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Our Reference : ZI-18

Sent By : E-Mail

7 October 2021

Dear Zac

SUSTAINABILITY STATEMENT (RENEWABLE ENERGY)

Statement By :	Joe Solti Accredited SAP Assessor
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Thank you for sending the drawings. We are pleased to present our report as follows.

Development Details

Site Location :	Stakers Farm, North End Lane, Yapton BN18 0DU
Development :	3 New Dwellings (Conversion of Barns)
Local Authority :	Arun District Council
Policy ECC SP2 :	Energy : At Least 10% of energy from renewable or low carbon energy generation (or equivalent fabric first approach)
Renewables/LZCs :	Ground or air source heat pump(s)

Baseline Demand (CO2 & Energy)	
Development :	3 New Dwellings (Conversion of Barns)
Total Floor Area :	561m ² (approx)
Base CO2 Emissions :	Total = 31,815 kg/year
Base Energy :	Total = 58,688 kWh/year
Note 1 : Prior to renewables being added (see SAP calculations)	
Note 2 : Calculations are based on SAP 2012 (Part L Building Regulations 2013)	

Actual Demand (CO2 & Energy)	
Development :	3 New Dwellings (Conversion of Barns)
Total Floor Area :	561m ² (approx)
Actual CO2 Emissions :	Total = 19,518 kg/year
Saving :	31,815 - 19,518 = 12,297 = 33.65%
Actual Energy :	Total = 36,076 kWh/year
Saving :	58,688 - 36,076 = 22,612 = 38.53%
Note 1 : Ground or air source heat pump(s) (see SAP calculations)	
Note 2 : Heat pumps based on "default" efficiency of 170% (CoP 1.7). However, it is very likely that the heat pumps installed will have a much better (higher) efficiency.	
Note 3 : Calculations are based on SAP 2012 (Part L Building Regulations 2013)	

Design

Energy & CO₂ Emissions

- > Fabric insulation standards (including glazing) will meet (or in most cases) be better than current (2013) Building Regulations Part L standards.
- > Advanced detailing to minimise thermal bridging and air leakage at junctions.
- > Most (or all) internal fixed lighting and external lighting will be low-energy (eg LEDs).
- > Advanced heating controls (where suitable).
- > Where supplied, white goods will be energy efficient (A++, A+ or A rated or better).

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 (if applicable), dual-flush toilets, and (where applicable) washing machines and dishwashers with low water usage.

Surface Water & Flood Risk

- > Where possible, Sustainable Drainage Systems will be used to avoid, reduce, and delay the discharge of rain-fall run-off to public watercourses and sewers.
- > Measures are to be undertaken to reduce the risk of flooding where developments are in medium or high risk flood zones.

Waste

- > Construction site waste is to be minimised (diverted from landfill) by re-using materials on site (or to/from other sites), returning to the supplier where possible/practical, recovery/recycling, and composting.
- > Hazardous waste will be avoided (or minimised where unavoidable).
- > If available, the kitchen design will incorporate fixed bin(s) in the kitchen cupboards to encourage recycling.

Health & Wellbeing

- > Key rooms to have good levels of daylighting, with décor to enhance this

(the need for artificial lighting will also be reduced).

- > Sound insulation (between dwellings, and within dwellings), will meet or be better than current Building Regulation Part E standards.
- > To ensure the dwellings are usable/adaptable for all potential existing and future owners or occupiers, as many as possible/practical of the 16 no Lifetime Homes criteria will be incorporated into the design and construction of the dwellings.

Management

- > Guidance will be provided to the end owner/occupier of the dwellings, providing information on the correct and efficient use of their home.
- > Security measures will be incorporated into the design and construction of the dwellings.

Renewable Energy (and LZCs)

Various other options were considered, with the following results :

- > Solar PV = A possibility, but concerns over the appearance of the panels.
- > Solar Thermal = Savings not as good as solar PV (does not meet the targets)
- > Biomass = Not practical/suitable. No saving in energy use.
- > Wind Power = Siting extremely difficult, location not suitable.
- > Combined Heat & Power (CHP) = Limited savings in energy and CO2 emissions.

Summary/Conclusion

The dwellings are to be designed to high levels of fabric insulation and air tightness, in line with current thinking, with ground or air source heat pump(s) to ensure that at least 10% of the developments energy is from renewables or low carbon energy production.

Therefore the proposal meets the requirements of Arun District Council's Local Plan (July 2018) Policy ECC SP2 (Energy and Climate Change Mitigation).

Construction and Insulation

<u>Element</u>	<u>U-Value</u> (W/m²K)
<u>Exposed Wall</u> Solid brick wall + 50mm timber battens/cavity + 75mm PIR insulation + 32.5mm insulated plasterboard (20mm PIR insulation + 12.5mm plasterboard).	0.19
<u>Party Wall</u> Masonry construction (all cavities where applicable fully insulated, all edges fully sealed).	0.00
<u>Ground Floor</u> (Option 1) 22mm moisture resistant flooring board + 100mm PIR insulation (between timber joists).	0.22-0.23
<u>Ground Floor</u> (Option 2) Screed + 75mm PIR insulation + solid concrete floor slab.	0.20-0.21
<u>Roof</u> 100mm PIR insulation (between rafters) + mult-foil insulation over rafters.	0.18
<u>Windows</u> Timber frame double-glazed + 16mm cavity (argon gas fill) + soft coat low-E glass, or similar to achieve a U-value of 1.60W/m²K (or better).	1.60
<u>Doors</u> Timber frame double-glazed + 16mm cavity (argon gas fill) + soft coat low-E glass, or similar to achieve a U-value of 1.80W/m²K (or better).	1.80
<u>Rooflights</u> Conservation style metal frame double-glazed + 16mm cavity (argon gas fill) + soft coat low-E glass, or similar to achieve a U-value of 1.60W/m²K (or better).	1.60

Heating, Ventilation & RenewablesMain Heating System

Electric ground or air source heat pump(s) + wet underfloor heating and radiators. Standard tariff electric.

Water Heating

From heat pump + electric immersion boost.

Ventilation

Background ventilators + intermittent extract fans (Approved Document F1, 2010, amended 2013).

OtherWater Use

Total water use < 125 litres/person/day. Water efficient sanitary fittings and white goods.

Lighting

Min 75% of light fittings are dedicated low-energy (lamp luminous efficacy > 45 lumens/circuit watt, total output > 400 lamp lumens)

Air Tightness

Part L1B - air testing not required.

SAP Input

Property Details Z1301A

Address: Base Energy, Barn 1, Stakers Farm, North End Lane, Yapton, BN18 0DU
Located in: England
Region: South East England
UPRN:
Date of assessment: 07 October 2021
Date of certificate: 07 October 2021
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Low
Water use <= 125 litres/ person/ day: True
PCDF Version: 482

Property Description

Dwelling type: House
Detachment: Semi-detached
Year Completed: 2021

Floor Location:

Floor area:

Storey height:

Floor 0	156 m ²	2.8 m
Floor 1	51 m ²	3.1 m

Living area: 70 m² (fraction 0.338)
Front of dwelling faces: South East

Opening Details

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door (SE)	Manufacturer	Half glazed	low-E, En = 0.05, soft coat	Yes	Wood
Windows (NE)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Windows (NW)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Windows (SE)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Windows (SW)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Glazed Doors (NE)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Glazed Doors (SW)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Rooflights (NW)	Manufacturer	Roof Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Door (SE)	16mm or more mm	0.7	0.63	1.8	2.5	1
Windows (NE)	16mm or more	0.7	0.63	1.6	0.5	1
Windows (NW)	16mm or more	0.7	0.63	1.6	1	1
Windows (SE)	16mm or more	0.7	0.63	1.6	8	1
Windows (SW)	16mm or more	0.7	0.63	1.6	6	1
Glazed Doors (NE)	16mm or more	0.7	0.63	1.8	5	1
Glazed Doors (SW)	16mm or more	0.7	0.63	1.8	5	1
Rooflights (NW)	16mm or more	0.8	0.63	1.6	2.5	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door (SE)		Wall	South East	0	0
Windows (NE)		Wall	North East	0	0
Windows (NW)		Wall	North West	0	0
Windows (SE)		Wall	South East	0	0
Windows (SW)		Wall	South West	0	0
Glazed Doors (NE)		Wall	North East	0	0
Glazed Doors (SW)		Wall	South West	0	0
Rooflights (NW)		Roof	North West	0.001	0

SAP Input

Overshading: Average or unknown

Opaque Elements

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Wall	235	28	207	0.19	0	False	N/A
Roof	156	2.5	153.5	0.18	0		N/A
Ground Floor	156			0.23			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							
Party Wall	8.5						N/A

Thermal Bridges

Thermal bridges: No information on thermal bridging ($\gamma = 0.15$) ($\gamma = 0.15$)

Ventilation

Pressure test: No (Assumed)
 Ventilation: Natural ventilation (extract fans)
 Number of chimneys: 0
 Number of open flues: 0
 Number of fans: 4
 Number of passive stacks: 0
 Number of sides sheltered: 1
 Pressure test: 15

Main heating system

Main heating system: Boiler systems with radiators or underfloor heating
 Electric boilers
 Fuel: Electricity
 Info Source: SAP Tables
 SAP Table: 191
 Direct acting electric boiler
 Underfloor heating and radiators, pipes in screed above insulation
 Central heating pump : 2013 or later
 Design flow temperature: Design flow temperature > 45°C
 Boiler interlock: Yes

Main heating Control

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
 Control code: 2110

Secondary heating system

Secondary heating system: None

Water heating

Water heating: From main heating system
 Water code: 901
 Fuel :Electricity
 Hot water cylinder
 Cylinder volume: 210 litres
 Cylinder insulation: Measured loss, 2kWh/day
 Primary pipework insulation: True
 Cylinderstat: True
 Cylinder in heated space: True
 Immersion: Single
 Solar panel: False

Others

Electricity tariff: Standard Tariff
 In Smoke Control Area: Unknown

SAP Input

Conservatory:	No conservatory
Low energy lights:	75%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name: Joe Solti **Stroma Number:** STRO003946
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.49

Property Address: Z1 001A

Address : Base Energy, Barn 1, Stakers Farm, North End Lane, Yapton, BN18 0DU

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	156	(1a) x	2.8	(2a) =	436.8 (3a)
First floor	51	(1b) x	3.1	(2b) =	158.1 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	207	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	594.9 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ 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							4	x 10 =	40 (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) =	40	÷ (5) =	0.07 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
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)
<i>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</i>			
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			15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.82 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			1 (19)
Shelter factor	{20} = 1 - {0.075 x (19)} =		0.92 (20)
Infiltration rate incorporating shelter factor	{21} = {18} x {20} =		0.76 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

{22}m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.96	0.94	0.93	0.83	0.81	0.72	0.72	0.7	0.76	0.81	0.85	0.89
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(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)m x 0.5]

(24d)m=	0.96	0.95	0.93	0.85	0.83	0.76	0.76	0.74	0.79	0.83	0.86	0.89
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(24d)

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

(25)m=	0.96	0.95	0.93	0.85	0.83	0.76	0.76	0.74	0.79	0.83	0.86	0.89
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(25)

3. Heat losses and heat loss parameter

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² ·K	A X k kJ/K
Doors			2.5	x 1.8	= 4.5		(26)
Windows Type 1			0.5	x 1/[1/(1.6) + 0.04]	= 0.75		(27)
Windows Type 2			1	x 1/[1/(1.6) + 0.04]	= 1.5		(27)
Windows Type 3			8	x 1/[1/(1.6) + 0.04]	= 12.03		(27)
Windows Type 4			6	x 1/[1/(1.6) + 0.04]	= 9.02		(27)
Windows Type 5			5	x 1/[1/(1.8) + 0.04]	= 8.4		(27)
Windows Type 6			5	x 1/[1/(1.8) + 0.04]	= 8.4		(27)
Rooflights			2.5	x 1/[1/(1.6) + 0.04]	= 4		(27b)
Floor			156	x 0.23	= 35.88		(28)
Walls	235	28	207	x 0.19	= 39.33		(29)
Roof	156	2.5	153.5	x 0.18	= 27.63		(30)
Total area of elements, m ²			547				(31)
Party wall			8.5	x 0	= 0		(32)

* 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) = 151.2 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7894.5 (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

SAP WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

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

82.05 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

(33) + (36) =

233.25 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	189.34	185.8	182.33	166.03	162.98	148.78	148.78	146.15	154.25	162.98	169.15	175.6

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=	422.59	419.05	415.58	399.28	396.23	382.03	382.03	379.4	387.5	396.23	402.4	408.85
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Average = Sum(39)_{1...12} / 12 =

399.27 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	2.04	2.02	2.01	1.93	1.91	1.85	1.85	1.83	1.87	1.91	1.94	1.98
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Average = Sum(40)_{1...12} / 12 =

1.93 (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

3.01

(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

105.71

(43)

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

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

(44)m=	116.28	112.05	107.83	103.6	99.37	95.14	95.14	99.37	103.6	107.83	112.05	116.28
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Total = Sum(44)_{1...12} =

1268.54 (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=	172.44	150.82	155.63	135.69	130.19	112.35	104.11	119.46	120.89	140.89	153.79	167
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Total = Sum(45)_{1...12} =

1663.26 (45)

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

(46)m=	25.87	22.62	23.35	20.35	19.53	16.85	15.62	17.92	18.13	21.13	23.07	25.05
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(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

210

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

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

2

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

1.08

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

SAP WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year

$$\{47\} \times \{51\} \times \{52\} \times \{53\} =$$

0

(54)

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

1.08

(55)

Water storage loss calculated for each month

$$\{56\}m = \{55\} \times \{41\}m$$

(56)m= 33.48 30.24 33.48 32.4 33.48 32.4 33.48 33.48 32.4 33.48 32.4 33.48

(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= 33.48 30.24 33.48 32.4 33.48 32.4 33.48 33.48 32.4 33.48 32.4 33.48

(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= 0 0 0 0 0 0 0 0 0 0 0 0

(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= 205.92 181.06 189.11 168.09 163.67 144.75 137.59 152.94 153.29 174.37 186.19 200.48

(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= 205.92 181.06 189.11 168.09 163.67 144.75 137.59 152.94 153.29 174.37 186.19 200.48

Output from water heater (annual) × 1.12

2057.46

(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m= 84.12 74.34 78.53 71.04 70.07 63.28 61.4 66.51 66.12 73.63 77.05 82.31

(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=	180.66	180.66	180.66	180.66	180.66	180.66	180.66	180.66	180.66	180.66	180.66	180.66

(66)

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

(67)m= 110.93 98.53 80.13 60.66 45.34 38.28 41.36 53.77 72.17 91.63 106.95 114.01

(67)

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

(68)m= 563.66 569.51 554.77 523.39 483.78 446.55 421.68 415.83 430.57 461.95 501.56 538.79

(68)

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

(69)m= 56.08 56.08 56.08 56.08 56.08 56.08 56.08 56.08 56.08 56.08 56.08 56.08

(69)

Pumps and fans gains (Table 5a)

(70)m= 3 3 3 3 3 3 3 3 3 3 3 3

(70)

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

(71)m= -120.44 -120.44 -120.44 -120.44 -120.44 -120.44 -120.44 -120.44 -120.44 -120.44 -120.44 -120.44

(71)

Water heating gains (Table 5)

(72)m= 113.07 110.62 105.55 98.66 94.18 87.88 82.53 89.39 91.83 98.96 107.02 110.64

(72)

Total internal gains =

$$\{66\}m + \{67\}m + \{68\}m + \{69\}m + \{70\}m + \{71\}m + \{72\}m$$

(73)m= 906.95 897.95 859.75 802.01 742.61 692.01 664.87 678.29 713.86 771.84 834.83 882.73

(73)

6. Solar gains

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

SAP WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	0.5	x	11.28	x	0.63	x	0.7	=	1.72	(75)
Northeast 0.9x	0.77	x	5	x	11.28	x	0.63	x	0.7	=	17.24	(75)
Northeast 0.9x	0.77	x	0.5	x	22.97	x	0.63	x	0.7	=	3.51	(75)
Northeast 0.9x	0.77	x	5	x	22.97	x	0.63	x	0.7	=	35.09	(75)
Northeast 0.9x	0.77	x	0.5	x	41.38	x	0.63	x	0.7	=	6.32	(75)
Northeast 0.9x	0.77	x	5	x	41.38	x	0.63	x	0.7	=	63.23	(75)
Northeast 0.9x	0.77	x	0.5	x	67.96	x	0.63	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	5	x	67.96	x	0.63	x	0.7	=	103.84	(75)
Northeast 0.9x	0.77	x	0.5	x	91.35	x	0.63	x	0.7	=	13.96	(75)
Northeast 0.9x	0.77	x	5	x	91.35	x	0.63	x	0.7	=	139.58	(75)
Northeast 0.9x	0.77	x	0.5	x	97.38	x	0.63	x	0.7	=	14.88	(75)
Northeast 0.9x	0.77	x	5	x	97.38	x	0.63	x	0.7	=	148.81	(75)
Northeast 0.9x	0.77	x	0.5	x	91.1	x	0.63	x	0.7	=	13.92	(75)
Northeast 0.9x	0.77	x	5	x	91.1	x	0.63	x	0.7	=	139.21	(75)
Northeast 0.9x	0.77	x	0.5	x	72.63	x	0.63	x	0.7	=	11.1	(75)
Northeast 0.9x	0.77	x	5	x	72.63	x	0.63	x	0.7	=	110.98	(75)
Northeast 0.9x	0.77	x	0.5	x	50.42	x	0.63	x	0.7	=	7.7	(75)
Northeast 0.9x	0.77	x	5	x	50.42	x	0.63	x	0.7	=	77.05	(75)
Northeast 0.9x	0.77	x	0.5	x	28.07	x	0.63	x	0.7	=	4.29	(75)
Northeast 0.9x	0.77	x	5	x	28.07	x	0.63	x	0.7	=	42.89	(75)
Northeast 0.9x	0.77	x	0.5	x	14.2	x	0.63	x	0.7	=	2.17	(75)
Northeast 0.9x	0.77	x	5	x	14.2	x	0.63	x	0.7	=	21.69	(75)
Northeast 0.9x	0.77	x	0.5	x	9.21	x	0.63	x	0.7	=	1.41	(75)
Northeast 0.9x	0.77	x	5	x	9.21	x	0.63	x	0.7	=	14.08	(75)
Southeast 0.9x	0.77	x	8	x	36.79	x	0.63	x	0.7	=	89.96	(77)
Southeast 0.9x	0.77	x	8	x	62.67	x	0.63	x	0.7	=	153.23	(77)
Southeast 0.9x	0.77	x	8	x	85.75	x	0.63	x	0.7	=	209.66	(77)
Southeast 0.9x	0.77	x	8	x	106.25	x	0.63	x	0.7	=	259.78	(77)
Southeast 0.9x	0.77	x	8	x	119.01	x	0.63	x	0.7	=	290.97	(77)
Southeast 0.9x	0.77	x	8	x	118.15	x	0.63	x	0.7	=	288.87	(77)
Southeast 0.9x	0.77	x	8	x	113.91	x	0.63	x	0.7	=	278.5	(77)
Southeast 0.9x	0.77	x	8	x	104.39	x	0.63	x	0.7	=	255.22	(77)
Southeast 0.9x	0.77	x	8	x	92.85	x	0.63	x	0.7	=	227.01	(77)
Southeast 0.9x	0.77	x	8	x	69.27	x	0.63	x	0.7	=	169.35	(77)
Southeast 0.9x	0.77	x	8	x	44.07	x	0.63	x	0.7	=	107.75	(77)
Southeast 0.9x	0.77	x	8	x	31.49	x	0.63	x	0.7	=	76.98	(77)
Southwest 0.9x	0.77	x	6	x	36.79		0.63	x	0.7	=	67.47	(79)
Southwest 0.9x	0.77	x	5	x	36.79		0.63	x	0.7	=	56.22	(79)
Southwest 0.9x	0.77	x	6	x	62.67		0.63	x	0.7	=	114.92	(79)

