Energy Statement

3no. New Flats

170-175 High Street, Teddington.

May 2012

The Warehouse
Saxon Street
Denton
Manchester
M34 3DS

t. 0161 337 4353
w. www.ashmount.net
e. office@ashmount.net

Daniel Watt MEng LCEA MIChemE
CIBSE Accreditation Nos:
LCCSIM084077
LCCD084077
LCEA084077

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1. Executive Summary

This document is in response to the London Borough of Richmond Upon Thames Council planning policy in respect of energy consumption and carbon dioxide emissions relating to the new development at 170 – 175 High Street, Teddington.

It has been produced with reference to the Council's planning policy and the methodology used for any calculations is consistent with the London Renewables Toolkit and Part L of the Building Regulations. Figures used in the Energy calculations are taken from current SAP calculations.

Proposed Development

The proposed development consists of the construction of an additional floor at 170-175 High Street to create 3no new self-contained flats.

Energy saving measures are proposed to be integrated into the design by the appointed design team, to reduce the Developments' Carbon Dioxide Emissions and energy consumption; in doing so, helping to achieve Part L1A compliance.

London Borough of Richmond Upon Thames Council seeks to minimize energy use and promote energy from renewable sources. Developments should aim to achieve a minimum reduction in carbon dioxide emissions of 20% from onsite renewable energy generation (which can include sources of decentralised renewable energy).

There is no district heating system close to the Site, therefore the proposed development cannot be connected to a district heating scheme.

It is proposed that the development will include the following renewable technology:

- 3.2KWp PV Array (23m^2)

The predicted annual saving in energy for the development has been calculated as **3349.7 kWh** which equates to a saving of **1599.7 kg CO2/yr.**

This represents a reduction of **32.9%** CO2 emissions from energy efficiency measures and onsite renewable technologies.

The Energy Demand summary & predicted carbon dioxide emissions are shown in Figure 1 below.

A detailed breakdown of the energy demands and carbon emissions for the site can be seen in Appendix A - Energy Demand Assessment, 170-175 High Street.

	Energy demand (kWh pa)	Energy saving achieved (%)	Regulated CO_2 emissions (kg pa)	Saving achieved on residual CO_2 emissions (%)
Building Regulations Part L compliance ("Baseline" energy demand & emissions)	16291.2		4520.7	
Proposed scheme after energy efficiency measures and CHP ("Residual" energy demand & emissions)	15612.7	4.2%	4350.0	
Proposed scheme after on-site renewables	12941.5	20.6%	2921.0	32.9%
Proposed scheme offset for financial contribution or other "allowable solution"			0	0
Total savings on residual emissions				**32.9%**

Fig 1. Energy statement sheet

Key energy efficient design measures

The Proposed Development features the following key energy efficient design measures:

High levels of insulation in building fabric and high specification energy efficiency measures including:

1. **"A" Rated combination boiler**
2. **Delayed start Thermostat**
3. **Time & Temperature Zone Control**
4. **Flue gas heat recovery system**
5. **Air Permeability of $5m^3hm^2$**
6. **100% low energy lighting**
7. **100% draft proofed**
8. **External walls U-value of 0.25 W/m^2K**
9. **Roof U-value of 0.16 W/m^2K**
10. **Glazing U-value of 1.5 W/m^2K**
11. **Y value of 0.04 through the use of Accredited Construction Details**

Summary of proposed heating and cooling systems

Proposed heating and hot water by efficient Gas boilers.

Choice and impact of renewable energy technologies

3.2 KWp PV array.

2 Feasibility assessment of renewable energy technologies

Solar Hot Water (Thermal)

Solar water heating systems are one of the more familiar renewable technologies used at the moment. They use the energy from the sun to heat water, most commonly for hot water needs. Solar heating systems use a heat collector that is usually mounted on a roof in which a fluid is heated by the sun. This fluid is used to heat water that is stored in either a separate hot water cylinder or in a twin-coil hot water cylinder (the second coil is used to provide additional heating from a boiler or other heat source).

Solar panels would be feasible for this development however the amount is limited due to the water demand and so the saving is not as great as that with PV.

Wind

Wind turbines convert the kinetic energy in wind into mechanical energy that is then converted to electricity. Turbines are available in a range of sizes and designs and can either be free-standing, mounted on a building or integrated into a building structure.

For a development of this size and location only a building mounted turbine could be considered, however due to the building design and location the wind would be very turbulent and the average wind speed in the area is below the recommended level therefore this technology was not deemed feasible.

Photovoltaic (PV) Panels

Photovoltaic (PV) modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases of silicon. Through a process called doping, a very small amount of impurities are added to the semiconductor, which creates two different layers called n-type and p-type layers.

Certain wavelengths of light are able to ionise the silicon atoms, which separates some of the positive charges (holes) from the negative charges (electrons). The holes move into the positive or p-layer and the electrons into the negative or n-layer. These opposite charges are attracted to each other, but most of them can only re-combine by the electrons passing through an external circuit, due to an internal potential energy barrier. This flow of electrons produces a DC current.

PV would be suitable for the development and would provide the necessary saving required. The panels would have to be frame mounted on the flat roof south facing.

Biomass Heating

Biomass is any plant-derived organic material that renews itself over a short period.

Biomass energy systems are based on either the direct or indirect combustion of fuels derived from those plant sources. The most common form of biomass is the direct combustion of wood in treated or untreated forms. The use of biomass is becoming increasingly common in some European countries (some countries such as Austria are heavily dependent on biomass).

The environmental benefits relate to the significantly lower amounts of energy used in biomass production and processing compared to the energy released when they are burnt. This can range from a four-fold return for biodiesel to an approximate 20-fold energy return for woody biomass. Biomass-fuels can be used to produce energy on a continuous basis (unlike renewables such as wind or solar energy) and it can be an economic alternative to fossil fuels as it is a potential source of both heat and electricity.

However Biomass systems have particular design management and maintenance requirements associated with sourcing, transportation and storage and are therefore more commonly used in commercial developments rather than domestic installations. It can be less convenient to operate than mains-supplied fuels such as natural gas and are more management intensive and require expertise in facilities management. Sources of biomass can also fluctuate, so boilers should be specified to operate on a variety of fuels without risk of overheating or tripping out.

A communal biomass system would not be feasible for this development due to use, space and maintenance issues. The system would be quite large and there is no space around the property to locate the boiler, hopper and fuel store that is suitable for deliveries but also appropriate for feeding the boiler.

Ground Source Heat pumps

A heat pump is a device that takes up heat at a certain temperature and releases it at a higher temperature. The essential components of a heat pump are heat exchangers (through which energy is extracted and emitted) and a means of pumping heat between the exchangers. The effectiveness of the heat pump is measured by the ratio of the heating capacity to the effective power input, usually known as the coefficient of performance (COP).

Ground-source heat pumps (GSHP) extract heat from the ground. They are classified as either water-to-air or water-to-water units depending on whether the heat distribution system in the building uses air or water. Ground source heat pumps either use long shallow trenches or deep vertical boreholes to take low grade heat from the ground and then compress it to create higher temperatures.

Ground source heat pumps would not be suitable due to the lack of land space around the property.

Air Source Heat pumps

Air source heat pumps absorb heat from the outside air. This is usually used to heat radiators, underfloor heating systems, or warm air convectors and hot water in your home. An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside.

The system performs down to air temperatures of -20°c which means that they are more than suitable for installations within the UK. Hot water and Heating can be provided 365 days a year. The hot water is produced without the aid of electrical immersions and at 55°c is more than hot enough for baths and showers.

There are two main types of air source heat pump system:

- An air-to-water system distributes heat via your wet central heating system. Heat pumps work much more efficiently at a lower temperature than a standard boiler system would. So they are more suitable for under-floor heating systems or larger radiators, which give out heat at lower temperatures over longer periods of time.
- An air-to-air system produces warm air which is circulated by fans to heat your home. They are unlikely to provide you with hot water as well.

Air source heat pumps would not be deemed suitable due to the lack of space around the property, the size and noise of the systems could also have a detrimental effect on the property and surrounding area.

3 Energy Demand Assessment Summary

A detailed breakdown of the energy demands and carbon emissions for the site can be seen in Appendix A - Energy Demand Assessment, 170-175 High Street.

This document draws on figures from draft Baseline SAP reports for the development to ensure accurate figures. Example SAP report can be seen in:

- Appendix B - Baseline SAP Calculations
- Appendix C –Improved SAP Calculations
- Appendix D - Final SAP Calculations

A summary of all stages of the energy demand assessment from baseline figures to final carbon reduction is shown in Figure 1 earlier in this report.

3.1 Baseline energy demand

'Standard Assessment Procedure - SAP 2009' was used to produce SAP reports for the residential units. The baseline figure was taken from the minimum Part L Buildings Regulation levels of specification for each property.

The excel document shows how the energy efficiency measures proposed reduce the predicted CO2 emissions from baseline levels and section 1 of this report details how this is achieved with high specification building materials.

Baseline energy demand (kWh pa)	**16,291.2**
Regulated emissions (kg pa)	**4520.7**

3.2 Heating

The heating and cooling hierarchy has been applied to the design process of the development. It has resulted in large focus on energy efficiency measures as can be seen in Figure 1.

Combined Heat and Power / Tri-generation summary

Energy savings from the use of CHP systems (kWh pa)	**0**
Emission savings from the use of CHP systems (kg pa)	**0**
Total regulated emissions after CHP savings (kg pa)	**4520.7**

3.3 Energy efficiency

The following table demonstrates how the development achieves the reduction in carbon dioxide emissions from energy efficiency measures.

Energy savings from energy efficiency measures (kWh pa)	**678.5**
Emission savings from energy efficiency measures (kg pa)	**170.7**
Total regulated emissions after CHP savings and energy efficiency measure s (kg pa) ("residual emissions")	**4350.0**

3.4 On-site renewables

This development is predicted to achieve a reduction in carbon dioxide emissions of 32.9% from on-site renewables incorporated after energy efficient measures have been taken into account.

Saving on residual emissions from the use of renewables (kg pa)	**1429**
Saving on residual emissions from the use of renewables (%)	**32.9**

4 Sustainability Statement

The following section summarises the sustainability approach to the development.

Climate Change adaption, mitigation & Energy

- Y value of 0.04 through the use of Accredited Construction Details
- 100% of new internal fixed lighting and external lighting will be dedicated low-energy.
- Where supplied, white goods will be energy efficient (A+ or A rated).
- Smart meters will be installed to each dwelling to display current consumption data.
- "A" Rated combination boilers with extra low NOx emissions.
- Delayed start Thermostat
- Time & Temperature Zone Control
- Air Permeability of $5m^3hm^2$
- 100% draft proofed
- External walls U-value of 0.25 W/m^2K
- Roof U-value of 0.16 W/m^2K
- Glazing U-value of 1.5 W/m^2K
- No additional 'run off' in to public watercourses.

Materials

- Consideration will be given to using materials and construction that have a low environmental impact, such as those achieving an A+ or A rated under BRE's Green Guide.
- Where possible, materials will be chosen that are responsibly sourced (such as FSC timber), recycled or reclaimed.
- All insulation materials will have a GWP (Global Warming Potential) of 5 or less.

Water Use

- Indoor water use will be restricted by use of fittings with lower flow rates, baths with smaller capacity, dual-flush toilets, and (where applicable) washing machines and dishwashers with low water usage.

Waste

- The contractor will be obligated to produce a Site Waste Management Plan (SWMP) to set targets and monitor to reduce waste and divert from landfill.
- The dwelling will incorporate dedicated internal and external general waste and recyclable storage in accordance with the LA collection.

Health & Wellbeing

- Key rooms have good levels of day lighting, and décor will enhance this (the need for artificial lighting will also be reduced).
- Materials with low VOC emissions will be used.
- Improved acoustic performance between dwellings.

Management

- A robust Home User Guide (HUG) will be provided to the end owner/occupier of the dwelling, providing information on the correct and efficient use of their home and the surrounding area to make the most of nearby amenities.

Ecology

- Any existing features of ecological value will be protected during construction.

