Full SAP Calculation Printout

Property Reference: S1502-HOUSE
Survey Reference: ASHP
Property: NW6

Issued on Date: 05.Aug.2015
Prop Type Ref:

SAP Rating:	71 C	**CO2 Emissions (t/year):**	2.57	**DER:** 29.13 Fail	**TER:** 26.23	**Percentage DER<TER:**	-11.07 %
Environmental:	74 C	**General Requirements Compliance:**	Fail	**DFEE:**72.69 Fail	**TFEE:**58.95	**Percentage DFEE<TFEE:**	-23.30 %

CfSH Results **Version:** **ENE1 Credits:** N/A **ENE2 Credits:** N/A **ENE7 Credits:** N/A **CfSH Level:** N/A

Surveyor: Ian Turvey, Tel: 01763 273315 Surveyor ID: 6195-0001
Address: The Folly, Buntingford, Herts, SG9 9EB
Client:

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.01r13
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Dwelling As Designed

CALCULATION DETAILS for survey reference no 'ASHP'
SAP2012 - 9.92 input data (DesignData) -


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SAP2012 Input Data (House)     11/08/2015

FullRefNo:                     ASHP

Regs Region:                   England
SAP Region:                    Thames Valley
Postcode:                      NW6
DwellingOrientation:           North
Property Type:                 House, Detached
Storeys:                       3
Date Built:                    2015
Sheltered Sides:               2
Sunlight Shade:                Average or unknown
Measurements                   Perimeter, Floor Area, Storey Height
    1st Storey:               25.2, 41.18, 2.7
    2nd Storey:               25.2, 40.32, 2.7
    3rd Storey:               20.8, 24.73, 1.98
Living Area:                   35 m2, fraction: 32.9%
Thermal Mass:                  Simple calculation
Thermal Mass Simple:           Low
Thermal MassValue:             100
External Walls                 Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Wall 1                         103.33, 124.74, 9, SolidWallPlasterOnDabsInsul, Solid, 0, 0.28, Gross
Wall 2                         11.34, 11.34, 9, SolidWallPlasterOnDabsInsul, Solid, 0, 0.48, Gross
Wall 3                         20.8, 20.8, 18, TimberWallTwoLayers, TimberFrame, 0, 0.17, Gross
External Roofs                 Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    External Roof 1           32.32, 33.63, 9, Plasterboard, insulated slope, 0.18
    External Roof 2           5.4, 5.4, 9, Plasterboard, insulated flat roof, 0.15
    External Roof 3           15.59, 15.59, 9, Plasterboard, insulated flat roof, 0.16
Heat Loss Floors               Area, Kappa, Construction, Element, Type, UValueFinal, ShelterFactor
    Heat Loss Floor 1         41.18, 110, Slab on ground, screed over insulation, Ground Floor - Solid, 0, 0.19
Description                    Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Opening Type 1            Manufacturer, Window, Double Low-E Hard 0.15, , , 0.72, , 0.7,
    Opening Type 2            SAP table, Solid Door, , , , , , , 3.00
    Opening Type 3            Manufacturer, Roof Window, Double Low-E Hard 0.15, , , 0.72, , 0.7,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    Opening 1                 Solid Door, Wall 1, North, , , , , 0, 0, 0, 2.21,
    Opening 2                 Window, Wall 1, East, , None, 0, , 0, 0, 0, 5.40,
    Opening 3                 Window, Wall 1, East, , None, 0, , 0, 0, 0, 5.40,
    Opening 4                 Window, Wall 1, North, , None, 0, , 0, 0, 0, 1.20,
    Opening 5                 Window, Wall 1, East, , None, 0, , 0, 0, 0, 1.80,
    Opening 6                 Window, Wall 1, East, , None, 0, , 0, 0, 0, 5.40,
    Opening 7                 Roof Window, External Roof 1, South, 0, None, , , 0, 0, 0, 1.31,
Conservatory:                  None
Draught Proofing:              100
Draught Lobby:                 No
Thermal Bridges
    Bridging:                 Default
    Y                         0.15
Pressure Test:                 True
Designed q50:                  8
AsBuilt q50:                   10
Property Tested:               False
Mechanical Ventilation
    MV System Present         Yes
    Windows In Hot Weather    Windows half open
    Cross Ventilation         Yes
    Night Ventilation         Yes
    Air Change Rate           4.00
    Approved Installation     Yes
    DataType                  Database
    Type                      Mechanical extract ventilation - decentralised
    Database Ref Number       500017
    DuctType                  Rigid
Decentralised MV               Sfp, Fan & Room Type, Count
    1                         0.35, In Room Fan Kitchen, 1
    2                         0.25, Through Wall Fan Other Wet Room, 3
Chimneys MHS:                  0
Chimneys SHS:                  0
Chimneys Other:                0
Chimneys Total:                0
Open Flues MHS:                0
Open Flues SHS:                0
Open Flues Other:              0
Open Flues Total:              0
Intermittent Fans:             0
Passive Vents:                 0
Flueless Gas Fires:            0
Cooling System                 None
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Light Fittings:               12
LEL Fittings:                 12
Percentage of LEL Fittings:   100
External Lights Fitted:       No
External LELs Fitted:         No
Electricity Tariff:           Standard
Main Heating 1
    Description               ASHP
    Percentage                100
    MHS                       Electricity PET Heat pump air-to-water
    SAP Code                  224
    Boiler Efficiency Type    SAP Table
    Efficiency                175.1
    Controls by PCDF          0
    MHS Controls              CHD Time and temperature zone control
    Boiler Interlock          No
    Ctrl SAP Code             2207
    MCS Installation CertificateYes
    Pumped                    Pump in heated space
    Heat Pump Age             2013 or later
    Heat Emitter              Radiators and Underfloor
    Flow Temperature          Normal (> 35°C)
    Under Floor Heating       Yes - Pipes in thin screed
Main Heating 2                None
Heating Systems Interaction   Each system heats separate parts of dwelling
Smoke Control Area            Unknown
Community Heating             None
Secondary Heating             None
Water Heating
    Type                      MainHeating1
    WHS                       HWP From main heating 1
    Low Water Usage           Yes
    SAP Code                  901
    Showers in Property       Non-electric only
    Suplementary Immersion    No
    Hot Water Cylinder
    Cylinder Type             HotWaterCylinder
    Cylinder Insulation Type MeasuredLoss
    Loss Factor               1.70
    Cylinder Volume           125.00
    Cylinder Stat             Yes
    Pipeworks Insulated       All accessible pipework insulated
    Cylinder in Heated Space Yes
    Separate Time Control     Yes
Flue Gas Heat Recovery System None
Waste Water Heat Recovery     none
PV Unit                       None
Wind Turbine                  None
Terrain Type:                 Urban
Small Scale Hydro             None
Special Features              None
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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Detached House, total floor area 106 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 26.23 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 29.13 kg/m²Fail
Excess emissions =2.90 kg/m² (11.1%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.0 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)72.7 kWh/m²Fail
Excess energy =13.7 kWh/m² (23.2%)

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2 Fabric U-values

Element	Average	Highest	
External wall	0.28 (max. 0.30)	0.48 (max. 0.70)	OK
Floor	0.19 (max. 0.25)	0.19 (max. 0.70)	OK
Roof	0.17 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.74 (max. 2.00)	3.00 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15

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3 Air permeability
Air permeability at 50 pascals: 8.00 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

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5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.70 kWh/day
Permitted by DBSCG 1.70 OK
Primary pipework insulated: No Fail

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6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%

Minimum	75%	OK

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8 Mechanical ventilation
Continuous extract system (decentralised)

Specific fan power:	0.3500 0.2500	
Maximum	0.7	OK

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9 Summertime temperature

Overheating risk (Thames Valley):	Medium	OK
Based on:		
Overshading:	Average	
Windows facing North:	1.20 m², No overhang	
Windows facing East:	18.00 m², No overhang	
Air change rate:	4.00 ach	
Blinds/curtains:	None	

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10 Key features
None

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.1800 (1b)	x	2.7000 (2b)	=	111.1860 (1b) - (3b)	
First floor	40.3200 (1c)	x	2.7000 (2c)	=	108.8640 (1c) - (3c)	
Second floor	24.7300 (1d)	x	1.9800 (2d)	=	48.9654 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.0154	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							0 * 10	=	0.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		8.0000	
Infiltration rate		0.4000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4335	0.4250	0.4165	0.3740	0.3655	0.3230	0.3230	0.3145	0.3400	0.3655	0.3825	0.3995	(22b)

Mechanical extract ventilation - decentralised
If mechanical ventilation: 0.5000 (23a)

Effective ac	0.6835	0.6750	0.6665	0.6240	0.6155	0.5730	0.5730	0.5645	0.5900	0.6155	0.6325	0.6495	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.60)			19.2000	1.5038	28.8722			(27)
Opening Type 2			2.2100	3.0000	6.6300			(26)
Opening Type 3 (Uw = 1.60)			1.3100	1.5038	1.9699			(27a)
Heat Loss Floor 1			41.1800	0.1900	7.8242			(28a)
Wall 1	124.7400	21.4100	103.3300	0.2800	28.9324			(29a)
Wall 2	11.3400		11.3400	0.4800	5.4432			(29a)
Wall 3	20.8000		20.8000	0.1700	3.5360			(29a)
External Roof 1	33.6300	1.3100	32.3200	0.1800	5.8176			(30)
External Roof 2	5.4000		5.4000	0.1500	0.8100			(30)
External Roof 3	15.5900		15.5900	0.1600	2.4944			(30)
Total net area of external elements Aum(A, m2)			252.6800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.3299			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area) 37.9020 (36)
Total fabric heat loss (33) + (36) = 130.2319 (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	60.6778	59.9232	59.1686	55.3957	54.6411	50.8681	50.8681	50.1135	52.3773	54.6411	56.1502	57.6594	(38)
Heat transfer coeff	190.9097	190.1551	189.4005	185.6276	184.8730	181.1000	181.1000	180.3454	182.6092	184.8730	186.3821	187.8913	(39)