SAP WorkSheet: New dwelling design stage

Southwest0.9x	0.77	x	5	x	62.67		0.63	x	0.7	=	95.77	(79)
Southwest0.9x	0.77	x	6	x	85.75		0.63	x	0.7	=	157.24	(79)
Southwest0.9x	0.77	x	5	x	85.75		0.63	x	0.7	=	131.04	(79)
Southwest0.9x	0.77	x	6	x	106.25		0.63	x	0.7	=	194.83	(79)
Southwest0.9x	0.77	x	5	x	106.25		0.63	x	0.7	=	162.36	(79)
Southwest0.9x	0.77	x	6	x	119.01		0.63	x	0.7	=	218.23	(79)
Southwest0.9x	0.77	x	5	x	119.01		0.63	x	0.7	=	181.86	(79)
Southwest0.9x	0.77	x	6	x	118.15		0.63	x	0.7	=	216.65	(79)
Southwest0.9x	0.77	x	5	x	118.15		0.63	x	0.7	=	180.54	(79)
Southwest0.9x	0.77	x	6	x	113.91		0.63	x	0.7	=	208.87	(79)
Southwest0.9x	0.77	x	5	x	113.91		0.63	x	0.7	=	174.06	(79)
Southwest0.9x	0.77	x	6	x	104.39		0.63	x	0.7	=	191.42	(79)
Southwest0.9x	0.77	x	5	x	104.39		0.63	x	0.7	=	159.52	(79)
Southwest0.9x	0.77	x	6	x	92.85		0.63	x	0.7	=	170.26	(79)
Southwest0.9x	0.77	x	5	x	92.85		0.63	x	0.7	=	141.88	(79)
Southwest0.9x	0.77	x	6	x	69.27		0.63	x	0.7	=	127.01	(79)
Southwest0.9x	0.77	x	5	x	69.27		0.63	x	0.7	=	105.85	(79)
Southwest0.9x	0.77	x	6	x	44.07		0.63	x	0.7	=	80.81	(79)
Southwest0.9x	0.77	x	5	x	44.07		0.63	x	0.7	=	67.34	(79)
Southwest0.9x	0.77	x	6	x	31.49		0.63	x	0.7	=	57.74	(79)
Southwest0.9x	0.77	x	5	x	31.49		0.63	x	0.7	=	48.12	(79)
Northwest0.9x	0.77	x	1	x	11.28	x	0.63	x	0.7	=	3.45	(81)
Northwest0.9x	0.77	x	1	x	22.97	x	0.63	x	0.7	=	7.02	(81)
Northwest0.9x	0.77	x	1	x	41.38	x	0.63	x	0.7	=	12.65	(81)
Northwest0.9x	0.77	x	1	x	67.96	x	0.63	x	0.7	=	20.77	(81)
Northwest0.9x	0.77	x	1	x	91.35	x	0.63	x	0.7	=	27.92	(81)
Northwest0.9x	0.77	x	1	x	97.38	x	0.63	x	0.7	=	29.76	(81)
Northwest0.9x	0.77	x	1	x	91.1	x	0.63	x	0.7	=	27.84	(81)
Northwest0.9x	0.77	x	1	x	72.63	x	0.63	x	0.7	=	22.2	(81)
Northwest0.9x	0.77	x	1	x	50.42	x	0.63	x	0.7	=	15.41	(81)
Northwest0.9x	0.77	x	1	x	28.07	x	0.63	x	0.7	=	8.58	(81)
Northwest0.9x	0.77	x	1	x	14.2	x	0.63	x	0.7	=	4.34	(81)
Northwest0.9x	0.77	x	1	x	9.21	x	0.63	x	0.7	=	2.82	(81)
Rooflights0.9x	1	x	2.5	x	16.37	x	0.63	x	0.8	=	18.56	(82)
Rooflights0.9x	1	x	2.5	x	33.68	x	0.63	x	0.8	=	38.2	(82)
Rooflights0.9x	1	x	2.5	x	62.13	x	0.63	x	0.8	=	70.45	(82)
Rooflights0.9x	1	x	2.5	x	104.87	x	0.63	x	0.8	=	118.93	(82)
Rooflights0.9x	1	x	2.5	x	143.66	x	0.63	x	0.8	=	162.91	(82)
Rooflights0.9x	1	x	2.5	x	154.33	x	0.63	x	0.8	=	175.01	(82)
Rooflights0.9x	1	x	2.5	x	143.9	x	0.63	x	0.8	=	163.19	(82)
Rooflights0.9x	1	x	2.5	x	113.05	x	0.63	x	0.8	=	128.2	(82)

SAP WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	2.5	x	76.56	x	0.63	x	0.8	=	86.82	(82)
Rooflights 0.9x	1	x	2.5	x	41.49	x	0.63	x	0.8	=	47.05	(82)
Rooflights 0.9x	1	x	2.5	x	20.65	x	0.63	x	0.8	=	23.41	(82)
Rooflights 0.9x	1	x	2.5	x	13.34	x	0.63	x	0.8	=	15.13	(82)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	254.62	447.74	650.59	870.89	1035.42	1054.52	1005.59	878.63	726.14	505.02	307.52	216.27	(83)
--------	--------	--------	--------	--------	---------	---------	---------	--------	--------	--------	--------	--------	------

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

(84)m=	1161.57	1345.7	1510.33	1672.89	1778.02	1746.54	1670.46	1556.92	1440	1276.86	1142.34	1099	(84)
--------	---------	--------	---------	---------	---------	---------	---------	---------	------	---------	---------	------	------

7. Mean internal temperature (resting period)

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

21 (35)

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=	0.97	0.96	0.95	0.91	0.86	0.77	0.67	0.71	0.84	0.93	0.96	0.98	(86)

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

(87)m=	17.94	18.16	18.58	19.18	19.76	20.29	20.57	20.53	20.11	19.37	18.59	17.95	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.31	19.32	19.33	19.38	19.39	19.44	19.44	19.45	19.42	19.39	19.37	19.35	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.97	0.96	0.93	0.89	0.82	0.69	0.52	0.56	0.78	0.91	0.96	0.97	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	15.4	15.72	16.32	17.21	18.02	18.75	19.08	19.05	18.52	17.48	16.36	15.44	(90)
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fLA = Living area ÷ (4) =

0.34 (91)

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

(92)m=	16.26	16.55	17.08	17.88	18.61	19.28	19.58	19.55	19.06	18.12	17.11	16.29	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	16.26	16.55	17.08	17.88	18.61	19.28	19.58	19.55	19.06	18.12	17.11	16.29	(93)
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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
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Utilisation factor for gains, hm:

(94)m=	0.95	0.94	0.91	0.87	0.79	0.67	0.53	0.58	0.76	0.88	0.94	0.96	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	1106.65	1261.04	1377.39	1449.04	1408.86	1178	893.45	897.31	1087.99	1126.87	1070.76	1052.01	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W =[(93)m – (96)m]

(97)m=	5054.6	4881.41	4397.34	3583.58	2737.79	1786.04	1140.26	1194.02	1920.63	2978.01	4028.92	4941.69	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	2937.28	2432.88	2246.84	1536.87	988.72	0	0	0	0	1377.25	2129.87	2893.92	
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Total per year (kWh/year) = Sum(98)1..12 =

16543.65 (98)

Space heating requirement in kWh/m²/year

79.92 (99)

SAP WorkSheet: New dwelling design stage

1a 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	$\{204\} = \{202\} \times [1 - \{203\}] =$	1	(204)
Efficiency of main space heating system 1		100	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

2937.28	2432.88	2246.84	1536.87	988.72	0	0	0	0	1377.25	2129.87	2893.92	
(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$												(211)
2937.28	2432.88	2246.84	1536.87	988.72	0	0	0	0	1377.25	2129.87	2893.92	
Total (kWh/year) = $\text{Sum}(\{211\}_{1..12}) =$												16543.65 (211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)]\} \times 100 \div (208)$												
(215)m=	0	0	0	0	0	0	0	0	0	0	0	
Total (kWh/year) = $\text{Sum}(\{215\}_{1..12}) =$												0 (215)

Water heating

Output from water heater (calculated above)

205.92	181.06	189.11	168.09	163.67	144.75	137.59	152.94	153.29	174.37	186.19	200.48	
Efficiency of water heater												100 (216)
(217)m=	100	100	100	100	100	100	100	100	100	100	100	(217)

Fuel for water heating, kWh/month

(219)m = $(64)m \times 100 \div (217)m$												
(219)m=	205.92	181.06	189.11	168.09	163.67	144.75	137.59	152.94	153.29	174.37	186.19	200.48
Total = $\text{Sum}(\{219a\}_{1..12}) =$												2057.46 (219)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1		16543.65
Water heating fuel used		2057.46

Electricity for pumps, fans and electric keep-hot

central heating pump:		30	(230c)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	30	(231)
Electricity for lighting		783.61	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		19414.72	(338)

1b Fuel costs - individual heating systems

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	13.19	x 0.01 = 2182.11 (240)
Space heating - main system 2	(213) x	0	x 0.01 = 0 (241)
Space heating - secondary	(215) x	13.19	x 0.01 = 0 (242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 = 271.38 (247)

SAP WorkSheet: New dwelling design stage

Pumps, fans and electric keep-hot (231) 13.19 × 0.01 = 3.96 (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) 13.19 × 0.01 = 103.36 (250)

Additional standing charges (Table 12) 0 (251)

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

Total energy cost (245)...(247) + (250)...(254) = 2560.8 (255)

11a SAP rating - individual heating systems

Energy cost deflator (Table 12) 0.42 (256)

Energy cost factor (ECF) [(255) × (256)] ÷ [(4) + 45.0] = 4.27 (257)

SAP rating (Section 12) 40.74 (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) ×	0.519	8586.15 (261)
Space heating (secondary)	(215) ×	0.519	0 (263)
Water heating	(219) ×	0.519	1067.82 (264)
Space and water heating	(261) + (262) + (263) + (264) =		9653.97 (265)
Electricity for pumps, fans and electric keep-hot	(231) ×	0.519	15.57 (267)
Electricity for lighting	(232) ×	0.519	406.69 (268)
Total CO2, kg/year		sum of (265)...(271) =	10076.24 (272)
CO2 emissions per m²		(272) ÷ (4) =	48.68 (273)
El rating (section 14)			48 (274)

13a Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) ×	3.07	50788.99 (261)
Space heating (secondary)	(215) ×	3.07	0 (263)
Energy for water heating	(219) ×	3.07	6316.4 (264)
Space and water heating	(261) + (262) + (263) + (264) =		57105.39 (265)
Electricity for pumps, fans and electric keep-hot	(231) ×	3.07	92.1 (267)
Electricity for lighting	(232) ×	0	2405.69 (268)
'Total Primary Energy		sum of (265)...(271) =	59603.18 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	287.94 (273)

SAP Input

Property Details: Z11802A

Address: Base Energy, Barn 2, Stakers Farm, North End Lane, Yapton, BN18 0DU
Located in: England
Region: South East England
UPRN:
Date of assessment: 07 October 2021
Date of certificate: 07 October 2021
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Low
Water use <= 125 litres/ person/ day: True
PCDF Version: 482

Property Description

Dwelling type: House
Detachment: Semi-detached
Year Completed: 2021

Floor Location:

Floor area:

Storey height:

Floor 0	204 m ²	3.7 m
Floor 1	39 m ²	2.7 m

Living area: 140 m² (fraction 0.576)
Front of dwelling faces: North West

Opening Details

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door (NW)	Manufacturer	Solid	low-E, En = 0.05, soft coat	Yes	Wood
Windows (NE)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Windows (SE)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Windows (SW)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Glazed Doors (NE)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Glazed Doors (NW)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Glazed Doors (SW)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Rooflights (NE)	Manufacturer	Roof Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break
Rooflights (SW)	Manufacturer	Roof Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Door (NW)	16mm or more mm	0.7	0.63	1.8	2	1
Windows (NE)	16mm or more	0.7	0.63	1.6	6	1
Windows (SE)	16mm or more	0.7	0.63	1.6	14	1
Windows (SW)	16mm or more	0.7	0.63	1.6	1	1
Glazed Doors (NE)	16mm or more	0.7	0.63	1.8	7.5	1
Glazed Doors (NW)	16mm or more	0.7	0.63	1.8	2	1
Glazed Doors (SW)	16mm or more	0.7	0.63	1.8	7.5	1
Rooflights (NE)	16mm or more	0.8	0.63	1.6	1.5	1
Rooflights (SW)	16mm or more	0.8	0.63	1.6	0.5	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door (NW)		Wall	North West	0	0
Windows (NE)		Wall	North East	0	0
Windows (SE)		Wall	South East	0	0
Windows (SW)		Wall	South West	0	0
Glazed Doors (NE)		Wall	North East	0	0
Glazed Doors (NW)		Wall	North West	0	0
Glazed Doors (SW)		Wall	South West	0	0

SAP Input

Rooflights (NE)	Roof	North West	0.001	0
Rooflights (SW)	Roof	South West	0.001	0

Overshading: Average or unknown

Gross Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Wall	254	40	214	0.19	0	False	N/A
Roof	222	2	220	0.18	0		N/A
Ground Floor	204			0.22			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							
Party Wall	8.5						N/A

Thermal bridges:

Thermal bridges: No information on thermal bridging ($\gamma = 0.15$) ($\gamma = 0.15$)

Ventilation:

Pressure test: No (Assumed)
 Ventilation: Natural ventilation (extract fans)
 Number of chimneys: 0
 Number of open flues: 0
 Number of fans: 5
 Number of passive stacks: 0
 Number of sides sheltered: 2
 Pressure test: 15

Main heating system

Main heating system: Boiler systems with radiators or underfloor heating
 Electric boilers
 Fuel: Electricity
 Info Source: SAP Tables
 SAP Table: 191
 Direct acting electric boiler
 Underfloor heating and radiators, pipes in screed above insulation
 Central heating pump : 2013 or later
 Design flow temperature: Design flow temperature > 45°C
 Boiler interlock: Yes

Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
 Control code: 2110

Secondary heating system

Secondary heating system: None

Water heating

Water heating: From main heating system
 Water code: 901
 Fuel :Electricity
 Hot water cylinder
 Cylinder volume: 210 litres
 Cylinder insulation: Measured loss, 2kWh/day
 Primary pipework insulation: True
 Cylinderstat: True
 Cylinder in heated space: True

SAP Input

Immersion: Single
Solar panel: False

Others:

Electricity tariff: Standard Tariff
In Smoke Control Area: Unknown
Conservatory: No conservatory
Low energy lights: 75%
Terrain type: Low rise urban / suburban
EPC language: English
Wind turbine: No
Photovoltaics: None
Assess Zero Carbon Home: No

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name: Joe Solti **Stroma Number:** STRO003946
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.49

Property Address: Z1 692A

Address : Base Energy, Barn 2, Stakers Farm, North End Lane, Yapton, BN18 0DU

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	204	(1a) x	3.7	(2a) =	754.8 (3a)
First floor	39	(1b) x	2.7	(2b) =	105.3 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	243	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	860.1 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ 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							5	x 10 =	50 (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) =	50	÷ (5) =	0.06 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
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)
<i>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</i>			
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			15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.81 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - {0.075 x (19)} =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.69 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.88	0.86	0.84	0.76	0.74	0.65	0.65	0.64	0.69	0.74	0.77	0.81
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(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)m x 0.5]

(24d)m=	0.88	0.87	0.85	0.79	0.77	0.71	0.71	0.7	0.74	0.77	0.8	0.83
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(24d)

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

(25)m=	0.88	0.87	0.85	0.79	0.77	0.71	0.71	0.7	0.74	0.77	0.8	0.83
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(25)

3. Thermal losses and heat capacity 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	1.8	3.6		(26)
Windows Type 1			6	$\times 1/[1/(1.6) + 0.04]$	9.02		(27)
Windows Type 2			14	$\times 1/[1/(1.6) + 0.04]$	21.05		(27)
Windows Type 3			1	$\times 1/[1/(1.6) + 0.04]$	1.5		(27)
Windows Type 4			7.5	$\times 1/[1/(1.8) + 0.04]$	12.59		(27)
Windows Type 5			2	$\times 1/[1/(1.8) + 0.04]$	3.36		(27)
Windows Type 6			7.5	$\times 1/[1/(1.8) + 0.04]$	12.59		(27)
Rooflights Type 1			1.5	$\times 1/[1/(1.6) + 0.04]$	2.4		(27b)
Rooflights Type 2			0.5	$\times 1/[1/(1.6) + 0.04]$	0.8		(27b)
Floor			204	0.22	44.88		(28)
Walls	254	40	214	0.19	40.66		(29)
Roof	222	2	220	0.18	39.6		(30)
Total area of elements, m²			680				(31)
Party wall			8.5	0	0		(32)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ 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) = 191.87 (33)