Flat	Flat 1	Flat 2	Flat 3		TOTAL (kWh/yr)		TOTAL (kgCO2/yr)
Summary of BASELINE Energy Demand	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Carbon Emission Factor**	**Associated Total CO2 (kgCO2/yr)**
Hot Water	2122.9	1990.7	1568.8		5682.4	0.198	1125.1
Space Heating	2614.3	1980.2	1954.8		6549.3	0.198	1296.8
Secondary Heating	0.0	0.0	0.0		0.0	0.517	0.0
Pumps & Fans	175.0	175.0	175.0		525.0	0.517	271.4
Lighting	347.6	302.4	169.4		819.3	0.517	423.6
Appliances/Non-regulated	1052.0	889.7	773.6	0.0	2715.2	0.517	1403.8
	6311.8	5337.9	4641.5	0.0			
TOTAL	**6311.8**	**5337.9**	**4641.5**	**0.0**	**16291.2**		**4520.7**

Summary of Energy Demand After Energy Efficiency Measures	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Carbon Emission Factor**	**Associated Total CO2 (kgCO2/yr)**
Hot Water	2122.9	1990.7	1568.8		5682.4	0.198	1125.1
Space Heating	2272.0	1932.3	1780.1		5984.4	0.198	1184.9
Secondary Heating	0.0	0.0	0.0		0.0	0.517	0.0
Pumps & Fans	175.0	175.0	175.0		525.0	0.517	271.4
Lighting	347.0	302.4	169.4		818.7	0.517	423.3
Appliances/Non-regulated	983.4	880.1	738.7	0.0	2602.1	0.517	1345.3
	5900.3	5280.5	4431.9	0.0			
TOTAL	**5900.3**	**5280.5**	**4431.9**	**0.0**	**15612.7**		**4350.0**

Summary of Energy Demand After Renewables	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Total Energy Demand (kWh/yr)**	**Carbon Emission Factor (kgCO2/kWh)**	**Associated Total CO2 (kgCO2/yr)**
Hot Water	2122.9	1990.7	1568.8		5682.4	0.198	1125.1
Space Heating	2272.0	1980.2	1780.1		6032.3	0.198	1194.4
Secondary Heating	0.0	0.0	0.0		0.0	0.517	0.0
Pumps & Fans	175.0	175.0	175.0		525.0	0.517	271.4
Lighting	347.0	302.4	169.4		818.7	0.517	423.3
PV Elec Generated	-1011.8	-1030.1	-686.7		-2728.6	0.529	-1443.5
Appliances/Non-regulated	983.4	889.7	738.7	0.0	2611.7	0.517	1350.2
	4888.4	4307.8	3745.2	0.0			
TOTAL	**4888.4**	**4307.8**	**3745.2**	**0.0**	**12941.5**		**2921.0**

Summary of CO2 Emission Reductions	**Total CO2 emissions (kgCO2/year)**
Baseline emissions	4520.7
Improved emissions (after application of energy efficiency measures)	4350.0
Improved emissions (after incorporation of efficient energy supply)	4350.0
Improved emissions (after incorporation of renewable energy technology) % CO2 displaced in total	2921.0
% CO2 displaced in total	35.39%
% CO2 displaced by energy efficiency measures	3.77%
% CO2 displaced by efficient supply of energy	0.00%
% CO2 displaced by renewable energy	31.6%

	Energy demand (kWh pa)	**Energy saving achieved (%)**	**Regulated CO_2 emissions (kg pa)**	**Saving achieved on residual CO_2 emissions (%)**
Building Regulations Part L compliance (“Baseline” energy demand & emissions)	16291.2		4520.7	
Proposed scheme after energy efficiency measures and CHP (“Residual” energy demand & emissions)	15612.7	4.2%	4350.0	
Proposed scheme after on-site renewables	12941.5	20.6%	2921.0	35.4%
Proposed scheme offset for financial contribution or other “allowable solution”			0	0
Total savings on residual emissions				**35.4%**

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Dan Watt	**Stroma Number:**	STRO000002
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.4.0.76

Property Address: Flat 8 Baseline

Address : 172 High St, Teddington, TW11 8HU

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Ground floor	63.2	(1a) x	2.67	(2a) =	168.74	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.2	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	168.74	(5)

2. Ventilation rate:

	main heating		Secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.12	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		6.5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.44	(18)

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

Number of sides on which sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

SAP WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.44	0.44	0.39	0.35	0.34	0.32	0.32	0.36	0.39	0.41	0.44

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	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
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	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
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.61	0.6	0.6	0.57	0.56	0.56	0.55	0.55	0.57	0.57	0.59	0.6	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.57	0.56	0.56	0.55	0.55	0.57	0.57	0.59	0.6	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.08	x	1.5	=	3.12			(26)
Windows			4.8	x1/[1/(1.5)+ 0.04]		=	6.79			(27)
Walls Type1	53	0	53	x	0.25	=	13.25			(29)
Walls Type2	24	2.08	21.92	x	0.23	=	4.95			(29)
Walls Type3	9.6	4.8	4.8	x	0.25	=	1.2			(29)
Roof Type1	50	0	50	x	0.16	=	8			(30)
Roof Type2	2.3	0	2.3	x	0.16	=	0.37			(30)
Total area of elements, m²			138.9							(31)
Party wall			28	x	0	=	0			(32)
Party floor			63.2							(32a)
Party ceiling			0							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 37.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 3841.46 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 11.11 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 48.79 (37)

SAP WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	33.84	33.19	33.19	32.01	31.3	30.97	30.66	30.66	31.47	32.01	32.58	33.19	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.63	81.98	81.98	80.8	80.09	79.76	79.45	79.45	80.26	80.8	81.37	81.98	

Average = Sum(39)$_{1...12}$ /12= 80.88 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.28	1.27	1.26	1.26	1.26	1.27	1.28	1.29	1.3	

Average = Sum(40)$_{1...12}$ /12= 1.28 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.07 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 87.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	96.54	93.03	89.52	86.01	82.5	78.99	78.99	82.5	86.01	89.52	93.03	96.54	

Total = Sum(44)$_{1...12}$ = 1053.15 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	143.51	125.51	129.52	112.92	108.35	93.49	86.64	99.42	100.6	117.24	127.98	138.98	

Total = Sum(45)$_{1...12}$ = 1384.16 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.53	18.83	19.43	16.94	16.25	14.02	13	14.91	15.09	17.59	19.2	20.85	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

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

Cylinder volume (litres) including any solar storage within same 0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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/year ((50) x (51) x (52) x (53) = 0 (54)

Enter (49) or (54) in (55) 0 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	49.2	42.82	45.62	42.41	42.04	38.95	40.25	42.04	42.41	45.62	45.88	49.2	(61)

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

(62)m=	192.7	168.33	175.14	155.33	150.39	132.45	126.89	141.46	143.02	162.86	173.86	188.17	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	192.7	168.33	175.14	155.33	150.39	132.45	126.89	141.46	143.02	162.86	173.86	188.17

Output from water heater (annual)$_{1...12}$ | 1910.59 | (64)

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

(65)m=	60.02	52.44	54.47	48.15	46.53	40.82	38.87	43.57	44.05	50.39	54.02	58.51	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	(66)

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

(67)m=	49.14	43.65	35.5	26.87	20.09	16.96	18.33	23.82	31.97	40.6	47.38	50.51	(67)

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

(68)m=	270.06	272.86	265.8	250.77	231.79	213.95	202.04	199.23	206.3	221.33	240.31	258.14	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	(71)

Water heating gains (Table 5)

(72)m=	80.67	78.03	73.21	66.87	62.55	56.7	52.24	58.56	61.19	67.73	75.03	78.64	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	500.77	495.45	475.41	445.42	415.33	388.52	373.51	382.51	400.36	430.55	463.62	488.2	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	4.8	x	47.32	x	0.63	x	0.7	=	69.42	(78)
South	0.9x	0.77	x	4.8	x	77.18	x	0.63	x	0.7	=	113.22	(78)

South	0.9x	0.77	x	4.8	x	94.25	x	0.63	x	0.7	=	138.25	(78)
South	0.9x	0.77	x	4.8	x	105.11	x	0.63	x	0.7	=	154.2	(78)
South	0.9x	0.77	x	4.8	x	108.55	x	0.63	x	0.7	=	159.24	(78)
South	0.9x	0.77	x	4.8	x	108.9	x	0.63	x	0.7	=	159.75	(78)
South	0.9x	0.77	x	4.8	x	107.14	x	0.63	x	0.7	=	157.16	(78)
South	0.9x	0.77	x	4.8	x	103.88	x	0.63	x	0.7	=	152.39	(78)
South	0.9x	0.77	x	4.8	x	99.99	x	0.63	x	0.7	=	146.68	(78)
South	0.9x	0.77	x	4.8	x	85.29	x	0.63	x	0.7	=	125.12	(78)
South	0.9x	0.77	x	4.8	x	56.07	x	0.63	x	0.7	=	82.25	(78)
South	0.9x	0.77	x	4.8	x	40.89	x	0.63	x	0.7	=	59.98	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	69.42	113.22	138.25	154.2	159.24	159.75	157.16	152.39	146.68	125.12	82.25	59.98	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	570.19	608.67	613.67	599.61	574.56	548.26	530.67	534.9	547.04	555.67	545.87	548.18	(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, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.93	0.91	0.89	0.86	0.8	0.69	0.53	0.52	0.7	0.83	0.91	0.93	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.76	18.96	19.33	19.71	20.22	20.63	20.87	20.88	20.59	20.02	19.26	18.82	(87)

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

(88)m=	19.84	19.85	19.85	19.86	19.87	19.87	19.88	19.88	19.87	19.86	19.85	19.85	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.91	0.9	0.87	0.84	0.76	0.61	0.41	0.41	0.64	0.8	0.89	0.92	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.91	17.2	17.74	18.27	18.99	19.54	19.8	19.8	19.47	18.72	17.64	17	(90)

fLA = Living area ÷ (4) = 0.38 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.61	17.87	18.34	18.82	19.46	19.95	20.21	20.21	19.9	19.22	18.26	17.69	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.46	17.72	18.19	18.67	19.31	19.8	20.06	20.06	19.75	19.07	18.11	17.54	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.88	0.87	0.84	0.81	0.73	0.61	0.43	0.43	0.63	0.77	0.86	0.89	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	504.44	527.24	514.16	483.11	420.42	333.05	228.55	228.96	343.36	428.96	469.07	486.14	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(97)m=	1071.04	1042.91	933.98	805.42	609.42	414.98	250.98	251.09	437.15	667.79	903.68	1036.12		(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	421.55	346.53	312.34	232.06	140.61	0	0	0	0	177.69	312.92	409.18		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2352.89 (98)

Space heating requirement in kWh/m²/year 37.23 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	421.55	346.53	312.34	232.06	140.61	0	0	0	0	177.69	312.92	409.18		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)	468.39	385.03	347.05	257.85	156.24	0	0	0	0	197.44	347.69	454.64		(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2614.33 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] + (214) m } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	192.7	168.33	175.14	155.33	150.39	132.45	126.89	141.46	143.02	162.86	173.86	188.17		
Efficiency of water heater													90	(216)
(217)m=	90	90	90	90	90	90	90	90	90	90	90	90		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	214.11	187.03	194.59	172.59	167.1	147.16	140.99	157.17	158.91	180.96	193.18	209.08

Total = Sum(219a)$_{1...12}$ = 2122.88 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2614.33	
Water heating fuel used			2122.88	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			347.16	(232)

10a. Fuel costs - individual heating systems:

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	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x		3.1	x 0.01 =	81.04	(240)
Space heating - main system 2	(213) x		0	x 0.01 =	0	(241)
Space heating - secondary	(215) x		0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.1	x 0.01 =	65.81	(247)
Pumps, fans and electric keep-hot	(231)		11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)		11.46	x 0.01 =	39.78	(250)
Additional standing charges (Table 12)					106	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)...(254) =	312.69	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.36	(257)
SAP rating (Section 12)		81.05	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.198	=	517.64	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Water heating	(219) x	0.198	=	420.33	(264)
Space and water heating	(261) + (262) + (263) + (264) =			937.97	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	90.48	(267)
Electricity for lighting	(232) x	0.517	=	179.48	(268)
Total CO2, kg/year		sum of (265)…(271) =		1207.92	(272)
CO2 emissions per m²		(272) ÷ (4) =		19.11	(273)
EI rating (section 14)				85	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.02	=	2666.61	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Energy for water heating	(219) x	1.02	=	2165.33	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4831.95	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511	(267)

Electricity for lighting	(232) x	0	=	1013.7 (268)
'Total Primary Energy		sum of (265)…(271) =		6356.65 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =		100.58 (273)

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User Details:

Assessor Name:	Dan Watt	**Stroma Number:**	STRO000002
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.4.0.76

Property Address: Flat 9 Baseline

Address : 172 High St, Teddington, TW11 8HU

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Ground floor	55.5	(1a) x	2.67	(2a) =	148.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	148.19	(5)

2. Ventilation rate:

	main heating		Secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		6	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.43	(18)

