)
Calculate effective air change rate for the applicable case:													
												0	(23a)
												0	(23b)
												0	(23c)
a) If balanced mechanical ventilation with heat recovery (MVHR)													
0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If balanced mechanical ventilation without heat recovery (MV)													
0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If whole house extract ventilation or positive input ventilation from outside													
0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If natural ventilation or whole house positive input ventilation from loft													
1	0.98	0.96	0.87	0.85	0.78	0.78	0.76	0.81	0.85	0.89	0.92		(24d)
Effective air change rate													
1	0.98	0.96	0.87	0.85	0.78	0.78	0.76	0.81	0.85	0.89	0.92		(25)
Effective air change rate from PCDB:													
1	0.98	0.96	0.87	0.85	0.78	0.78	0.76	0.81	0.85	0.89	0.92		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow for all different types of element e.g. 4 wall types. The k -value

ELEMENT	A X U (W/K)	A X k kJ/K	
Doors	2.73		(26)
Windows	20.05		(27)
Roof window	0		(27a)
Basement floor	0	0	(28)
Ground floor	0	0	(28a)
Exposed floor	0	0	(28b)
Basement wall	0	0	(29)
External wall	28.11	0	(29a)
Roof	14.56	0	(30)
Total area of external elements ∑A, m²		223.54	(31)

Party Wall	0	0	(32)
Party floor		0	(32a)
Party ceiling		0	(32b)
Internal wall **		0	(33c)
Internal floor		0	(32d)
Internal ceiling floor		0	(32e)
Fabric heat loss, W/K = ∑ (A x U)		65.45	(33)
Heat capacity Cm = ∑(A x k)		0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K		250	(35)
Linear Thermal bridges: ∑ (L x Ψ) calculated using Appendix K		44.71	(36)
Point Thermal bridges: ∑χ (W/K) if significant point thermal bridge present and values available		44.71	(36a)
Total fabric heat loss H = ∑(A × U) + ∑(L × Ψ) +∑χ		110.15	(37)

Ventilation heat loss calculated monthly

	97.85	95.95	94.09	85.35	83.72	76.1	76.1	74.69	79.04	83.72	87.02	90.48	(38)
Heat transfer coefficient, W/K													
	208	206.11	204.24	195.5	193.87	186.26	186.26	184.85	189.19	193.87	197.18	200.64	(39)
Heat loss parameter (HLP), W/m²K													
	1.86	1.84	1.82	1.75	1.73	1.66	1.66	1.65	1.69	1.73	1.76	1.79	(40)
Number of days in month (Table 1a)													
	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement

Assumed occupancy, N	2.83	(42)

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

	98.46	96.98	94.82	90.7	87.65	84.26	82.33	84.47	86.81	90.46	94.67	98.08	(42a)
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)													
	30.92	30.46	29.81	28.62	27.73	26.74	26.2	26.84	27.54	28.6	29.82	30.81	(42b)
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)													
	43.57	41.99	40.4	38.82	37.24	35.65	35.65	37.24	38.82	40.4	41.99	43.57	(42c)

Annual average hot water usage in litres per day Vd,average (from Appendix J)	159.31	(43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

	172.95	169.42	165.04	158.14	152.61	146.64	144.18	148.55	153.18	159.46	166.48	172.47	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)													
	273.91	241.26	253.66	216.48	205.45	180.32	174.37	183.93	188.88	216.39	237.18	270.04	(45)
Distribution loss (46) = 0.15 x (45)													
	41.09	36.19	38.05	32.47	30.82	27.05	26.16	27.59	28.33	32.46	35.58	40.51	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
Water storage loss (or HIU loss)		
a) If manufacturer's declared loss factor is known (kWh/day):	0	(48)
Temperature factor from Table 2b	0	(49)

Energy lost from water storage, kWh/day (48) x (49) = 0 (50)

b) If manufacturer's declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/day 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage (or HIU) loss calculated for each month (56) = (55) × (41)

0	0	0	0	0	0	0	0	0	0	0	0	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage,
(57)m = (56)m [(47) – Vs] ÷ (47), else (57)m = (56)m
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).

0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss for each month from Table 3
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only heat networks)

0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)

28.5	25.74	28.49	27.56	28.47	27.54	28.46	28.46	27.55	28.47	27.57	28.5	(61)

Total heat required for water heating calculated for each month (62) = 0.85 × (45) + (46) + (57) + (59) + (61)

302.4	266.99	282.15	244.04	233.92	207.86	202.83	212.39	216.43	244.87	264.75	298.54	2977.16	(62)

CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)

0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Solar DHW input calculated using Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0	(63c)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0	(63d)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

302.4	266.99	282.15	244.04	233.92	207.86	202.83	212.39	216.43	244.87	264.75	298.54	2977.16	(64)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

0	0	0	0	0	0	0	0	0	0	0	0	(64a)

Heat gains from water heating, kWh/month 0.25 x [0.85 × (45) + (61) + (64a)] + 0.8 x [(46) + (57) + (59)]