Average = Sum(39)m / 12 = 185.4389 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7971	1.7900	1.7829	1.7474	1.7403	1.7048	1.7048	1.6977	1.7190	1.7403	1.7545	1.7687	(40)
HLP (average)												1.7456	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7902 (42)
Average daily hot water use (litres/day) 100.4673 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5140	106.4953	102.4766	98.4579	94.4392	90.4205	90.4205	94.4392	98.4579	102.4766	106.4953	110.5140	(44)
Energy conte	163.8890	143.3384	147.9124	128.9536	123.7341	106.7731	98.9410	113.5362	114.8922	133.8958	146.1577	158.7178	(45)
Energy content (annual)										Total = Sum(45)m =		1580.7412	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5834	21.5008	22.1869	19.3430	18.5601	16.0160	14.8411	17.0304	17.2338	20.0844	21.9237	23.8077	(46)

Water storage loss:
Store volume 125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9180 (55)
Total storage loss
28.4580 25.7040 28.4580 27.5400 28.4580 27.5400 28.4580 28.4580 27.5400 28.4580 27.5400 28.4580 (56)
If cylinder contains dedicated solar storage
28.4580 25.7040 28.4580 27.5400 28.4580 27.5400 28.4580 28.4580 27.5400 28.4580 27.5400 28.4580 (57)
Primary loss 37.2980 33.6885 37.2980 36.0948 37.2980 36.0948 37.2980 37.2980 36.0948 37.2980 36.0948 37.2980 (59)
Total heat required for water heating calculated for each month
229.6450 202.7309 213.6684 192.5884 189.4900 170.4079 164.6969 179.2922 178.5270 199.6517 209.7925 224.4738 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
229.6450 202.7309 213.6684 192.5884 189.4900 170.4079 164.6969 179.2922 178.5270 199.6517 209.7925 224.4738 (64)
Total per year (kWh/year) = Sum(64)m = 2354.9646 (64)
Heat gains from water heating, kWh/month
107.0979 95.1740 101.7856 93.7849 93.7463 86.4099 85.5026 90.3556 89.1095 97.1251 99.5053 105.3784 (65)

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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	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
23.9425 21.2655 17.2943 13.0929 9.7871 8.2627 8.9281 11.6051 15.5763 19.7777 23.0835 24.6080 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
266.0241 268.7846 261.8282 247.0189 228.3249 210.7551 199.0174 196.2569 203.2133 218.0225 236.7166 254.2864 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
36.9510 36.9510 36.9510 36.9510 36.9510 36.9510 36.9510 36.9510 36.9510 36.9510 36.9510 36.9510 (69)
Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
-111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 (71)
Water heating gains (Table 5)
143.9488 141.6280 136.8087 130.2568 126.0031 120.0137 114.9229 121.4456 123.7632 130.5445 138.2018 141.6377 (72)
Total internal gains
501.7683 499.5311 483.7841 458.2216 431.9681 406.8845 390.7214 397.1607 410.4058 436.1978 465.8549 488.3850 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.2000	10.6334	0.7200	0.7000	0.7700	4.4567	(74)
East	18.0000	19.6403	0.7200	0.7000	0.7700	123.4763	(76)
South	1.3100	26.0000	0.7200	0.7000	1.0000	15.4496	(82)

Solar gains	143.3826	282.1505	469.3089	692.5343	856.4069	880.2044	836.5364	713.3408	548.3836	335.9712	179.0675	117.7348	(83)
Total gains	645.1510	781.6816	953.0930	1150.7560	1288.3750	1287.0889	1227.2578	1110.5015	958.7894	772.1690	644.9224	606.1198	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.4567	15.5180	15.5799	15.8965	15.9614	16.2939	16.2939	16.3621	16.1593	15.9614	15.8322	15.7050	
alpha	2.0304	2.0345	2.0387	2.0598	2.0641	2.0863	2.0863	2.0908	2.0773	2.0641	2.0555	2.0470	
util living area	0.9686	0.9529	0.9214	0.8588	0.7646	0.6400	0.5237	0.5741	0.7616	0.9030	0.9563	0.9723	(86)
MIT	18.2284	18.4778	18.9370	19.5562	20.1021	20.5175	20.7092	20.6690	20.3136	19.5878	18.8118	18.2035	(87)
Th 2	19.4720	19.4770	19.4820	19.5070	19.5121	19.5374	19.5374	19.5425	19.5272	19.5121	19.5020	19.4920	(88)
util rest of house	0.9628	0.9441	0.9060	0.8296	0.7112	0.5478	0.3870	0.4404	0.6861	0.8767	0.9466	0.9671	(89)
MIT 2	15.8790	16.2385	16.8957	17.7778	18.5204	19.0601	19.2636	19.2369	18.8297	17.8462	16.7349	15.8514	(90)
Living area fraction									fLA = Living area / (4) =			0.3295	(91)
MIT	16.6531	16.9763	17.5683	18.3637	19.0415	19.5403	19.7399	19.7087	19.3186	18.4200	17.4191	16.6264	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.6531	16.9763	17.5683	18.3637	19.0415	19.5403	19.7399	19.7087	19.3186	18.4200	17.4191	16.6264	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9467	0.9235	0.8797	0.8012	0.6910	0.5480	0.4083	0.4578	0.6730	0.8504	0.9271	0.9524	(94)
Useful gains	610.7581	721.8474	838.4261	921.9796	890.2809	705.3118	501.0349	508.4268	645.2434	656.6829	597.8893	577.2594	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2358.3209	2296.3699	2096.3399	1756.7276	1357.2514	894.6834	568.6339	596.7133	952.9588	1445.7058	1923.3047	2334.8070	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1300.1867	1058.0792	935.8879	601.0186	347.4261	0.0000	0.0000	0.0000	0.0000	587.0331	954.2991	1307.6154	(98)

Space heating 7091.5460 (98)
Space heating per m2 (98) / (4) = 66.7565 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 175.1000 (206)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4049.9977 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1300.1867	1058.0792	935.8879	601.0186	347.4261	0.0000	0.0000	0.0000	0.0000	587.0331	954.2991	1307.6154	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	742.5395	604.2714	534.4876	343.2430	198.4158	0.0000	0.0000	0.0000	0.0000	335.2559	545.0023	746.7821	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

	229.6450	202.7309	213.6684	192.5884	189.4900	170.4079	164.6969	179.2922	178.5270	199.6517	209.7925	224.4738	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	131.1508	115.7801	122.0265	109.9877	108.2182	97.3203	94.0588	102.3942	101.9572	114.0215	119.8130	128.1975	(219)

Water heating fuel used 1344.9255 (219)
Annual totals kWh/year
Space heating fuel - main system 4049.9977 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 12.8150, total flow = 37.0000, SFP = 0.3464)
mechanical ventilation fans (SFP = 0.3464) 113.6721 (230a)
central heating pump 30.0000 (230c)
Total electricity for the above, kWh/year 143.6721 (231)
Electricity for lighting (calculated in Appendix L) 422.8324 (232)
Total delivered energy for all uses 5961.4277 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4049.9977	0.5190	2101.9488	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1344.9255	0.5190	698.0163	(264)
Space and water heating			2799.9652	(265)
Pumps and fans	143.6721	0.5190	74.5658	(267)
Energy for lighting	422.8324	0.5190	219.4500	(268)
Total CO2, kg/year			3093.9810	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			29.1300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		29.1300	ZC1
Total Floor Area	TFA	106.2300	
Assumed number of occupants	N	2.7902	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.8395	ZC2
CO2 emissions from cooking, equation (L16)		1.7506	ZC3
Total CO2 emissions		45.7201	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		45.7201	ZC8

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.1800 (1b)	x	2.7000 (2b)	=	111.1860 (1b) - (3b)	
First floor	40.3200 (1c)	x	2.7000 (2c)	=	108.8640 (1c) - (3c)	
Second floor	24.7300 (1d)	x	1.9800 (2d)	=	48.9654 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.0154	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1487	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3987	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3389	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4321	0.4236	0.4151	0.3728	0.3643	0.3219	0.3219	0.3135	0.3389	0.3643	0.3812	0.3982	(22b)
Effective ac	0.5933	0.5897	0.5862	0.5695	0.5664	0.5518	0.5518	0.5491	0.5574	0.5664	0.5727	0.5793	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.2100	1.0000	2.2100			(26)
TER Opening Type (Uw = 1.40)			19.2000	1.3258	25.4545			(27)
TER Room Window (Uw = 1.70)			1.3100	1.5918	2.0852			(27a)
Heat Loss Floor 1			41.1800	0.1300	5.3534			(28a)
Wall 1	124.7400	21.4100	103.3300	0.1800	18.5994			(29a)
Wall 2	11.3400		11.3400	0.1800	2.0412			(29a)
Wall 3	20.8000		20.8000	0.1800	3.7440			(29a)
External Roof 1	33.6300	1.3100	32.3200	0.1300	4.2016			(30)
External Roof 2	5.4000		5.4000	0.1300	0.7020			(30)
External Roof 3	15.5900		15.5900	0.1300	2.0267			(30)
Total net area of external elements Aum(A, m2)			252.6800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.4181			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		12.6340 (36)
Total fabric heat loss	(33) + (36) =	79.0521 (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	52.6744	52.3526	52.0372	50.5557	50.2785	48.9882	48.9882	48.7492	49.4852	50.2785	50.8393	51.4255	(38)
Heat transfer coeff	131.7265	131.4047	131.0893	129.6078	129.3306	128.0402	128.0402	127.8013	128.5372	129.3306	129.8913	130.4775	(39)
Average = Sum(39)m / 12 =												129.6064	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2400	1.2370	1.2340	1.2201	1.2175	1.2053	1.2053	1.2031	1.2100	1.2175	1.2227	1.2283	(40)
HLP (average)												1.2201	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7902 (42)
Average daily hot water use (litres/day)	100.4673 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5140	106.4953	102.4766	98.4579	94.4392	90.4205	90.4205	94.4392	98.4579	102.4766	106.4953	110.5140	(44)
Energy conte	163.8890	143.3384	147.9124	128.9536	123.7341	106.7731	98.9410	113.5362	114.8922	133.8958	146.1577	158.7178	(45)
Energy content (annual)										Total = Sum(45)m =		1580.7412	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5834	21.5008	22.1869	19.3430	18.5601	16.0160	14.8411	17.0304	17.2338	20.0844	21.9237	23.8077	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2538	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6770	(55)
Total storage loss	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(56)