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

Number of sides on which sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.46	0.43	0.43	0.38	0.35	0.33	0.31	0.31	0.35	0.38	0.4	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	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
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	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
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.56	0.55	0.55	0.55	0.56	0.57	0.58	0.59	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.56	0.55	0.55	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.08	x	1.5	=	3.12			(26)
Windows Type 1			1.6	x1/[1/(1.5)+ 0.04]		=	2.26			(27)
Windows Type 2			3.2	x1/[1/(1.5)+ 0.04]		=	4.53			(27)
Walls Type1	41	0	41	x	0.25	=	10.25			(29)
Walls Type2	6	2.08	3.92	x	0.23	=	0.88			(29)
Walls Type3	9.6	4.8	4.8	x	0.25	=	1.2			(29)
Roof Type1	44	0	44	x	0.16	=	7.04			(30)
Roof Type2	2.3	0	2.3	x	0.16	=	0.37			(30)
Total area of elements, m²			102.9							(31)
Party wall			28	x	0	=	0			(32)
Party floor			63.2							(32a)
Party ceiling			0							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.66 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 3355.46 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 4.12 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

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Total fabric heat loss (33) + (36) = 33.77 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.51	28.97	28.97	27.97	27.37	27.09	26.83	26.83	27.51	27.97	28.45	28.97	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	63.29	62.74	62.74	61.74	61.14	60.86	60.6	60.6	61.29	61.74	62.22	62.74	

Average = $Sum(39)_{1...12}$ /12= 61.81 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.14	1.13	1.13	1.11	1.1	1.1	1.09	1.09	1.1	1.11	1.12	1.13	

Average = $Sum(40)_{1...12}$ /12= 1.11 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.85 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	90.53	87.24	83.95	80.65	77.36	74.07	74.07	77.36	80.65	83.95	87.24	90.53	

Total = $Sum(44)_{1...12}$ = 987.6 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.57	117.7	121.46	105.89	101.6	87.67	81.24	93.23	94.34	109.95	120.01	130.33	

Total = $Sum(45)_{1...12}$ = 1298 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.19	17.65	18.22	15.88	15.24	13.15	12.19	13.98	14.15	16.49	18	19.55	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

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

Cylinder volume (litres) including any solar storage within same 0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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/year ((50) x (51) x (52) x (53) = 0 (54)

Enter (49) or (54) in (55) 0 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	46.13	40.15	42.78	39.77	39.42	36.53	37.75	39.42	39.77	42.78	43.02	46.13	(61)

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

(62)m=	180.71	157.85	164.23	145.66	141.02	124.2	118.99	132.65	134.12	152.72	163.04	176.46	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	180.71	157.85	164.23	145.66	141.02	124.2	118.99	132.65	134.12	152.72	163.04	176.46

Output from water heater (annual)$_{1...12}$ | 1791.66 | (64)

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

(65)m=	56.28	49.17	51.08	45.15	43.64	38.28	36.45	40.85	41.31	47.25	50.66	54.87	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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=	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	(66)

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

(67)m=	42.8	38.01	30.92	23.41	17.5	14.77	15.96	20.75	27.84	35.36	41.26	43.99	(67)

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

(68)m=	241	243.51	237.2	223.79	206.85	190.93	180.3	177.8	184.1	197.52	214.45	230.37	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	(71)

Water heating gains (Table 5)

(72)m=	75.64	73.17	68.65	62.71	58.65	53.17	48.99	54.91	57.38	63.51	70.36	73.75	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	454.45	449.7	431.78	404.91	378	353.88	340.26	348.46	364.33	391.39	421.08	443.11	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.6	x	10.73	x	0.63	x	0.7	=	5.25	(74)
North	0.9x	0.77	x	1.6	x	20.36	x	0.63	x	0.7	=	9.96	(74)

North	0.9x	0.77	x	1.6	x	33.31	x	0.63	x	0.7	=	16.29	(74)
North	0.9x	0.77	x	1.6	x	54.64	x	0.63	x	0.7	=	26.72	(74)
North	0.9x	0.77	x	1.6	x	75.22	x	0.63	x	0.7	=	36.78	(74)
North	0.9x	0.77	x	1.6	x	84.09	x	0.63	x	0.7	=	41.12	(74)
North	0.9x	0.77	x	1.6	x	79.12	x	0.63	x	0.7	=	38.69	(74)
North	0.9x	0.77	x	1.6	x	61.56	x	0.63	x	0.7	=	30.1	(74)
North	0.9x	0.77	x	1.6	x	41.09	x	0.63	x	0.7	=	20.09	(74)
North	0.9x	0.77	x	1.6	x	24.81	x	0.63	x	0.7	=	12.13	(74)
North	0.9x	0.77	x	1.6	x	13.22	x	0.63	x	0.7	=	6.46	(74)
North	0.9x	0.77	x	1.6	x	8.94	x	0.63	x	0.7	=	4.37	(74)
East	0.9x	1	x	3.2	x	19.87	x	0.63	x	0.7	=	19.43	(76)
East	0.9x	1	x	3.2	x	38.52	x	0.63	x	0.7	=	37.67	(76)
East	0.9x	1	x	3.2	x	61.57	x	0.63	x	0.7	=	60.21	(76)
East	0.9x	1	x	3.2	x	91.41	x	0.63	x	0.7	=	89.4	(76)
East	0.9x	1	x	3.2	x	111.22	x	0.63	x	0.7	=	108.77	(76)
East	0.9x	1	x	3.2	x	116.05	x	0.63	x	0.7	=	113.49	(76)
East	0.9x	1	x	3.2	x	112.64	x	0.63	x	0.7	=	110.16	(76)
East	0.9x	1	x	3.2	x	98.03	x	0.63	x	0.7	=	95.87	(76)
East	0.9x	1	x	3.2	x	73.6	x	0.63	x	0.7	=	71.98	(76)
East	0.9x	1	x	3.2	x	46.91	x	0.63	x	0.7	=	45.87	(76)
East	0.9x	1	x	3.2	x	24.71	x	0.63	x	0.7	=	24.16	(76)
East	0.9x	1	x	3.2	x	16.39	x	0.63	x	0.7	=	16.03	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	24.68	47.62	76.5	116.11	145.55	154.61	148.85	125.98	92.07	58.01	30.63	20.41	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	479.13	497.32	508.27	521.02	523.55	508.49	489.1	474.44	456.4	449.4	451.71	463.52	(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, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.93	0.91	0.89	0.85	0.76	0.63	0.46	0.48	0.69	0.84	0.91	0.93	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.06	19.22	19.57	19.96	20.44	20.77	20.93	20.93	20.68	20.17	19.5	19.12	(87)

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

(88)m=	19.97	19.98	19.98	19.99	20	20.01	20.01	20.01	20	19.99	19.99	19.98	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.9	0.87	0.82	0.72	0.56	0.37	0.38	0.63	0.81	0.89	0.92	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.41	17.65	18.16	18.71	19.37	19.79	19.97	19.96	19.69	19.01	18.06	17.5	(90)

fLA = Living area ÷ (4) = 0.54 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.3	18.5	18.92	19.39	19.95	20.32	20.49	20.48	20.23	19.64	18.84	18.38	(92)

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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.15	18.35	18.77	19.24	19.8	20.17	20.34	20.33	20.08	19.49	18.69	18.23	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.89	0.88	0.85	0.8	0.71	0.57	0.4	0.41	0.63	0.79	0.87	0.89	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	427.63	437.21	430.96	417.9	370.46	289.96	195.76	194.75	287.82	354.08	392.98	414.18	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	864.05	837.43	751.17	650.51	494.98	338.86	208.26	208.03	354.17	536.39	727.24	836.06	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	324.7	268.94	238.23	167.48	92.64	0	0	0	0	135.64	240.66	313.88	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1782.18 (98)

Space heating requirement in kWh/m²/year 32.11 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	324.7	268.94	238.23	167.48	92.64	0	0	0	0	135.64	240.66	313.88	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	360.78	298.82	264.7	186.09	102.94	0	0	0	0	150.71	267.4	348.75	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1980.19 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] + (214) m } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)													
	180.71	157.85	164.23	145.66	141.02	124.2	118.99	132.65	134.12	152.72	163.04	176.46	
Efficiency of water heater												90	(216)
(217)m=	90	90	90	90	90	90	90	90	90	90	90	90	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	200.79	175.39	182.48	161.85	156.69	138	132.21	147.39	149.02	169.69	181.15	196.07	

Total = Sum(219a)$_{1...12}$ = 1990.73 (219)

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Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1980.19	
Water heating fuel used			1990.73	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			302.35	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.1	x 0.01 =	61.39	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.1	x 0.01 =	61.71	(247)
Pumps, fans and electric keep-hot	(231)	11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	11.46	x 0.01 =	34.65	(250)
Additional standing charges (Table 12)				106	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	283.8	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.33	(257)
SAP rating (Section 12)		81.49	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.198	=	392.08	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Water heating	(219) x	0.198	=	394.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =			786.24	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	90.48	(267)
Electricity for lighting	(232) x	0.517	=	156.31	(268)
Total CO2, kg/year		sum of (265)…(271) =		1033.03	(272)
CO2 emissions per m²		(272) ÷ (4) =		18.61	(273)

EI rating (section 14)				86	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.02	=	2019.8	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Energy for water heating	(219) x	1.02	=	2030.55	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4050.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511	(267)
Electricity for lighting	(232) x	0	=	882.86	(268)
'Total Primary Energy		sum of (265)…(271) =		5444.2	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		98.09	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Dan Watt	**Stroma Number:**	STRO000002
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.4.0.76

Property Address: Flat 10 Baseline

Address : 172 High St, Teddington, TW11 8HU

1. Overall dwelling dimensions:

	Area(m²)			Ave Height(m)			Volume(m³)	
Ground floor	29	(1a)	x	2.67	(2a)	=	77.43	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	29	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	77.43	(5)

2. Ventilation rate:

	main heating		Secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.26	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		9.3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.72	(18)

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

Number of sides on which sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.56	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.76	0.71	0.71	0.63	0.57	0.55	0.52	0.52	0.59	0.63	0.67	0.71

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	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

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.79	0.76	0.76	0.7	0.67	0.65	0.63	0.63	0.67	0.7	0.73	0.76	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.79	0.76	0.76	0.7	0.67	0.65	0.63	0.63	0.67	0.7	0.73	0.76	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.08	x	1.5	=	3.12			(26)
Windows			3.2	x1/[1/(1.5)+ 0.04]		=	4.53			(27)
Walls Type1	38	0	38	x	0.25	=	9.5			(29)
Walls Type2	22	2.08	19.92	x	0.23	=	4.5			(29)
Walls Type3	6.4	3.2	3.2	x	0.25	=	0.8			(29)
Roof Type1	25	0	25	x	0.16	=	4			(30)
Roof Type2	1.5	0	1.5	x	0.16	=	0.24			(30)
Total area of elements, m²			92.9							(31)
Party wall			28	x	0	=	0			(32)
Party floor			63.2							(32a)
Party ceiling			0							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 26.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 3423.86 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 3.72 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 30.4 (37)

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Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	20.09	19.3	19.3	17.86	16.99	16.59	16.21	16.21	17.2	17.86	18.56	19.3	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	50.49	49.7	49.7	48.26	47.39	46.99	46.61	46.61	47.6	48.26	48.96	49.7	

Average = $Sum(39)_{1...12}$ /12= 48.36 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.74	1.71	1.71	1.66	1.63	1.62	1.61	1.61	1.64	1.66	1.69	1.71	

Average = $Sum(40)_{1...12}$ /12= 1.67 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 64.86 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	71.34	68.75	66.15	63.56	60.97	58.37	58.37	60.97	63.56	66.15	68.75	71.34	

Total = $Sum(44)_{1...12}$ = 778.28 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	106.05	92.75	95.71	83.44	80.07	69.09	64.02	73.47	74.35	86.64	94.58	102.7	

Total = $Sum(45)_{1...12}$ = 1022.88 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	15.91	13.91	14.36	12.52	12.01	10.36	9.6	11.02	11.15	13	14.19	15.41	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

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

Cylinder volume (litres) including any solar storage within same 0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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/year ((50) x (51) x (52) x (53) = 0 (54)

Enter (49) or (54) in (55) 0 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	36.36	31.64	33.71	31.34	31.07	28.79	29.75	31.07	31.34	33.71	33.9	36.36	(61)

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

(62)m=	142.41	124.4	129.42	114.79	111.13	97.88	93.77	104.54	105.69	120.35	128.48	139.06	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	142.41	124.4	129.42	114.79	111.13	97.88	93.77	104.54	105.69	120.35	128.48	139.06

Output from water heater (annual)$_{1\ldots12}$ | 1411.92 | (64)