98.2	86.65	91.46	78.87	75.43	66.84	65.09	68.27	69.69	79.07	85.75	96.91	(65)

include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network

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

Metabolic gains (Table 5), watts

169.57	169.57	169.57	169.57	169.57	169.57	169.57	169.57	169.57	169.57	169.57	169.57	(66)

Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5

41.89	37.2	30.25	22.9	17.12	14.45	15.62	20.3	27.25	34.6	40.38	43.05	(67)

Appliances gains (calculated in Appendix L, equation L16 or L16a), also see Table 5

409.51	413.76	403.05	380.25	351.48	324.43	306.36	302.11	312.82	335.62	364.39	391.44	(68)

Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

54.78	54.78	54.78	54.78	54.78	54.78	54.78	54.78	54.78	54.78	54.78	54.78	(69)

Pumps and fans gains (Table 5a)

3	3	3	3	3	0	0	0	0	3	3	3	(70)

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

-113.05	-113.05	-113.05	-113.05	-113.05	-113.05	-113.05	-113.05	-113.05	-113.05	-113.05	-113.05	(71)

Water heating gains (Table 5)

131.99	128.95	122.93	109.54	101.38	92.83	87.49	91.76	96.79	106.28	119.1	130.26	(72)

Total internal gains

697.69	694.21	670.55	627.01	584.29	543.03	520.78	525.48	548.17	590.8	638.19	679.06	(73)

6. Solar gains

Solar gains in watts, calculated for each month

94.24	171.65	264.44	377.22	467.75	484.27	458.61	388.02	303.01	197.69	114.9	79.34	(83)

Total gains – internal and solar (watts)

791.93	865.87	934.98	1004.22	1052.04	1027.3	979.39	913.5	851.18	788.49	753.09	758.39	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, 1,m (see Table 9a)

1	0.99	0.99	0.97	0.94	0.85	0.72	0.76	0.92	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)

18.72	18.91	19.26	19.8	20.29	20.72	20.9	20.87	20.54	19.92	19.28	18.76	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

19.43	19.44	19.45	19.51	19.52	19.57	19.57	19.58	19.55	19.52	19.5	19.48	(88)

Roof

Utilisation factor for gains for rest of dwelling, 2,m (see Table 9a)

0.99	0.99	0.98	0.96	0.9	0.75	0.53	0.59	0.86	0.97	0.99	0.99	(89)

Roof

Mean internal temperature in the rest of dwelling T2

16.86	17.11	17.56	18.28	18.89	19.39	19.53	19.53	19.21	18.45	17.62	16.93	(90)

Living area fraction 0.31 (91)

Mean internal temperature (for the whole dwelling)

17.44	17.67	18.09	18.75	19.32	19.8	19.96	19.94	19.62	18.9	18.14	17.5	(92)

Adjusted mean internal temperature:

17.44	17.67	18.09	18.75	19.32	19.8	19.96	19.94	19.62	18.9	18.14	17.5	(93)

8. Space heating requirement

Utilisation factor for gains,

0.99	0.99	0.98	0.95	0.9	0.77	0.59	0.65	0.86	0.96	0.99	0.99	(94)

Useful gains, mGm , W

784.46	854.12	913.53	957.41	942.82	788.14	578.32	589.25	733.38	758.2	742.54	752.4	(95)

Monthly average external temperature from Table U1

4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature

2732.99	2631.26	2367.5	1926.22	1478.18	968.91	625.16	654.67	1045.24	1610.02	2176	2668.55	(97)

Space heating requirement for each month

1449.71	1194.24	1081.75	697.55	398.31	0	0	0	0	633.75	1032.09	1425.62	(98a)

Solar space heating calculated using Appendix H (negative quantity)

0	0	0	0	0	0	0	0	0	0	0	0	(98b)

Space heating requirement for each month after solar contribution

1449.71	1194.24	1081.75	697.55	398.31	0	0	0	0	633.75	1032.09	1425.62	(98c)

Space heating requirement in kWh/m²/year 70.66 (99)

8c. Space Cooling requirement

Heat loss rate,

0	0	0	0	0	0	0	0	0	0	0	0	(100)

Utilisation factor for loss

0	0	0	0	0	0	0	0	0	0	0	0	(101)

Useful loss, mLm (watts)

0	0	0	0	0	0	0	0	0	0	0	0	(102)

Gains

0	0	0	0	0	0	0	0	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) (104)

0	0	0	0	0	0	0	0	0	0	0	0	(104)

Cooled fraction 0 (105)

Intermittency factor

0	0	0	0	0	0	0	0	0	0	0	0	(106)

Space cooling requirement for month 0 0

0	0	0	0	0	0	0	0	0	0	0	0	(107)

Space cooling requirement in kWh/m²/year 0 (108)

8f. Space heating requirement

Fabric Energy Efficiency, 0 0 (109)