Heat capacity Cm = S(A x k) ((28) ..(30) + (32) + (32a)... (32e) = 9516 (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

SAP WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

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

102 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

(33) + (36) =

293.87 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	250.77	246.55	242.4	222.94	219.3	202.35	202.35	199.21	208.88	219.3	226.67	234.37

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=	544.64	540.42	536.27	516.81	513.17	496.22	496.22	493.08	502.75	513.17	520.54	528.24
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Average = Sum(39)_{1...12} / 12 =

516.8 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	2.24	2.22	2.21	2.13	2.11	2.04	2.04	2.03	2.07	2.11	2.14	2.17
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Average = Sum(40)_{1...12} / 12 =

2.13 (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

3.06

(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

106.82

(43)

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

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

(44)m=	117.51	113.23	108.96	104.69	100.41	96.14	96.14	100.41	104.69	108.96	113.23	117.51
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Total = Sum(44)_{1...12} =

1281.88 (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=	174.26	152.41	157.27	137.11	131.56	113.53	105.2	120.72	122.16	142.37	155.4	168.76
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Total = Sum(45)_{1...12} =

1680.75 (45)

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

(46)m=	26.14	22.86	23.59	20.57	19.73	17.03	15.78	18.11	18.32	21.36	23.31	25.31
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(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

210

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

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

2

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

1.08

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

SAP WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year

$$\{47\} \times \{51\} \times \{52\} \times \{53\} =$$

0

(54)

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

1.08

(55)

Water storage loss calculated for each month

$$\{56\}m = \{55\} \times \{41\}m$$

(56)m=	33.48	30.24	33.48	32.4	33.48	32.4	33.48	33.48	32.4	33.48	32.4	33.48
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(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=	33.48	30.24	33.48	32.4	33.48	32.4	33.48	33.48	32.4	33.48	32.4	33.48
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(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
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(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(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=	207.74	182.65	190.75	169.51	165.04	145.93	138.68	154.2	154.56	175.85	187.8	202.24
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(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
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(63)

Output from water heater

(64)m=	207.74	182.65	190.75	169.51	165.04	145.93	138.68	154.2	154.56	175.85	187.8	202.24
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Output from water heater (annual) × 1.08

2074.95

(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	84.72	74.87	79.08	71.51	70.53	63.67	61.76	66.92	66.54	74.12	77.59	82.9
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(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=	183.47	183.47	183.47	183.47	183.47	183.47	183.47	183.47	183.47	183.47	183.47	183.47

(66)

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

(67)m=	118.18	104.96	85.36	64.63	48.31	40.78	44.07	57.28	76.88	97.62	113.94	121.46
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(67)

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

(68)m=	612.35	618.7	602.69	568.6	525.57	485.13	458.11	451.76	467.77	501.86	544.89	585.33
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(68)

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

(69)m=	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4
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(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3
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(70)

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

(71)m=	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31
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(71)

Water heating gains (Table 5)

(72)m=	113.88	111.41	106.29	99.32	94.8	88.43	83.02	89.95	92.41	99.62	107.77	111.42
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(72)

Total internal gains =

$$\{66\}m + \{67\}m + \{68\}m + \{69\}m + \{70\}m + \{71\}m + \{72\}m$$

(73)m=	964.97	955.64	914.9	853.11	789.24	734.9	705.75	719.55	757.63	819.66	887.15	938.78
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(73)

6. Solar gains

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

SAP WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	6	x	11.28	x	0.63	x	0.7	=	20.69	(75)
Northeast 0.9x	0.77	x	7.5	x	11.28	x	0.63	x	0.7	=	25.86	(75)
Northeast 0.9x	0.77	x	6	x	22.97	x	0.63	x	0.7	=	42.11	(75)
Northeast 0.9x	0.77	x	7.5	x	22.97	x	0.63	x	0.7	=	52.64	(75)
Northeast 0.9x	0.77	x	6	x	41.38	x	0.63	x	0.7	=	75.88	(75)
Northeast 0.9x	0.77	x	7.5	x	41.38	x	0.63	x	0.7	=	94.84	(75)
Northeast 0.9x	0.77	x	6	x	67.96	x	0.63	x	0.7	=	124.61	(75)
Northeast 0.9x	0.77	x	7.5	x	67.96	x	0.63	x	0.7	=	155.76	(75)
Northeast 0.9x	0.77	x	6	x	91.35	x	0.63	x	0.7	=	167.5	(75)
Northeast 0.9x	0.77	x	7.5	x	91.35	x	0.63	x	0.7	=	209.37	(75)
Northeast 0.9x	0.77	x	6	x	97.38	x	0.63	x	0.7	=	178.57	(75)
Northeast 0.9x	0.77	x	7.5	x	97.38	x	0.63	x	0.7	=	223.21	(75)
Northeast 0.9x	0.77	x	6	x	91.1	x	0.63	x	0.7	=	167.05	(75)
Northeast 0.9x	0.77	x	7.5	x	91.1	x	0.63	x	0.7	=	208.81	(75)
Northeast 0.9x	0.77	x	6	x	72.63	x	0.63	x	0.7	=	133.17	(75)
Northeast 0.9x	0.77	x	7.5	x	72.63	x	0.63	x	0.7	=	166.47	(75)
Northeast 0.9x	0.77	x	6	x	50.42	x	0.63	x	0.7	=	92.46	(75)
Northeast 0.9x	0.77	x	7.5	x	50.42	x	0.63	x	0.7	=	115.57	(75)
Northeast 0.9x	0.77	x	6	x	28.07	x	0.63	x	0.7	=	51.47	(75)
Northeast 0.9x	0.77	x	7.5	x	28.07	x	0.63	x	0.7	=	64.33	(75)
Northeast 0.9x	0.77	x	6	x	14.2	x	0.63	x	0.7	=	26.03	(75)
Northeast 0.9x	0.77	x	7.5	x	14.2	x	0.63	x	0.7	=	32.54	(75)
Northeast 0.9x	0.77	x	6	x	9.21	x	0.63	x	0.7	=	16.9	(75)
Northeast 0.9x	0.77	x	7.5	x	9.21	x	0.63	x	0.7	=	21.12	(75)
Southeast 0.9x	0.77	x	14	x	36.79	x	0.63	x	0.7	=	157.43	(77)
Southeast 0.9x	0.77	x	14	x	62.67	x	0.63	x	0.7	=	268.15	(77)
Southeast 0.9x	0.77	x	14	x	85.75	x	0.63	x	0.7	=	366.9	(77)
Southeast 0.9x	0.77	x	14	x	106.25	x	0.63	x	0.7	=	454.61	(77)
Southeast 0.9x	0.77	x	14	x	119.01	x	0.63	x	0.7	=	509.2	(77)
Southeast 0.9x	0.77	x	14	x	118.15	x	0.63	x	0.7	=	505.51	(77)
Southeast 0.9x	0.77	x	14	x	113.91	x	0.63	x	0.7	=	487.37	(77)
Southeast 0.9x	0.77	x	14	x	104.39	x	0.63	x	0.7	=	446.64	(77)
Southeast 0.9x	0.77	x	14	x	92.85	x	0.63	x	0.7	=	397.27	(77)
Southeast 0.9x	0.77	x	14	x	69.27	x	0.63	x	0.7	=	296.37	(77)
Southeast 0.9x	0.77	x	14	x	44.07	x	0.63	x	0.7	=	188.56	(77)
Southeast 0.9x	0.77	x	14	x	31.49	x	0.63	x	0.7	=	134.72	(77)
Southwest 0.9x	0.77	x	1	x	36.79		0.63	x	0.7	=	11.24	(79)
Southwest 0.9x	0.77	x	7.5	x	36.79		0.63	x	0.7	=	84.34	(79)
Southwest 0.9x	0.77	x	1	x	62.67		0.63	x	0.7	=	19.15	(79)

SAP WorkSheet: New dwelling design stage

Southwest0.9x	0.77	x	7.5	x	62.67		0.63	x	0.7	=	143.65	(79)
Southwest0.9x	0.77	x	1	x	85.75		0.63	x	0.7	=	26.21	(79)
Southwest0.9x	0.77	x	7.5	x	85.75		0.63	x	0.7	=	196.55	(79)
Southwest0.9x	0.77	x	1	x	106.25		0.63	x	0.7	=	32.47	(79)
Southwest0.9x	0.77	x	7.5	x	106.25		0.63	x	0.7	=	243.54	(79)
Southwest0.9x	0.77	x	1	x	119.01		0.63	x	0.7	=	36.37	(79)
Southwest0.9x	0.77	x	7.5	x	119.01		0.63	x	0.7	=	272.78	(79)
Southwest0.9x	0.77	x	1	x	118.15		0.63	x	0.7	=	36.11	(79)
Southwest0.9x	0.77	x	7.5	x	118.15		0.63	x	0.7	=	270.81	(79)
Southwest0.9x	0.77	x	1	x	113.91		0.63	x	0.7	=	34.81	(79)
Southwest0.9x	0.77	x	7.5	x	113.91		0.63	x	0.7	=	261.09	(79)
Southwest0.9x	0.77	x	1	x	104.39		0.63	x	0.7	=	31.9	(79)
Southwest0.9x	0.77	x	7.5	x	104.39		0.63	x	0.7	=	239.27	(79)
Southwest0.9x	0.77	x	1	x	92.85		0.63	x	0.7	=	28.38	(79)
Southwest0.9x	0.77	x	7.5	x	92.85		0.63	x	0.7	=	212.83	(79)
Southwest0.9x	0.77	x	1	x	69.27		0.63	x	0.7	=	21.17	(79)
Southwest0.9x	0.77	x	7.5	x	69.27		0.63	x	0.7	=	158.77	(79)
Southwest0.9x	0.77	x	1	x	44.07		0.63	x	0.7	=	13.47	(79)
Southwest0.9x	0.77	x	7.5	x	44.07		0.63	x	0.7	=	101.01	(79)
Southwest0.9x	0.77	x	1	x	31.49		0.63	x	0.7	=	9.62	(79)
Southwest0.9x	0.77	x	7.5	x	31.49		0.63	x	0.7	=	72.17	(79)
Northwest0.9x	0.77	x	2	x	11.28	x	0.63	x	0.7	=	6.9	(81)
Northwest0.9x	0.77	x	2	x	22.97	x	0.63	x	0.7	=	14.04	(81)
Northwest0.9x	0.77	x	2	x	41.38	x	0.63	x	0.7	=	25.29	(81)
Northwest0.9x	0.77	x	2	x	67.96	x	0.63	x	0.7	=	41.54	(81)
Northwest0.9x	0.77	x	2	x	91.35	x	0.63	x	0.7	=	55.83	(81)
Northwest0.9x	0.77	x	2	x	97.38	x	0.63	x	0.7	=	59.52	(81)
Northwest0.9x	0.77	x	2	x	91.1	x	0.63	x	0.7	=	55.68	(81)
Northwest0.9x	0.77	x	2	x	72.63	x	0.63	x	0.7	=	44.39	(81)
Northwest0.9x	0.77	x	2	x	50.42	x	0.63	x	0.7	=	30.82	(81)
Northwest0.9x	0.77	x	2	x	28.07	x	0.63	x	0.7	=	17.16	(81)
Northwest0.9x	0.77	x	2	x	14.2	x	0.63	x	0.7	=	8.68	(81)
Northwest0.9x	0.77	x	2	x	9.21	x	0.63	x	0.7	=	5.63	(81)
Rooflights0.9x	1	x	1.5	x	16.37	x	0.63	x	0.8	=	11.14	(82)
Rooflights0.9x	1	x	0.5	x	39.98	x	0.63	x	0.8	=	9.07	(82)
Rooflights0.9x	1	x	1.5	x	33.68	x	0.63	x	0.8	=	22.92	(82)
Rooflights0.9x	1	x	0.5	x	73.48	x	0.63	x	0.8	=	16.67	(82)
Rooflights0.9x	1	x	1.5	x	62.13	x	0.63	x	0.8	=	42.27	(82)
Rooflights0.9x	1	x	0.5	x	112.11	x	0.63	x	0.8	=	25.43	(82)
Rooflights0.9x	1	x	1.5	x	104.87	x	0.63	x	0.8	=	71.36	(82)
Rooflights0.9x	1	x	0.5	x	153.81	x	0.63	x	0.8	=	34.88	(82)

SAP WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	1.5	x	143.66	x	0.63	x	0.8	=	97.74	(82)
Rooflights 0.9x	1	x	0.5	x	182.63	x	0.63	x	0.8	=	41.42	(82)
Rooflights 0.9x	1	x	1.5	x	154.33	x	0.63	x	0.8	=	105.01	(82)
Rooflights 0.9x	1	x	0.5	x	184.99	x	0.63	x	0.8	=	41.96	(82)
Rooflights 0.9x	1	x	1.5	x	143.9	x	0.63	x	0.8	=	97.91	(82)
Rooflights 0.9x	1	x	0.5	x	176.88	x	0.63	x	0.8	=	40.12	(82)
Rooflights 0.9x	1	x	1.5	x	113.05	x	0.63	x	0.8	=	76.92	(82)
Rooflights 0.9x	1	x	0.5	x	155.4	x	0.63	x	0.8	=	35.24	(82)
Rooflights 0.9x	1	x	1.5	x	76.56	x	0.63	x	0.8	=	52.09	(82)
Rooflights 0.9x	1	x	0.5	x	126.86	x	0.63	x	0.8	=	28.77	(82)
Rooflights 0.9x	1	x	1.5	x	41.49	x	0.63	x	0.8	=	28.23	(82)
Rooflights 0.9x	1	x	0.5	x	84.6	x	0.63	x	0.8	=	19.19	(82)
Rooflights 0.9x	1	x	1.5	x	20.65	x	0.63	x	0.8	=	14.05	(82)
Rooflights 0.9x	1	x	0.5	x	48.93	x	0.63	x	0.8	=	11.1	(82)
Rooflights 0.9x	1	x	1.5	x	13.34	x	0.63	x	0.8	=	9.08	(82)
Rooflights 0.9x	1	x	0.5	x	33.5	x	0.63	x	0.8	=	7.6	(82)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	326.65	579.34	853.37	1158.76	1390.22	1420.71	1352.85	1174.02	958.18	656.68	395.44	276.84	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	1291.62	1534.98	1768.27	2011.87	2179.46	2155.61	2058.6	1893.56	1715.81	1476.34	1282.59	1215.62	(84)
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4. Mean internal temperature (heating periods)

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=	0.98	0.97	0.95	0.92	0.86	0.77	0.68	0.71	0.85	0.93	0.97	0.98	(86)

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

(87)m=	17.75	17.98	18.41	19.05	19.67	20.23	20.53	20.48	20.02	19.23	18.41	17.75	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.18	19.19	19.2	19.25	19.26	19.31	19.31	19.31	19.29	19.26	19.24	19.22	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.96	0.94	0.89	0.82	0.68	0.51	0.56	0.78	0.91	0.96	0.97	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	15.08	15.41	16.03	16.96	17.82	18.58	18.93	18.89	18.33	17.23	16.06	15.1	(90)
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fLA = Living area ÷ (4) =

0.58 (91)

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

(92)m=	16.62	16.89	17.41	18.16	18.88	19.53	19.85	19.8	19.3	18.38	17.41	16.63	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	16.62	16.89	17.41	18.16	18.88	19.53	19.85	19.8	19.3	18.38	17.41	16.63	(93)
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5. 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	
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SAP WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.96	0.94	0.92	0.88	0.8	0.7	0.57	0.62	0.78	0.9	0.95	0.96	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	1239.64	1449.9	1626.82	1760.6	1753.2	1501.62	1181.28	1167.17	1339.17	1323.84	1213.81	1171.65	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	6707.94	6479.79	5848.08	4787.46	3685.84	2446.51	1613.04	1678.18	2615.42	3992.76	5368.53	6564.25	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	4068.41	3380.08	3140.62	2179.35	1437.89	0	0	0	0	1985.67	2991.4	4012.1	(98)
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Total per year (kWh/year) = Sum(98)_{1..5,10..12} = 23195.52 (98)

Space heating requirement in kWh/m²/year

95.45 (99)

3a 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) x [1 – (203)] =

1 (204)

Efficiency of main space heating system 1

100 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

4068.41	3380.08	3140.62	2179.35	1437.89	0	0	0	0	1985.67	2991.4	4012.1
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(211)m = {[[(98)m x (204)] } x 100 ÷ (206)

(211)

4068.41	3380.08	3140.62	2179.35	1437.89	0	0	0	0	1985.67	2991.4	4012.1
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Total (kWh/year) =Sum(211)_{1..5,10..12} = 23195.52 (211)

Space heating fuel (secondary), kWh/month

= {[[(98)m x (201)] } x 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)

207.74	182.65	190.75	169.51	165.04	145.93	138.68	154.2	154.56	175.85	187.8	202.24
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Efficiency of water heater

100 (216)

(217)m=	100	100	100	100	100	100	100	100	100	100	100
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(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	207.74	182.65	190.75	169.51	165.04	145.93	138.68	154.2	154.56	175.85	187.8	202.24
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Total = Sum(219a)_{1..12} = 2074.95 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

23195.52

Water heating fuel used

2074.95

Electricity for pumps, fans and electric keep-hot

SAP WorkSheet: New dwelling design stage

central heating pump:

30

(230c)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

30

(231)

Electricity for lighting

834.83

(232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

26135.3

(338)

10a. Fuel costs - individual heating systems

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	13.19	x 0.01 = 3059.49 (240)
Space heating - main system 2	(213) x	0	x 0.01 = 0 (241)
Space heating - secondary	(215) x	13.19	x 0.01 = 0 (242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 = 273.69 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 = 3.96 (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)	13.19	x 0.01 = 110.11 (250)
Additional standing charges (Table 12)			0 (251)