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

(65)m=	44.35	38.75	40.25	35.58	34.39	30.17	28.72	32.19	32.56	37.24	39.92	43.24	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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=	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	23.98	21.3	17.32	13.11	9.8	8.27	8.94	11.62	15.6	19.81	23.12	24.64	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	142.02	143.49	139.78	131.87	121.89	112.51	106.25	104.77	108.49	116.39	126.37	135.75	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	(69)
Pumps and fans gains (Table 5a)													
(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	(71)
Water heating gains (Table 5)													
(72)m=	59.61	57.67	54.1	49.42	46.22	41.9	38.61	43.27	45.22	50.05	55.45	58.12	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	301.77	298.62	287.37	270.57	254.08	238.85	229.96	235.83	245.47	262.41	281.1	294.68	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.2	x	10.73	x	0.63	x	0.7	=	10.49	(74)
North	0.9x	0.77	x	3.2	x	20.36	x	0.63	x	0.7	=	19.91	(74)

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North	0.9x	0.77	x	3.2	x	33.31	x	0.63	x	0.7	=	32.57	(74)
North	0.9x	0.77	x	3.2	x	54.64	x	0.63	x	0.7	=	53.44	(74)
North	0.9x	0.77	x	3.2	x	75.22	x	0.63	x	0.7	=	73.56	(74)
North	0.9x	0.77	x	3.2	x	84.09	x	0.63	x	0.7	=	82.24	(74)
North	0.9x	0.77	x	3.2	x	79.12	x	0.63	x	0.7	=	77.38	(74)
North	0.9x	0.77	x	3.2	x	61.56	x	0.63	x	0.7	=	60.21	(74)
North	0.9x	0.77	x	3.2	x	41.09	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	3.2	x	24.81	x	0.63	x	0.7	=	24.27	(74)
North	0.9x	0.77	x	3.2	x	13.22	x	0.63	x	0.7	=	12.93	(74)
North	0.9x	0.77	x	3.2	x	8.94	x	0.63	x	0.7	=	8.75	(74)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	10.49	19.91	32.57	53.44	73.56	82.24	77.38	60.21	40.18	24.27	12.93	8.75	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	312.26	318.53	319.94	324	327.64	321.09	307.34	296.04	285.65	286.68	294.03	303.42	(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, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.91	0.9	0.88	0.85	0.77	0.66	0.51	0.53	0.72	0.84	0.9	0.91	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.2	18.39	18.82	19.34	20.01	20.53	20.82	20.81	20.4	19.68	18.81	18.3	(87)

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

(88)m=	19.52	19.54	19.54	19.57	19.59	19.6	19.61	19.61	19.59	19.57	19.55	19.54	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.9	0.89	0.86	0.82	0.72	0.57	0.37	0.38	0.64	0.8	0.88	0.9	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	15.97	16.24	16.86	17.6	18.54	19.2	19.52	19.52	19.05	18.09	16.85	16.12	(90)

fLA = Living area ÷ (4) = | 1.03 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.27	18.46	18.89	19.4	20.06	20.57	20.87	20.86	20.45	19.73	18.88	18.38	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.12	18.31	18.74	19.25	19.91	20.42	20.72	20.71	20.3	19.58	18.73	18.23	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.88	0.87	0.85	0.81	0.74	0.63	0.49	0.5	0.68	0.8	0.86	0.88	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	275.59	278.19	272.01	263.94	241.58	200.99	149.79	147.95	194.25	229	253.69	267.82	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	687.97	661.6	593.39	509.01	389.33	273.68	177.91	177.45	285.41	423.92	574.07	662.49	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	306.81	257.66	239.1	176.45	109.92	0	0	0	0	145.02	230.68	293.63	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1759.28 (98)

Space heating requirement in kWh/m²/year 60.66 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	306.81	257.66	239.1	176.45	109.92	0	0	0	0	145.02	230.68	293.63	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)	340.9	286.29	265.67	196.06	122.14	0	0	0	0	161.14	256.31	326.26	(211)

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 1954.76 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] + (214) m } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =$Sum(215)_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	142.41	124.4	129.42	114.79	111.13	97.88	93.77	104.54	105.69	120.35	128.48	139.06	
Efficiency of water heater												90	(216)
(217)m=	90	90	90	90	90	90	90	90	90	90	90	90	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	158.23	138.22	143.8	127.54	123.48	108.75	104.19	116.15	117.43	133.73	142.76	154.51

Total = $Sum(219a)_{1...12}$ = 1568.8 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1954.76	
Water heating fuel used			1568.8	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			169.38	(232)

10a. Fuel costs - individual heating systems:

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		Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1		(211) x	3.1	x 0.01 =	60.6	(240)
Space heating - main system 2		(213) x	0	x 0.01 =	0	(241)
Space heating - secondary		(215) x	0	x 0.01 =	0	(242)
Water heating cost (other fuel)		(219)	3.1	x 0.01 =	48.63	(247)
Pumps, fans and electric keep-hot		(231)	11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting		(232)	11.46	x 0.01 =	19.41	(250)
Additional standing charges (Table 12)					106	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)...(254) =	254.7	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.62	(257)
SAP rating (Section 12)		77.43	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.198	=	387.04	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Water heating	(219) x	0.198	=	310.62	(264)
Space and water heating	(261) + (262) + (263) + (264) =			697.66	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	90.48	(267)
Electricity for lighting	(232) x	0.517	=	87.57	(268)
Total CO2, kg/year		sum of (265)…(271) =		875.71	(272)
CO2 emissions per m²		(272) ÷ (4) =		30.2	(273)
EI rating (section 14)				84	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.02	=	1993.85	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Energy for water heating	(219) x	1.02	=	1600.17	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3594.02	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511	(267)

Electricity for lighting	(232) x	0	=	494.59 (268)
'Total Primary Energy		sum of (265)…(271) =		4599.61 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =		158.61 (273)

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User Details:

Assessor Name:	Dan Watt	**Stroma Number:**	STRO000002
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.4.0.76

Property Address: Flat 8

Address : 172 High St, Teddington, TW11 8HU

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Ground floor	63.2	(1a) x	2.67	(2a) =	168.74	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.2	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	168.74	(5)

2. Ventilation rate:

	main heating		Secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.12	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)

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

Number of sides on which sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.39	0.36	0.36	0.32	0.29	0.28	0.26	0.26	0.3	0.32	0.34	0.36

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	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

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.54	0.54	0.53	0.53	0.54	0.55	0.56	0.57	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.54	0.54	0.53	0.53	0.54	0.55	0.56	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.08	x	1.5	=	3.12			(26)
Windows			4.8	x1/[1/(1.5)+ 0.04]		=	6.79			(27)
Walls Type1	53	0	53	x	0.25	=	13.25			(29)
Walls Type2	24	2.08	21.92	x	0.23	=	4.95			(29)
Walls Type3	9.6	4.8	4.8	x	0.25	=	1.2			(29)
Roof Type1	50	0	50	x	0.16	=	8			(30)
Roof Type2	2.3	0	2.3	x	0.16	=	0.37			(30)
Total area of elements, m²			138.9							(31)
Party wall			28	x	0	=	0			(32)
Party floor			63.2							(32a)
Party ceiling			0							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 37.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 3841.46 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.56 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 43.23 (37)

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Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	31.98	31.53	31.53	30.72	30.23	30	29.79	29.79	30.35	30.72	31.11	31.53	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	75.22	74.77	74.77	73.95	73.46	73.24	73.02	73.02	73.58	73.95	74.35	74.77	

Average = $Sum(39)_{1...12}$ /12= 74.01 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.19	1.18	1.18	1.17	1.16	1.16	1.16	1.16	1.16	1.17	1.18	1.18	

Average = $Sum(40)_{1...12}$ /12= 1.17 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.07 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 87.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	96.54	93.03	89.52	86.01	82.5	78.99	78.99	82.5	86.01	89.52	93.03	96.54	

Total = $Sum(44)_{1...12}$ = 1053.15 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	143.51	125.51	129.52	112.92	108.35	93.49	86.64	99.42	100.6	117.24	127.98	138.98	

Total = $Sum(45)_{1...12}$ = 1384.16 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.53	18.83	19.43	16.94	16.25	14.02	13	14.91	15.09	17.59	19.2	20.85	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

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

Cylinder volume (litres) including any solar storage within same 0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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/year ((50) x (51) x (52) x (53) = 0 (54)

Enter (49) or (54) in (55) 0 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	49.2	42.82	45.62	42.41	42.04	38.95	40.25	42.04	42.41	45.62	45.88	49.2	(61)

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

(62)m=	192.7	168.33	175.14	155.33	150.39	132.45	126.89	141.46	143.02	162.86	173.86	188.17	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	192.7	168.33	175.14	155.33	150.39	132.45	126.89	141.46	143.02	162.86	173.86	188.17

Output from water heater (annual)$_{1...12}$ | 1910.59 | (64)

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

(65)m=	60.02	52.44	54.47	48.15	46.53	40.82	38.87	43.57	44.05	50.39	54.02	58.51	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	(66)

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

(67)m=	49.14	43.65	35.5	26.87	20.09	16.96	18.33	23.82	31.97	40.6	47.38	50.51	(67)

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

(68)m=	270.06	272.86	265.8	250.77	231.79	213.95	202.04	199.23	206.3	221.33	240.31	258.14	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	(71)

Water heating gains (Table 5)

(72)m=	80.67	78.03	73.21	66.87	62.55	56.7	52.24	58.56	61.19	67.73	75.03	78.64	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	500.77	495.45	475.41	445.42	415.33	388.52	373.51	382.51	400.36	430.55	463.62	488.2	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	4.8	x	47.32	x	0.63	x	0.7	=	69.42	(78)
South	0.9x	0.77	x	4.8	x	77.18	x	0.63	x	0.7	=	113.22	(78)

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South	0.9x	0.77	x	4.8	x	94.25	x	0.63	x	0.7	=	138.25	(78)
South	0.9x	0.77	x	4.8	x	105.11	x	0.63	x	0.7	=	154.2	(78)
South	0.9x	0.77	x	4.8	x	108.55	x	0.63	x	0.7	=	159.24	(78)
South	0.9x	0.77	x	4.8	x	108.9	x	0.63	x	0.7	=	159.75	(78)
South	0.9x	0.77	x	4.8	x	107.14	x	0.63	x	0.7	=	157.16	(78)
South	0.9x	0.77	x	4.8	x	103.88	x	0.63	x	0.7	=	152.39	(78)
South	0.9x	0.77	x	4.8	x	99.99	x	0.63	x	0.7	=	146.68	(78)
South	0.9x	0.77	x	4.8	x	85.29	x	0.63	x	0.7	=	125.12	(78)
South	0.9x	0.77	x	4.8	x	56.07	x	0.63	x	0.7	=	82.25	(78)
South	0.9x	0.77	x	4.8	x	40.89	x	0.63	x	0.7	=	59.98	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	69.42	113.22	138.25	154.2	159.24	159.75	157.16	152.39	146.68	125.12	82.25	59.98	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	570.19	608.67	613.67	599.61	574.56	548.26	530.67	534.9	547.04	555.67	545.87	548.18	(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, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.92	0.9	0.88	0.85	0.78	0.66	0.5	0.5	0.68	0.82	0.9	0.92	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19	19.2	19.54	19.88	20.34	20.7	20.9	20.91	20.66	20.16	19.46	19.05	(87)

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

(88)m=	19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.94	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.91	0.89	0.86	0.83	0.74	0.59	0.39	0.39	0.62	0.79	0.88	0.91	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.31	17.59	18.08	18.56	19.21	19.68	19.9	19.9	19.63	18.96	17.97	17.38	(90)

fLA = Living area ÷ (4) = 0.38 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.95	18.2	18.64	19.06	19.64	20.07	20.28	20.28	20.02	19.42	18.54	18.01	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.8	18.05	18.49	18.91	19.49	19.92	20.13	20.13	19.87	19.27	18.39	17.86	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.88	0.86	0.83	0.8	0.72	0.59	0.41	0.41	0.61	0.76	0.86	0.88	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	502.82	524.82	510.64	478.58	413.77	323.96	219.15	219.48	334.54	423.71	466.74	484.67	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)

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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1000.62	975.54	873.7	755.25	572.11	389.53	235.94	236.02	409.99	626.31	846.69	969.34	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	370.37	302.88	270.12	199.21	117.81	0	0	0	0	150.74	273.57	360.59	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2045.27 (98)