If cylinder contains dedicated solar storage

	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)

Total heat required for water heating calculated for each month

	208.1392	183.3063	192.1626	171.7764	167.9842	149.5958	143.1911	157.7864	157.7149	178.1459	188.9804	202.9680 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	208.1392	183.3063	192.1626	171.7764	167.9842	149.5958	143.1911	157.7864	157.7149	178.1459	188.9804	202.9680 (64)

Total per year (kWh/year) = Sum(64)m = 2101.7513 (64)

Heat gains from water heating, kWh/month

	89.8932	79.6343	84.5810	77.1353	76.5417	69.7603	68.2980	73.1509	72.4598	79.9205	82.8556	88.1738 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	(66)

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

	23.9425	21.2655	17.2943	13.0929	9.7871	8.2627	8.9281	11.6051	15.5763	19.7777	23.0835	24.6080 (67)

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

	266.0241	268.7846	261.8282	247.0189	228.3249	210.7551	199.0174	196.2569	203.2133	218.0225	236.7166	254.2864 (68)

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

	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

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

	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080 (71)

Water heating gains (Table 5)

	120.8243	118.5035	113.6842	107.1323	102.8786	96.8892	91.7984	98.3211	100.6387	107.4200	115.0773	118.5132 (72)

Total internal gains

	478.6438	476.4066	460.6596	435.0971	408.8436	383.7600	367.5969	374.0362	387.2813	413.0733	442.7304	465.2605 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.2000	10.6334	0.6300	0.7000	0.7700	3.8996	(74)
East	18.0000	19.6403	0.6300	0.7000	0.7700	108.0418	(76)
South	1.3100	26.0000	0.6300	0.7000	1.0000	13.5184	(82)

Solar gains	125.4598	246.8817	410.6453	605.9675	749.3560	770.1788	731.9694	624.1732	479.8356	293.9748	156.6841	103.0179 (83)
Total gains	604.1037	723.2883	871.3049	1041.0647	1158.1996	1153.9388	1099.5663	998.2094	867.1169	707.0481	599.4145	568.2785 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.0030	56.1402	56.2753	56.9185	57.0405	57.6154	57.6154	57.7231	57.3926	57.0405	56.7943	56.5391	
alpha	4.7335	4.7427	4.7517	4.7946	4.8027	4.8410	4.8410	4.8482	4.8262	4.8027	4.7863	4.7693	
util living area	0.9984	0.9959	0.9865	0.9480	0.8429	0.6647	0.5024	0.5695	0.8376	0.9779	0.9966	0.9988	(86)
MIT	19.6112	19.7857	20.0934	20.4926	20.8022	20.9541	20.9904	20.9830	20.8595	20.4291	19.9459	19.5841	(87)
Th 2	19.8881	19.8905	19.8929	19.9040	19.9061	19.9158	19.9158	19.9176	19.9120	19.9061	19.9019	19.8975	(88)
util rest of house	0.9978	0.9945	0.9816	0.9288	0.7896	0.5701	0.3837	0.4451	0.7614	0.9664	0.9951	0.9984	(89)
MIT 2	18.0401	18.2965	18.7446	19.3168	19.7183	19.8866	19.9124	19.9109	19.8008	19.2406	18.5391	18.0070	(90)
Living area fraction										fLA = Living area / (4) =		0.3295	(91)
MIT	18.5577	18.7872	19.1890	19.7042	20.0754	20.2383	20.2676	20.2641	20.1496	19.6322	19.0026	18.5266	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5577	18.7872	19.1890	19.7042	20.0754	20.2383	20.2676	20.2641	20.1496	19.6322	19.0026	18.5266	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9968	0.9925	0.9774	0.9245	0.7988	0.5998	0.4231	0.4863	0.7803	0.9626	0.9934	0.9976	(94)
Useful gains	602.1920	717.8422	851.6158	962.4931	925.2160	692.0977	465.1891	485.4718	676.6459	680.5764	595.4612	566.9253	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1878.1220	1824.8413	1663.3891	1400.3057	1083.2001	721.9356	469.5957	493.8366	777.6021	1168.1355	1546.0470	1869.2974	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	949.2920	743.9034	603.9593	315.2251	117.5402	0.0000	0.0000	0.0000	0.0000	362.7440	684.4218	968.9649	(98)

Space heating 4746.0506 (98)

Space heating per m2 (98) / (4) = 44.6771 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	93.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	5075.9900 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	949.2920	743.9034	603.9593	315.2251	117.5402	0.0000	0.0000	0.0000	0.0000	362.7440	684.4218	968.9649	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1015.2855	795.6186	645.9458	337.1391	125.7115	0.0000	0.0000	0.0000	0.0000	387.9615	732.0020	1036.3261	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	208.1392	183.3063	192.1626	171.7764	167.9842	149.5958	143.1911	157.7864	157.7149	178.1459	188.9804	202.9680	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.3692	88.1630	87.6628	86.4131	83.8827	79.8000	79.8000	79.8000	79.8000	86.6724	87.9484	88.4461	(217)
Fuel for water heating, kWh/month													
	235.5336	207.9176	219.2064	198.7851	200.2608	187.4635	179.4375	197.7273	197.6378	205.5394	214.8765	229.4822	(219)
Water heating fuel used												2473.8677	(219)
Annual totals kWh/year													
Space heating fuel - main system												5075.9900	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												422.8324	(232)
Total delivered energy for all uses												8047.6900	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5075.9900	0.2160	1096.4138	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2473.8677	0.2160	534.3554	(264)
Space and water heating			1630.7693	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	422.8324	0.5190	219.4500	(268)
Total CO2, kg/m2/year			1889.1443	(272)
Emissions per m2 for space and water heating			15.3513	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.0658	(272b)
Emissions per m2 for pumps and fans			0.3664	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.3513 * 1.55) + 2.0658 + 0.3664, rounded to 2 d.p.			26.2300	(273)

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.1800 (1b)	x	2.7000 (2b)	=	111.1860 (1b)	- (3b)
First floor	40.3200 (1c)	x	2.7000 (2c)	=	108.8640 (1c)	- (3c)
Second floor	24.7300 (1d)	x	1.9800 (2d)	=	48.9654 (1d)	- (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.0154	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1487	(8)
Pressure test		Yes	
Measured/design q50		8.0000	
Infiltration rate		0.5487	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4664	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5946	0.5830	0.5713	0.5130	0.5014	0.4431	0.4431	0.4314	0.4664	0.5014	0.5247	0.5480	(22b)
Effective ac	0.6768	0.6699	0.6632	0.6316	0.6257	0.5982	0.5982	0.5931	0.6088	0.6257	0.6376	0.6502	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.60)			19.2000	1.5038	28.8722			(27)
Opening Type 2			2.2100	3.0000	6.6300			(26)
Opening Type 3 (Uw = 1.60)			1.3100	1.5038	1.9699			(27a)
Heat Loss Floor 1			41.1800	0.1900	7.8242			(28a)
Wall 1	124.7400	21.4100	103.3300	0.2800	28.9324			(29a)
Wall 2	11.3400		11.3400	0.4800	5.4432			(29a)
Wall 3	20.8000		20.8000	0.1700	3.5360			(29a)
External Roof 1	33.6300	1.3100	32.3200	0.1800	5.8176			(30)
External Roof 2	5.4000		5.4000	0.1500	0.8100			(30)
External Roof 3	15.5900		15.5900	0.1600	2.4944			(30)
Total net area of external elements Aum(A, m2)			252.6800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.3299			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area)		37.9020 (36)
Total fabric heat loss	(33) + (36) =	130.2319 (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	60.0830	59.4735	58.8761	56.0701	55.5451	53.1012	53.1012	52.6486	54.0426	55.5451	56.6072	57.7175	(38)
Heat transfer coeff	190.3149	189.7054	189.1080	186.3020	185.7770	183.3331	183.3331	182.8805	184.2745	185.7770	186.8391	187.9494	(39)
Average = Sum(39)m / 12 =												186.2995	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7915	1.7858	1.7802	1.7538	1.7488	1.7258	1.7258	1.7216	1.7347	1.7488	1.7588	1.7693	(40)
HLP (average)												1.7537	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7902 (42)
Average daily hot water use (litres/day)	100.4673 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5140	106.4953	102.4766	98.4579	94.4392	90.4205	90.4205	94.4392	98.4579	102.4766	106.4953	110.5140	(44)
Energy conte	163.8890	143.3384	147.9124	128.9536	123.7341	106.7731	98.9410	113.5362	114.8922	133.8958	146.1577	158.7178	(45)
Energy content (annual)										Total = Sum(45)m =		1580.7412	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													