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

Total energy cost

(245)...(247) + (250)...(254) =

3447.25

(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	5.03	(257)
SAP rating (Section 12)		32.14	(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	0.519	= 12038.48 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 1076.9 (264)
Space and water heating	(261) + (262) + (263) + (264) =		13115.37 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 15.57 (267)
Electricity for lighting	(232) x	0.519	= 433.28 (268)
Total CO2, kg/year		sum of (265)...(271) =	13564.22 (272)
CO2 emissions per m²		(272) ÷ (4) =	55.82 (273)
EI rating (section 14)			41 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	3.07	= 71210.25 (261)

SAP WorkSheet: New dwelling design stage

Space heating (secondary)	{215} x	3.07	=	0	{263}
Energy for water heating	{219} x	3.07	=	6370.09	{264}
Space and water heating	{261} + {262} + {263} + {264} =			77580.34	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	3.07	=	92.1	{267}
Electricity for lighting	{232} x	0	=	2562.92	{268}
'Total Primary Energy		sum of {265}...{271} =		80235.36	{272}
Primary energy kWh/m²/year		{272} ÷ {4} =		330.19	{273}

SAP Input

Property Details: Z11803A

Address: Base Energy, Barn 3, Stakers Farm, North End Lane, Yapton, BN18 0DU
Located in: England
Region: South East England
UPRN:
Date of assessment: 07 October 2021
Date of certificate: 07 October 2021
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Low
Water use <= 125 litres/ person/ day: True
PCDF Version: 482

Property description:

Dwelling type: Bungalow
Detachment: Detached
Year Completed: 2021
Floor Location: **Floor area:** **Storey height:**
 Floor 0 111 m² 3.1 m
Living area: 40 m² (fraction 0.36)
Front of dwelling faces: North East

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door (NE)	Manufacturer	Half glazed	low-E, En = 0.05, soft coat	Yes	Wood
Windows (NE)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Windows (SE)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Glazed Doors (NE)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Glazed Doors (NW)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Rooflights (SW)	Manufacturer	Roof Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Door (NE)	16mm or more mm	0.7	0.63	1.8	4.5	1
Windows (NE)	16mm or more	0.7	0.63	1.6	13.5	1
Windows (SE)	16mm or more	0.7	0.63	1.6	1.5	1
Glazed Doors (NE)	16mm or more	0.7	0.63	1.8	2	1
Glazed Doors (NW)	16mm or more	0.7	0.63	1.8	3.5	1
Rooflights (SW)	16mm or more	0.8	0.63	1.6	2	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door (NE)		Wall	North East	0	0
Windows (NE)		Wall	North East	0	0
Windows (SE)		Wall	South East	0	0
Glazed Doors (NE)		Wall	North East	0	0
Glazed Doors (NW)		Wall	North West	0	0
Rooflights (SW)		Roof	South West	0.001	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Wall	133	25	108	0.19	0	False	N/A

SAP Input

Roof	128	2	126	0.18	0	N/A
Ground Floor	111			0.23		N/A

Internal Elements

Party Elements

Thermal bridges:

Thermal bridges: No information on thermal bridging (y= 0.15) (y = 0.15)

Ventilation:

Pressure test: No (Assumed)
 Ventilation: Natural ventilation (extract fans)
 Number of chimneys: 0
 Number of open flues: 0
 Number of fans: 4
 Number of passive stacks: 0
 Number of sides sheltered: 1
 Pressure test: 15

Main heating system:

Main heating system: Boiler systems with radiators or underfloor heating
 Electric boilers
 Fuel: Electricity
 Info Source: SAP Tables
 SAP Table: 191
 Direct acting electric boiler
 Underfloor heating and radiators, pipes in screed above insulation
 Central heating pump : 2013 or later
 Design flow temperature: Design flow temperature > 45°C
 Boiler interlock: Yes

Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
 Control code: 2110

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: From main heating system
 Water code: 901
 Fuel :Electricity
 Hot water cylinder
 Cylinder volume: 210 litres
 Cylinder insulation: Measured loss, 2kWh/day
 Primary pipework insulation: True
 Cylinderstat: True
 Cylinder in heated space: True
 Immersion: Single
 Solar panel: False

Others:

Electricity tariff: Standard Tariff
 In Smoke Control Area: Unknown
 Conservatory: No conservatory
 Low energy lights: 75%
 Terrain type: Low rise urban / suburban
 EPC language: English
 Wind turbine: No
 Photovoltaics: None

SAP Input

Assess Zero Carbon Home: No

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name: Joe Solti **Stroma Number:** STRO003946
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.49

Property Address: ZH 003A

Address : Base Energy, Barn 3, Stakers Farm, North End Lane, Yapton, BN18 0DU

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	111 (1a)	3.1 (2a)	344.1 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	111 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	344.1 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				4	40 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.12 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
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)
<i>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</i>			
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			15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.87 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.8 (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=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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SAP WorkSheet: New dwelling design stage

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

1.02	1	0.98	0.88	0.86	0.76	0.76	0.74	0.8	0.86	0.9	0.94
------	---	------	------	------	------	------	------	-----	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (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= 1.02 1 0.98 0.89 0.87 0.79 0.79 0.77 0.82 0.87 0.91 0.94 (24d)

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

(25)m= 1.02 1 0.98 0.89 0.87 0.79 0.79 0.77 0.82 0.87 0.91 0.94 (25)

3. Heat losses and heat capacity 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			4.5	1.8	8.099999		(26)
Windows Type 1			13.5	$\times 1/[1/(1.6) + 0.04]$	20.3		(27)
Windows Type 2			1.5	$\times 1/[1/(1.6) + 0.04]$	2.26		(27)
Windows Type 3			2	$\times 1/[1/(1.8) + 0.04]$	3.36		(27)
Windows Type 4			3.5	$\times 1/[1/(1.8) + 0.04]$	5.88		(27)
Rooflights			2	$\times 1/[1/(1.6) + 0.04]$	3.2		(27b)
Floor			111	0.23	25.53		(28)
Walls	133	25	108	0.19	20.52		(29)
Roof	128	2	126	0.18	22.68		(30)
Total area of elements, m²			372				(31)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ 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) = 111.63 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4326 (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 55.8 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 167.43 (37)

Ventilation heat loss calculated monthly (36)m = 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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SAP WorkSheet: New dwelling design stage

(36)m=	116.01	113.73	111.48	100.88	98.9	89.68	89.68	87.97	93.23	98.9	102.91	107.1	(38)
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Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

(39)m=	283.44	281.16	278.91	268.31	266.33	257.1	257.1	255.4	260.66	266.33	270.34	274.53	
--------	--------	--------	--------	--------	--------	-------	-------	-------	--------	--------	--------	--------	--

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

268.3 (39)

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	2.55	2.53	2.51	2.42	2.4	2.32	2.32	2.3	2.35	2.4	2.44	2.47	
--------	------	------	------	------	-----	------	------	-----	------	-----	------	------	--

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

2.42 (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

2.82 (42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

101.19 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	111.31	107.26	103.22	99.17	95.12	91.07	91.07	95.12	99.17	103.22	107.26	111.31	

Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$

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

1214.3 (44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	165.07	144.37	148.98	129.88	124.63	107.54	99.65	114.35	115.72	134.86	147.21	159.86	
	Total = Sum(45) _{1..12} =											1592.14	(45)

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

(46)m=	24.76	21.66	22.35	19.48	18.69	16.13	14.95	17.15	17.36	20.23	22.08	23.98	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

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

2 (48)

Temperature factor from Table 2b

0.54 (49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

1.08 (50)

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

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

0 (51)

If community heating see section 4.3

Volume factor from Table 2a

0 (52)

Temperature factor from Table 2b

0 (53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0 (54)

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

1.08 (55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	33.48	30.24	33.48	32.4	33.48	32.4	33.48	33.48	32.4	33.48	32.4	33.48	(56)
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If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	33.48	30.24	33.48	32.4	33.48	32.4	33.48	33.48	32.4	33.48	32.4	33.48	(57)
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SAP WorkSheet: New dwelling design stage

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
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(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(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=	198.55	174.61	182.46	162.28	158.11	139.94	133.13	147.83	148.12	168.34	179.61	193.34
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(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
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(63)

Output from water heater

(64)m=	198.55	174.61	182.46	162.28	158.11	139.94	133.13	147.83	148.12	168.34	179.61	193.34
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Output from water heater (annual) L12

1986.34

(64)

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

(65)m=	81.67	72.2	76.32	69.11	68.22	61.68	59.92	64.81	64.4	71.63	74.87	79.94
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(65)

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

6. 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=	169.24	169.24	169.24	169.24	169.24	169.24	169.24	169.24	169.24	169.24	169.24	169.24

(66)

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

(67)m=	76.05	67.55	54.93	41.59	31.09	26.25	28.36	36.86	49.48	62.82	73.32	78.17
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(67)

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

(68)m=	407.44	411.67	401.01	378.33	349.7	322.79	304.81	300.59	311.24	333.92	362.55	389.46
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------

(68)

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

(69)m=	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3
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(70)

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

(71)m=	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

(71)

Water heating gains (Table 5)

(72)m=	109.77	107.43	102.58	95.98	91.7	85.66	80.54	87.11	89.44	96.27	103.98	107.44
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(72)

Total internal gains =

(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	707.42	700.81	672.69	630.06	586.64	548.86	527.87	538.71	564.32	607.17	654.02	689.23
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(73)

7. 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 m ²	Flux Table 6a	g _o Table 6b	FF Table 6c	Gains (W)	
Northeast 0.9x	0.77	13.5	11.28	0.63	0.7	46.55	(75)
Northeast 0.9x	0.77	2	11.28	0.63	0.7	6.9	(75)

SAP WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	13.5	x	22.97	x	0.63	x	0.7	=	94.76	(75)
Northeast 0.9x	0.77	x	2	x	22.97	x	0.63	x	0.7	=	14.04	(75)
Northeast 0.9x	0.77	x	13.5	x	41.38	x	0.63	x	0.7	=	170.72	(75)
Northeast 0.9x	0.77	x	2	x	41.38	x	0.63	x	0.7	=	25.29	(75)
Northeast 0.9x	0.77	x	13.5	x	67.96	x	0.63	x	0.7	=	280.37	(75)
Northeast 0.9x	0.77	x	2	x	67.96	x	0.63	x	0.7	=	41.54	(75)
Northeast 0.9x	0.77	x	13.5	x	91.35	x	0.63	x	0.7	=	376.87	(75)
Northeast 0.9x	0.77	x	2	x	91.35	x	0.63	x	0.7	=	55.83	(75)
Northeast 0.9x	0.77	x	13.5	x	97.38	x	0.63	x	0.7	=	401.79	(75)
Northeast 0.9x	0.77	x	2	x	97.38	x	0.63	x	0.7	=	59.52	(75)
Northeast 0.9x	0.77	x	13.5	x	91.1	x	0.63	x	0.7	=	375.86	(75)
Northeast 0.9x	0.77	x	2	x	91.1	x	0.63	x	0.7	=	55.68	(75)
Northeast 0.9x	0.77	x	13.5	x	72.63	x	0.63	x	0.7	=	299.64	(75)
Northeast 0.9x	0.77	x	2	x	72.63	x	0.63	x	0.7	=	44.39	(75)
Northeast 0.9x	0.77	x	13.5	x	50.42	x	0.63	x	0.7	=	208.02	(75)
Northeast 0.9x	0.77	x	2	x	50.42	x	0.63	x	0.7	=	30.82	(75)
Northeast 0.9x	0.77	x	13.5	x	28.07	x	0.63	x	0.7	=	115.8	(75)
Northeast 0.9x	0.77	x	2	x	28.07	x	0.63	x	0.7	=	17.16	(75)
Northeast 0.9x	0.77	x	13.5	x	14.2	x	0.63	x	0.7	=	58.57	(75)
Northeast 0.9x	0.77	x	2	x	14.2	x	0.63	x	0.7	=	8.68	(75)
Northeast 0.9x	0.77	x	13.5	x	9.21	x	0.63	x	0.7	=	38.02	(75)
Northeast 0.9x	0.77	x	2	x	9.21	x	0.63	x	0.7	=	5.63	(75)
Southeast 0.9x	0.77	x	1.5	x	36.79	x	0.63	x	0.7	=	16.87	(77)
Southeast 0.9x	0.77	x	1.5	x	62.67	x	0.63	x	0.7	=	28.73	(77)
Southeast 0.9x	0.77	x	1.5	x	85.75	x	0.63	x	0.7	=	39.31	(77)
Southeast 0.9x	0.77	x	1.5	x	106.25	x	0.63	x	0.7	=	48.71	(77)
Southeast 0.9x	0.77	x	1.5	x	119.01	x	0.63	x	0.7	=	54.56	(77)
Southeast 0.9x	0.77	x	1.5	x	118.15	x	0.63	x	0.7	=	54.16	(77)
Southeast 0.9x	0.77	x	1.5	x	113.91	x	0.63	x	0.7	=	52.22	(77)
Southeast 0.9x	0.77	x	1.5	x	104.39	x	0.63	x	0.7	=	47.85	(77)
Southeast 0.9x	0.77	x	1.5	x	92.85	x	0.63	x	0.7	=	42.57	(77)
Southeast 0.9x	0.77	x	1.5	x	69.27	x	0.63	x	0.7	=	31.75	(77)
Southeast 0.9x	0.77	x	1.5	x	44.07	x	0.63	x	0.7	=	20.2	(77)
Southeast 0.9x	0.77	x	1.5	x	31.49	x	0.63	x	0.7	=	14.43	(77)
Northwest 0.9x	0.77	x	3.5	x	11.28	x	0.63	x	0.7	=	12.07	(81)
Northwest 0.9x	0.77	x	3.5	x	22.97	x	0.63	x	0.7	=	24.57	(81)
Northwest 0.9x	0.77	x	3.5	x	41.38	x	0.63	x	0.7	=	44.26	(81)
Northwest 0.9x	0.77	x	3.5	x	67.96	x	0.63	x	0.7	=	72.69	(81)
Northwest 0.9x	0.77	x	3.5	x	91.35	x	0.63	x	0.7	=	97.71	(81)
Northwest 0.9x	0.77	x	3.5	x	97.38	x	0.63	x	0.7	=	104.17	(81)
Northwest 0.9x	0.77	x	3.5	x	91.1	x	0.63	x	0.7	=	97.45	(81)

SAP WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	3.5	x	72.63	x	0.63	x	0.7	=	77.69	(81)
Northwest 0.9x	0.77	x	3.5	x	50.42	x	0.63	x	0.7	=	53.93	(81)
Northwest 0.9x	0.77	x	3.5	x	28.07	x	0.63	x	0.7	=	30.02	(81)
Northwest 0.9x	0.77	x	3.5	x	14.2	x	0.63	x	0.7	=	15.19	(81)
Northwest 0.9x	0.77	x	3.5	x	9.21	x	0.63	x	0.7	=	9.86	(81)
Rooflights 0.9x	1	x	2	x	38.23	x	0.63	x	0.8	=	34.69	(82)
Rooflights 0.9x	1	x	2	x	71.75	x	0.63	x	0.8	=	65.09	(82)
Rooflights 0.9x	1	x	2	x	112.53	x	0.63	x	0.8	=	102.09	(82)
Rooflights 0.9x	1	x	2	x	158.21	x	0.63	x	0.8	=	143.53	(82)
Rooflights 0.9x	1	x	2	x	190.52	x	0.63	x	0.8	=	172.84	(82)
Rooflights 0.9x	1	x	2	x	193.98	x	0.63	x	0.8	=	175.98	(82)
Rooflights 0.9x	1	x	2	x	185.08	x	0.63	x	0.8	=	167.9	(82)
Rooflights 0.9x	1	x	2	x	160.91	x	0.63	x	0.8	=	145.98	(82)
Rooflights 0.9x	1	x	2	x	128.69	x	0.63	x	0.8	=	116.75	(82)
Rooflights 0.9x	1	x	2	x	83.48	x	0.63	x	0.8	=	75.74	(82)
Rooflights 0.9x	1	x	2	x	47.08	x	0.63	x	0.8	=	42.71	(82)
Rooflights 0.9x	1	x	2	x	31.85	x	0.63	x	0.8	=	28.89	(82)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	117.07	227.18	381.67	586.83	757.81	795.61	749.11	615.55	452.09	270.47	145.35	96.83	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	824.49	927.99	1054.36	1216.89	1344.45	1344.47	1276.98	1154.26	1016.41	877.64	799.37	786.06	(84)
--------	--------	--------	---------	---------	---------	---------	---------	---------	---------	--------	--------	--------	------

7. Mean internal temperature (heating periods)

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=	0.96	0.95	0.93	0.88	0.81	0.71	0.6	0.65	0.8	0.91	0.95	0.96	(86)

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

(87)m=	17.7	17.92	18.37	19.05	19.7	20.26	20.55	20.49	20.02	19.21	18.38	17.71	(87)
--------	------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	18.99	19	19.01	19.07	19.08	19.13	19.13	19.14	19.11	19.08	19.06	19.04	(88)
--------	-------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.95	0.94	0.91	0.85	0.75	0.6	0.42	0.48	0.72	0.88	0.93	0.95	(89)
--------	------	------	------	------	------	-----	------	------	------	------	------	------	------

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

(90)m=	14.94	15.26	15.9	16.86	17.74	18.48	18.79	18.75	18.21	17.1	15.93	14.97	(90)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.36

(91)

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

(92)m=	15.94	16.22	16.79	17.65	18.44	19.12	19.42	19.38	18.86	17.86	16.81	15.96	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	15.94	16.22	16.79	17.65	18.44	19.12	19.42	19.38	18.86	17.86	16.81	15.96	(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
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

SAP WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.93	0.91	0.88	0.82	0.73	0.6	0.46	0.51	0.7	0.85	0.91	0.93	(94)
--------	------	------	------	------	------	-----	------	------	-----	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	766.62	847.34	929.13	997.68	977.83	800.42	582.83	583.44	715.05	744.55	728.18	734.7	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

Monthly average external temperature from Table 8

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

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

(97)m=	3298.69	3182.34	2869.92	2348.01	1796.29	1162.66	725.28	760.64	1241.54	1934.32	2625.9	3227.18	(97)
--------	---------	---------	---------	---------	---------	---------	--------	--------	---------	---------	--------	---------	------

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

(98)m=	1883.86	1569.12	1443.95	972.24	608.93	0	0	0	0	885.19	1366.36	1854.4	(98)
--------	---------	---------	---------	--------	--------	---	---	---	---	--------	---------	--------	------