Space heating requirement in kWh/m²/year 32.36 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 90 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	370.37	302.88	270.12	199.21	117.81	0	0	0	0	150.74	273.57	360.59	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	411.52	336.54	300.13	221.34	130.9	0	0	0	0	167.48	303.96	400.66	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2272.52 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] + (214) m } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	192.7	168.33	175.14	155.33	150.39	132.45	126.89	141.46	143.02	162.86	173.86	188.17	
Efficiency of water heater												90	(216)
(217)m=	90	90	90	90	90	90	90	90	90	90	90	90	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	214.11	187.03	194.59	172.59	167.1	147.16	140.99	157.17	158.91	180.96	193.18	209.08

Total = Sum(219a)$_{1...12}$ = 2122.88 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2272.52	
Water heating fuel used			2122.88	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			347.16	(232)

10a. Fuel costs - individual heating systems:

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	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x		3.1	x 0.01 =	70.45	(240)
Space heating - main system 2	(213) x		0	x 0.01 =	0	(241)
Space heating - secondary	(215) x		0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.1	x 0.01 =	65.81	(247)
Pumps, fans and electric keep-hot	(231)		11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)		11.46	x 0.01 =	39.78	(250)
Additional standing charges (Table 12)					106	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)...(254) =	302.1	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.31	(257)
SAP rating (Section 12)		81.69	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.198	=	449.96	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Water heating	(219) x	0.198	=	420.33	(264)
Space and water heating	(261) + (262) + (263) + (264) =			870.29	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	90.48	(267)
Electricity for lighting	(232) x	0.517	=	179.48	(268)
Total CO2, kg/year		sum of (265)…(271) =		1140.25	(272)
CO2 emissions per m²		(272) ÷ (4) =		18.04	(273)
EI rating (section 14)				86	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.02	=	2317.97	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Energy for water heating	(219) x	1.02	=	2165.33	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4483.31	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511	(267)

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Electricity for lighting	(232) x	0	=	1013.7 (268)
'Total Primary Energy		sum of (265)…(271) =		6008.01 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =		95.06 (273)

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User Details:

Assessor Name:	Dan Watt	**Stroma Number:**	STRO000002
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.4.0.76

Property Address: Flat 9

Address : 172 High St, Teddington, TW11 8HU

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Ground floor	55.5	(1a) x	2.67	(2a) =	148.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	148.19	(5)

2. Ventilation rate:

	main heating		Secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

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

Number of sides on which sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.4	0.38	0.38	0.34	0.31	0.29	0.28	0.28	0.31	0.34	0.36	0.38

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	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
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	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
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.08	x	1.5	=	3.12			(26)
Windows Type 1			1.6	x1/[1/(1.5)+ 0.04]		=	2.26			(27)
Windows Type 2			3.2	x1/[1/(1.5)+ 0.04]		=	4.53			(27)
Walls Type1	41	0	41	x	0.25	=	10.25			(29)
Walls Type2	6	2.08	3.92	x	0.23	=	0.88			(29)
Walls Type3	9.6	4.8	4.8	x	0.25	=	1.2			(29)
Roof Type1	44	0	44	x	0.16	=	7.04			(30)
Roof Type2	2.3	0	2.3	x	0.16	=	0.37			(30)
Total area of elements, m²			102.9							(31)
Party wall			28	x	0	=	0			(32)
Party floor			63.2							(32a)
Party ceiling			0							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.66 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 3355.46 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 4.12 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

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Total fabric heat loss (33) + (36) = 33.77 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.42	27.99	27.99	27.21	26.74	26.52	26.31	26.31	26.85	27.21	27.58	27.99	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	62.19	61.76	61.76	60.98	60.51	60.29	60.08	60.08	60.62	60.98	61.36	61.76	

Average = $Sum(39)_{1...12}$ /12= 61.03 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.12	1.11	1.11	1.1	1.09	1.09	1.08	1.08	1.09	1.1	1.11	1.11	

Average = $Sum(40)_{1...12}$ /12= 1.1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.85 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 82.3 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	90.53	87.24	83.95	80.65	77.36	74.07	74.07	77.36	80.65	83.95	87.24	90.53	

Total = $Sum(44)_{1...12}$ = 987.6 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	134.57	117.7	121.46	105.89	101.6	87.67	81.24	93.23	94.34	109.95	120.01	130.33	

Total = $Sum(45)_{1...12}$ = 1298 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.19	17.65	18.22	15.88	15.24	13.15	12.19	13.98	14.15	16.49	18	19.55	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

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

Cylinder volume (litres) including any solar storage within same 0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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/year ((50) x (51) x (52) x (53) = 0 (54)

Enter (49) or (54) in (55) 0 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	46.13	40.15	42.78	39.77	39.42	36.53	37.75	39.42	39.77	42.78	43.02	46.13	(61)

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

(62)m=	180.71	157.85	164.23	145.66	141.02	124.2	118.99	132.65	134.12	152.72	163.04	176.46	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	180.71	157.85	164.23	145.66	141.02	124.2	118.99	132.65	134.12	152.72	163.04	176.46

Output from water heater (annual)1…12 | 1791.66 | (64)

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

(65)m=	56.28	49.17	51.08	45.15	43.64	38.28	36.45	40.85	41.31	47.25	50.66	54.87	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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=	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	(66)

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

(67)m=	42.8	38.01	30.92	23.41	17.5	14.77	15.96	20.75	27.84	35.36	41.26	43.99	(67)

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

(68)m=	241	243.51	237.2	223.79	206.85	190.93	180.3	177.8	184.1	197.52	214.45	230.37	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	(71)

Water heating gains (Table 5)

(72)m=	75.64	73.17	68.65	62.71	58.65	53.17	48.99	54.91	57.38	63.51	70.36	73.75	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	454.45	449.7	431.78	404.91	378	353.88	340.26	348.46	364.33	391.39	421.08	443.11	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.6	x	10.73	x	0.63	x	0.7	=	5.25	(74)
North	0.9x	0.77	x	1.6	x	20.36	x	0.63	x	0.7	=	9.96	(74)

North	0.9x	0.77	x	1.6	x	33.31	x	0.63	x	0.7	=	16.29	(74)
North	0.9x	0.77	x	1.6	x	54.64	x	0.63	x	0.7	=	26.72	(74)
North	0.9x	0.77	x	1.6	x	75.22	x	0.63	x	0.7	=	36.78	(74)
North	0.9x	0.77	x	1.6	x	84.09	x	0.63	x	0.7	=	41.12	(74)
North	0.9x	0.77	x	1.6	x	79.12	x	0.63	x	0.7	=	38.69	(74)
North	0.9x	0.77	x	1.6	x	61.56	x	0.63	x	0.7	=	30.1	(74)
North	0.9x	0.77	x	1.6	x	41.09	x	0.63	x	0.7	=	20.09	(74)
North	0.9x	0.77	x	1.6	x	24.81	x	0.63	x	0.7	=	12.13	(74)
North	0.9x	0.77	x	1.6	x	13.22	x	0.63	x	0.7	=	6.46	(74)
North	0.9x	0.77	x	1.6	x	8.94	x	0.63	x	0.7	=	4.37	(74)
East	0.9x	1	x	3.2	x	19.87	x	0.63	x	0.7	=	19.43	(76)
East	0.9x	1	x	3.2	x	38.52	x	0.63	x	0.7	=	37.67	(76)
East	0.9x	1	x	3.2	x	61.57	x	0.63	x	0.7	=	60.21	(76)
East	0.9x	1	x	3.2	x	91.41	x	0.63	x	0.7	=	89.4	(76)
East	0.9x	1	x	3.2	x	111.22	x	0.63	x	0.7	=	108.77	(76)
East	0.9x	1	x	3.2	x	116.05	x	0.63	x	0.7	=	113.49	(76)
East	0.9x	1	x	3.2	x	112.64	x	0.63	x	0.7	=	110.16	(76)
East	0.9x	1	x	3.2	x	98.03	x	0.63	x	0.7	=	95.87	(76)
East	0.9x	1	x	3.2	x	73.6	x	0.63	x	0.7	=	71.98	(76)
East	0.9x	1	x	3.2	x	46.91	x	0.63	x	0.7	=	45.87	(76)
East	0.9x	1	x	3.2	x	24.71	x	0.63	x	0.7	=	24.16	(76)
East	0.9x	1	x	3.2	x	16.39	x	0.63	x	0.7	=	16.03	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	24.68	47.62	76.5	116.11	145.55	154.61	148.85	125.98	92.07	58.01	30.63	20.41	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	479.13	497.32	508.27	521.02	523.55	508.49	489.1	474.44	456.4	449.4	451.71	463.52	(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, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.92	0.91	0.89	0.84	0.76	0.62	0.46	0.47	0.69	0.83	0.91	0.93	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.1	19.26	19.61	19.98	20.45	20.77	20.93	20.93	20.69	20.19	19.53	19.16	(87)

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

(88)m=	19.99	19.99	19.99	20	20.01	20.01	20.02	20.02	20.01	20	20	19.99	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.91	0.9	0.87	0.82	0.71	0.56	0.36	0.37	0.62	0.8	0.89	0.92	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.49	17.71	18.21	18.75	19.39	19.8	19.97	19.97	19.71	19.04	18.11	17.57	(90)

fLA = Living area ÷ (4) = | 0.54 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.36	18.55	18.97	19.42	19.96	20.33	20.49	20.49	20.24	19.66	18.88	18.43	(92)

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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	18.21	18.4	18.82	19.27	19.81	20.18	20.34	20.34	20.09	19.51	18.73	18.28		(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.89	0.88	0.85	0.8	0.71	0.57	0.4	0.41	0.63	0.79	0.87	0.89		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	427.32	436.85	430.4	417.2	369.5	288.8	194.74	193.75	286.75	353.43	392.64	413.91		(95)
Monthly average external temperature from Table 8														
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	852.62	827.44	742.2	644.31	490.95	336.28	206.81	206.59	351.13	531.31	719.51	826.1		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	316.42	262.48	231.98	163.52	90.35	0	0	0	0	132.34	235.34	306.67		
Total per year (kWh/year) = Sum(98)1...5,9...12 =													1739.12	(98)
Space heating requirement in kWh/m²/year													31.34	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	316.42	262.48	231.98	163.52	90.35	0	0	0	0	132.34	235.34	306.67		
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)														(211)
	351.58	291.64	257.76	181.69	100.39	0	0	0	0	147.05	261.49	340.74		
Total (kWh/year) =Sum(211)1...5,10...12=													1932.35	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] + (214) m } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10...12=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	180.71	157.85	164.23	145.66	141.02	124.2	118.99	132.65	134.12	152.72	163.04	176.46		
Efficiency of water heater													90	(216)
(217)m=	90	90	90	90	90	90	90	90	90	90	90	90		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	200.79	175.39	182.48	161.85	156.69	138	132.21	147.39	149.02	169.69	181.15	196.07		
Total = Sum(219a)1...12 =													1990.73	(219)

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Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1932.35	
Water heating fuel used			1990.73	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			302.35	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.1	x 0.01 =	59.9	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.1	x 0.01 =	61.71	(247)
Pumps, fans and electric keep-hot	(231)	11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	11.46	x 0.01 =	34.65	(250)
Additional standing charges (Table 12)				106	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	282.32	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.32	(257)
SAP rating (Section 12)		81.58	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.198	=	382.61	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Water heating	(219) x	0.198	=	394.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =			776.77	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	90.48	(267)
Electricity for lighting	(232) x	0.517	=	156.31	(268)
Total CO2, kg/year		sum of (265)…(271) =		1023.56	(272)
CO2 emissions per m²		(272) ÷ (4) =		18.44	(273)

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EI rating (section 14)				86	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.02	=	1971	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Energy for water heating	(219) x	1.02	=	2030.55	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4001.55	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511	(267)
Electricity for lighting	(232) x	0	=	882.86	(268)
‘Total Primary Energy		sum of (265)…(271) =		5395.4	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		97.21	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Dan Watt	**Stroma Number:**	STRO000002
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.4.0.76

Property Address: Flat 10

Address : 172 High St, Teddington, TW11 8HU

1. Overall dwelling dimensions:

	Area(m²)			Ave Height(m)			Volume(m³)	
Ground floor	29	(1a)	x	2.67	(2a)	=	77.43	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	29	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			77.43	(5)

2. Ventilation rate:

	main heating		Secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.26	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.51	(18)

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

Number of sides on which sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7 (22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
Wind Factor (22a)m = (22)m ÷ 4 (22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.53	0.5	0.5	0.44	0.4	0.38	0.36	0.36	0.41	0.44	0.47	0.5

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	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