	34.8264	30.4594	31.4314	27.4026	26.2935	22.6893	21.0250	24.1264	24.4146	28.4528	31.0585	33.7275 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	(66)

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

	23.9425	21.2655	17.2943	13.0929	9.7871	8.2627	8.9281	11.6051	15.5763	19.7777	23.0835	24.6080	(67)

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

	266.0241	268.7846	261.8282	247.0189	228.3249	210.7551	199.0174	196.2569	203.2133	218.0225	236.7166	254.2864	(68)

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

	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

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

	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	(71)

Water heating gains (Table 5)

	46.8097	45.3265	42.2465	38.0592	35.3407	31.5129	28.2593	32.4280	33.9092	38.2431	43.1368	45.3327	(72)

Total internal gains

	401.6293	400.2296	386.2220	363.0240	338.3057	315.3837	301.0579	305.1430	317.5518	340.8964	367.7900	389.0800	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.2000	10.6334	0.7200	0.7000	0.7700	4.4567	(74)
East	18.0000	19.6403	0.7200	0.7000	0.7700	123.4763	(76)
South	1.3100	26.0000	0.7200	0.7000	1.0000	15.4496	(82)

Solar gains	143.3826	282.1505	469.3089	692.5343	856.4069	880.2044	836.5364	713.3408	548.3836	335.9712	179.0675	117.7348	(83)
Total gains	545.0119	682.3801	855.5308	1055.5584	1194.7126	1195.5880	1137.5943	1018.4838	865.9354	676.8675	546.8575	506.8148	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.5050	15.5548	15.6040	15.8390	15.8837	16.0955	16.0955	16.1353	16.0133	15.8837	15.7934	15.7001	
alpha	2.0337	2.0370	2.0403	2.0559	2.0589	2.0730	2.0730	2.0757	2.0676	2.0589	2.0529	2.0467	
util living area	0.9769	0.9629	0.9342	0.8761	0.7866	0.6682	0.5540	0.6086	0.7918	0.9219	0.9675	0.9801	(86)
MIT	17.3601	17.6967	18.3184	19.1509	19.9026	20.4751	20.7527	20.6892	20.1806	19.1781	18.1280	17.3158	(87)
Th 2	19.4759	19.4800	19.4839	19.5025	19.5060	19.5224	19.5224	19.5254	19.5161	19.5060	19.4990	19.4916	(88)
util rest of house	0.9725	0.9558	0.9210	0.8494	0.7357	0.5763	0.4129	0.4718	0.7205	0.8997	0.9601	0.9763	(89)
MIT 2	16.2317	16.5673	17.1824	18.0023	18.7104	19.2232	19.4298	19.3977	18.9928	18.0498	17.0108	16.1972	(90)
Living area fraction										fLA = Living area / (4) =		0.3295	(91)
MIT	16.6035	16.9394	17.5567	18.3807	19.1032	19.6356	19.8657	19.8232	19.3842	18.4215	17.3789	16.5658	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.6035	16.9394	17.5567	18.3807	19.1032	19.6356	19.8657	19.8232	19.3842	18.4215	17.3789	16.5658	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9599	0.9386	0.8978	0.8238	0.7191	0.5844	0.4498	0.5035	0.7126	0.8773	0.9445	0.9650	(94)
Useful gains	523.1806	640.4639	768.1199	869.6086	859.1641	698.7141	511.6345	512.8541	617.0945	593.8407	516.5269	489.0919	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2341.5338	2283.9396	2090.9093	1766.2826	1375.3405	923.1989	598.7023	626.0327	973.7418	1453.0571	1920.5015	2324.1397	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1352.8548	1104.4157	984.1553	645.6053	384.0352	0.0000	0.0000	0.0000	0.0000	639.2570	1010.8617	1365.2756	(98)
Space heating												7486.4606	(98)
Space heating per m2											(98) / (4) =	70.4741	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1723.3312	1356.6650	1389.8920	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6234	0.6891	0.6474	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1074.3906	934.8656	899.8635	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1485.8107	1416.7649	1282.7213	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	296.2225	358.5331	284.8462	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												939.6017	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	74.0556	89.6333	71.2115	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												234.9004	(107)
Space cooling per m2												2.2112	(108)
Energy for space heating												70.4741	(99)
Energy for space cooling												2.2112	(108)
Total												72.6853	(109)
Dwelling Fabric Energy Efficiency (DFEE)												72.7	(109)

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.1800 (1b)	x	2.7000 (2b)	=	111.1860	(1b) - (3b)
First floor	40.3200 (1c)	x	2.7000 (2c)	=	108.8640	(1c) - (3c)
Second floor	24.7300 (1d)	x	1.9800 (2d)	=	48.9654	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		269.0154	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1487	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3987	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3389	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4321	0.4236	0.4151	0.3728	0.3643	0.3219	0.3219	0.3135	0.3389	0.3643	0.3812	0.3982	(22b)
Effective ac	0.5933	0.5897	0.5862	0.5695	0.5664	0.5518	0.5518	0.5491	0.5574	0.5664	0.5727	0.5793	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.2100	1.0000	2.2100			(26)
TER Opening Type (Uw = 1.40)			19.2000	1.3258	25.4545			(27)
TER Room Window (Uw = 1.70)			1.3100	1.5918	2.0852			(27a)
Heat Loss Floor 1			41.1800	0.1300	5.3534			(28a)
Wall 1	124.7400	21.4100	103.3300	0.1800	18.5994			(29a)
Wall 2	11.3400		11.3400	0.1800	2.0412			(29a)
Wall 3	20.8000		20.8000	0.1800	3.7440			(29a)
External Roof 1	33.6300	1.3100	32.3200	0.1300	4.2016			(30)
External Roof 2	5.4000		5.4000	0.1300	0.7020			(30)
External Roof 3	15.5900		15.5900	0.1300	2.0267			(30)
Total net area of external elements Aum(A, m2)			252.6800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.4181			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)		12.6340 (36)
Total fabric heat loss	(33) + (36) =	79.0521 (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	52.6744	52.3526	52.0372	50.5557	50.2785	48.9882	48.9882	48.7492	49.4852	50.2785	50.8393	51.4255	(38)
Heat transfer coeff	131.7265	131.4047	131.0893	129.6078	129.3306	128.0402	128.0402	127.8013	128.5372	129.3306	129.8913	130.4775	(39)
Average = Sum(39)m / 12 =												129.6064	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2400	1.2370	1.2340	1.2201	1.2175	1.2053	1.2053	1.2031	1.2100	1.2175	1.2227	1.2283	(40)
HLP (average)												1.2201	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7902 (42)
Average daily hot water use (litres/day)	100.4673 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5140	106.4953	102.4766	98.4579	94.4392	90.4205	90.4205	94.4392	98.4579	102.4766	106.4953	110.5140	(44)
Energy conte	163.8890	143.3384	147.9124	128.9536	123.7341	106.7731	98.9410	113.5362	114.8922	133.8958	146.1577	158.7178	(45)
Energy content (annual)										Total = Sum(45)m =		1580.7412	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													

	34.8264	30.4594	31.4314	27.4026	26.2935	22.6893	21.0250	24.1264	24.4146	28.4528	31.0585	33.7275 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	139.5100	(66)

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

	23.9425	21.2655	17.2943	13.0929	9.7871	8.2627	8.9281	11.6051	15.5763	19.7777	23.0835	24.6080	(67)

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

	266.0241	268.7846	261.8282	247.0189	228.3249	210.7551	199.0174	196.2569	203.2133	218.0225	236.7166	254.2864	(68)

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

	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	36.9510	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

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

	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	(71)

Water heating gains (Table 5)

	46.8097	45.3265	42.2465	38.0592	35.3407	31.5129	28.2593	32.4280	33.9092	38.2431	43.1368	45.3327	(72)

Total internal gains

	401.6293	400.2296	386.2220	363.0240	338.3057	315.3837	301.0579	305.1430	317.5518	340.8964	367.7900	389.0800	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.2000	10.6334	0.6300	0.7000	0.7700	3.8996	(74)
East	18.0000	19.6403	0.6300	0.7000	0.7700	108.0418	(76)
South	1.3100	26.0000	0.6300	0.7000	1.0000	13.5184	(82)

