SAP WORKSHEET (Version - 9.80) - Final

1. Overall dwelling dimensions

	Area (m^2)			Average storey height (m)		Volume (m^3)	
Ground floor		(1a)	×		=		(1)
First floor		(2a)	×		=		(2)
Second floor		(3a)	×		=		(3)
Third and other floors		(4a)	×		=		(4)
Total floor area (1a) + (2a) + (3a) + (4a) =		(5)					
Dwelling volume				(1) + (2) + (3) + (4) =			(6)

2. Ventilation rate

			m³ per hour	
Number of chimneys		× 40 =		(7)
Number of open flues		× 20 =		(8)
Number of intermittent fans or passive vents		× 10 =		(9)
Number of flueless gas fires		× 40 =		(9a)

Air changes per hour

Infiltration due to chimneys, flues and fans = (7)+(8)+(9)+(9a) = [ ] ÷ box (6) = [ ] (10)

If a pressurisation test has been carried out, proceed to box (19)

Number of storeys in the dwelling [ ] (11)

Additional infiltration [(11) - 1] × 0.1 = [ ] (12)

Structural infiltration: *0.25 for steel or timber frame or 0.35 for masonry construction* [ ] (13)

If suspended wooden floor, *enter 0.2 (unsealed) or 0.1 (sealed)*, else enter 0 [ ] (14)

If no draught lobby, enter 0.05, else enter 0 [ ] (15)

Percentage of windows and doors draught stripped [ ] (16)

Enter 100 in box (16) for new dwellings which are to comply with Building Regulations

Window infiltration 0.25 - [0.2 × (16) ÷ 100] = [ ] (17)

Infiltration rate (10) + (12) + (13) + (14) + (15) + (17) = [ ] (18)

If based on air permeability value, then $[q_{50} \div 20]$+(10) in box (19), otherwise (19) = (18) [ ] (19)

Air permeability value applies if a pressurisation test has been done, or a design air permeability is being used

Number of sides on which sheltered [ ] (20)

(Enter 2 in box (20) for new dwellings where location is not shown)

Shelter factor 1 - [0.075 × (20)] = [ ] (21)

Adjusted infiltration rate (19) × (21) = [ ] (22)

Calculate effective air change rate for the applicable case

a) If balanced whole house mechanical ventilation with heat recovery (22) + 0.17 = [ ] (23)

b) If balanced whole house mechanical ventilation without heat recovery (22) + 0.5 = [ ] (23a)

c) If whole house extract ventilation or positive input ventilation from outside

if (22) < 0.25, then (23b) = 0.5; otherwise (23b) = 0.25 + (22) [ ] (23b)

d) If natural ventilation or whole house positive input ventilation from loft

if (22) ≥ 1, then (24) = (22); otherwise (24) = 0.5 + [(22)² × 0.5] [ ] (24)

Effective air change rate - enter (23) or (23a) or (23b) or (24) in box (25) [ ] (25)

3. Heat losses and heat loss parameter

ELEMENT	Area (m²)		U-value		A×U (W/K)	
Doors		×		=		(26)
Windows (type 1)*		×	1/[(1/U-value)+0.04]	=		(27)
Windows (type 2)*		×	1/[(1/U-value)+0.04]	=		(27a)
Rooflights*		×	1/[(1/U-value)+0.04]	=		(27b)
Ground floor		×		=		(28)
Walls (type 1) *excluding windows and doors*		×		=		(29)
Walls (type 2) *excluding windows and doors*		×		=		(29a)
Roof (type 1) *excluding rooflights*		×		=		(30)
Roof (type 2) *excluding rooflights*		×		=		(30a)
Other		×		=		(31)
Total area of elements ΣA, m²		(32)				

**for windows and rooflights, use effective window U-value calculated as given in paragraph 3.2*

Fabric heat loss, W/K	(26)+(27)+(27a)+(27b)+(28)+(29)+(29a)+(30)+(30a)+(31) =		(33)
Thermal bridges - Σ (l×Ψ) calculated using Appendix K			(34)
if details of thermal bridging are not known calculate y× (32) [see Appendix K] and enter in box (34)			
Total fabric heat loss	(33) + (34) =		(35)
Ventilation heat loss	(25) × 0.33 × (6) =		(36)
Heat loss coefficient, W/K	(35) + (36) =		(37)
Heat loss parameter (HLP), W/m²K	(37) ÷ (5) =		(38)

4. Water heating energy requirements

		kWh/year	
Energy content of hot water used from Table 1 column (b)			(39)
Distribution loss from Table 1 column (c)			(40)

If instantaneous water heating at point of use, enter "0" in boxes (40) to (45)

For community heating use Table 1 (c) whether or not hot water tank is present

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):			(41)
Temperature factor from Table 2b			(41a)
Energy lost from water storage, kWh/year	(41) × (41a) × 365 =		(42)