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.64	0.63	0.63	0.6	0.58	0.57	0.57	0.57	0.59	0.6	0.61	0.63	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.64	0.63	0.63	0.6	0.58	0.57	0.57	0.57	0.59	0.6	0.61	0.63	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.08	x	1.5	=	3.12			(26)
Windows			3.2	x1/[1/(1.5)+ 0.04]		=	4.53			(27)
Walls Type1	38	0	38	x	0.25	=	9.5			(29)
Walls Type2	22	2.08	19.92	x	0.23	=	4.5			(29)
Walls Type3	6.4	3.2	3.2	x	0.25	=	0.8			(29)
Roof Type1	25	0	25	x	0.16	=	4			(30)
Roof Type2	1.5	0	1.5	x	0.16	=	0.24			(30)
Total area of elements, m²			92.9							(31)
Party wall			28	x	0	=	0			(32)
Party floor			63.2							(32a)
Party ceiling			0							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 26.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 3423.86 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 3.72 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 30.4 (37)

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Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	16.39	16	16	15.29	14.86	14.66	14.47	14.47	14.96	15.29	15.63	16	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	46.79	46.4	46.4	45.69	45.26	45.06	44.87	44.87	45.36	45.69	46.03	46.4	

Average = Sum(39)$_{1...12}$ /12= 45.74 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.61	1.6	1.6	1.58	1.56	1.55	1.55	1.55	1.56	1.58	1.59	1.6	

Average = Sum(40)$_{1...12}$ /12= 1.58 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 64.86 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	71.34	68.75	66.15	63.56	60.97	58.37	58.37	60.97	63.56	66.15	68.75	71.34	

Total = Sum(44)$_{1...12}$ = 778.28 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	106.05	92.75	95.71	83.44	80.07	69.09	64.02	73.47	74.35	86.64	94.58	102.7	

Total = Sum(45)$_{1...12}$ = 1022.88 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	15.91	13.91	14.36	12.52	12.01	10.36	9.6	11.02	11.15	13	14.19	15.41	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

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

Cylinder volume (litres) including any solar storage within same 0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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/year ((50) x (51) x (52) x (53) = 0 (54)

Enter (49) or (54) in (55) 0 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	36.36	31.64	33.71	31.34	31.07	28.79	29.75	31.07	31.34	33.71	33.9	36.36	(61)

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

(62)m=	142.41	124.4	129.42	114.79	111.13	97.88	93.77	104.54	105.69	120.35	128.48	139.06	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	142.41	124.4	129.42	114.79	111.13	97.88	93.77	104.54	105.69	120.35	128.48	139.06	

Output from water heater (annual)$_{1…12}$	1411.92	(64)

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

(65)m=	44.35	38.75	40.25	35.58	34.39	30.17	28.72	32.19	32.56	37.24	39.92	43.24	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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=	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	(66)

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

(67)m=	23.98	21.3	17.32	13.11	9.8	8.27	8.94	11.62	15.6	19.81	23.12	24.64	(67)

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

(68)m=	142.02	143.49	139.78	131.87	121.89	112.51	106.25	104.77	108.49	116.39	126.37	135.75	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	(71)

Water heating gains (Table 5)

(72)m=	59.61	57.67	54.1	49.42	46.22	41.9	38.61	43.27	45.22	50.05	55.45	58.12	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	301.77	298.62	287.37	270.57	254.08	238.85	229.96	235.83	245.47	262.41	281.1	294.68	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.2	x	10.73	x	0.63	x	0.7	=	10.49	(74)
North	0.9x	0.77	x	3.2	x	20.36	x	0.63	x	0.7	=	19.91	(74)

North	0.9x	0.77	x	3.2	x	33.31	x	0.63	x	0.7	=	32.57	(74)
North	0.9x	0.77	x	3.2	x	54.64	x	0.63	x	0.7	=	53.44	(74)
North	0.9x	0.77	x	3.2	x	75.22	x	0.63	x	0.7	=	73.56	(74)
North	0.9x	0.77	x	3.2	x	84.09	x	0.63	x	0.7	=	82.24	(74)
North	0.9x	0.77	x	3.2	x	79.12	x	0.63	x	0.7	=	77.38	(74)
North	0.9x	0.77	x	3.2	x	61.56	x	0.63	x	0.7	=	60.21	(74)
North	0.9x	0.77	x	3.2	x	41.09	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	3.2	x	24.81	x	0.63	x	0.7	=	24.27	(74)
North	0.9x	0.77	x	3.2	x	13.22	x	0.63	x	0.7	=	12.93	(74)
North	0.9x	0.77	x	3.2	x	8.94	x	0.63	x	0.7	=	8.75	(74)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	10.49	19.91	32.57	53.44	73.56	82.24	77.38	60.21	40.18	24.27	12.93	8.75	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	312.26	318.53	319.94	324	327.64	321.09	307.34	296.04	285.65	286.68	294.03	303.42	(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, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.91	0.9	0.88	0.85	0.77	0.65	0.5	0.52	0.71	0.83	0.89	0.91	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.41	18.57	18.99	19.45	20.09	20.57	20.84	20.83	20.45	19.78	18.95	18.49	(87)

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

(88)m=	19.61	19.62	19.62	19.64	19.65	19.65	19.66	19.66	19.64	19.64	19.63	19.62	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.9	0.89	0.86	0.82	0.72	0.56	0.37	0.38	0.63	0.79	0.87	0.9	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.3	16.53	17.13	17.79	18.66	19.28	19.57	19.57	19.15	18.25	17.09	16.42	(90)

fLA = Living area ÷ (4) = 1.03 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.48	18.64	19.05	19.51	20.13	20.61	20.88	20.87	20.5	19.83	19.02	18.56	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.33	18.49	18.9	19.36	19.98	20.46	20.73	20.72	20.35	19.68	18.87	18.41	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.88	0.87	0.85	0.81	0.73	0.62	0.48	0.49	0.67	0.79	0.86	0.88	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	274.7	277.22	270.71	262.44	239.53	198.3	146.92	145.21	191.91	227.51	252.76	267.03	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	647.22	626.09	561.54	487.04	374.94	264.16	172	171.59	274.24	405.6	546.36	626.92	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	277.15	234.44	216.38	161.71	100.75	0	0	0	0	132.5	211.39	267.76

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1602.08 (98)

Space heating requirement in kWh/m²/year 55.24 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 90 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	277.15	234.44	216.38	161.71	100.75	0	0	0	0	132.5	211.39	267.76	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)	307.95	260.49	240.42	179.68	111.94	0	0	0	0	147.22	234.88	297.51	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1780.09 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] + (214) m } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	142.41	124.4	129.42	114.79	111.13	97.88	93.77	104.54	105.69	120.35	128.48	139.06

Efficiency of water heater 90 (216)

(217)m=	90	90	90	90	90	90	90	90	90	90	90	90	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	158.23	138.22	143.8	127.54	123.48	108.75	104.19	116.15	117.43	133.73	142.76	154.51

Total = Sum(219a)$_{1...12}$ = 1568.8 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1780.09	
Water heating fuel used			1568.8	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			169.38	(232)

10a. Fuel costs - individual heating systems:

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	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x		3.1	x 0.01 =	55.18	(240)
Space heating - main system 2	(213) x		0	x 0.01 =	0	(241)
Space heating - secondary	(215) x		0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.1	x 0.01 =	48.63	(247)
Pumps, fans and electric keep-hot	(231)		11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)		11.46	x 0.01 =	19.41	(250)
Additional standing charges (Table 12)					106	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)...(254) =	249.28	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.58	(257)
SAP rating (Section 12)		77.91	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.198	=	352.46	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Water heating	(219) x	0.198	=	310.62	(264)
Space and water heating	(261) + (262) + (263) + (264) =			663.08	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	90.48	(267)
Electricity for lighting	(232) x	0.517	=	87.57	(268)
Total CO2, kg/year		sum of (265)…(271) =		841.12	(272)
CO2 emissions per m²		(272) ÷ (4) =		29	(273)
EI rating (section 14)				85	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.02	=	1815.69	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Energy for water heating	(219) x	1.02	=	1600.17	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3415.86	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511	(267)

Electricity for lighting	(232) x	0	=	494.59	(268)
'Total Primary Energy		sum of (265)…(271) =		4421.45	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		152.46	(273)

SAP WorkSheet: New dwelling design stage

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User Details:

Assessor Name:	Dan Watt	**Stroma Number:**	STRO000002
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.4.0.79

Property Address: Flat 8 20%

Address : 172 High St, Teddington, TW11 8HU

1. Overall dwelling dimensions:

	Area(m²)			Ave Height(m)			Volume(m³)	
Ground floor	63.2	(1a)	x	2.67	(2a)	=	168.74	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	63.2	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	168.74	(5)

2. Ventilation rate:

	main heating		Secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.12	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)

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

Number of sides on which sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.39	0.36	0.36	0.32	0.29	0.28	0.26	0.26	0.3	0.32	0.34	0.36

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	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

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.57	0.57	0.57	0.55	0.54	0.54	0.53	0.53	0.54	0.55	0.56	0.57	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.57	0.57	0.57	0.55	0.54	0.54	0.53	0.53	0.54	0.55	0.56	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.08	x	1.5	=	3.12			(26)
Windows			4.8	x1/[1/(1.5)+ 0.04]		=	6.79			(27)
Walls Type1	53	0	53	x	0.25	=	13.25			(29)
Walls Type2	24	2.08	21.92	x	0.23	=	4.95			(29)
Walls Type3	9.6	4.8	4.8	x	0.25	=	1.2			(29)
Roof Type1	50	0	50	x	0.16	=	8			(30)
Roof Type2	2.3	0	2.3	x	0.16	=	0.37			(30)
Total area of elements, m²			138.9							(31)
Party wall			28	x	0	=	0			(32)
Party floor			63.2							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 37.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 3841.46 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.56 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 43.23 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m=	31.98	31.53	31.53	30.72	30.23	30	29.79	29.79	30.35	30.72	31.11	31.53	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	75.22	74.77	74.77	73.95	73.46	73.24	73.02	73.02	73.58	73.95	74.35	74.77	

Average = Sum(39)$_{1…12}$ /12= 74.01 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.19	1.18	1.18	1.17	1.16	1.16	1.16	1.16	1.16	1.17	1.18	1.18

Average = Sum(40)$_{1…12}$ /12= 1.17 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.07 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 83.37 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	91.71	88.38	85.04	81.71	78.37	75.04	75.04	78.37	81.71	85.04	88.38	91.71

Total = Sum(44)$_{1…12}$ = 1000.5 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	136.33	119.24	123.04	107.27	102.93	88.82	82.3	94.45	95.57	111.38	121.58	132.03

Total = Sum(45)$_{1…12}$ = 1314.95 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.45	17.89	18.46	16.09	15.44	13.32	12.35	14.17	14.34	16.71	18.24	19.8	(46)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

If manufacturer’s declared cylinder loss factor is not known:

Cylinder volume (litres) including any solar storage within same 0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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/year ((50) x (51) x (52) x (53) = 0 (54)

Enter (49) or (54) in (55) 0 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	46.74	40.68	43.34	40.29	39.94	37	38.24	39.94	40.29	43.34	43.58	46.74	(61)

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

(62)m=	183.07	159.91	166.38	147.56	142.87	125.82	120.54	134.38	135.87	154.72	165.17	178.77	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	183.07	159.91	166.38	147.56	142.87	125.82	120.54	134.38	135.87	154.72	165.17	178.77

Output from water heater (annual)$_{1...12}$ | 1815.06 | (64)

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

(65)m=	57.01	49.82	51.75	45.74	44.21	38.78	36.93	41.39	41.85	47.87	51.32	55.58	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	124.23	(66)

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

(67)m=	49.14	43.65	35.5	26.87	20.09	16.96	18.33	23.82	31.97	40.6	47.38	50.51	(67)

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

(68)m=	270.06	272.86	265.8	250.77	231.79	213.95	202.04	199.23	206.3	221.33	240.31	258.14	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	49.49	(69)

Pumps and fans gains (Table 5a)

(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)

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

(71)m=	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	-82.82	(71)

Water heating gains (Table 5)

(72)m=	76.63	74.13	69.55	63.53	59.42	53.87	49.63	55.63	58.13	64.34	71.28	74.71	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	496.74	491.54	471.75	442.07	412.2	385.68	370.9	379.59	397.3	427.17	459.87	484.27	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x	4.8	x	47.32	x	0.63	x	0.7	=	69.42	(78)
South	0.9x	0.77	x	4.8	x	77.18	x	0.63	x	0.7	=	113.22	(78)