Solar gains	125.4598	246.8817	410.6453	605.9675	749.3560	770.1788	731.9694	624.1732	479.8356	293.9748	156.6841	103.0179	(83)
Total gains	527.0891	647.1113	796.8672	968.9916	1087.6617	1085.5625	1033.0272	929.3162	797.3874	634.8711	524.4740	492.0980	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.0030	56.1402	56.2753	56.9185	57.0405	57.6154	57.6154	57.7231	57.3926	57.0405	56.7943	56.5391	
alpha	4.7335	4.7427	4.7517	4.7946	4.8027	4.8410	4.8410	4.8482	4.8262	4.8027	4.7863	4.7693	
util living area													
	0.9991	0.9975	0.9906	0.9595	0.8665	0.6961	0.5318	0.6055	0.8693	0.9855	0.9981	0.9994	(86)
MIT	19.5446	19.7205	20.0322	20.4426	20.7727	20.9441	20.9877	20.9779	20.8305	20.3717	19.8814	19.5180	(87)
Th 2	19.8881	19.8905	19.8929	19.9040	19.9061	19.9158	19.9158	19.9176	19.9120	19.9061	19.9019	19.8975	(88)
util rest of house													
	0.9988	0.9966	0.9871	0.9438	0.8174	0.6009	0.4077	0.4762	0.8003	0.9776	0.9973	0.9992	(89)
MIT 2	18.5600	18.7374	19.0490	19.4573	19.7556	19.8909	19.9128	19.9115	19.8168	19.3970	18.9073	18.5407	(90)
Living area fraction									fLA = Living area / (4) =			0.3295	(91)
MIT	18.8844	19.0614	19.3730	19.7819	20.0907	20.2379	20.2670	20.2628	20.1508	19.7181	19.2283	18.8627	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8844	19.0614	19.3730	19.7819	20.0907	20.2379	20.2670	20.2628	20.1508	19.7181	19.2283	18.8627	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9956	0.9849	0.9416	0.8267	0.6309	0.4490	0.5193	0.8179	0.9757	0.9965	0.9989	(94)
Useful gains	526.2494	644.2880	784.8085	912.4223	899.1882	684.9169	463.8293	482.6249	652.1604	619.4700	522.6608	491.5348	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1921.1508	1860.8682	1687.5078	1410.3838	1085.1721	721.8827	469.5171	493.6752	777.7502	1179.2507	1575.3572	1913.1551	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1037.8067	817.5419	671.6083	358.5323	138.3721	0.0000	0.0000	0.0000	0.0000	416.4768	757.9414	1057.6855	(98)
Space heating												5255.9649	(98)
Space heating per m2											(98) / (4) =	49.4772	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1203.5781	947.4977	971.2897	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8751	0.9298	0.8988	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1053.3047	881.0232	873.0276	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1359.7174	1296.9138	1180.4683	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	220.6172	309.4226	228.7358	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												758.7756	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	55.1543	77.3556	57.1840	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												189.6939	(107)
Space cooling per m2												1.7857	(108)
Energy for space heating												49.4772	(99)
Energy for space cooling												1.7857	(108)
Total												51.2629	(109)
Target Fabric Energy Efficiency (TFEE)												59.0	(109)

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.1800 (1b)	x	2.7000 (2b)	=	111.1860 (1b) - (3b)	
First floor	40.3200 (1c)	x	2.7000 (2c)	=	108.8640 (1c) - (3c)	
Second floor	24.7300 (1d)	x	1.9800 (2d)	=	48.9654 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.0154	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							0 * 10	=	0.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		8.0000	
Infiltration rate		0.4000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.2000	4.1000	3.9000	3.9000	3.4000	3.6000	3.4000	3.4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0500	1.0250	0.9750	0.9750	0.8500	0.9000	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.3655	0.3570	0.3485	0.3315	0.3315	0.2890	0.3060	0.2890	0.2890	0.3145	0.3060	0.3400	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.6155	0.6070	0.5985	0.5815	0.5815	0.5390	0.5560	0.5390	0.5390	0.5645	0.5560	0.5900	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.60)			19.2000	1.5038	28.8722			(27)
Opening Type 2			2.2100	3.0000	6.6300			(26)
Opening Type 3 (Uw = 1.60)			1.3100	1.5038	1.9699			(27a)
Heat Loss Floor 1			41.1800	0.1900	7.8242			(28a)
Wall 1	124.7400	21.4100	103.3300	0.2800	28.9324			(29a)
Wall 2	11.3400		11.3400	0.4800	5.4432			(29a)
Wall 3	20.8000		20.8000	0.1700	3.5360			(29a)
External Roof 1	33.6300	1.3100	32.3200	0.1800	5.8176			(30)
External Roof 2	5.4000		5.4000	0.1500	0.8100			(30)
External Roof 3	15.5900		15.5900	0.1600	2.4944			(30)
Total net area of external elements Aum(A, m2)			252.6800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.3299			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							37.9020	(36)
Total fabric heat loss					(33) + (36) =		130.2319	(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	54.6411	53.8865	53.1319	51.6227	51.6227	47.8498	49.3589	47.8498	47.8498	50.1135	49.3589	52.3773	(38)
Heat transfer coeff	184.8730	184.1184	183.3638	181.8546	181.8546	178.0817	179.5909	178.0817	178.0817	180.3454	179.5909	182.6092	(39)
Average = Sum(39)m / 12 =												181.0371	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7403	1.7332	1.7261	1.7119	1.7119	1.6764	1.6906	1.6764	1.6764	1.6977	1.6906	1.7190	(40)
HLP (average)												1.7042	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7902	(42)
Average daily hot water use (litres/day)												100.4673	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5140	106.4953	102.4766	98.4579	94.4392	90.4205	90.4205	94.4392	98.4579	102.4766	106.4953	110.5140	(44)
Energy conte	163.8890	143.3384	147.9124	128.9536	123.7341	106.7731	98.9410	113.5362	114.8922	133.8958	146.1577	158.7178	(45)
Energy content (annual)										Total = Sum(45)m =		1580.7412	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5834	21.5008	22.1869	19.3430	18.5601	16.0160	14.8411	17.0304	17.2338	20.0844	21.9237	23.8077	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)

Enter (49) or (54) in (55) 0.9180 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss	37.2980	33.6885	37.2980	36.0948	37.2980	36.0948	37.2980	37.2980	36.0948	37.2980	36.0948	37.2980	(59)
Total heat required for water heating calculated for each month	229.6450	202.7309	213.6684	192.5884	189.4900	170.4079	164.6969	179.2922	178.5270	199.6517	209.7925	224.4738	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from w/h	229.6450	202.7309	213.6684	192.5884	189.4900	170.4079	164.6969	179.2922	178.5270	199.6517	209.7925	224.4738	(64)

Total per year (kWh/year) = Sum(64)m = 2354.9646 (64)

RHI water heating demand 2355 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	107.0979	95.1740	101.7856	93.7849	93.7463	86.4099	85.5026	90.3556	89.1095	97.1251	99.5053	105.3784	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.8563	53.1638	43.2357	32.7322	24.4677	20.6567	22.3203	29.0127	38.9408	49.4443	57.7088	61.5199	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	397.0508	401.1710	390.7883	368.6850	340.7834	314.5598	297.0409	292.9208	303.3034	325.4068	353.3084	379.5319	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	(71)
Water heating gains (Table 5)	143.9488	141.6280	136.8087	130.2568	126.0031	120.0137	114.9229	121.4456	123.7632	130.5445	138.2018	141.6377	(72)
Total internal gains	714.1913	709.2982	684.1681	645.0094	604.5897	568.5657	547.6195	556.7146	579.3428	618.7310	662.5544	696.0249	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	1.2000	11.5683	0.7200	0.7000	0.7700	4.8486 (74)
East	18.0000	21.5704	0.7200	0.7000	0.7700	135.6105 (76)
South	1.3100	29.0000	0.7200	0.7000	1.0000	17.2323 (82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	157.6914	278.5330	464.2402	705.0441	846.4422	927.8264	879.9502	771.0888	594.9254	362.0738	203.3798	127.1094	(83)
Total gains	871.8827	987.8312	1148.4084	1350.0535	1451.0319	1496.3920	1427.5697	1327.8034	1174.2682	980.8049	865.9342	823.1342	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.9614	16.0268	16.0928	16.2263	16.2263	16.5701	16.4309	16.5701	16.5701	16.3621	16.4309	16.1593	
alpha	2.0641	2.0685	2.0729	2.0818	2.0818	2.1047	2.0954	2.1047	2.1047	2.0908	2.0954	2.0773	
util living area	0.9394	0.9209	0.8739	0.7858	0.6544	0.4575	0.2949	0.3337	0.6082	0.8224	0.9131	0.9449	(86)
MIT	18.7086	18.9084	19.4010	19.9568	20.4345	20.7488	20.8430	20.8331	20.6094	20.0260	19.3088	18.6897	(87)
Th 2	19.5121	19.5171	19.5222	19.5323	19.5323	19.5578	19.5476	19.5578	19.5578	19.5425	19.5476	19.5272	(88)
util rest of house	0.9282	0.9064	0.8495	0.7424	0.5776	0.3351	0.1301	0.1654	0.4971	0.7749	0.8941	0.9346	(89)
MIT 2	16.5836	16.8695	17.5673	18.3339	18.9482	19.3062	19.3587	19.3664	19.1851	18.4580	17.4624	16.5644	(90)

Living area fraction fLA = Living area / (4) = 0.3295 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	17.2837	17.5412	18.1715	18.8686	19.4379	19.7815	19.8477	19.8496	19.6544	18.9746	18.0707	17.2647	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.2837	17.5412	18.1715	18.8686	19.4379	19.7815	19.8477	19.8496	19.6544	18.9746	18.0707	17.2647	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9049	0.8803	0.8209	0.7188	0.5720	0.3557	0.1661	0.2018	0.5057	0.7516	0.8681	0.9125	(94)
Useful gains	788.9382	869.5739	942.6971	970.4178	829.9880	532.3377	237.1428	267.8861	593.7696	737.2142	751.6809	751.1063	(95)
Ext temp.	5.4000	5.9000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.6000	12.1000	8.4000	5.4000	(96)
Heat loss rate W	2196.9755	2143.3672	1883.4151	1540.0582	1079.8323	584.3720	242.0413	275.9581	722.0062	1239.8048	1736.7753	2166.5963	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1047.5797	855.9891	699.8942	410.1411	185.8842	0.0000	0.0000	0.0000	0.0000	373.9274	709.2679	1053.1246	(98)

Space heating 5335.8083 (98)

RHI space heating demand 5336 (98)

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.1800 (1b)	x	2.7000 (2b)	=	111.1860 (1b) - (3b)	
First floor	40.3200 (1c)	x	2.7000 (2c)	=	108.8640 (1c) - (3c)	
Second floor	24.7300 (1d)	x	1.9800 (2d)	=	48.9654 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.0154	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		8.0000	
Infiltration rate		0.4000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4335	0.4250	0.4165	0.3740	0.3655	0.3230	0.3230	0.3145	0.3400	0.3655	0.3825	0.3995	(22b)