Total per year (kWh/year) = Sum(98)_{1..5,10..12} = 10584.06 (98)

Space heating requirement in kWh/m²/year

95.35 (99)

3a 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) x [1 - (203)] = 1 (204)

Efficiency of main space heating system 1 100 (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)

1883.86	1569.12	1443.95	972.24	608.93	0	0	0	0	885.19	1366.36	1854.4
---------	---------	---------	--------	--------	---	---	---	---	--------	---------	--------

(211)m = {[(98)m x (204)]} x 100 ÷ (206) (211)

1883.86	1569.12	1443.95	972.24	608.93	0	0	0	0	885.19	1366.36	1854.4
---------	---------	---------	--------	--------	---	---	---	---	--------	---------	--------

Total (kWh/year) = Sum(211)_{1..5,10..12} = 10584.06 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)]} x 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)

198.55	174.61	182.46	162.28	158.11	139.94	133.13	147.83	148.12	168.34	179.61	193.34
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater 100 (216)

(217)m=	100	100	100	100	100	100	100	100	100	100	100	100	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	198.55	174.61	182.46	162.28	158.11	139.94	133.13	147.83	148.12	168.34	179.61	193.34	(219)
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Total = Sum(219a)_{1..12} = 1986.34 (219)

Annual totals

kWh/year kWh/year

Space heating fuel used, main system 1 10584.06

Water heating fuel used 1986.34

Electricity for pumps, fans and electric keep-hot

SAP WorkSheet: New dwelling design stage

central heating pump:		30	(230c)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	30	(231)
Electricity for lighting		537.24	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		13137.64	(338)

10a. Fuel costs - individual heating systems

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	13.19	x 0.01 = 1396.04 (240)
Space heating - main system 2	(213) x	0	x 0.01 = 0 (241)
Space heating - secondary	(215) x	13.19	x 0.01 = 0 (242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 = 262 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 = 3.96 (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)	13.19	x 0.01 = 70.86 (250)
Additional standing charges (Table 12)			0 (251)
Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)...(254) =		1732.85 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	4.67	(257)
SAP rating (Section 12)		36.06	(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	0.519	= 5493.12 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 1030.91 (264)
Space and water heating	(261) + (262) + (263) + (264) =		6524.03 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 15.57 (267)
Electricity for lighting	(232) x	0.519	= 278.83 (268)
Total CO2, kg/year		sum of (265)...(271) =	6818.43 (272)
CO2 emissions per m²		(272) ÷ (4) =	61.43 (273)
EI rating (section 14)			44 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	3.07	= 32493.05 (261)

SAP WorkSheet: New dwelling design stage

Space heating (secondary)	{215} x	3.07	=	0	{263}
Energy for water heating	{219} x	3.07	=	6098.06	{264}
Space and water heating	{261} + {262} + {263} + {264} =			38591.11	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	3.07	=	92.1	{267}
Electricity for lighting	{232} x	0	=	1649.34	{268}
'Total Primary Energy		sum of {265}...{271} =		40332.55	{272}
Primary energy kWh/m²/year		{272} ÷ {4} =		363.36	{273}

SAP Input

Property Details: Z11801B

Address: Actual Energy, Barn 1, Stakers Farm, North End Lane, Yapton, BN18 0DU
Located in: England
Region: South East England
UPRN:
Date of assessment: 07 October 2021
Date of certificate: 07 October 2021
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Low
Water use <= 125 litres/ person/ day: True
PCDF Version: 482

Property Description

Dwelling type: House
Detachment: Semi-detached
Year Completed: 2021

Floor Location:

Floor area:

Storey height:

Floor	Floor area	Storey height
Floor 0	156 m ²	2.8 m
Floor 1	51 m ²	3.1 m

Living area: 70 m² (fraction 0.338)
Front of dwelling faces: South East

Opening Details

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door (SE)	Manufacturer	Half glazed	low-E, En = 0.05, soft coat	Yes	Wood
Windows (NE)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Windows (NW)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Windows (SE)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Windows (SW)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Glazed Doors (NE)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Glazed Doors (SW)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Rooflights (NW)	Manufacturer	Roof Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Door (SE)	16mm or more mm	0.7	0.63	1.8	2.5	1
Windows (NE)	16mm or more	0.7	0.63	1.6	0.5	1
Windows (NW)	16mm or more	0.7	0.63	1.6	1	1
Windows (SE)	16mm or more	0.7	0.63	1.6	8	1
Windows (SW)	16mm or more	0.7	0.63	1.6	6	1
Glazed Doors (NE)	16mm or more	0.7	0.63	1.8	5	1
Glazed Doors (SW)	16mm or more	0.7	0.63	1.8	5	1
Rooflights (NW)	16mm or more	0.8	0.63	1.6	2.5	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door (SE)		Wall	South East	0	0
Windows (NE)		Wall	North East	0	0
Windows (NW)		Wall	North West	0	0
Windows (SE)		Wall	South East	0	0
Windows (SW)		Wall	South West	0	0
Glazed Doors (NE)		Wall	North East	0	0
Glazed Doors (SW)		Wall	South West	0	0
Rooflights (NW)		Roof	North West	0.001	0

SAP Input

Overshading: Average or unknown

Opaque Elements

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Wall	235	28	207	0.19	0	False	N/A
Roof	156	2.5	153.5	0.18	0		N/A
Ground Floor	156			0.23			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							
Party Wall	8.5						N/A

Thermal Bridges

Thermal bridges: No information on thermal bridging (y= 0.15) (y = 0.15)

Ventilation

Pressure test: No (Assumed)
 Ventilation: Natural ventilation (extract fans)
 Number of chimneys: 0
 Number of open flues: 0
 Number of fans: 4
 Number of passive stacks: 0
 Number of sides sheltered: 1
 Pressure test: 15

Main heating system

Main heating system: Heat pumps with radiators or underfloor heating
 Electric heat pumps
 Fuel: Electricity
 Info Source: SAP Tables
 SAP Table: 221
 Ground source heat pump in other cases
 Underfloor heating and radiators, pipes in screed above insulation
 Design flow temperature: Design flow temperature > 45°C
 Boiler interlock: No

Main heating Control

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
 Control code: 2207

Secondary heating system

Secondary heating system: None

Water heating

Water heating: From main heating system
 Water code: 901
 Fuel :Electricity
 Hot water cylinder
 Cylinder volume: 210 litres
 Cylinder insulation: Measured loss, 2kWh/day
 Primary pipework insulation: True
 Cylinderstat: True
 Cylinder in heated space: True
 Immersion: Single
 Solar panel: False

Others

Electricity tariff: Standard Tariff
 In Smoke Control Area: Unknown

SAP Input

Conservatory:	No conservatory
Low energy lights:	75%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name: Joe Solti **Stroma Number:** STRO003946
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.49

Property Address: Z1001B

Address : Actual Energy, Barn 1, Stakers Farm, North End Lane, Yapton, BN18 0DU

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	156	(1a) x	2.8	(2a) =	436.8 (3a)
First floor	51	(1b) x	3.1	(2b) =	158.1 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	207	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	594.9 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ 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							4	x 10 =	40 (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) =	40	÷ (5) =	0.07 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
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)
<i>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</i>			
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			15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.82 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			1 (19)
Shelter factor	{20} = 1 - {0.075 x (19)} =		0.92 (20)
Infiltration rate incorporating shelter factor	{21} = {18} x {20} =		0.76 (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=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.96	0.94	0.93	0.83	0.81	0.72	0.72	0.7	0.76	0.81	0.85	0.89
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(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)m x 0.5]

(24d)m=	0.96	0.95	0.93	0.85	0.83	0.76	0.76	0.74	0.79	0.83	0.86	0.89
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(24d)

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

(25)m=	0.96	0.95	0.93	0.85	0.83	0.76	0.76	0.74	0.79	0.83	0.86	0.89
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(25)

3. Heat losses and heat loss parameter

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² ·K	A X k kJ/K
Doors			2.5	1.8	4.5		(26)
Windows Type 1			0.5	$\times 1/[1/(1.6) + 0.04]$	0.75		(27)
Windows Type 2			1	$\times 1/[1/(1.6) + 0.04]$	1.5		(27)
Windows Type 3			8	$\times 1/[1/(1.6) + 0.04]$	12.03		(27)
Windows Type 4			6	$\times 1/[1/(1.6) + 0.04]$	9.02		(27)
Windows Type 5			5	$\times 1/[1/(1.8) + 0.04]$	8.4		(27)
Windows Type 6			5	$\times 1/[1/(1.8) + 0.04]$	8.4		(27)
Rooflights			2.5	$\times 1/[1/(1.6) + 0.04]$	4		(27b)
Floor			156	0.23	35.88		(28)
Walls	235	28	207	0.19	39.33		(29)
Roof	156	2.5	153.5	0.18	27.63		(30)
Total area of elements, m ²			547				(31)
Party wall			8.5	0	0		(32)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ 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) = 151.2 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 7894.5 (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

SAP WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

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

82.05 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

(33) + (36) =

233.25 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	189.34	185.8	182.33	166.03	162.98	148.78	148.78	146.15	154.25	162.98	169.15	175.6

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=	422.59	419.05	415.58	399.28	396.23	382.03	382.03	379.4	387.5	396.23	402.4	408.85
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Average = Sum(39)_{1...12} / 12 =

399.27 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	2.04	2.02	2.01	1.93	1.91	1.85	1.85	1.83	1.87	1.91	1.94	1.98
--------	------	------	------	------	------	------	------	------	------	------	------	------

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

1.93 (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

3.01

(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

105.71

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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=	116.28	112.05	107.83	103.6	99.37	95.14	95.14	99.37	103.6	107.83	112.05	116.28
--------	--------	--------	--------	-------	-------	-------	-------	-------	-------	--------	--------	--------

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

1268.54 (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=	172.44	150.82	155.63	135.69	130.19	112.35	104.11	119.46	120.89	140.89	153.79	167
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----

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

1663.26 (45)

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

(46)m=	25.87	22.62	23.35	20.35	19.53	16.85	15.62	17.92	18.13	21.13	23.07	25.05
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

210

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

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

2

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

1.08

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

SAP WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year

$$\{47\} \times \{51\} \times \{52\} \times \{53\} =$$

0

(54)

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

1.08

(55)

Water storage loss calculated for each month

$$\{56\}m = \{55\} \times \{41\}m$$

(56)m=	33.48	30.24	33.48	32.4	33.48	32.4	33.48	33.48	32.4	33.48	32.4	33.48
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------

(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=	33.48	30.24	33.48	32.4	33.48	32.4	33.48	33.48	32.4	33.48	32.4	33.48
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------

(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(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=	229.19	202.07	212.38	190.6	186.94	167.26	160.85	176.21	175.8	197.63	208.7	223.75
--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	-------	--------

(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=	229.19	202.07	212.38	190.6	186.94	167.26	160.85	176.21	175.8	197.63	208.7	223.75
--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	-------	--------

Output from water heater (annual) × 1.12

2331.36

(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	102.73	91.15	97.14	89.04	88.68	81.28	80.01	85.12	84.13	92.24	95.06	100.92
--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--------

(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=	180.66	180.66	180.66	180.66	180.66	180.66	180.66	180.66	180.66	180.66	180.66	180.66

(66)

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

(67)m=	110.93	98.53	80.13	60.66	45.34	38.28	41.36	53.77	72.17	91.63	106.95	114.01
--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--------	--------

(67)

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

(68)m=	563.66	569.51	554.77	523.39	483.78	446.55	421.68	415.83	430.57	461.95	501.56	538.79
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(68)

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

(69)m=	56.08	56.08	56.08	56.08	56.08	56.08	56.08	56.08	56.08	56.08	56.08	56.08
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(70)

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

(71)m=	-120.44	-120.44	-120.44	-120.44	-120.44	-120.44	-120.44	-120.44	-120.44	-120.44	-120.44	-120.44
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

(71)

Water heating gains (Table 5)

(72)m=	138.08	135.64	130.57	123.67	119.2	112.9	107.54	114.4	116.84	123.98	132.03	135.65
--------	--------	--------	--------	--------	-------	-------	--------	-------	--------	--------	--------	--------

(72)

Total internal gains =

$$\{66\}m + \{67\}m + \{68\}m + \{69\}m + \{70\}m + \{71\}m + \{72\}m$$

(73)m=	928.96	919.97	881.76	824.02	764.62	714.03	686.88	700.3	735.88	793.86	856.84	904.74
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(73)

6. Solar gains

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

SAP WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	0.5	x	11.28	x	0.63	x	0.7	=	1.72	(75)
Northeast 0.9x	0.77	x	5	x	11.28	x	0.63	x	0.7	=	17.24	(75)
Northeast 0.9x	0.77	x	0.5	x	22.97	x	0.63	x	0.7	=	3.51	(75)
Northeast 0.9x	0.77	x	5	x	22.97	x	0.63	x	0.7	=	35.09	(75)
Northeast 0.9x	0.77	x	0.5	x	41.38	x	0.63	x	0.7	=	6.32	(75)
Northeast 0.9x	0.77	x	5	x	41.38	x	0.63	x	0.7	=	63.23	(75)
Northeast 0.9x	0.77	x	0.5	x	67.96	x	0.63	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	5	x	67.96	x	0.63	x	0.7	=	103.84	(75)
Northeast 0.9x	0.77	x	0.5	x	91.35	x	0.63	x	0.7	=	13.96	(75)
Northeast 0.9x	0.77	x	5	x	91.35	x	0.63	x	0.7	=	139.58	(75)
Northeast 0.9x	0.77	x	0.5	x	97.38	x	0.63	x	0.7	=	14.88	(75)
Northeast 0.9x	0.77	x	5	x	97.38	x	0.63	x	0.7	=	148.81	(75)
Northeast 0.9x	0.77	x	0.5	x	91.1	x	0.63	x	0.7	=	13.92	(75)
Northeast 0.9x	0.77	x	5	x	91.1	x	0.63	x	0.7	=	139.21	(75)
Northeast 0.9x	0.77	x	0.5	x	72.63	x	0.63	x	0.7	=	11.1	(75)
Northeast 0.9x	0.77	x	5	x	72.63	x	0.63	x	0.7	=	110.98	(75)
Northeast 0.9x	0.77	x	0.5	x	50.42	x	0.63	x	0.7	=	7.7	(75)
Northeast 0.9x	0.77	x	5	x	50.42	x	0.63	x	0.7	=	77.05	(75)
Northeast 0.9x	0.77	x	0.5	x	28.07	x	0.63	x	0.7	=	4.29	(75)
Northeast 0.9x	0.77	x	5	x	28.07	x	0.63	x	0.7	=	42.89	(75)
Northeast 0.9x	0.77	x	0.5	x	14.2	x	0.63	x	0.7	=	2.17	(75)
Northeast 0.9x	0.77	x	5	x	14.2	x	0.63	x	0.7	=	21.69	(75)
Northeast 0.9x	0.77	x	0.5	x	9.21	x	0.63	x	0.7	=	1.41	(75)
Northeast 0.9x	0.77	x	5	x	9.21	x	0.63	x	0.7	=	14.08	(75)
Southeast 0.9x	0.77	x	8	x	36.79	x	0.63	x	0.7	=	89.96	(77)
Southeast 0.9x	0.77	x	8	x	62.67	x	0.63	x	0.7	=	153.23	(77)
Southeast 0.9x	0.77	x	8	x	85.75	x	0.63	x	0.7	=	209.66	(77)
Southeast 0.9x	0.77	x	8	x	106.25	x	0.63	x	0.7	=	259.78	(77)
Southeast 0.9x	0.77	x	8	x	119.01	x	0.63	x	0.7	=	290.97	(77)
Southeast 0.9x	0.77	x	8	x	118.15	x	0.63	x	0.7	=	288.87	(77)
Southeast 0.9x	0.77	x	8	x	113.91	x	0.63	x	0.7	=	278.5	(77)
Southeast 0.9x	0.77	x	8	x	104.39	x	0.63	x	0.7	=	255.22	(77)
Southeast 0.9x	0.77	x	8	x	92.85	x	0.63	x	0.7	=	227.01	(77)
Southeast 0.9x	0.77	x	8	x	69.27	x	0.63	x	0.7	=	169.35	(77)
Southeast 0.9x	0.77	x	8	x	44.07	x	0.63	x	0.7	=	107.75	(77)
Southeast 0.9x	0.77	x	8	x	31.49	x	0.63	x	0.7	=	76.98	(77)
Southwest 0.9x	0.77	x	6	x	36.79		0.63	x	0.7	=	67.47	(79)
Southwest 0.9x	0.77	x	5	x	36.79		0.63	x	0.7	=	56.22	(79)
Southwest 0.9x	0.77	x	6	x	62.67		0.63	x	0.7	=	114.92	(79)