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South	0.9x	0.77	x	4.8	x	94.25	x	0.63	x	0.7	=	138.25	(78)
South	0.9x	0.77	x	4.8	x	105.11	x	0.63	x	0.7	=	154.2	(78)
South	0.9x	0.77	x	4.8	x	108.55	x	0.63	x	0.7	=	159.24	(78)
South	0.9x	0.77	x	4.8	x	108.9	x	0.63	x	0.7	=	159.75	(78)
South	0.9x	0.77	x	4.8	x	107.14	x	0.63	x	0.7	=	157.16	(78)
South	0.9x	0.77	x	4.8	x	103.88	x	0.63	x	0.7	=	152.39	(78)
South	0.9x	0.77	x	4.8	x	99.99	x	0.63	x	0.7	=	146.68	(78)
South	0.9x	0.77	x	4.8	x	85.29	x	0.63	x	0.7	=	125.12	(78)
South	0.9x	0.77	x	4.8	x	56.07	x	0.63	x	0.7	=	82.25	(78)
South	0.9x	0.77	x	4.8	x	40.89	x	0.63	x	0.7	=	59.98	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	69.42	113.22	138.25	154.2	159.24	159.75	157.16	152.39	146.68	125.12	82.25	59.98	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	566.16	604.77	610	596.27	571.44	545.43	528.06	531.98	543.98	552.29	542.12	544.25	(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, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.92	0.91	0.88	0.85	0.78	0.67	0.5	0.5	0.69	0.82	0.9	0.92	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19	19.19	19.53	19.87	20.34	20.7	20.9	20.91	20.66	20.16	19.45	19.04	(87)

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

(88)m=	19.93	19.94	19.94	19.95	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.94	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.91	0.89	0.86	0.83	0.74	0.6	0.4	0.39	0.62	0.79	0.89	0.91	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.3	17.58	18.07	18.56	19.2	19.68	19.9	19.9	19.63	18.96	17.96	17.37	(90)

fLA = Living area ÷ (4) = | 0.38 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.94	18.19	18.63	19.06	19.63	20.07	20.28	20.28	20.02	19.41	18.53	18	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.79	18.04	18.48	18.91	19.48	19.92	20.13	20.13	19.87	19.26	18.38	17.85	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.88	0.86	0.83	0.8	0.72	0.59	0.41	0.41	0.61	0.76	0.86	0.89	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	500.01	522.26	508.46	476.8	412.52	323.31	218.94	219.25	333.77	422.13	464.34	481.92	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	999.81	974.8	873.07	754.75	571.77	389.36	235.89	235.97	409.79	625.87	846	968.54	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	371.85	304.1	271.27	200.12	118.48	0	0	0	0	151.58	274.79	362.05	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2054.24 (98)

Space heating requirement in kWh/m²/year 32.5 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	371.85	304.1	271.27	200.12	118.48	0	0	0	0	151.58	274.79	362.05	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206) (211)	413.17	337.89	301.41	222.36	131.64	0	0	0	0	168.43	305.33	402.27	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2282.49 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] + (214) m } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

183.07	159.91	166.38	147.56	142.87	125.82	120.54	134.38	135.87	154.72	165.17	178.77

Efficiency of water heater 90 (216)

(217)m=	90	90	90	90	90	90	90	90	90	90	90	90	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	203.41	177.68	184.86	163.96	158.74	139.8	133.94	149.31	150.96	171.91	183.52	198.63

Total = Sum(219a)$_{1...12}$ = 2016.73 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2282.49	
Water heating fuel used			2016.73	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			347.16	(232)
Electricity generated by PVs			-1011.84	(233)

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10a. Fuel costs - individual heating systems:

		Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x		3.1	x 0.01 =	70.76	(240)
Space heating - main system 2	(213) x		0	x 0.01 =	0	(241)
Space heating - secondary	(215) x		0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.1	x 0.01 =	62.52	(247)
Pumps, fans and electric keep-hot	(231)		11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	11.46	x 0.01 =	39.78	(250)
Additional standing charges (Table 12)				106	(251)
	one of (233) to (235) x)	11.46	x 0.01 =	-115.96	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	183.16	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.8	(257)
SAP rating (Section 12)		88.9	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.198	=	451.93	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Water heating	(219) x	0.198	=	399.31	(264)
Space and water heating	(261) + (262) + (263) + (264) =			851.25	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	90.48	(267)
Electricity for lighting	(232) x	0.517	=	179.48	(268)
Energy saving/generation technologies Item 1		0.529	=	-535.26	(269)
Total CO2, kg/year		sum of (265)…(271) =		585.94	(272)
CO2 emissions per m²		(272) ÷ (4) =		9.27	(273)
EI rating (section 14)				93	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.02	=	2328.14	(261)

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Space heating (secondary)	(215) x	0	=	0	(263)
Energy for water heating	(219) x	1.02	=	2057.07	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4385.21	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511	(267)
Electricity for lighting	(232) x	0	=	1013.7	(268)
Energy saving/generation technologies					
Item 1		2.92	=	-2954.57	(269)
'Total Primary Energy	sum of (265)…(271) =			2955.34	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			46.76	(273)

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User Details:

Assessor Name:	Dan Watt	**Stroma Number:**	STRO000002
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.4.0.79

Property Address: Flat 9 20%

Address : 172 High St, Teddington, TW11 8HU

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Ground floor	55.5	(1a) x	2.67	(2a) =	148.19	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.5	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	148.19	(5)

2. Ventilation rate:

	main heating		Secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

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

Number of sides on which sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.3	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7 (22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
Wind Factor (22a)m = (22)m ÷ 4 (22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.4	0.38	0.38	0.34	0.31	0.29	0.28	0.28	0.31	0.34	0.36	0.38

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	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

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.58	0.57	0.57	0.56	0.55	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.08	x	1.5	=	3.12			(26)
Windows Type 1			1.6	x1/[1/(1.5)+ 0.04]		=	2.26			(27)
Windows Type 2			3.2	x1/[1/(1.5)+ 0.04]		=	4.53			(27)
Walls Type1	41	0	41	x	0.25	=	10.25			(29)
Walls Type2	6	2.08	3.92	x	0.23	=	0.88			(29)
Walls Type3	9.6	4.8	4.8	x	0.25	=	1.2			(29)
Roof Type1	44	0	44	x	0.16	=	7.04			(30)
Roof Type2	2.3	0	2.3	x	0.16	=	0.37			(30)
Total area of elements, m²			102.9							(31)
Party wall			28	x	0	=	0			(32)
Party floor			63.2							(32a)

* *for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

** *include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 29.66 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 3355.46 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 4.12 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 33.77 (37)

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Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.42	27.99	27.99	27.21	26.74	26.52	26.31	26.31	26.85	27.21	27.58	27.99	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	62.19	61.76	61.76	60.98	60.51	60.29	60.08	60.08	60.62	60.98	61.36	61.76	

Average = Sum(39)$_{1...12}$ /12= 61.03 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.12	1.11	1.11	1.1	1.09	1.09	1.08	1.08	1.09	1.1	1.11	1.11	

Average = Sum(40)$_{1...12}$ /12= 1.1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.85 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.18 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	86	82.88	79.75	76.62	73.49	70.37	70.37	73.49	76.62	79.75	82.88	86	

Total = Sum(44)$_{1...12}$ = 938.22 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	127.85	111.81	115.38	100.59	96.52	83.29	77.18	88.57	89.62	104.45	114.01	123.81	

Total = Sum(45)$_{1...12}$ = 1233.1 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.18	16.77	17.31	15.09	14.48	12.49	11.58	13.28	13.44	15.67	17.1	18.57	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

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

Cylinder volume (litres) including any solar storage within same 0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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/year ((50) x (51) x (52) x (53) = 0 (54)

Enter (49) or (54) in (55) 0 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	43.83	38.15	40.64	37.79	37.45	34.7	35.86	37.45	37.79	40.64	40.87	43.83	(61)

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

(62)m=	171.67	149.96	156.02	138.38	133.97	117.99	113.04	126.02	127.41	145.09	154.88	167.64	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	171.67	149.96	156.02	138.38	133.97	117.99	113.04	126.02	127.41	145.09	154.88	167.64	

Output from water heater (annual)$_{1...12}$ 1702.08 (64)

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

(65)m=	53.47	46.71	48.52	42.89	41.46	36.37	34.63	38.81	39.25	44.89	48.13	52.12	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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=	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	111.12	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	42.8	38.01	30.92	23.41	17.5	14.77	15.96	20.75	27.84	35.36	41.26	43.99	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	241	243.51	237.2	223.79	206.85	190.93	180.3	177.8	184.1	197.52	214.45	230.37	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	47.96	(69)
Pumps and fans gains (Table 5a)													
(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	-74.08	(71)
Water heating gains (Table 5)													
(72)m=	71.86	69.52	65.22	59.57	55.72	50.51	46.54	52.17	54.51	60.33	66.84	70.06	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	450.67	446.04	428.34	401.77	375.07	351.22	337.81	345.71	361.46	388.21	417.57	439.42	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.6	x	10.73	x	0.63	x	0.7	=	5.25	(74)
North	0.9x	0.77	x	1.6	x	20.36	x	0.63	x	0.7	=	9.96	(74)

North	0.9x	0.77	x	1.6	x	33.31	x	0.63	x	0.7	=	16.29	(74)
North	0.9x	0.77	x	1.6	x	54.64	x	0.63	x	0.7	=	26.72	(74)
North	0.9x	0.77	x	1.6	x	75.22	x	0.63	x	0.7	=	36.78	(74)
North	0.9x	0.77	x	1.6	x	84.09	x	0.63	x	0.7	=	41.12	(74)
North	0.9x	0.77	x	1.6	x	79.12	x	0.63	x	0.7	=	38.69	(74)
North	0.9x	0.77	x	1.6	x	61.56	x	0.63	x	0.7	=	30.1	(74)
North	0.9x	0.77	x	1.6	x	41.09	x	0.63	x	0.7	=	20.09	(74)
North	0.9x	0.77	x	1.6	x	24.81	x	0.63	x	0.7	=	12.13	(74)
North	0.9x	0.77	x	1.6	x	13.22	x	0.63	x	0.7	=	6.46	(74)
North	0.9x	0.77	x	1.6	x	8.94	x	0.63	x	0.7	=	4.37	(74)
East	0.9x	1	x	3.2	x	19.87	x	0.63	x	0.7	=	19.43	(76)
East	0.9x	1	x	3.2	x	38.52	x	0.63	x	0.7	=	37.67	(76)
East	0.9x	1	x	3.2	x	61.57	x	0.63	x	0.7	=	60.21	(76)
East	0.9x	1	x	3.2	x	91.41	x	0.63	x	0.7	=	89.4	(76)
East	0.9x	1	x	3.2	x	111.22	x	0.63	x	0.7	=	108.77	(76)
East	0.9x	1	x	3.2	x	116.05	x	0.63	x	0.7	=	113.49	(76)
East	0.9x	1	x	3.2	x	112.64	x	0.63	x	0.7	=	110.16	(76)
East	0.9x	1	x	3.2	x	98.03	x	0.63	x	0.7	=	95.87	(76)
East	0.9x	1	x	3.2	x	73.6	x	0.63	x	0.7	=	71.98	(76)
East	0.9x	1	x	3.2	x	46.91	x	0.63	x	0.7	=	45.87	(76)
East	0.9x	1	x	3.2	x	24.71	x	0.63	x	0.7	=	24.16	(76)
East	0.9x	1	x	3.2	x	16.39	x	0.63	x	0.7	=	16.03	(76)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	24.68	47.62	76.5	116.11	145.55	154.61	148.85	125.98	92.07	58.01	30.63	20.41	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	475.35	493.67	504.84	517.88	520.62	505.83	486.65	471.69	453.53	446.22	448.19	459.83	(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, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.93	0.91	0.89	0.85	0.76	0.63	0.46	0.48	0.69	0.84	0.91	0.93	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.09	19.25	19.6	19.98	20.45	20.77	20.93	20.93	20.69	20.18	19.52	19.15	(87)

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

(88)m=	19.99	19.99	19.99	20	20.01	20.01	20.02	20.02	20.01	20	20	19.99	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.92	0.9	0.87	0.82	0.72	0.56	0.37	0.38	0.63	0.81	0.89	0.92	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.47	17.7	18.2	18.74	19.39	19.8	19.97	19.97	19.71	19.04	18.1	17.55	(90)

fLA = Living area ÷ (4) = 0.54 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.35	18.54	18.96	19.41	19.96	20.33	20.49	20.49	20.24	19.66	18.87	18.41	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.2	18.39	18.81	19.26	19.81	20.18	20.34	20.34	20.09	19.51	18.72	18.26	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.89	0.88	0.85	0.8	0.71	0.57	0.4	0.41	0.63	0.79	0.87	0.89	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	424.63	434.35	428.29	415.56	368.43	288.28	194.58	193.56	286	351.84	390.32	411.28	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	851.92	826.79	741.65	643.89	490.69	336.16	206.77	206.54	350.95	530.9	718.9	825.42	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	317.9	263.72	233.14	164.4	90.96	0	0	0	0	133.22	236.58	308.12	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1748.05 (98)