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

Cylinder volume (litres) including any solar storage within same cylinder			(43)
If community heating and no tank in dwelling, enter 110 litres in box (43)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (43)			
Hot water storage loss factor from Table 2 (kWh/litre/day)			(44)
If community heating and no tank in dwelling, use cylinder loss from Table 2 for 50 mm factory insulation in box (44)			
Volume factor from Table 2a			(44a)
Temperature factor from Table 2b			(44b)
Energy lost from water storage, kWh/year	(43) × (44) × (44a) × (44b) × 365		(45)

Enter (42) or (45) in box (46)			(46)
If cylinder contains dedicated solar storage, box (47) = (46) × [(43) – (H11)] / (43), else (47) = (46)			(47)
Primary circuit loss from Table 3			(48)
Combi loss from Table 3a (enter "0" if not a combi boiler)			(49)
Solar DHW input calculated using Appendix H (enter "0" if no solar collector)			(50)
Output from water heater, kWh/year	(39)+(40)+(47)+(48)+(49) – (50) =		(51)
Heat gains from water heating, kWh/year	0.25 × [(39)+(49)]+0.8 × [(40)+(47)+(48)] =		(52)

include (47) in calculation of (52) only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains

		Watts	
Lights, appliances, cooking and metabolic (Table 5)			(53)
Reduction of internal gains due to low energy lighting (calculated in Appendix L)			(53a)
Additional gains from Table 5a			(53b)
Water heating	(52) ÷ 8.76 =		(54)
Total internal gains	(53) + (53b) + (54) – (53a) =		(55)

6. Solar gains

	Access factor Table 6d		Area m²		Flux Table 6a		g⊥ Table 6b		FF Table 6c		Gains (W)	
North		×		×		× 0.9 ×		×		=		(56)
Northeast		×		×		× 0.9 ×		×		=		(57)
East		×		×		× 0.9 ×		×		=		(58)
Southeast		×		×		× 0.9 ×		×		=		(59)
South		×		×		× 0.9 ×		×		=		(60)
Southwest		×		×		× 0.9 ×		×		=		(61)
West		×		×		× 0.9 ×		×		=		(62)
Northwest		×		×		× 0.9 ×		×		=		(63)
Rooflights		×		×		× 0.9 ×		×		=		(64)

Total solar gains:	[(56) + ... + (64)]	=		(65)

Note: for new dwellings where overshading is not known, the solar access factor is '0.77'

Total gains, W	(55) + (65) =		(66)
Gain/loss ratio (GLR)	(66) ÷ (37) =		(67)
Utilisation factor (Table 7, using GLR in box (67)			(68)
Useful gains, W	(66) × (68) =		(69)

7. Mean internal temperature

		°C	
Mean internal temperature of the living area (Table 8)			(70)
Temperature adjustment from Table 4e, where appropriate			(71)
Adjustment for gains	{[(69) ÷ (37)] - 4.0} × 0.2 × R =		(72)

R is obtained from the 'responsiveness' column of Table 4a or Table 4d

Adjusted living room temperature	(70) + (71) + (72) =		(73)
Temperature difference between zones (Table 9)			(74)
Living area fraction (0 to 1.0)	living room area ÷ (5) =		(75)
Rest-of -house fraction	1 - (75) =		(76)
Mean internal temperature	(73) - [(74) × (76)] =		(77)

8. Degree days

Temperature rise from gains	(69) ÷ (37) =		(78)
Base temperature	(77) - (78) =		(79)
Degree-days, *use box (79) and Table 10*			(80)

9. Space heating requirement

Space heating requirement (useful), kWh/year	0.024 × (80) × (37) =		(81)

For range cooker boilers where efficiency is obtained from the Boiler Efficiency Database or manufacturer's declared value, multiply the result in box (81) by $(1 - \Phi_{case}/\Phi_{water})$ where Φ_{case} is the heat emission from the case of the range cooker at full load (in kW); and Φ_{water} is the heat transferred to water at full load (in kW). Φ_{case} and Φ_{water} are obtained from the database record for the range cooker boiler or manufacturer's declared value.