Mechanical extract ventilation - decentralised		
If mechanical ventilation:	0.5000	(23a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.6835	0.6750	0.6665	0.6240	0.6155	0.5730	0.5730	0.5645	0.5900	0.6155	0.6325	0.6495	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.60)			19.2000	1.5038	28.8722			(27)
Opening Type 2			2.2100	3.0000	6.6300			(26)
Opening Type 3 (Uw = 1.60)			1.3100	1.5038	1.9699			(27a)
Heat Loss Floor 1			41.1800	0.1900	7.8242			(28a)
Wall 1	124.7400	21.4100	103.3300	0.2800	28.9324			(29a)
Wall 2	11.3400		11.3400	0.4800	5.4432			(29a)
Wall 3	20.8000		20.8000	0.1700	3.5360			(29a)
External Roof 1	33.6300	1.3100	32.3200	0.1800	5.8176			(30)
External Roof 2	5.4000		5.4000	0.1500	0.8100			(30)
External Roof 3	15.5900		15.5900	0.1600	2.4944			(30)
Total net area of external elements Aum(A, m2)			252.6800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.3299			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	37.9020	(36)
Total fabric heat loss	(33) + (36) = 130.2319	(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	60.6778	59.9232	59.1686	55.3957	54.6411	50.8681	50.8681	50.1135	52.3773	54.6411	56.1502	57.6594	(38)
Heat transfer coeff	190.9097	190.1551	189.4005	185.6276	184.8730	181.1000	181.1000	180.3454	182.6092	184.8730	186.3821	187.8913	(39)

Average = Sum(39)m / 12 =	185.4389 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7971	1.7900	1.7829	1.7474	1.7403	1.7048	1.7048	1.6977	1.7190	1.7403	1.7545	1.7687	(40)
HLP (average)												1.7456	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7902 (42)
Average daily hot water use (litres/day)	100.4673 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5140	106.4953	102.4766	98.4579	94.4392	90.4205	90.4205	94.4392	98.4579	102.4766	106.4953	110.5140	(44)
Energy conte	163.8890	143.3384	147.9124	128.9536	123.7341	106.7731	98.9410	113.5362	114.8922	133.8958	146.1577	158.7178	(45)
Energy content (annual)										Total = Sum(45)m =		1580.7412	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5834	21.5008	22.1869	19.3430	18.5601	16.0160	14.8411	17.0304	17.2338	20.0844	21.9237	23.8077	(46)

Water storage loss:		
Store volume	125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.7000	(48)
Temperature factor from Table 2b	0.5400	(49)

Enter (49) or (54) in (55) 0.9180 (55)

Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss	37.2980	33.6885	37.2980	36.0948	37.2980	36.0948	37.2980	37.2980	36.0948	37.2980	36.0948	37.2980	(59)
Total heat required for water heating calculated for each month	229.6450	202.7309	213.6684	192.5884	189.4900	170.4079	164.6969	179.2922	178.5270	199.6517	209.7925	224.4738	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Output from w/h	229.6450	202.7309	213.6684	192.5884	189.4900	170.4079	164.6969	179.2922	178.5270	199.6517	209.7925	224.4738	(64)
Heat gains from water heating, kWh/month	107.0979	95.1740	101.7856	93.7849	93.7463	86.4099	85.5026	90.3556	89.1095	97.1251	99.5053	105.3784	(65)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Total per year (kWh/year) = Sum(64)m = 2354.9646 (64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.8563	53.1638	43.2357	32.7322	24.4677	20.6567	22.3203	29.0127	38.9408	49.4443	57.7088	61.5199	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	397.0508	401.1710	390.7883	368.6850	340.7834	314.5598	297.0409	292.9208	303.3034	325.4068	353.3084	379.5319	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	(71)
Water heating gains (Table 5)	143.9488	141.6280	136.8087	130.2568	126.0031	120.0137	114.9229	121.4456	123.7632	130.5445	138.2018	141.6377	(72)
Total internal gains	714.1913	709.2982	684.1681	645.0094	604.5897	568.5657	547.6195	556.7146	579.3428	618.7310	662.5544	696.0249	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.2000	10.6334	0.7200	0.7000	0.7700	4.4567	(74)
East	18.0000	19.6403	0.7200	0.7000	0.7700	123.4763	(76)
South	1.3100	26.0000	0.7200	0.7000	1.0000	15.4496	(82)

Solar gains	143.3826	282.1505	469.3089	692.5343	856.4069	880.2044	836.5364	713.3408	548.3836	335.9712	179.0675	117.7348	(83)
Total gains	857.5739	991.4487	1153.4770	1337.5437	1460.9966	1448.7700	1384.1559	1270.0554	1127.7264	954.7022	841.6219	813.7597	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.4567	15.5180	15.5799	15.8965	15.9614	16.2939	16.2939	16.3621	16.1593	15.9614	15.8322	15.7050	
alpha	2.0304	2.0345	2.0387	2.0598	2.0641	2.0863	2.0863	2.0908	2.0773	2.0641	2.0555	2.0470	
util living area	0.9482	0.9295	0.8934	0.8251	0.7267	0.5982	0.4813	0.5261	0.7117	0.8656	0.9308	0.9530	(86)
MIT	18.4223	18.6602	19.0947	19.6768	20.1822	20.5629	20.7341	20.7015	20.3897	19.7229	18.9856	18.3969	(87)
Th 2	19.4720	19.4770	19.4820	19.5070	19.5121	19.5374	19.5374	19.5425	19.5272	19.5121	19.5020	19.4920	(88)
util rest of house	0.9390	0.9170	0.8739	0.7915	0.6697	0.5057	0.3504	0.3964	0.6306	0.8321	0.9165	0.9446	(89)
MIT 2	16.1544	16.4951	17.1128	17.9359	18.6151	19.1027	19.2790	19.2591	18.9113	18.0250	16.9787	16.1269	(90)
MIT	16.9016	17.2084	17.7658	18.5095	19.1314	19.5838	19.7584	19.7343	19.3984	18.5844	17.6399	16.8748	(92)
adjusted MIT	16.9016	17.2084	17.7658	18.5095	19.1314	19.5838	19.7584	19.7343	19.3984	18.5844	17.6399	16.8748	(93)

Living area fraction fLA = Living area / (4) = 0.3295 (91)

Temperature adjustment 0.0000

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9171	0.8916	0.8450	0.7639	0.6527	0.5090	0.3722	0.4155	0.6221	0.8050	0.8918	0.9240	(94)
Useful gains	786.4962	883.9708	974.6701	1021.7564	953.6165	737.4563	515.1695	527.7135	701.5848	768.5419	750.5491	751.9450	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2405.7688	2340.5054	2133.7440	1783.7846	1373.8678	902.5646	571.9920	601.3335	967.5352	1476.1061	1964.4500	2381.4837	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1204.7388	978.7913	862.3510	548.6603	312.6670	0.0000	0.0000	0.0000	0.0000	526.4278	874.0087	1212.3768	(98)

Space heating 6520.0216 (98)

Space heating per m2 (98) / (4) = 61.3765 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 175.1000 (206)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3723.5989 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1204.7388	978.7913	862.3510	548.6603	312.6670	0.0000	0.0000	0.0000	0.0000	526.4278	874.0087	1212.3768	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	688.0290	558.9899	492.4906	313.3411	178.5648	0.0000	0.0000	0.0000	0.0000	300.6441	499.1483	692.3911	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

	229.6450	202.7309	213.6684	192.5884	189.4900	170.4079	164.6969	179.2922	178.5270	199.6517	209.7925	224.4738	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	131.1508	115.7801	122.0265	109.9877	108.2182	97.3203	94.0588	102.3942	101.9572	114.0215	119.8130	128.1975	(219)
Water heating fuel used												1344.9255	(219)
Annual totals kWh/year													
Space heating fuel - main system												3723.5989	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 12.8150, total flow = 37.0000, SFP = 0.3464)
mechanical ventilation fans (SFP = 0.3464) 113.6721 (230a)
central heating pump 30.0000 (230c)
Total electricity for the above, kWh/year 143.6721 (231)
Electricity for lighting (calculated in Appendix L) 422.8324 (232)
Total delivered energy for all uses 5635.0288 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3723.5989	13.1900	491.1427	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1344.9255	13.1900	177.3957	(247)
Mechanical ventilation fans	113.6721	13.1900	14.9933	(249)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	422.8324	13.1900	55.7716	(250)
Additional standing charges			0.0000	(251)
Total energy cost			743.2603	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 2.0642 (257)
SAP value 71.2044
SAP rating (Section 12) 71 (258)
SAP band C

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3723.5989	0.5190	1932.5478	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1344.9255	0.5190	698.0163	(264)
Space and water heating			2630.5641	(265)
Pumps and fans	143.6721	0.5190	74.5658	(267)
Energy for lighting	422.8324	0.5190	219.4500	(268)
Total kg/year			2924.5800	(272)
CO2 emissions per m2			27.5300	(273)
EI value			74.0862	
EI rating			74	(274)
EI band			C	

Calculation of stars for heating and DHW

Main heating energy efficiency 13.19 × (1 + 0.29 × 0.25) / 1.7510 = 8.079, stars = 2
Main heating environmental impact 0.519 × (1 + 0.29 × 0.25) / 1.7510 = 0.3179, stars = 4
Water heating energy efficiency 13.19 / 1.7510 = 7.533, stars = 2
Water heating environmental impact 0.519 / 1.7510 = 0.2964, stars = 4