Space heating requirement in kWh/m²/year 31.5 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	317.9	263.72	233.14	164.4	90.96	0	0	0	0	133.22	236.58	308.12	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)													(211)
	353.22	293.02	259.05	182.67	101.06	0	0	0	0	148.02	262.87	342.35	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1942.27 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] + (214) m } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	171.67	149.96	156.02	138.38	133.97	117.99	113.04	126.02	127.41	145.09	154.88	167.64

Efficiency of water heater 90 (216)

(217)m=	90	90	90	90	90	90	90	90	90	90	90	90	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	190.75	166.62	173.36	153.75	148.86	131.1	125.6	140.02	141.57	161.21	172.09	186.26

Total = Sum(219a)$_{1...12}$ = 1891.2 (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			1942.27	
Water heating fuel used			1891.2	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			302.35	(232)
Electricity generated by PVs			-1030.08	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	3.1	x 0.01 =	60.21	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.1	x 0.01 =	58.63	(247)
Pumps, fans and electric keep-hot	(231)	11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	11.46	x 0.01 =	34.65	(250)
Additional standing charges (Table 12)				106	(251)
	one of (233) to (235) x)	11.46	x 0.01 =	-118.05	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	161.49	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.76	(257)
SAP rating (Section 12)		89.46	(258)

12a. CO_2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.198	=	384.57	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Water heating	(219) x	0.198	=	374.46	(264)
Space and water heating	(261) + (262) + (263) + (264) =			759.03	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	90.48	(267)
Electricity for lighting	(232) x	0.517	=	156.31	(268)

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Energy saving/generation technologies					
Item 1		0.529	=	-544.91	(269)
Total CO2, kg/year	sum of (265)…(271) =			460.9	(272)
CO2 emissions per m²	(272) ÷ (4) =			8.3	(273)
EI rating (section 14)				94	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.02	=	1981.12	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Energy for water heating	(219) x	1.02	=	1929.02	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3910.14	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511	(267)
Electricity for lighting	(232) x	0	=	882.86	(268)
Energy saving/generation technologies					
Item 1		2.92	=	-3007.83	(269)
‘Total Primary Energy	sum of (265)…(271) =			2296.16	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			41.37	(273)

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User Details:

Assessor Name:	Dan Watt	**Stroma Number:**	STRO000002
Software Name:	Stroma FSAP 2009	**Software Version:**	Version: 1.4.0.79

Property Address: Flat 10 20%

Address : 172 High St, Teddington, TW11 8HU

1. Overall dwelling dimensions:

	Area(m²)		Ave Height(m)		Volume(m³)	
Ground floor	29	(1a) x	2.67	(2a) =	77.43	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	29	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	77.43	(5)

2. Ventilation rate:

	main heating		Secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.26	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.51	(18)

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

Number of sides on which sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.39	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.4	5.1	5.1	4.5	4.1	3.9	3.7	3.7	4.2	4.5	4.8	5.1
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.2	1.27

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.53	0.5	0.5	0.44	0.4	0.38	0.36	0.36	0.41	0.44	0.47	0.5

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	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

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.64	0.63	0.63	0.6	0.58	0.57	0.57	0.57	0.59	0.6	0.61	0.63	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.64	0.63	0.63	0.6	0.58	0.57	0.57	0.57	0.59	0.6	0.61	0.63	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.08	x	1.5	=	3.12			(26)
Windows			3.2	x1/[1/(1.5)+ 0.04]		=	4.53			(27)
Walls Type1	38	0	38	x	0.25	=	9.5			(29)
Walls Type2	22	2.08	19.92	x	0.23	=	4.5			(29)
Walls Type3	6.4	3.2	3.2	x	0.25	=	0.8			(29)
Roof Type1	25	0	25	x	0.16	=	4			(30)
Roof Type2	1.5	0	1.5	x	0.16	=	0.24			(30)
Total area of elements, m²			92.9							(31)
Party wall			28	x	0	=	0			(32)
Party floor			63.2							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 26.68 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 3423.86 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 3.72 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 30.4 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(38)m=	16.39	16	16	15.29	14.86	14.66	14.47	14.47	14.96	15.29	15.63	16	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	46.79	46.4	46.4	45.69	45.26	45.06	44.87	44.87	45.36	45.69	46.03	46.4	

Average = $Sum(39)_{1...12}$ /12= 45.74 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.61	1.6	1.6	1.58	1.56	1.55	1.55	1.55	1.56	1.58	1.59	1.6	

Average = $Sum(40)_{1...12}$ /12= 1.58 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.15 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 61.61 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	67.77	65.31	62.85	60.38	57.92	55.45	55.45	57.92	60.38	62.85	65.31	67.77	
Total = $Sum(44)_{1...12}$ = 739.36													(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	100.75	88.12	90.93	79.27	76.06	65.64	60.82	69.79	70.63	82.31	89.85	97.57	
Total = $Sum(45)_{1...12}$ = 971.74													(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	15.11	13.22	13.64	11.89	11.41	9.85	9.12	10.47	10.59	12.35	13.48	14.64	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (47)

Temperature factor from Table 2b 0 (48)

Energy lost from water storage, kWh/year (47) x (48) = 0 (49)

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

Cylinder volume (litres) including any solar storage within same 0 (50)

If community heating and no tank in dwelling, enter 110 litres in box (50)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in box (50)

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/year ((50) x (51) x (52) x (53) = 0 (54)

Enter (49) or (54) in (55) 0 (55)

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	34.54	30.06	32.03	29.78	29.51	27.35	28.26	29.51	29.78	32.03	32.21	34.54	(61)

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

(62)m=	135.29	118.18	122.95	109.05	105.58	92.98	89.08	99.31	100.41	114.34	122.06	132.11	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	135.29	118.18	122.95	109.05	105.58	92.98	89.08	99.31	100.41	114.34	122.06	132.11

Output from water heater (annual)$_{1\ldots12}$ | 1341.32 | (64)

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

(65)m=	42.13	36.81	38.24	33.8	32.67	28.66	27.29	30.59	30.93	35.37	37.93	41.08	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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=	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	69.26	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	23.98	21.3	17.32	13.11	9.8	8.27	8.94	11.62	15.6	19.81	23.12	24.64	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	142.02	143.49	139.78	131.87	121.89	112.51	106.25	104.77	108.49	116.39	126.37	135.75	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	43.08	(69)
Pumps and fans gains (Table 5a)													
(70)m=	10	10	10	10	10	10	10	10	10	10	10	10	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	-46.17	(71)
Water heating gains (Table 5)													
(72)m=	56.63	54.78	51.4	46.95	43.91	39.81	36.68	41.11	42.96	47.55	52.68	55.21	(72)
Total internal gains =					(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m								
(73)m=	298.79	295.74	284.66	268.1	251.77	236.76	228.03	233.67	243.21	259.91	278.33	291.77	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.2	x	10.73	x	0.63	x	0.7	=	10.49	(74)
North	0.9x	0.77	x	3.2	x	20.36	x	0.63	x	0.7	=	19.91	(74)

North	0.9x	0.77	x	3.2	x	33.31	x	0.63	x	0.7	=	32.57	(74)
North	0.9x	0.77	x	3.2	x	54.64	x	0.63	x	0.7	=	53.44	(74)
North	0.9x	0.77	x	3.2	x	75.22	x	0.63	x	0.7	=	73.56	(74)
North	0.9x	0.77	x	3.2	x	84.09	x	0.63	x	0.7	=	82.24	(74)
North	0.9x	0.77	x	3.2	x	79.12	x	0.63	x	0.7	=	77.38	(74)
North	0.9x	0.77	x	3.2	x	61.56	x	0.63	x	0.7	=	60.21	(74)
North	0.9x	0.77	x	3.2	x	41.09	x	0.63	x	0.7	=	40.18	(74)
North	0.9x	0.77	x	3.2	x	24.81	x	0.63	x	0.7	=	24.27	(74)
North	0.9x	0.77	x	3.2	x	13.22	x	0.63	x	0.7	=	12.93	(74)
North	0.9x	0.77	x	3.2	x	8.94	x	0.63	x	0.7	=	8.75	(74)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	10.49	19.91	32.57	53.44	73.56	82.24	77.38	60.21	40.18	24.27	12.93	8.75	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	309.28	315.65	317.23	321.53	325.33	319	305.41	293.88	283.39	284.18	291.26	300.52	(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, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.91	0.9	0.88	0.85	0.77	0.65	0.5	0.52	0.71	0.83	0.89	0.91	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.4	18.56	18.98	19.45	20.08	20.56	20.84	20.83	20.45	19.77	18.94	18.48	(87)

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

(88)m=	19.61	19.62	19.62	19.64	19.65	19.65	19.66	19.66	19.64	19.64	19.63	19.62	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.9	0.89	0.86	0.82	0.72	0.57	0.37	0.38	0.63	0.79	0.87	0.9	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.28	16.52	17.11	17.78	18.66	19.28	19.57	19.57	19.14	18.24	17.07	16.4	(90)

fLA = Living area ÷ (4) = 1.03 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.47	18.63	19.04	19.5	20.13	20.61	20.88	20.87	20.49	19.82	19.01	18.55	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.32	18.48	18.89	19.35	19.98	20.46	20.73	20.72	20.34	19.67	18.86	18.4	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.88	0.87	0.85	0.81	0.73	0.62	0.48	0.49	0.67	0.8	0.86	0.88	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	272.58	275.24	268.97	261.03	238.5	197.69	146.63	144.87	191.1	226.15	250.91	264.96	(95)
Monthly average external temperature from Table 8													
(96)m=	4.5	5	6.8	8.7	11.7	14.6	16.9	16.9	14.3	10.8	7	4.9	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	646.66	625.57	561.08	486.67	374.68	264.01	171.93	171.51	274.03	405.24	545.88	626.38	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	278.31	235.43	217.33	162.46	101.31	0	0	0	0	133.25	212.38	268.89	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1609.37 (98)

Space heating requirement in kWh/m²/year 55.5 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	278.31	235.43	217.33	162.46	101.31	0	0	0	0	133.25	212.38	268.89	
(211)m = {[(98)m x (204)] + (210)m } x 100 ÷ (206)	309.24	261.59	241.48	180.52	112.57	0	0	0	0	148.05	235.98	298.77	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1788.19 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] + (214) m } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	135.29	118.18	122.95	109.05	105.58	92.98	89.08	99.31	100.41	114.34	122.06	132.11

Efficiency of water heater 90 (216)

(217)m=	90	90	90	90	90	90	90	90	90	90	90	90	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	150.32	131.31	136.61	121.17	117.31	103.32	98.98	110.34	111.56	127.04	135.62	146.79

Total = Sum(219a)$_{1...12}$ = 1490.36 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1788.19	
Water heating fuel used			1490.36	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		130		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		175	(231)
Electricity for lighting			169.38	(232)
Electricity generated by PVs			-686.72	(233)

10a. Fuel costs - individual heating systems:

		Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x		3.1	x 0.01 =	55.43	(240)
Space heating - main system 2	(213) x		0	x 0.01 =	0	(241)
Space heating - secondary	(215) x		0	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.1	x 0.01 =	46.2	(247)
Pumps, fans and electric keep-hot	(231)		11.46	x 0.01 =	20.06	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	11.46	x 0.01 =	19.41	(250)
Additional standing charges (Table 12)				106	(251)
	one of (233) to (235) x)	11.46	x 0.01 =	-78.7	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	168.4	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.07	(257)
SAP rating (Section 12)		85.08	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.198	=	354.06	(261)
Space heating (secondary)	(215) x	0	=	0	(263)
Water heating	(219) x	0.198	=	295.09	(264)
Space and water heating	(261) + (262) + (263) + (264) =			649.15	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.517	=	90.48	(267)
Electricity for lighting	(232) x	0.517	=	87.57	(268)
Energy saving/generation technologies Item 1		0.529	=	-363.27	(269)
Total CO2, kg/year		sum of (265)…(271) =		463.92	(272)
CO2 emissions per m²		(272) ÷ (4) =		16	(273)
EI rating (section 14)				92	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.02	=	1823.95	(261)

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Space heating (secondary)	(215) x	0	=	0	(263)
Energy for water heating	(219) x	1.02	=	1520.16	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3344.11	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	2.92	=	511	(267)
Electricity for lighting	(232) x	0	=	494.59	(268)
Energy saving/generation technologies					
Item 1		2.92	=	-2005.22	(269)
‘Total Primary Energy	sum of (265)…(271) =			2344.48	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			80.84	(273)