SAP WorkSheet: New dwelling design stage

Southwest0.9x	0.77	x	5	x	62.67	0.63	x	0.7	=	95.77	(79)
Southwest0.9x	0.77	x	6	x	85.75	0.63	x	0.7	=	157.24	(79)
Southwest0.9x	0.77	x	5	x	85.75	0.63	x	0.7	=	131.04	(79)
Southwest0.9x	0.77	x	6	x	106.25	0.63	x	0.7	=	194.83	(79)
Southwest0.9x	0.77	x	5	x	106.25	0.63	x	0.7	=	162.36	(79)
Southwest0.9x	0.77	x	6	x	119.01	0.63	x	0.7	=	218.23	(79)
Southwest0.9x	0.77	x	5	x	119.01	0.63	x	0.7	=	181.86	(79)
Southwest0.9x	0.77	x	6	x	118.15	0.63	x	0.7	=	216.65	(79)
Southwest0.9x	0.77	x	5	x	118.15	0.63	x	0.7	=	180.54	(79)
Southwest0.9x	0.77	x	6	x	113.91	0.63	x	0.7	=	208.87	(79)
Southwest0.9x	0.77	x	5	x	113.91	0.63	x	0.7	=	174.06	(79)
Southwest0.9x	0.77	x	6	x	104.39	0.63	x	0.7	=	191.42	(79)
Southwest0.9x	0.77	x	5	x	104.39	0.63	x	0.7	=	159.52	(79)
Southwest0.9x	0.77	x	6	x	92.85	0.63	x	0.7	=	170.26	(79)
Southwest0.9x	0.77	x	5	x	92.85	0.63	x	0.7	=	141.88	(79)
Southwest0.9x	0.77	x	6	x	69.27	0.63	x	0.7	=	127.01	(79)
Southwest0.9x	0.77	x	5	x	69.27	0.63	x	0.7	=	105.85	(79)
Southwest0.9x	0.77	x	6	x	44.07	0.63	x	0.7	=	80.81	(79)
Southwest0.9x	0.77	x	5	x	44.07	0.63	x	0.7	=	67.34	(79)
Southwest0.9x	0.77	x	6	x	31.49	0.63	x	0.7	=	57.74	(79)
Southwest0.9x	0.77	x	5	x	31.49	0.63	x	0.7	=	48.12	(79)
Northwest0.9x	0.77	x	1	x	11.28	0.63	x	0.7	=	3.45	(81)
Northwest0.9x	0.77	x	1	x	22.97	0.63	x	0.7	=	7.02	(81)
Northwest0.9x	0.77	x	1	x	41.38	0.63	x	0.7	=	12.65	(81)
Northwest0.9x	0.77	x	1	x	67.96	0.63	x	0.7	=	20.77	(81)
Northwest0.9x	0.77	x	1	x	91.35	0.63	x	0.7	=	27.92	(81)
Northwest0.9x	0.77	x	1	x	97.38	0.63	x	0.7	=	29.76	(81)
Northwest0.9x	0.77	x	1	x	91.1	0.63	x	0.7	=	27.84	(81)
Northwest0.9x	0.77	x	1	x	72.63	0.63	x	0.7	=	22.2	(81)
Northwest0.9x	0.77	x	1	x	50.42	0.63	x	0.7	=	15.41	(81)
Northwest0.9x	0.77	x	1	x	28.07	0.63	x	0.7	=	8.58	(81)
Northwest0.9x	0.77	x	1	x	14.2	0.63	x	0.7	=	4.34	(81)
Northwest0.9x	0.77	x	1	x	9.21	0.63	x	0.7	=	2.82	(81)
Rooflights 0.9x	1	x	2.5	x	16.37	0.63	x	0.8	=	18.56	(82)
Rooflights 0.9x	1	x	2.5	x	33.68	0.63	x	0.8	=	38.2	(82)
Rooflights 0.9x	1	x	2.5	x	62.13	0.63	x	0.8	=	70.45	(82)
Rooflights 0.9x	1	x	2.5	x	104.87	0.63	x	0.8	=	118.93	(82)
Rooflights 0.9x	1	x	2.5	x	143.66	0.63	x	0.8	=	162.91	(82)
Rooflights 0.9x	1	x	2.5	x	154.33	0.63	x	0.8	=	175.01	(82)
Rooflights 0.9x	1	x	2.5	x	143.9	0.63	x	0.8	=	163.19	(82)
Rooflights 0.9x	1	x	2.5	x	113.05	0.63	x	0.8	=	128.2	(82)

SAP WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	2.5	x	76.56	x	0.63	x	0.8	=	86.82	(82)
Rooflights 0.9x	1	x	2.5	x	41.49	x	0.63	x	0.8	=	47.05	(82)
Rooflights 0.9x	1	x	2.5	x	20.65	x	0.63	x	0.8	=	23.41	(82)
Rooflights 0.9x	1	x	2.5	x	13.34	x	0.63	x	0.8	=	15.13	(82)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	254.62	447.74	650.59	870.89	1035.42	1054.52	1005.59	878.63	726.14	505.02	307.52	216.27	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	1183.59	1367.71	1532.35	1694.91	1800.04	1768.55	1692.47	1578.93	1462.02	1298.88	1164.36	1121.01	(84)
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

7. Mean internal temperature (resting person)

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

21 (35)

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=	0.97	0.96	0.95	0.91	0.86	0.77	0.66	0.7	0.84	0.93	0.96	0.97	(86)

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

(87)m=	17.95	18.17	18.58	19.19	19.77	20.3	20.58	20.53	20.12	19.37	18.6	17.96	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.31	19.32	19.33	19.38	19.39	19.44	19.44	19.45	19.42	19.39	19.37	19.35	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.95	0.93	0.89	0.82	0.68	0.51	0.56	0.77	0.9	0.95	0.97	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	15.42	15.74	16.33	17.22	18.03	18.76	19.08	19.05	18.53	17.49	16.37	15.45	(90)
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fLA = Living area ÷ (4) =

0.34 (91)

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

(92)m=	16.27	16.56	17.09	17.89	18.62	19.28	19.59	19.55	19.06	18.13	17.12	16.3	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	16.27	16.56	17.09	17.89	18.62	19.28	19.59	19.55	19.06	18.13	17.12	16.3	(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=	0.95	0.94	0.91	0.86	0.79	0.67	0.53	0.57	0.75	0.88	0.94	0.96	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	1125.96	1279.56	1394.68	1464.22	1421.1	1186.23	898.09	902.89	1098.84	1142.75	1089.25	1071.54	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W =[(93)m – (96)m]

(97)m=	5060.02	4886.63	4402.26	3587.89	2741.25	1788.26	1141.46	1195.47	1923.65	2982.48	4034.06	4947.08	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	2926.94	2423.95	2237.64	1529.04	982.19	0	0	0	0	1368.76	2120.26	2883.4	(98)
--------	---------	---------	---------	---------	--------	---	---	---	---	---------	---------	--------	------

Total per year (kWh/year) = Sum(98)1..12 =

16472.18 (98)

Space heating requirement in kWh/m²/year

79.58 (99)

SAP WorkSheet: New dwelling design stage

1a 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	$\{204\} = \{202\} \times [1 - \{203\}] =$	1	(204)
Efficiency of main space heating system 1		170	(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)

2926.94	2423.95	2237.64	1529.04	982.19	0	0	0	0	1368.76	2120.26	2883.4
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(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

1721.73	1425.86	1316.26	899.43	577.76	0	0	0	0	805.15	1247.21	1696.12
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Total (kWh/year) = $\text{Sum}(\{211\}_{1..12}) =$ 9689.52 (211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m =	0	0	0	0	0	0	0	0	0	0	0
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Total (kWh/year) = $\text{Sum}(\{215\}_{1..12}) =$ 0 (215)

Water heating

Output from water heater (calculated above)

229.19	202.07	212.38	190.6	186.94	167.26	160.85	176.21	175.8	197.63	208.7	223.75
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Efficiency of water heater 170 (216)

(217)m = 170 170 170 170 170 170 170 170 170 170 170 170 (217)

Fuel for water heating, kWh/month

(219)m = $(64)m \times 100 \div (217)m$

(219)m =	134.82	118.87	124.93	112.12	109.96	98.39	94.62	103.65	103.41	116.25	122.76	131.62
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Total = $\text{Sum}(\{219a\}_{1..12}) =$ 1371.39 (219)

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1	9689.52	
Water heating fuel used	1371.39	

Electricity for pumps, fans and electric keep-hot

central heating pump: 120 (230c)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 120 (231)

Electricity for lighting 783.61 (232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 11964.52 (338)

1b Fuel costs - individual heating systems

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	13.19	$\times 0.01 =$ 1278.05 (240)
Space heating - main system 2	(213) x	0	$\times 0.01 =$ 0 (241)
Space heating - secondary	(215) x	13.19	$\times 0.01 =$ 0 (242)
Water heating cost (other fuel)	(219)	13.19	$\times 0.01 =$ 180.89 (247)

SAP WorkSheet: New dwelling design stage

Pumps, fans and electric keep-hot (231) 13.19 × 0.01 = 15.83 (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) 13.19 × 0.01 = 103.36 (250)

Additional standing charges (Table 12) 0 (251)

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

Total energy cost (245)...(247) + (250)...(254) = 1578.12 (255)

11a SAP rating – individual heating systems

Energy cost deflator (Table 12) 0.42 (256)

Energy cost factor (ECF) [(255) × (256)] ÷ [(4) + 45.0] = 2.63 (257)

SAP rating (Section 12) 63.31 (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) ×	0.519	5028.86 (261)
Space heating (secondary)	(215) ×	0.519	0 (263)
Water heating	(219) ×	0.519	711.75 (264)
Space and water heating	(261) + (262) + (263) + (264) =		5740.61 (265)
Electricity for pumps, fans and electric keep-hot	(231) ×	0.519	62.28 (267)
Electricity for lighting	(232) ×	0.519	406.69 (268)
Total CO2, kg/year		sum of (265)...(271) =	6209.58 (272)
CO2 emissions per m²		(272) ÷ (4) =	30 (273)
El rating (section 14)			67 (274)

13a Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) ×	3.07	29746.83 (261)
Space heating (secondary)	(215) ×	3.07	0 (263)
Energy for water heating	(219) ×	3.07	4210.15 (264)
Space and water heating	(261) + (262) + (263) + (264) =		33956.98 (265)
Electricity for pumps, fans and electric keep-hot	(231) ×	3.07	368.4 (267)
Electricity for lighting	(232) ×	0	2405.69 (268)
*Total Primary Energy		sum of (265)...(271) =	36731.06 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =	177.44 (273)

SAP Input

Property Details: Z118025

Address: Actual Energy, Barn 2, Stakers Farm, North End Lane, Yapton, BN18 0DU
Located in: England
Region: South East England
UPRN:
Date of assessment: 07 October 2021
Date of certificate: 07 October 2021
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Low
Water use <= 125 litres/ person/ day: True
PCDF Version: 482

Property Description

Dwelling type: House
Detachment: Semi-detached
Year Completed: 2021

	Floor Location:	Floor area:	Storey height:
Floor 0	204 m ²	3.7 m	
Floor 1	39 m ²	2.7 m	
Living area:	140 m ² (fraction 0.576)		
Front of dwelling faces:	North West		

Opening Details

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door (NW)	Manufacturer	Solid	low-E, En = 0.05, soft coat	Yes	Wood
Windows (NE)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Windows (SE)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Windows (SW)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Glazed Doors (NE)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Glazed Doors (NW)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Glazed Doors (SW)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Rooflights (NE)	Manufacturer	Roof Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break
Rooflights (SW)	Manufacturer	Roof Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Door (NW)	16mm or more mm	0.7	0.63	1.8	2	1
Windows (NE)	16mm or more	0.7	0.63	1.6	6	1
Windows (SE)	16mm or more	0.7	0.63	1.6	14	1
Windows (SW)	16mm or more	0.7	0.63	1.6	1	1
Glazed Doors (NE)	16mm or more	0.7	0.63	1.8	7.5	1
Glazed Doors (NW)	16mm or more	0.7	0.63	1.8	2	1
Glazed Doors (SW)	16mm or more	0.7	0.63	1.8	7.5	1
Rooflights (NE)	16mm or more	0.8	0.63	1.6	1.5	1
Rooflights (SW)	16mm or more	0.8	0.63	1.6	0.5	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door (NW)		Wall	North West	0	0
Windows (NE)		Wall	North East	0	0
Windows (SE)		Wall	South East	0	0
Windows (SW)		Wall	South West	0	0
Glazed Doors (NE)		Wall	North East	0	0
Glazed Doors (NW)		Wall	North West	0	0
Glazed Doors (SW)		Wall	South West	0	0

SAP Input

Rooflights (NE)	Roof	North West	0.001	0
Rooflights (SW)	Roof	South West	0.001	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Wall	254	40	214	0.19	0	False	N/A
Roof	222	2	220	0.18	0		N/A
Ground Floor	204			0.22			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							
Party Wall	8.5						N/A

Thermal bridges:

Thermal bridges: No information on thermal bridging ($\gamma = 0.15$) ($\gamma = 0.15$)

Ventilation:

Pressure test: No (Assumed)
 Ventilation: Natural ventilation (extract fans)
 Number of chimneys: 0
 Number of open flues: 0
 Number of fans: 5
 Number of passive stacks: 0
 Number of sides sheltered: 2
 Pressure test: 15

Main heating system

Main heating system: Heat pumps with radiators or underfloor heating
 Electric heat pumps
 Fuel: Electricity
 Info Source: SAP Tables
 SAP Table: 221
 Ground source heat pump in other cases
 Underfloor heating and radiators, pipes in screed above insulation
 Design flow temperature: Design flow temperature > 45°C
 Boiler interlock: No

Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
 Control code: 2207

Secondary heating system

Secondary heating system: None

Water heating

Water heating: From main heating system
 Water code: 901
 Fuel :Electricity
 Hot water cylinder
 Cylinder volume: 210 litres
 Cylinder insulation: Measured loss, 2kWh/day
 Primary pipework insulation: True
 Cylinderstat: True
 Cylinder in heated space: True
 Immersion: Single

SAP Input

Solar panel: False

Others

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory
Low energy lights:	75%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name: Joe Solti **Stroma Number:** STRO003946
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.49

Property Address: ZH002B

Address : Actual Energy, Barn 2, Stakers Farm, North End Lane, Yapton, BN18 0DU

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	204	(1a) x	3.7	(2a) =	754.8 (3a)
First floor	39	(1b) x	2.7	(2b) =	105.3 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	243	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	860.1 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ 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							5	x 10 =	50 (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) =	50	÷ (5) =	0.06 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
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)
<i>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</i>			
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			15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.81 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - {0.075 x (19)} =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.69 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.88	0.86	0.84	0.76	0.74	0.65	0.65	0.64	0.69	0.74	0.77	0.81
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

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

(23b)

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

(23c)

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(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)m x 0.5]

(24d)m=	0.88	0.87	0.85	0.79	0.77	0.71	0.71	0.7	0.74	0.77	0.8	0.83
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(24d)

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

(25)m=	0.88	0.87	0.85	0.79	0.77	0.71	0.71	0.7	0.74	0.77	0.8	0.83
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(25)

3. Thermal losses and heat capacity 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	1.8	3.6		(26)
Windows Type 1			6	$\frac{1}{\frac{1}{1.6} + 0.04}$	9.02		(27)
Windows Type 2			14	$\frac{1}{\frac{1}{1.6} + 0.04}$	21.05		(27)
Windows Type 3			1	$\frac{1}{\frac{1}{1.6} + 0.04}$	1.5		(27)
Windows Type 4			7.5	$\frac{1}{\frac{1}{1.8} + 0.04}$	12.59		(27)
Windows Type 5			2	$\frac{1}{\frac{1}{1.8} + 0.04}$	3.36		(27)
Windows Type 6			7.5	$\frac{1}{\frac{1}{1.8} + 0.04}$	12.59		(27)
Rooflights Type 1			1.5	$\frac{1}{\frac{1}{1.6} + 0.04}$	2.4		(27b)
Rooflights Type 2			0.5	$\frac{1}{\frac{1}{1.6} + 0.04}$	0.8		(27b)
Floor			204	0.22	44.88		(28)
Walls	254	40	214	0.19	40.66		(29)
Roof	222	2	220	0.18	39.6		(30)
Total area of elements, m²			680				(31)
Party wall			8.5	0	0		(32)

* for windows and roof windows, use effective window U-value calculated using formula $\frac{1}{\frac{1}{U\text{-value}} + 0.04}$ 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) = 191.87 (33)

Heat capacity Cm = S(A x k) ((28) ..(30) + (32) + (32a)... (32e) = 9516 (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

SAP WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

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

102 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

(33) + (36) =

293.87 (37)

Ventilation heat loss calculated monthly

(38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	250.77	246.55	242.4	222.94	219.3	202.35	202.35	199.21	208.88	219.3	226.67	234.37

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=	544.64	540.42	536.27	516.81	513.17	496.22	496.22	493.08	502.75	513.17	520.54	528.24
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Average = Sum(39)_{1...12} / 12 =

516.8 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	2.24	2.22	2.21	2.13	2.11	2.04	2.04	2.03	2.07	2.11	2.14	2.17
--------	------	------	------	------	------	------	------	------	------	------	------	------

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

2.13 (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

3.06

(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

106.82

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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=	117.51	113.23	108.96	104.69	100.41	96.14	96.14	100.41	104.69	108.96	113.23	117.51
--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------

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

1281.88 (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=	174.26	152.41	157.27	137.11	131.56	113.53	105.2	120.72	122.16	142.37	155.4	168.76
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------

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

1680.75 (45)

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

(46)m=	26.14	22.86	23.59	20.57	19.73	17.03	15.78	18.11	18.32	21.36	23.31	25.31
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

210

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

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

2

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

1.08

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

SAP WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year

$$\{47\} \times \{51\} \times \{52\} \times \{53\} =$$

0

(54)

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

1.08

(55)

Water storage loss calculated for each month

$$\{56\}m = \{55\} \times \{41\}m$$

(56)m=	33.48	30.24	33.48	32.4	33.48	32.4	33.48	33.48	32.4	33.48	32.4	33.48
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------

(56)

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

(57)m=	33.48	30.24	33.48	32.4	33.48	32.4	33.48	33.48	32.4	33.48	32.4	33.48
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------

(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(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=	231	203.66	214.01	192.02	188.3	168.44	161.94	177.46	177.07	199.11	210.32	225.5
--------	-----	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	-------

(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=	231	203.66	214.01	192.02	188.3	168.44	161.94	177.46	177.07	199.11	210.32	225.5
--------	-----	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	-------

Output from water heater (annual) × 1.08

2348.85

(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	103.33	91.68	97.69	89.52	89.14	81.68	80.37	85.53	84.55	92.73	95.6	101.51
--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	--------

(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=	183.47	183.47	183.47	183.47	183.47	183.47	183.47	183.47	183.47	183.47	183.47	183.47

(66)

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

(67)m=	118.18	104.96	85.36	64.63	48.31	40.78	44.07	57.28	76.88	97.62	113.94	121.46
--------	--------	--------	-------	-------	-------	-------	-------	-------	-------	-------	--------	--------

(67)

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

(68)m=	612.35	618.7	602.69	568.6	525.57	485.13	458.11	451.76	467.77	501.86	544.89	585.33
--------	--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

(68)

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

(69)m=	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4
--------	------	------	------	------	------	------	------	------	------	------	------	------

(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(70)

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

(71)m=	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31	-122.31
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

(71)

Water heating gains (Table 5)

(72)m=	138.89	136.42	131.3	124.33	119.81	113.44	108.03	114.96	117.43	124.64	132.78	136.43
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(72)