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.1800 (1b)	x	2.7000 (2b)	=	111.1860 (1b) - (3b)	
First floor	40.3200 (1c)	x	2.7000 (2c)	=	108.8640 (1c) - (3c)	
Second floor	24.7300 (1d)	x	1.9800 (2d)	=	48.9654 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.0154	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		8.0000	
Infiltration rate		0.4000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.2000	4.1000	3.9000	3.9000	3.4000	3.6000	3.4000	3.4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0500	1.0250	0.9750	0.9750	0.8500	0.9000	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.3655	0.3570	0.3485	0.3315	0.3315	0.2890	0.3060	0.2890	0.2890	0.3145	0.3060	0.3400	(22b)

Mechanical extract ventilation - decentralised
If mechanical ventilation: 0.5000 (23a)

Effective ac	0.6155	0.6070	0.5985	0.5815	0.5815	0.5390	0.5560	0.5390	0.5390	0.5645	0.5560	0.5900	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.60)			19.2000	1.5038	28.8722			(27)
Opening Type 2			2.2100	3.0000	6.6300			(26)
Opening Type 3 (Uw = 1.60)			1.3100	1.5038	1.9699			(27a)
Heat Loss Floor 1			41.1800	0.1900	7.8242			(28a)
Wall 1	124.7400	21.4100	103.3300	0.2800	28.9324			(29a)
Wall 2	11.3400		11.3400	0.4800	5.4432			(29a)
Wall 3	20.8000		20.8000	0.1700	3.5360			(29a)
External Roof 1	33.6300	1.3100	32.3200	0.1800	5.8176			(30)
External Roof 2	5.4000		5.4000	0.1500	0.8100			(30)
External Roof 3	15.5900		15.5900	0.1600	2.4944			(30)
Total net area of external elements Aum(A, m2)			252.6800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.3299			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area) 37.9020 (36)
Total fabric heat loss (33) + (36) = 130.2319 (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	54.6411	53.8865	53.1319	51.6227	51.6227	47.8498	49.3589	47.8498	47.8498	50.1135	49.3589	52.3773	(38)
Heat transfer coeff	184.8730	184.1184	183.3638	181.8546	181.8546	178.0817	179.5909	178.0817	178.0817	180.3454	179.5909	182.6092	(39)

Average = Sum(39)m / 12 = 181.0371 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7403	1.7332	1.7261	1.7119	1.7119	1.6764	1.6906	1.6764	1.6764	1.6977	1.6906	1.7190	(40)
HLP (average)												1.7042	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7902 (42)
Average daily hot water use (litres/day) 100.4673 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5140	106.4953	102.4766	98.4579	94.4392	90.4205	90.4205	94.4392	98.4579	102.4766	106.4953	110.5140	(44)
Energy conte	163.8890	143.3384	147.9124	128.9536	123.7341	106.7731	98.9410	113.5362	114.8922	133.8958	146.1577	158.7178	(45)

Energy content (annual) Total = Sum(45)m = 1580.7412 (45)

Distribution loss (46)m = 0.15 x (45)m	24.5834	21.5008	22.1869	19.3430	18.5601	16.0160	14.8411	17.0304	17.2338	20.0844	21.9237	23.8077	(46)

Water storage loss:
Store volume 125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9180 (55)
Total storage loss
28.4580 25.7040 28.4580 27.5400 28.4580 27.5400 28.4580 28.4580 27.5400 28.4580 27.5400 28.4580 (56)
If cylinder contains dedicated solar storage
28.4580 25.7040 28.4580 27.5400 28.4580 27.5400 28.4580 28.4580 27.5400 28.4580 27.5400 28.4580 (57)
Primary loss 37.2980 33.6885 37.2980 36.0948 37.2980 36.0948 37.2980 37.2980 36.0948 37.2980 36.0948 37.2980 (59)
Total heat required for water heating calculated for each month
229.6450 202.7309 213.6684 192.5884 189.4900 170.4079 164.6969 179.2922 178.5270 199.6517 209.7925 224.4738 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
229.6450 202.7309 213.6684 192.5884 189.4900 170.4079 164.6969 179.2922 178.5270 199.6517 209.7925 224.4738 (64)
Total per year (kWh/year) = Sum(64)m = 2354.9646 (64)
Heat gains from water heating, kWh/month
107.0979 95.1740 101.7856 93.7849 93.7463 86.4099 85.5026 90.3556 89.1095 97.1251 99.5053 105.3784 (65)

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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	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
59.8563 53.1638 43.2357 32.7322 24.4677 20.6567 22.3203 29.0127 38.9408 49.4443 57.7088 61.5199 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
397.0508 401.1710 390.7883 368.6850 340.7834 314.5598 297.0409 292.9208 303.3034 325.4068 353.3084 379.5319 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
54.5314 54.5314 54.5314 54.5314 54.5314 54.5314 54.5314 54.5314 54.5314 54.5314 54.5314 54.5314 (69)
Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
-111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 -111.6080 (71)
Water heating gains (Table 5)
143.9488 141.6280 136.8087 130.2568 126.0031 120.0137 114.9229 121.4456 123.7632 130.5445 138.2018 141.6377 (72)
Total internal gains
714.1913 709.2982 684.1681 645.0094 604.5897 568.5657 547.6195 556.7146 579.3428 618.7310 662.5544 696.0249 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.2000	11.5683	0.7200	0.7000	0.7700	4.8486	(74)
East	18.0000	21.5704	0.7200	0.7000	0.7700	135.6105	(76)
South	1.3100	29.0000	0.7200	0.7000	1.0000	17.2323	(82)

Solar gains	157.6914	278.5330	464.2402	705.0441	846.4422	927.8264	879.9502	771.0888	594.9254	362.0738	203.3798	127.1094	(83)
Total gains	871.8827	987.8312	1148.4084	1350.0535	1451.0319	1496.3920	1427.5697	1327.8034	1174.2682	980.8049	865.9342	823.1342	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.9614	16.0268	16.0928	16.2263	16.2263	16.5701	16.4309	16.5701	16.5701	16.3621	16.4309	16.1593	
alpha	2.0641	2.0685	2.0729	2.0818	2.0818	2.1047	2.0954	2.1047	2.1047	2.0908	2.0954	2.0773	
util living area	0.9394	0.9209	0.8739	0.7858	0.6544	0.4575	0.2949	0.3337	0.6082	0.8224	0.9131	0.9449	(86)
MIT	18.7086	18.9084	19.4010	19.9568	20.4345	20.7488	20.8430	20.8331	20.6094	20.0260	19.3088	18.6897	(87)
Th 2	19.5121	19.5171	19.5222	19.5323	19.5323	19.5578	19.5476	19.5578	19.5578	19.5425	19.5476	19.5272	(88)
util rest of house	0.9282	0.9064	0.8495	0.7424	0.5776	0.3351	0.1301	0.1654	0.4971	0.7749	0.8941	0.9346	(89)
MIT 2	16.5836	16.8695	17.5673	18.3339	18.9482	19.3062	19.3587	19.3664	19.1851	18.4580	17.4624	16.5644	(90)
Living area fraction									fLA = Living area / (4) =			0.3295	(91)
MIT	17.2837	17.5412	18.1715	18.8686	19.4379	19.7815	19.8477	19.8496	19.6544	18.9746	18.0707	17.2647	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.2837	17.5412	18.1715	18.8686	19.4379	19.7815	19.8477	19.8496	19.6544	18.9746	18.0707	17.2647	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9049	0.8803	0.8209	0.7188	0.5720	0.3557	0.1661	0.2018	0.5057	0.7516	0.8681	0.9125	(94)
Useful gains	788.9382	869.5739	942.6971	970.4178	829.9880	532.3377	237.1428	267.8861	593.7696	737.2142	751.6809	751.1063	(95)
Ext temp.	5.4000	5.9000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.6000	12.1000	8.4000	5.4000	(96)
Heat loss rate W	2196.9755	2143.3672	1883.4151	1540.0582	1079.8323	584.3720	242.0413	275.9581	722.0062	1239.8048	1736.7753	2166.5963	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1047.5797	855.9891	699.8942	410.1411	185.8842	0.0000	0.0000	0.0000	0.0000	373.9274	709.2679	1053.1246	(98)

Space heating 5335.8083 (98)
Space heating per m2 (98) / (4) = 50.2288 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 175.1000 (206)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3047.2920 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1047.5797	855.9891	699.8942	410.1411	185.8842	0.0000	0.0000	0.0000	0.0000	373.9274	709.2679	1053.1246	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	598.2751	488.8573	399.7111	234.2325	106.1589	0.0000	0.0000	0.0000	0.0000	213.5508	405.0645	601.4418	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

	229.6450	202.7309	213.6684	192.5884	189.4900	170.4079	164.6969	179.2922	178.5270	199.6517	209.7925	224.4738	(64)

Efficiency of water heater 175.1000 (216)

(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)

Fuel for water heating, kWh/month

	131.1508	115.7801	122.0265	109.9877	108.2182	97.3203	94.0588	102.3942	101.9572	114.0215	119.8130	128.1975	(219)

Water heating fuel used 1344.9255 (219)
Annual totals kWh/year
Space heating fuel - main system 3047.2920 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 12.8150, total flow = 37.0000, SFP = 0.3464)
mechanical ventilation fans (SFP = 0.3464) 113.6721 (230a)
central heating pump 30.0000 (230c)
Total electricity for the above, kWh/year 143.6721 (231)
Electricity for lighting (calculated in Appendix L) 422.8324 (232)
Total delivered energy for all uses 4958.7220 (238)