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

Note: when space and water heating is provided by community heating use the alternative worksheet 9b

Space heating:

Fraction of heat from secondary/supplementary system *(use value from Table 11, Table 12a or Appendix F)*			(82)
Efficiency of main heating system, % *(SEDBUK or from Table 4a or 4b, adjusted where appropriate by the amount shown in the 'efficiency adjustment' column of Table 4c)*			(83)
Efficiency of secondary/supplementary heating system, % *(use value from Table 4a or Appendix E)*			(84)
Space heating fuel (main) requirement, kWh/year	[1 - (82)] × (81) × 100 ÷ (83) =		(85)
Space heating fuel (secondary), kWh/year	(82) × (81) × 100 ÷ (84) =		(85a)

Water heating:

Efficiency of water heater, % *(SEDBUK or from Table 4a or 4b, adjusted where appropriate by the amount shown in the 'efficiency adjustment' column of Table 4c)*			(86)
Energy required for water heating, kWh/year	(51) × 100 ÷ (86) =		(86a)

Electricity for pumps and fans:

	kWh/year	
each central heating pump, (Table 4f)		(87a)
each boiler with a fan-assisted flue (Table 4f)		(87b)
warm air heating system fans (Table 4f)		(87c)
mechanical ventilation - balanced, extract or positive input from outside (Table 4f)		(87d)
maintaining keep-hot facility for gas combi boiler (Table 4f)		(87e)
pump for solar water heating (Table 4f)		(87f)

Total electricity for the above equipment, kWh/year (87a) + (87b) + (87c) + (87d) + (87e)+ (87f) = [ ] (87)

10a. Fuel costs - individual heating systems

	Fuel kWh/year		Fuel price (Table 12)		Fuel cost £/year	
Space heating - main system	(85)	×		× 0.01 =		(88)
Space heating - secondary	(85a)	×		× 0.01 =		(89)
Water heating						
Water heating cost (electric, off-peak tariff)						
On-peak fraction (Table 13, or Appendix F for electric CPSUs)						(90)
Off-peak fraction			1.0 - (90) =			(90a)
			Fuel price			
On-peak cost	(86a) × (90)	×		× 0.01 =		(91)
Off-peak cost	(86a) × (90a)	×		× 0.01 =		(91a)
Water heating cost (other fuel)	(86a)	×		× 0.01 =		(91b)
Pump and fan energy cost	(87)	×		× 0.01 =		(92)
Energy for lighting (calculated in Appendix L)		×		× 0.01 =		(93)
Additional standing charges (Table 12)						(94)
Renewable and energy-saving technologies (Appendices M, N and Q)						
Energy produced or saved, kWh/year		(95)				
Cost of energy produced or saved, £/year	(95)	×		× 0.01 =		(95a)
Energy consumed by the technology, kWh/year		(96)				
Cost of energy consumed, £/year	(96)	×		× 0.01 =		(96a)

Total energy cost (88)+(89)+(91)+(91a)+(91b)+(92)+(93)+(94) - (95a)+(96a) = [ ] (97)

11a. SAP rating - individual heating systems

Energy cost deflator (SAP 2005)		**0.91**	(98)
Energy cost factor (ECF)	{[(97) × (98)] - 30.0} ÷ {(5) + 45.0} =		(99)
SAP rating (Table 14)			(100)

9b. Energy requirements - Community heating scheme

This page should used when space and water heating is provided by community heating only, with or without CHP or heat recovered from power stations. If CHP is not involved enter "0" on box (83*), and "1.0" in box (84*)

Overall system efficiency of the heating plant				(82*)
(100 % minus the amount shown in the 'efficiency adjustment' column of Table 4c(3) where appropriate)				
Fraction of heat from CHP unit or fraction of heat recovered from power station				(83*)
(from operational records or the plant design specification)				
Fraction of heat from boilers	1 - (83*)	=		(84*)
Distribution loss factor (Table 12c)				(85*)
			kWh/year	
Space heating from CHP or recovered heat, kWh/year	[(81) × (83*) × 100] ÷ (82*) × (85*)	=		(86*)
Space heating from boilers, kWh/year	[(81) × (84*) × 100] ÷ (82*) × (85*)	=		(87*)
Electricity for pumps and fans: from Table 4f for dwellings with mechanical ventilation, otherwise enter "0"				(88*)

10b. Fuel costs - Community heating scheme

	Fuel required	×	**Fuel price**	=	**Fuel cost**	
Space heating	kWh/year		(Table 12)		£/year	
Space heating (CHP or from power stations)	(86*)	×		× 0.01 =		(89*)
For CHP price from Table 12 is irrespective of fuel used by CHP						
Space heating (community boilers)	(87*)	×		× 0.01 =		(90*)
Water heating						
			Fuel price			
Water heated by CHP or recovered heat	(51) × (83*) × (85*) ×			× 0.01 =		(91*)
Water heated by boilers	(51) × (84*) × (85*) ×			× 0.01 =		(92*)

Water heated by immersion heater only; *if not heated by immersion heater, go to box (94*)*