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

Fraction of space heat from secondary/supplementary system,								0				0	(201)
Fraction of space heat from main system(s),												1	(202)
Fraction of main heating from main system 2,												0	(203)
Fraction of total space heat from main system 1,												1	(204)
Fraction of total space heat from main system 2,												0	(205)
Efficiency of main space heating system 1 (in %),												88.7	(206)
Efficiency of main space heating system 2 (in %),												0	(207)
Efficiency of secondary/supplementary heating system, %,												0	(208)
Cooling System Seasonal Energy Efficiency Ratio,								0				0	(209)
Space heating requirement (calculated above),													
0	0	0	0	0	0	0	0		0	0	0		(210)
Space heating fuel (main heating system 1), kWh/month								0				0	
1634.39	1346.38	1219.56	786.41	449.05	0	0	0		0	714.49	1163.57	1607.24	(211)
Space heating fuel (main heating system 2), kWh/month								0				0	
0	0	0	0	0	0	0	0		0	0	0	0	(213)
Space heating fuel (secondary), kWh/month								0				0	
0	0	0	0	0	0	0	0		0	0	0	0	(215)
Output from water heater),								0				87.6	(216)
Efficiency of water heater													
88.51	88.5	88.47	88.41	88.29	87.6	87.6	87.6		87.6	88.39	88.47	88.51	(217)
Fuel for water heating													
341.67	301.7	318.92	276.02	264.94	237.28	231.54	242.46		247.06	277.03	299.24	337.3	3375.16 (219)
Space Cooling													
0	0	0	0	0	0	0	0		0	0	0	0	(221)

Annual totals	kWh/year	kWh/year	
Space heating fuel used, main system 1			8921.1 (211)
Space heating fuel used, main system 2			0 (213)
Space heating fuel used, secondary			0 (215)
Water heating fuel used			3375.16 (219)
Electricity for instantaneous electric shower(s)			0 (64a)
Space cooling fuel used			0 (221)
Electricity for pumps, fans and electric keep-hot			
Mechanical vent fans - balanced, extract or positive input from outside	0	0	0 (230a)
warm air heating system fans			0 (230b)
Heating circulation pump or water pump within warm air heating unit			41 (230c)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)			0 (230d)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)			45 (230e)
Maintaining electric keep-hot facility for gas combi boiler			0 (230f)
Pump for solar water heating			0 (230g)
Pump for storage WWHRS			0 (230h)
Total electricity for the above			86 (231)
Electricity for lighting			295.88 (232)

Energy saving/generation technologies (Appendices M, N) - Energy used in dwelling

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

0	0	0	0	0	0	0	0	0	0	0	0	0	(233a)

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

0	0	0	0	0	0	0	0	0	0	0	0	0	(234a)

Electricity generated by hydro-electric generators

0	0	0	0	0	0	0	0	0	0	0	0	0	(235a)

Electricity used or net electricity generated by micro-CHP

0	0	0	0	0	0	0	0	0	0	0	0	0	(235c)

Energy saving/generation technologies (Appendices M, N) - Energy exported

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

0	0	0	0	0	0	0	0	0	0	0	0	0	(233b)

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

0	0	0	0	0	0	0	0	0	0	0	0	0	(234b)

Electricity generated by hydro-electric generators

0	0	0	0	0	0	0	0	0	0	0	0	0	(235b)

Electricity used or net electricity generated by micro-CHP

0	0	0	0	0	0	0	0	0	0	0	0	0	(235d)

Appendix Q items: annual energy

Appendix Q, <item 1 description>	Fuel	kWh/year		
energy saved			0	(236a)
energy used			0	(237a)
Total delivered energy for all uses			12678.14	

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/year	
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		324.73	(240a)
Low-rate fraction	0		324.73	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		324.73	(241a)
Low-rate fraction	0		324.73	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		324.73	(242a)

Low-rate fraction	0		324.73	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		122.86	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		14.18	(249)
Energy For lighting	0		48.79	(250)
Additional standing charges	0		92	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1 description>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		602.56	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP

Energy cost deflator		0.36	(256)
Energy cost factor (ECF)		1.38	(257)
SAP rating		77.6	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy KWh/year	Emission factor kg	Emissions kg CO2/year	
Space heating - main system 1			1873.43	(261)
Space heating - main system 2			0	(262)
Space heating - secondary			0	(263)
Energy for water heating			708.78	(264)
Energy for instantaneous electric shower(s)			0	(264a)

Space and water heating		2582.21	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		11.93	(267)
Electricity for lighting		42.71	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		2636.85	(272)
Dwelling CO2 Emission Rate		23.55	(273)
EI rating		77	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy KWh/year	Emission factor kg	Emissionsr kg CO2/year	
Space heating - main system 1			10080.84	(275)
Space heating - main system 2			0	(276)
Space heating - secondary			0	(277)
Energy for water heating			3813.93	(278)
Energy for instantaneous electric shower(s)			0	(278a)
Space and water heating			13894.77	(279)
Space cooling			0	(280)
Electricity for pumps, fans and electric keep			130.1	(281)
Electricity for lighting			453.84	(282)
energy saved or generated	0		0	
Appendix Q items				
energy saved	0		0	
energy used	0		0	
energy saved	0		0	(284b)
energy used			0	(285b)
Total PE, kWh/year			14478.71	(286)
Dwelling PE Rate			129.3	(287)