Total internal gains =

$$\{66\}m + \{67\}m + \{68\}m + \{69\}m + \{70\}m + \{71\}m + \{72\}m$$

(73)m=	986.98	977.65	936.91	875.12	811.25	756.91	727.77	741.56	779.64	841.68	909.17	960.79
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(73)

6. Solar gains

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

SAP WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	6	x	11.28	x	0.63	x	0.7	=	20.69	(75)
Northeast 0.9x	0.77	x	7.5	x	11.28	x	0.63	x	0.7	=	25.86	(75)
Northeast 0.9x	0.77	x	6	x	22.97	x	0.63	x	0.7	=	42.11	(75)
Northeast 0.9x	0.77	x	7.5	x	22.97	x	0.63	x	0.7	=	52.64	(75)
Northeast 0.9x	0.77	x	6	x	41.38	x	0.63	x	0.7	=	75.88	(75)
Northeast 0.9x	0.77	x	7.5	x	41.38	x	0.63	x	0.7	=	94.84	(75)
Northeast 0.9x	0.77	x	6	x	67.96	x	0.63	x	0.7	=	124.61	(75)
Northeast 0.9x	0.77	x	7.5	x	67.96	x	0.63	x	0.7	=	155.76	(75)
Northeast 0.9x	0.77	x	6	x	91.35	x	0.63	x	0.7	=	167.5	(75)
Northeast 0.9x	0.77	x	7.5	x	91.35	x	0.63	x	0.7	=	209.37	(75)
Northeast 0.9x	0.77	x	6	x	97.38	x	0.63	x	0.7	=	178.57	(75)
Northeast 0.9x	0.77	x	7.5	x	97.38	x	0.63	x	0.7	=	223.21	(75)
Northeast 0.9x	0.77	x	6	x	91.1	x	0.63	x	0.7	=	167.05	(75)
Northeast 0.9x	0.77	x	7.5	x	91.1	x	0.63	x	0.7	=	208.81	(75)
Northeast 0.9x	0.77	x	6	x	72.63	x	0.63	x	0.7	=	133.17	(75)
Northeast 0.9x	0.77	x	7.5	x	72.63	x	0.63	x	0.7	=	166.47	(75)
Northeast 0.9x	0.77	x	6	x	50.42	x	0.63	x	0.7	=	92.46	(75)
Northeast 0.9x	0.77	x	7.5	x	50.42	x	0.63	x	0.7	=	115.57	(75)
Northeast 0.9x	0.77	x	6	x	28.07	x	0.63	x	0.7	=	51.47	(75)
Northeast 0.9x	0.77	x	7.5	x	28.07	x	0.63	x	0.7	=	64.33	(75)
Northeast 0.9x	0.77	x	6	x	14.2	x	0.63	x	0.7	=	26.03	(75)
Northeast 0.9x	0.77	x	7.5	x	14.2	x	0.63	x	0.7	=	32.54	(75)
Northeast 0.9x	0.77	x	6	x	9.21	x	0.63	x	0.7	=	16.9	(75)
Northeast 0.9x	0.77	x	7.5	x	9.21	x	0.63	x	0.7	=	21.12	(75)
Southeast 0.9x	0.77	x	14	x	36.79	x	0.63	x	0.7	=	157.43	(77)
Southeast 0.9x	0.77	x	14	x	62.67	x	0.63	x	0.7	=	268.15	(77)
Southeast 0.9x	0.77	x	14	x	85.75	x	0.63	x	0.7	=	366.9	(77)
Southeast 0.9x	0.77	x	14	x	106.25	x	0.63	x	0.7	=	454.61	(77)
Southeast 0.9x	0.77	x	14	x	119.01	x	0.63	x	0.7	=	509.2	(77)
Southeast 0.9x	0.77	x	14	x	118.15	x	0.63	x	0.7	=	505.51	(77)
Southeast 0.9x	0.77	x	14	x	113.91	x	0.63	x	0.7	=	487.37	(77)
Southeast 0.9x	0.77	x	14	x	104.39	x	0.63	x	0.7	=	446.64	(77)
Southeast 0.9x	0.77	x	14	x	92.85	x	0.63	x	0.7	=	397.27	(77)
Southeast 0.9x	0.77	x	14	x	69.27	x	0.63	x	0.7	=	296.37	(77)
Southeast 0.9x	0.77	x	14	x	44.07	x	0.63	x	0.7	=	188.56	(77)
Southeast 0.9x	0.77	x	14	x	31.49	x	0.63	x	0.7	=	134.72	(77)
Southwest 0.9x	0.77	x	1	x	36.79		0.63	x	0.7	=	11.24	(79)
Southwest 0.9x	0.77	x	7.5	x	36.79		0.63	x	0.7	=	84.34	(79)
Southwest 0.9x	0.77	x	1	x	62.67		0.63	x	0.7	=	19.15	(79)

SAP WorkSheet: New dwelling design stage

Southwest0.9x	0.77	x	7.5	x	62.67	0.63	x	0.7	=	143.65	(79)
Southwest0.9x	0.77	x	1	x	85.75	0.63	x	0.7	=	26.21	(79)
Southwest0.9x	0.77	x	7.5	x	85.75	0.63	x	0.7	=	196.55	(79)
Southwest0.9x	0.77	x	1	x	106.25	0.63	x	0.7	=	32.47	(79)
Southwest0.9x	0.77	x	7.5	x	106.25	0.63	x	0.7	=	243.54	(79)
Southwest0.9x	0.77	x	1	x	119.01	0.63	x	0.7	=	36.37	(79)
Southwest0.9x	0.77	x	7.5	x	119.01	0.63	x	0.7	=	272.78	(79)
Southwest0.9x	0.77	x	1	x	118.15	0.63	x	0.7	=	36.11	(79)
Southwest0.9x	0.77	x	7.5	x	118.15	0.63	x	0.7	=	270.81	(79)
Southwest0.9x	0.77	x	1	x	113.91	0.63	x	0.7	=	34.81	(79)
Southwest0.9x	0.77	x	7.5	x	113.91	0.63	x	0.7	=	261.09	(79)
Southwest0.9x	0.77	x	1	x	104.39	0.63	x	0.7	=	31.9	(79)
Southwest0.9x	0.77	x	7.5	x	104.39	0.63	x	0.7	=	239.27	(79)
Southwest0.9x	0.77	x	1	x	92.85	0.63	x	0.7	=	28.38	(79)
Southwest0.9x	0.77	x	7.5	x	92.85	0.63	x	0.7	=	212.83	(79)
Southwest0.9x	0.77	x	1	x	69.27	0.63	x	0.7	=	21.17	(79)
Southwest0.9x	0.77	x	7.5	x	69.27	0.63	x	0.7	=	158.77	(79)
Southwest0.9x	0.77	x	1	x	44.07	0.63	x	0.7	=	13.47	(79)
Southwest0.9x	0.77	x	7.5	x	44.07	0.63	x	0.7	=	101.01	(79)
Southwest0.9x	0.77	x	1	x	31.49	0.63	x	0.7	=	9.62	(79)
Southwest0.9x	0.77	x	7.5	x	31.49	0.63	x	0.7	=	72.17	(79)
Northwest0.9x	0.77	x	2	x	11.28	0.63	x	0.7	=	6.9	(81)
Northwest0.9x	0.77	x	2	x	22.97	0.63	x	0.7	=	14.04	(81)
Northwest0.9x	0.77	x	2	x	41.38	0.63	x	0.7	=	25.29	(81)
Northwest0.9x	0.77	x	2	x	67.96	0.63	x	0.7	=	41.54	(81)
Northwest0.9x	0.77	x	2	x	91.35	0.63	x	0.7	=	55.83	(81)
Northwest0.9x	0.77	x	2	x	97.38	0.63	x	0.7	=	59.52	(81)
Northwest0.9x	0.77	x	2	x	91.1	0.63	x	0.7	=	55.68	(81)
Northwest0.9x	0.77	x	2	x	72.63	0.63	x	0.7	=	44.39	(81)
Northwest0.9x	0.77	x	2	x	50.42	0.63	x	0.7	=	30.82	(81)
Northwest0.9x	0.77	x	2	x	28.07	0.63	x	0.7	=	17.16	(81)
Northwest0.9x	0.77	x	2	x	14.2	0.63	x	0.7	=	8.68	(81)
Northwest0.9x	0.77	x	2	x	9.21	0.63	x	0.7	=	5.63	(81)
Rooflights 0.9x	1	x	1.5	x	16.37	0.63	x	0.8	=	11.14	(82)
Rooflights 0.9x	1	x	0.5	x	39.98	0.63	x	0.8	=	9.07	(82)
Rooflights 0.9x	1	x	1.5	x	33.68	0.63	x	0.8	=	22.92	(82)
Rooflights 0.9x	1	x	0.5	x	73.48	0.63	x	0.8	=	16.67	(82)
Rooflights 0.9x	1	x	1.5	x	62.13	0.63	x	0.8	=	42.27	(82)
Rooflights 0.9x	1	x	0.5	x	112.11	0.63	x	0.8	=	25.43	(82)
Rooflights 0.9x	1	x	1.5	x	104.87	0.63	x	0.8	=	71.36	(82)
Rooflights 0.9x	1	x	0.5	x	153.81	0.63	x	0.8	=	34.88	(82)

SAP WorkSheet: New dwelling design stage

Rooflights 0.9x	1	x	1.5	x	143.66	x	0.63	x	0.8	=	97.74	(82)
Rooflights 0.9x	1	x	0.5	x	182.63	x	0.63	x	0.8	=	41.42	(82)
Rooflights 0.9x	1	x	1.5	x	154.33	x	0.63	x	0.8	=	105.01	(82)
Rooflights 0.9x	1	x	0.5	x	184.99	x	0.63	x	0.8	=	41.96	(82)
Rooflights 0.9x	1	x	1.5	x	143.9	x	0.63	x	0.8	=	97.91	(82)
Rooflights 0.9x	1	x	0.5	x	176.88	x	0.63	x	0.8	=	40.12	(82)
Rooflights 0.9x	1	x	1.5	x	113.05	x	0.63	x	0.8	=	76.92	(82)
Rooflights 0.9x	1	x	0.5	x	155.4	x	0.63	x	0.8	=	35.24	(82)
Rooflights 0.9x	1	x	1.5	x	76.56	x	0.63	x	0.8	=	52.09	(82)
Rooflights 0.9x	1	x	0.5	x	126.86	x	0.63	x	0.8	=	28.77	(82)
Rooflights 0.9x	1	x	1.5	x	41.49	x	0.63	x	0.8	=	28.23	(82)
Rooflights 0.9x	1	x	0.5	x	84.6	x	0.63	x	0.8	=	19.19	(82)
Rooflights 0.9x	1	x	1.5	x	20.65	x	0.63	x	0.8	=	14.05	(82)
Rooflights 0.9x	1	x	0.5	x	48.93	x	0.63	x	0.8	=	11.1	(82)
Rooflights 0.9x	1	x	1.5	x	13.34	x	0.63	x	0.8	=	9.08	(82)
Rooflights 0.9x	1	x	0.5	x	33.5	x	0.63	x	0.8	=	7.6	(82)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	326.65	579.34	853.37	1158.76	1390.22	1420.71	1352.85	1174.02	958.18	656.68	395.44	276.84	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	1313.63	1556.99	1790.29	2033.89	2201.47	2177.62	2080.62	1915.58	1737.82	1498.36	1304.6	1237.63	(84)
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7. Mean internal temperature (heating periods)

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=	0.97	0.96	0.95	0.91	0.86	0.77	0.67	0.71	0.84	0.93	0.97	0.98	(86)

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

(87)m=	17.75	17.99	18.42	19.06	19.67	20.23	20.53	20.48	20.03	19.24	18.42	17.76	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.18	19.19	19.2	19.25	19.26	19.31	19.31	19.31	19.29	19.26	19.24	19.22	(88)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.97	0.96	0.94	0.89	0.81	0.68	0.51	0.56	0.78	0.91	0.96	0.97	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	15.09	15.42	16.05	16.97	17.82	18.59	18.93	18.89	18.33	17.24	16.07	15.11	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.58

(91)

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

(92)m=	16.63	16.9	17.41	18.17	18.89	19.53	19.85	19.81	19.31	18.39	17.42	16.64	(92)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	16.63	16.9	17.41	18.17	18.89	19.53	19.85	19.81	19.31	18.39	17.42	16.64	(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	
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--

SAP WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.96	0.94	0.92	0.87	0.8	0.69	0.57	0.61	0.78	0.89	0.94	0.96	(94)
--------	------	------	------	------	-----	------	------	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	1259.38	1468.85	1644.56	1776.27	1766	1510.66	1186.95	1173.9	1351.04	1340.45	1232.82	1191.59	(95)
--------	---------	---------	---------	---------	------	---------	---------	--------	---------	---------	---------	---------	------

Monthly average external temperature from Table 8

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

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

(97)m=	6713.16	6484.83	5852.84	4791.67	3689.27	2448.84	1614.44	1679.86	2618.56	3997.18	5373.52	6569.45	(97)
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

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

(98)m=	4057.61	3370.74	3130.96	2171.09	1430.91	0	0	0	0	1976.6	2981.31	4001.13	(98)
--------	---------	---------	---------	---------	---------	---	---	---	---	--------	---------	---------	------

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

23120.35

Space heating requirement in kWh/m²/year

95.15

3a 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) x [1 - (203)] =

1 (204)

Efficiency of main space heating system 1

170 (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)

4057.61	3370.74	3130.96	2171.09	1430.91	0	0	0	0	1976.6	2981.31	4001.13
---------	---------	---------	---------	---------	---	---	---	---	--------	---------	---------

(211)m = [(98)m x (204)] x 100 ÷ (206)

(211)

2386.83	1982.79	1841.74	1277.11	841.71	0	0	0	0	1162.71	1753.71	2353.61
---------	---------	---------	---------	--------	---	---	---	---	---------	---------	---------

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

13600.21 (211)

Space heating fuel (secondary), kWh/month

= [(98)m x (201)] x 100 ÷ (208)

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

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

0

Water heating

Output from water heater (calculated above)

231	203.66	214.01	192.02	188.3	168.44	161.94	177.46	177.07	199.11	210.32	225.5
-----	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	-------

Efficiency of water heater

170 (216)

(217)m=	170	170	170	170	170	170	170	170	170	170	170	170	(217)
---------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	135.88	119.8	125.89	112.96	110.77	99.08	95.26	104.39	104.16	117.12	123.72	132.65	(219)
---------	--------	-------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------	-------

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

1381.67

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

13600.21

Water heating fuel used

1381.67

Electricity for pumps, fans and electric keep-hot

SAP WorkSheet: New dwelling design stage

central heating pump:

120

(230c)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

120

(231)

Electricity for lighting

834.83

(232)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =

15936.71

(338)

10a. Fuel costs - individual heating systems

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	13.19	x 0.01 = 1793.87 (240)
Space heating - main system 2	(213) x	0	x 0.01 = 0 (241)
Space heating - secondary	(215) x	13.19	x 0.01 = 0 (242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 = 182.24 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 = 15.83 (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)	13.19	x 0.01 = 110.11 (250)
Additional standing charges (Table 12)			0 (251)

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

Total energy cost

(245)...(247) + (250)...(254) =

2102.05

(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	3.07	(257)
SAP rating (Section 12)		57.24	(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	0.519	= 7058.51 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 717.09 (264)
Space and water heating	(261) + (262) + (263) + (264) =		7775.6 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 62.28 (267)
Electricity for lighting	(232) x	0.519	= 433.28 (268)
Total CO2, kg/year		sum of (265)...(271) =	8271.15 (272)
CO2 emissions per m²		(272) ÷ (4) =	34.04 (273)
EI rating (section 14)			61 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	3.07	= 41752.63 (261)

SAP WorkSheet: New dwelling design stage

Space heating (secondary)	{215} x	3.07	=	0	{263}
Energy for water heating	{219} x	3.07	=	4241.74	{264}
Space and water heating	{261} + {262} + {263} + {264} =			45994.37	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	3.07	=	368.4	{267}
Electricity for lighting	{232} x	0	=	2562.92	{268}
'Total Primary Energy		sum of {265}...{271} =		48925.69	{272}
Primary energy kWh/m²/year		{272} ÷ {4} =		201.34	{273}

SAP Input

Property Details: Z11803B

Address: Actual Energy, Barn 3, Stakers Farm, North End Lane, Yapton, BN18 0DU
Located in: England
Region: South East England
UPRN:
Date of assessment: 07 October 2021
Date of certificate: 07 October 2021
Assessment type: New dwelling design stage
Transaction type: New dwelling
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Low
Water use <= 125 litres/ person/ day: True
PCDF Version: 482

Property description:

Dwelling type: Bungalow
Detachment: Detached
Year Completed: 2021
Floor Location: **Floor area:** **Storey height:**
 Floor 0 111 m² 3.1 m
Living area: 40 m² (fraction 0.36)
Front of dwelling faces: North East

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Door (NE)	Manufacturer	Half glazed	low-E, En = 0.05, soft coat	Yes	Wood
Windows (NE)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Windows (SE)	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	Wood
Glazed Doors (NE)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Glazed Doors (NW)	SAP 2012	Windows	low-E, En = 0.1, soft coat	Yes	Wood
Rooflights (SW)	Manufacturer	Roof Windows	low-E, En = 0.05, soft coat	Yes	Metal, thermal break

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Door (NE)	16mm or more mm	0.7	0.63	1.8	4.5	1
Windows (NE)	16mm or more	0.7	0.63	1.6	13.5	1
Windows (SE)	16mm or more	0.7	0.63	1.6	1.5	1
Glazed Doors (NE)	16mm or more	0.7	0.63	1.8	2	1
Glazed Doors (NW)	16mm or more	0.7	0.63	1.8	3.5	1
Rooflights (SW)	16mm or more	0.8	0.63	1.6	2	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Door (NE)		Wall	North East	0	0
Windows (NE)		Wall	North East	0	0
Windows (SE)		Wall	South East	0	0
Glazed Doors (NE)		Wall	North East	0	0
Glazed Doors (NW)		Wall	North West	0	0
Rooflights (SW)		Roof	South West	0.001	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Wall	133	25	108	0.19	0	False	N/A

SAP Input

Roof	128	2	126	0.18	0	N/A
Ground Floor	111			0.23		N/A

Internal Elements

Party Elements

Thermal bridges:

Thermal bridges: No information on thermal bridging (y= 0.15) (y = 0.15)

Ventilation:

Pressure test: No (Assumed)
 Ventilation: Natural ventilation (extract fans)
 Number of chimneys: 0
 Number of open flues: 0
 Number of fans: 4
 Number of passive stacks: 0
 Number of sides sheltered: 1
 Pressure test: 15

Main heating system:

Main heating system: Heat pumps with radiators or underfloor heating
 Electric heat pumps
 Fuel: Electricity
 Info Source: SAP Tables
 SAP Table: 221
 Ground source heat pump in other cases
 Underfloor heating and radiators, pipes in screed above insulation
 Design flow temperature: Design flow temperature > 45°C
 Boiler interlock: No

Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
 Control code: 2207

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: From main heating system
 Water code: 901
 Fuel :Electricity
 Hot water cylinder
 Cylinder volume: 210 litres
 Cylinder insulation: Measured loss, 2kWh/day
 Primary pipework insulation: True
 Cylinderstat: True
 Cylinder in heated space: True
 Immersion: Single
 Solar panel: False

Other:

Electricity tariff: Standard Tariff
 In Smoke Control Area: Unknown
 Conservatory: No conservatory
 Low energy lights: 75%
 Terrain type: Low rise urban / suburban
 EPC language: English
 Wind turbine: No
 Photovoltaics: None
 Assess Zero Carbon Home: No

SAP Input

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name: Joe Solti **Stroma Number:** STRO003946
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.49

Property Address: ZH003B

Address : Actual Energy, Barn 3, Stakers Farm, North End Lane, Yapton, BN18 0DU

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	111 (1a)	3.1 (2a)	344.1 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	111 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	344.1 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				4	40 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.12 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
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)
<i>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</i>			
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			15 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.87 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.8 (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=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

SAP WorkSheet: New dwelling design stage

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

1.02	1	0.98	0.88	0.86	0.76	0.76	0.74	0.8	0.86	0.9	0.94
------	---	------	------	------	------	------	------	-----	------	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x 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) x [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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (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= 1.02 1 0.98 0.89 0.87 0.79 0.79 0.77 0.82 0.87 0.91 0.94 (24d)

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

(25)m= 1.02 1 0.98 0.89 0.87 0.79 0.79 0.77 0.82 0.87 0.91 0.94 (25)

3. Heat losses and heat capacity 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			4.5	1.8	8.099999		(26)
Windows Type 1			13.5	$\times 1/[1/(1.6) + 0.04]$	20.3		(27)
Windows Type 2			1.5	$\times 1/[1/(1.6) + 0.04]$	2.26		(27)
Windows Type 3			2	$\times 1/[1/(1.8) + 0.04]$	3.36		(27)
Windows Type 4			3.5	$\times 1/[1/(1.8) + 0.04]$	5.88		(27)
Rooflights			2	$\times 1/[1/(1.6) + 0.04]$	3.2		(27b)
Floor			111	0.23	25.53		(28)
Walls	133	25	108	0.19	20.52		(29)
Roof	128	2	126	0.18	22.68		(30)
Total area of elements, m²			372				(31)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ 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) = 111.63 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4326 (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 55.8 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 167.43 (37)

Ventilation heat loss calculated monthly (36)m = 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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SAP WorkSheet: New dwelling design stage

(36)m=	116.01	113.73	111.48	100.88	98.9	89.68	89.68	87.97	93.23	98.9	102.91	107.1	(38)
--------	--------	--------	--------	--------	------	-------	-------	-------	-------	------	--------	-------	------

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

(39)m=	283.44	281.16	278.91	268.31	266.33	257.1	257.1	255.4	260.66	266.33	270.34	274.53	
--------	--------	--------	--------	--------	--------	-------	-------	-------	--------	--------	--------	--------	--

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

268.3

(39)

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	2.55	2.53	2.51	2.42	2.4	2.32	2.32	2.3	2.35	2.4	2.44	2.47	
--------	------	------	------	------	-----	------	------	-----	------	-----	------	------	--

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

2.42

(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

2.82

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

101.19

(43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	111.31	107.26	103.22	99.17	95.12	91.07	91.07	95.12	99.17	103.22	107.26	111.31	
	Total = Sum(44) _{1...12} =											1214.3	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	165.07	144.37	148.98	129.88	124.63	107.54	99.65	114.35	115.72	134.86	147.21	159.86	
	Total = Sum(45) _{1...12} =											1592.14	(45)

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

(46)m=	24.76	21.66	22.35	19.48	18.69	16.13	14.95	17.15	17.36	20.23	22.08	23.98	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

210

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

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

2

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

1.08

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

1.08

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	33.48	30.24	33.48	32.4	33.48	32.4	33.48	33.48	32.4	33.48	32.4	33.48	(56)
--------	-------	-------	-------	------	-------	------	-------	-------	------	-------	------	-------	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	33.48	30.24	33.48	32.4	33.48	32.4	33.48	33.48	32.4	33.48	32.4	33.48	(57)
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SAP WorkSheet: New dwelling design stage

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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(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=	221.81	195.62	205.72	184.8	181.37	162.45	156.4	171.1	170.63	191.6	202.12	216.6
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(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=	221.81	195.62	205.72	184.8	181.37	162.45	156.4	171.1	170.63	191.6	202.12	216.6
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Output from water heater (annual) 1, 12

2260.23

(64)

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

(65)m=	100.28	89	94.93	87.12	86.83	79.69	78.53	83.42	82.41	90.24	92.88	98.55
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(65)

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

6. 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=	169.24	169.24	169.24	169.24	169.24	169.24	169.24	169.24	169.24	169.24	169.24	169.24

(66)

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

(67)m=	76.05	67.55	54.93	41.59	31.09	26.25	28.36	36.86	49.48	62.82	73.32	78.17
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(67)

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

(68)m=	407.44	411.67	401.01	378.33	349.7	322.79	304.81	300.59	311.24	333.92	362.55	389.46
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------

(68)

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

(69)m=	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74	54.74
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(70)

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

(71)m=	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83	-112.83
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(71)

Water heating gains (Table 5)

(72)m=	134.78	132.45	127.59	120.99	116.71	110.68	105.55	112.12	114.45	121.28	129	132.46
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	--------

(72)

Total internal gains =

(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	729.44	722.82	694.7	652.07	608.66	570.87	549.88	560.73	586.33	629.19	676.03	711.25
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(73)

7. 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 m ²	Flux Table 6a	g _g Table 6b	FF Table 6c	Gains (W)	
Northeast 0.9x	0.77	13.5	11.28	0.63	0.7	46.55	(75)
Northeast 0.9x	0.77	2	11.28	0.63	0.7	6.9	(75)

SAP WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	13.5	x	22.97	x	0.63	x	0.7	=	94.76	(75)
Northeast 0.9x	0.77	x	2	x	22.97	x	0.63	x	0.7	=	14.04	(75)
Northeast 0.9x	0.77	x	13.5	x	41.38	x	0.63	x	0.7	=	170.72	(75)
Northeast 0.9x	0.77	x	2	x	41.38	x	0.63	x	0.7	=	25.29	(75)
Northeast 0.9x	0.77	x	13.5	x	67.96	x	0.63	x	0.7	=	280.37	(75)
Northeast 0.9x	0.77	x	2	x	67.96	x	0.63	x	0.7	=	41.54	(75)
Northeast 0.9x	0.77	x	13.5	x	91.35	x	0.63	x	0.7	=	376.87	(75)
Northeast 0.9x	0.77	x	2	x	91.35	x	0.63	x	0.7	=	55.83	(75)
Northeast 0.9x	0.77	x	13.5	x	97.38	x	0.63	x	0.7	=	401.79	(75)
Northeast 0.9x	0.77	x	2	x	97.38	x	0.63	x	0.7	=	59.52	(75)
Northeast 0.9x	0.77	x	13.5	x	91.1	x	0.63	x	0.7	=	375.86	(75)
Northeast 0.9x	0.77	x	2	x	91.1	x	0.63	x	0.7	=	55.68	(75)
Northeast 0.9x	0.77	x	13.5	x	72.63	x	0.63	x	0.7	=	299.64	(75)
Northeast 0.9x	0.77	x	2	x	72.63	x	0.63	x	0.7	=	44.39	(75)
Northeast 0.9x	0.77	x	13.5	x	50.42	x	0.63	x	0.7	=	208.02	(75)
Northeast 0.9x	0.77	x	2	x	50.42	x	0.63	x	0.7	=	30.82	(75)
Northeast 0.9x	0.77	x	13.5	x	28.07	x	0.63	x	0.7	=	115.8	(75)
Northeast 0.9x	0.77	x	2	x	28.07	x	0.63	x	0.7	=	17.16	(75)
Northeast 0.9x	0.77	x	13.5	x	14.2	x	0.63	x	0.7	=	58.57	(75)
Northeast 0.9x	0.77	x	2	x	14.2	x	0.63	x	0.7	=	8.68	(75)
Northeast 0.9x	0.77	x	13.5	x	9.21	x	0.63	x	0.7	=	38.02	(75)
Northeast 0.9x	0.77	x	2	x	9.21	x	0.63	x	0.7	=	5.63	(75)
Southeast 0.9x	0.77	x	1.5	x	36.79	x	0.63	x	0.7	=	16.87	(77)
Southeast 0.9x	0.77	x	1.5	x	62.67	x	0.63	x	0.7	=	28.73	(77)
Southeast 0.9x	0.77	x	1.5	x	85.75	x	0.63	x	0.7	=	39.31	(77)
Southeast 0.9x	0.77	x	1.5	x	106.25	x	0.63	x	0.7	=	48.71	(77)
Southeast 0.9x	0.77	x	1.5	x	119.01	x	0.63	x	0.7	=	54.56	(77)
Southeast 0.9x	0.77	x	1.5	x	118.15	x	0.63	x	0.7	=	54.16	(77)
Southeast 0.9x	0.77	x	1.5	x	113.91	x	0.63	x	0.7	=	52.22	(77)
Southeast 0.9x	0.77	x	1.5	x	104.39	x	0.63	x	0.7	=	47.85	(77)
Southeast 0.9x	0.77	x	1.5	x	92.85	x	0.63	x	0.7	=	42.57	(77)
Southeast 0.9x	0.77	x	1.5	x	69.27	x	0.63	x	0.7	=	31.75	(77)
Southeast 0.9x	0.77	x	1.5	x	44.07	x	0.63	x	0.7	=	20.2	(77)
Southeast 0.9x	0.77	x	1.5	x	31.49	x	0.63	x	0.7	=	14.43	(77)
Northwest 0.9x	0.77	x	3.5	x	11.28	x	0.63	x	0.7	=	12.07	(81)
Northwest 0.9x	0.77	x	3.5	x	22.97	x	0.63	x	0.7	=	24.57	(81)
Northwest 0.9x	0.77	x	3.5	x	41.38	x	0.63	x	0.7	=	44.26	(81)
Northwest 0.9x	0.77	x	3.5	x	67.96	x	0.63	x	0.7	=	72.69	(81)
Northwest 0.9x	0.77	x	3.5	x	91.35	x	0.63	x	0.7	=	97.71	(81)
Northwest 0.9x	0.77	x	3.5	x	97.38	x	0.63	x	0.7	=	104.17	(81)
Northwest 0.9x	0.77	x	3.5	x	91.1	x	0.63	x	0.7	=	97.45	(81)

SAP WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	3.5	x	72.63	x	0.63	x	0.7	=	77.69	(81)
Northwest 0.9x	0.77	x	3.5	x	50.42	x	0.63	x	0.7	=	53.93	(81)
Northwest 0.9x	0.77	x	3.5	x	28.07	x	0.63	x	0.7	=	30.02	(81)
Northwest 0.9x	0.77	x	3.5	x	14.2	x	0.63	x	0.7	=	15.19	(81)
Northwest 0.9x	0.77	x	3.5	x	9.21	x	0.63	x	0.7	=	9.86	(81)
Rooflights 0.9x	1	x	2	x	38.23	x	0.63	x	0.8	=	34.69	(82)
Rooflights 0.9x	1	x	2	x	71.75	x	0.63	x	0.8	=	65.09	(82)
Rooflights 0.9x	1	x	2	x	112.53	x	0.63	x	0.8	=	102.09	(82)
Rooflights 0.9x	1	x	2	x	158.21	x	0.63	x	0.8	=	143.53	(82)
Rooflights 0.9x	1	x	2	x	190.52	x	0.63	x	0.8	=	172.84	(82)
Rooflights 0.9x	1	x	2	x	193.98	x	0.63	x	0.8	=	175.98	(82)
Rooflights 0.9x	1	x	2	x	185.08	x	0.63	x	0.8	=	167.9	(82)
Rooflights 0.9x	1	x	2	x	160.91	x	0.63	x	0.8	=	145.98	(82)
Rooflights 0.9x	1	x	2	x	128.69	x	0.63	x	0.8	=	116.75	(82)
Rooflights 0.9x	1	x	2	x	83.48	x	0.63	x	0.8	=	75.74	(82)
Rooflights 0.9x	1	x	2	x	47.08	x	0.63	x	0.8	=	42.71	(82)
Rooflights 0.9x	1	x	2	x	31.85	x	0.63	x	0.8	=	28.89	(82)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	117.07	227.18	381.67	586.83	757.81	795.61	749.11	615.55	452.09	270.47	145.35	96.83	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	846.5	950.01	1076.37	1238.9	1366.47	1366.49	1298.99	1176.28	1038.42	899.65	821.38	808.07	(84)
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7. Mean internal temperature (living areas)

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=	0.96	0.95	0.92	0.88	0.81	0.7	0.6	0.64	0.8	0.9	0.95	0.96	(86)

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

(87)m=	17.72	17.94	18.39	19.07	19.71	20.27	20.55	20.5	20.04	19.22	18.4	17.72	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	18.99	19	19.01	19.07	19.08	19.13	19.13	19.14	19.11	19.08	19.06	19.04	(88)
--------	-------	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.95	0.93	0.91	0.85	0.75	0.59	0.42	0.47	0.71	0.87	0.93	0.95	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	14.97	15.28	15.92	16.88	17.75	18.49	18.79	18.76	18.22	17.12	15.95	14.99	(90)
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fLA = Living area ÷ (4) =

0.36

(91)

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

(92)m=	15.96	16.24	16.81	17.67	18.46	19.13	19.42	19.38	18.87	17.88	16.83	15.98	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	15.96	16.24	16.81	17.67	18.46	19.13	19.42	19.38	18.87	17.88	16.83	15.98	(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
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SAP WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.93	0.91	0.88	0.82	0.72	0.59	0.45	0.5	0.7	0.84	0.91	0.93	(94)
--------	------	------	------	------	------	------	------	-----	-----	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	784.92	864.86	945.24	1011.28	988.17	806.9	586.29	587.83	724.58	759.23	745.56	753.21	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm, W = [(39)m x ((93)m - (96)m)]

(97)m=	3304.24	3187.69	2874.88	2352.2	1799.43	1164.51	726.23	761.86	1244.39	1938.81	2631.15	3232.73	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m

(98)m=	1874.38	1560.94	1435.66	965.46	603.58	0	0	0	0	877.61	1357.63	1844.76	(98)
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Total per year (kWh/year) = Sum(98)_{1..12} = 10520.01 (98)

Space heating requirement in kWh/m²/year

94.77 (99)

3a 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) x [1 - (203)] = 1 (204)

Efficiency of main space heating system 1 170 (206)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

1874.38	1560.94	1435.66	965.46	603.58	0	0	0	0	877.61	1357.63	1844.76
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(211)m = [(98)m x (204)] x 100 ÷ (206) (211)

1102.57	918.2	844.5	567.92	355.04	0	0	0	0	516.24	798.6	1085.15
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Total (kWh/year) = Sum(211)_{1..12} = 6188.24 (211)

Space heating fuel (secondary), kWh/month

= [(98)m x (201)] x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
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Total (kWh/year) = Sum(215)_{1..12} = 0 (215)

Water heating

Output from water heater (calculated above)

221.81	195.62	205.72	184.8	181.37	162.45	156.4	171.1	170.63	191.6	202.12	216.6
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Efficiency of water heater 170 (216)

(217)m=	170	170	170	170	170	170	170	170	170	170	170	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	130.48	115.07	121.01	108.7	106.69	95.56	92	100.65	100.37	112.71	118.9	127.41	(219)
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Total = Sum(219a)_{1..12} = 1329.55 (219)

Annual totals

kWh/year kWh/year

Space heating fuel used, main system 1 6188.24

Water heating fuel used 1329.55

Electricity for pumps, fans and electric keep-hot

SAP WorkSheet: New dwelling design stage

central heating pump:		120	(230c)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	120	(231)
Electricity for lighting		537.24	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		8175.03	(338)

10a. Fuel costs - individual heating systems

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	13.19	x 0.01 = 816.23 (240)
Space heating - main system 2	(213) x	0	x 0.01 = 0 (241)
Space heating - secondary	(215) x	13.19	x 0.01 = 0 (242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 = 175.37 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 = 15.83 (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)	13.19	x 0.01 = 70.86 (250)
Additional standing charges (Table 12)			0 (251)

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

Total energy cost	(245)...(247) + (250)...(254) =	1078.29	(255)
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11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	2.9	(257)
SAP rating (Section 12)		59.5	(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	0.519	= 3211.7 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 690.04 (264)
Space and water heating	(261) + (262) + (263) + (264) =		3901.73 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 62.28 (267)
Electricity for lighting	(232) x	0.519	= 278.83 (268)
Total CO2, kg/year		sum of (265)...(271) =	4242.84 (272)
CO2 emissions per m²		(272) ÷ (4) =	38.22 (273)
EI rating (section 14)			64 (274)

13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	3.07	= 18997.89 (261)

SAP WorkSheet: New dwelling design stage

Space heating (secondary)	{215} x	3.07	=	0	{263}
Energy for water heating	{219} x	3.07	=	4081.72	{264}
Space and water heating	{261} + {262} + {263} + {264} =			23079.61	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	3.07	=	368.4	{267}
Electricity for lighting	{232} x	0	=	1649.34	{268}
'Total Primary Energy		sum of {265}...{271} =		25097.35	{272}
Primary energy kWh/m²/year		{272} ÷ {4} =		226.1	{273}