On-peak fraction (Table 13)						(93*)
Off-peak fraction	1.0 - (93*) =					(93a*)
			Fuel price			
On-peak cost	(51) × (93*) ×			× 0.01 =		(93b*)
Off-peak cost	(51) × (93a*) ×			× 0.01 =		(93c*)
Pump and fan energy cost	(88*)	×		× 0.01 =		(94*)
Energy for lighting (calculated in Appendix L)		×		× 0.01 =		(94a*)
Additional standing charges (Table 12)						(94b*)
Renewable and energy-saving technologies (Appendices M and Q)						
Energy produced or saved, kWh/year	(95*)					
Cost of energy produced or saved, £/year		(95*)		× 0.01 =		(95a*)
Energy consumed by the technology, kWh/year	(96*)					
Cost of energy consumed, £/year		(96*)		× 0.01 =		(96a*)
Total heating	(89*)+ (90*)+(91*)+(92*)+(93b*)+(93c*)+(94*)+(94a*)+(94b*) - (95a*) +(96a*) =					(97*)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		**0.91**	(98*)
Energy cost factor (ECF)	{[(97*) × (98*)] - 30.0} ÷ {(5) + 45} =		(99*)
SAP rating (Table 14)			(100*)

12a. Dwelling CO_2 Emission Rate (DER) for individual heating systems (including micro-CHP) and community heating without CHP

		Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Individual heating system:							
Space heating main from box (85)			×		=		(101)
Space heating secondary from box (85a)			×		=		(102)
Energy for water heating from box (86a)			×		=		(103)
Community scheme:							
Efficiency of community boilers %	[ ] (104)						
use actual efficiency if known, or value in Table 4a							
Energy for space heating	(87*) × 100 ÷ (104) =		×		=		(105)
Energy for water heating	(51) × (85*) × 100 ÷ (104) =		×		=		(106)
Space and water heating	[(101) + (102) + (103)] or [(105) + (106)]				=		(107)
Electricity for pumps and fans from box (87) or (88*)			×		=		(108)
Energy for lighting from Appendix L			×		=		(109)
Energy produced or saved in dwelling		(95) or (95*)	×		=		(110)
Energy consumed by the above technology		(96) or (96*)	×		=		(111)
Total CO_2, kg/year	(107) + (108) + (109) - (110) + (111)				=		(112)
Dwelling CO_2 Emission Rate	(112) ÷ (5)				=		(113)

12b. Dwelling CO_2 Emission Rate (DER) for community heating schemes with CHP or heat recovered from power stations

(for community schemes that recover heat from power stations refer to C2 in Appendix C and omit (101) to (106*))*

		Energy kWh/year		Emission factor kg CO_2/kWh		Emissions (kg CO_2/year)	
Electrical efficiency of CHP unit (e.g. 30%)	*from operational records or the CHP design specification*						(101*)
Heat efficiency of CHP unit (e.g. 50%)	*from operational records or the CHP design specification*						(102*)
CO_2 emission factor for the CHP fuel from Table 12				[ ] (103*)			
CO_2 emission factor for electricity generated by CHP (from Table 12)				[ ] (104*)			
CO_2 emitted by CHP per kWh of generated electricity	(103*) ÷ (101*) × 100 =						(105*)
Heat to Power ratio *enter if known, otherwise*	*(102*) ÷ (101*)*						(106*)
CO_2 emission factor for heat	[(105*) - (104*)] / (106*) =						(107*)

Note: with CHP the value in box (107) can be negative;*
with heat recovered from power stations enter emission factor for waste heat from Table 12 in box (107)*

		Energy		Emission factor:		Emissions	
Water heated by CHP or recovered heat from power station:			×	box (107*)	=		(108*)
Energy for water heated by CHP or recovered heat from power stations = (51) × (83) × (85*)*							
Efficiency of community boilers %	[ ] (109*)						
use actual efficiency if known, or value in Table 4a							
Water heated by boilers:	(51) × (84*) × (85*) × 100 ÷ (109*) =		×	[ ] Table 12	=		(110*)
If water heated by immersion heater, box 51)			×	[ ] Table 12	=		(111*)
Space heating from CHP or recovered heat , box (86*)			×	box (107*)	=		(112*)
Space heating from boilers	(87*) × 100 ÷ (109*) =		×	[ ] Table 12	=		(113*)
Electricity for pumps and fans, box (88*)			×	[ ] Table 12	=		(114*)
Total CO_2 associated with boilers, CHP or recovered heat	[(108*) + (110*) + ... + (114*)]				=		(115*)
If negative, enter "1" in box (115)*							
Energy for lighting from Appendix L			×	[ ] Table 12	=		(116*)
Energy produced or saved in dwelling		(95*)	×	[ ] Table 12	=		(117*)
Energy consumed by the above technology		(96*)	×	[ ] Table 12	=		(118*)
Total CO_2, kg/year	(115*) + (116*) - (117*) + (118*)				=		(119*)
Dwelling CO_2 Emission Rate	(119*) ÷ (5)				=		(120*)