10a. Fuel costs - using BEDF prices (381)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3047.2920	15.0600	458.9222	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1344.9255	15.0600	202.5458	(247)
Mechanical ventilation fans	113.6721	15.0600	17.1190	(249)
Pumps and fans for heating	30.0000	15.0600	4.5180	(249)
Energy for lighting	422.8324	15.0600	63.6786	(250)
Additional standing charges			0.0000	(251)
Total energy cost			746.7835	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3047.2920	0.5190	1581.5445	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1344.9255	0.5190	698.0163	(264)
Space and water heating			2279.5609	(265)
Pumps and fans	143.6721	0.5190	74.5658	(267)
Energy for lighting	422.8324	0.5190	219.4500	(268)
Total kg/year			2573.5767	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3047.2920	3.0700	9355.1864	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1344.9255	3.0700	4128.9213	(264)
Space and water heating			13484.1078	(265)
Pumps and fans	143.6721	3.0700	441.0733	(267)
Energy for lighting	422.8324	3.0700	1298.0954	(268)
Primary energy kWh/year			15223.2765	(272)
Primary energy kWh/m2/year			143.3049	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: C 71
Current environmental impact rating: C 74

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered

S	Not considered
T	Not considered
U Solar photovoltaic panels	Recommended
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 2.6	-£ 77	-265 kg (10.3%)
U Solar photovoltaic panels	+ 8.8	-£ 269	-928 kg (40.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	2.50 kg/m²	C 74	C 76
Solar photovoltaic panels	£269	8.73 kg/m²	B 83	B 84
Total Savings	£346	11.23 kg/m²		

Potential energy efficiency rating: B 83
Potential environmental impact rating: B 84

Fuel prices for cost data on this page from database revision number 381 TEST (27 Jul 2015)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£747	£670	£77
Space heating	£481	£481	-£1
Water heating	£203	£125	£78
Lighting	£64	£64	£0
Generated (PV)	-£0	-£269	£269
Total cost of fuels	£747	£401	£346
Total cost of uses	£748	£401	£346
Delivered energy	47 kWh/m²	25 kWh/m²	22 kWh/m²
Carbon dioxide emissions	2.6 tonnes	1.4 tonnes	1.2 tonnes
CO2 emissions per m²	24 kg/m²	13 kg/m²	11 kg/m²
Primary energy	143 kWh/m²	77 kWh/m²	66 kWh/m²

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.1800 (1b)	x	2.7000 (2b)	=	111.1860 (1b) - (3b)	
First floor	40.3200 (1c)	x	2.7000 (2c)	=	108.8640 (1c) - (3c)	
Second floor	24.7300 (1d)	x	1.9800 (2d)	=	48.9654 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.0154	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		8.0000	
Infiltration rate		0.4000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4335	0.4250	0.4165	0.3740	0.3655	0.3230	0.3230	0.3145	0.3400	0.3655	0.3825	0.3995	(22b)

Mechanical extract ventilation - decentralised
If mechanical ventilation: 0.5000 (23a)

Effective ac	0.6835	0.6750	0.6665	0.6240	0.6155	0.5730	0.5730	0.5645	0.5900	0.6155	0.6325	0.6495	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.60)			19.2000	1.5038	28.8722			(27)
Opening Type 2			2.2100	3.0000	6.6300			(26)
Opening Type 3 (Uw = 1.60)			1.3100	1.5038	1.9699			(27a)
Heat Loss Floor 1			41.1800	0.1900	7.8242			(28a)
Wall 1	124.7400	21.4100	103.3300	0.2800	28.9324			(29a)
Wall 2	11.3400		11.3400	0.4800	5.4432			(29a)
Wall 3	20.8000		20.8000	0.1700	3.5360			(29a)
External Roof 1	33.6300	1.3100	32.3200	0.1800	5.8176			(30)
External Roof 2	5.4000		5.4000	0.1500	0.8100			(30)
External Roof 3	15.5900		15.5900	0.1600	2.4944			(30)
Total net area of external elements Aum(A, m2)			252.6800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.3299			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area) 37.9020 (36)
Total fabric heat loss (33) + (36) = 130.2319 (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	60.6778	59.9232	59.1686	55.3957	54.6411	50.8681	50.8681	50.1135	52.3773	54.6411	56.1502	57.6594	(38)
Heat transfer coeff	190.9097	190.1551	189.4005	185.6276	184.8730	181.1000	181.1000	180.3454	182.6092	184.8730	186.3821	187.8913	(39)

Average = Sum(39)m / 12 = 185.4389 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7971	1.7900	1.7829	1.7474	1.7403	1.7048	1.7048	1.6977	1.7190	1.7403	1.7545	1.7687	(40)
HLP (average)												1.7456	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7902 (42)
Average daily hot water use (litres/day) 100.4673 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5140	106.4953	102.4766	98.4579	94.4392	90.4205	90.4205	94.4392	98.4579	102.4766	106.4953	110.5140	(44)
Energy conte	163.8890	143.3384	147.9124	128.9536	123.7341	106.7731	98.9410	113.5362	114.8922	133.8958	146.1577	158.7178	(45)

Energy content (annual) Total = Sum(45)m = 1580.7412 (45)

Distribution loss (46)m = 0.15 x (45)m	24.5834	21.5008	22.1869	19.3430	18.5601	16.0160	14.8411	17.0304	17.2338	20.0844	21.9237	23.8077	(46)

Water storage loss:
Store volume 125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55)													0.9180 (55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580 (56)	
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580 (57)	
Primary loss	37.2980	33.6885	35.0601	25.2664	16.7841	15.8817	16.4111	17.9030	27.4320	35.0601	36.0948	37.2980 (59)	
Total heat required for water heating calculated for each month													
	229.6450	202.7309	211.4305	181.7600	168.9761	150.1948	143.8101	159.8972	169.8642	197.4138	209.7925	224.4738 (62)	
Aperture area of solar collector													3.0000 (H1)
Zero-loss collector efficiency													0.7000 (H2)
Collector heat loss coefficient													1.8000 (H3)
Collector 2nd order heat loss coefficient													0.0050 (H3a)
Collector effective heat loss coefficient													1.8063 (H3b)
Collector performance ratio													2.5804 (H4)
Annual solar radiation per m2													1079.5246 (H5)
Overshading factor													0.8000 (H6)
Solar energy available													1813.6014 (H7)
Adjustment factor for showers													1.0000 (H7a)
Solar-to-load ratio													1.1473 (H8)
Utilisation factor													0.5817 (H9)
Collector performance factor													0.8793 (H10)
Dedicated solar storage volume													75.0000 (H11)
Effective solar volume													75.0000 (H13)
Daily hot water demand													100.4673 (H14)
Volume ratio Veff/V													0.7465 (H15)
Solar storage volume factor													0.9415 (H16)
Solar input													-873.4221 (H17)
Solar input	-25.3275	-42.2643	-71.9810	-96.4687	-119.1789	-117.1719	-115.6234	-101.0207	-79.1195	-54.0293	-30.0421	-21.1948 (63)	
								Solar input (sum of months) = Sum(63)m =				-873.4221 (63)	
Output from w/h													
	204.3175	160.4666	139.4495	85.2913	49.7972	33.0229	28.1867	58.8765	90.7447	143.3845	179.7504	203.2790 (64)	
								Total per year (kWh/year) = Sum(64)m =				1376.5668 (64)	
Heat gains from water heating, kWh/month													
	107.0979	95.1740	99.9953	85.1222	77.3352	70.2394	68.7932	74.8396	82.1793	95.3348	99.5053	105.3784 (65)	

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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	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	59.8563	53.1638	43.2357	32.7322	24.4677	20.6567	22.3203	29.0127	38.9408	49.4443	57.7088	61.5199	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	397.0508	401.1710	390.7883	368.6850	340.7834	314.5598	297.0409	292.9208	303.3034	325.4068	353.3084	379.5319	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	(71)
Water heating gains (Table 5)													
	143.9488	141.6280	134.4023	118.2252	103.9452	97.5548	92.4639	100.5909	114.1379	128.1382	138.2018	141.6377	(72)
Total internal gains													
	714.1913	709.2982	681.7618	632.9778	582.5317	546.1067	525.1605	535.8598	569.7175	616.3247	662.5544	696.0249	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.2000	10.6334	0.7200	0.7000	0.7700	4.4567	(74)
East	18.0000	19.6403	0.7200	0.7000	0.7700	123.4763	(76)
South	1.3100	26.0000	0.7200	0.7000	1.0000	15.4496	(82)

Solar gains	143.3826	282.1505	469.3089	692.5343	856.4069	880.2044	836.5364	713.3408	548.3836	335.9712	179.0675	117.7348	(83)
Total gains	857.5739	991.4487	1151.0707	1325.5121	1438.9386	1426.3110	1361.6969	1249.2006	1118.1011	952.2959	841.6219	813.7597	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.4567	15.5180	15.5799	15.8965	15.9614	16.2939	16.2939	16.3621	16.1593	15.9614	15.8322	15.7050	
alpha	2.0304	2.0345	2.0387	2.0598	2.0641	2.0863	2.0863	2.0908	2.0773	2.0641	2.0555	2.0470	
util living area													
	0.9482	0.9295	0.8938	0.8273	0.7314	0.6038	0.4870	0.5320	0.7144	0.8661	0.9308	0.9530	(86)
MIT	18.4223	18.6602	19.0928	19.6694	20.1726	20.5571	20.7309	20.6976	20.3858	19.7212	18.9856	18.3969	(87)
Th 2	19.4720	19.4770	19.4820	19.5070	19.5121	19.5374	19.5374	19.5425	19.5272	19.5121	19.5020	19.4920	(88)
util rest of house													
	0.9390	0.9170	0.8743	0.7940	0.6749	0.5112	0.3552	0.4017	0.6336	0.8327	0.9165	0.9446	(89)
MIT 2	16.1544	16.4951	17.1103	17.9263	18.6038	19.0973	19.2771	19.2566	18.9071	18.0228	16.9787	16.1269	(90)
Living area fraction									fLA = Living area / (4) =			0.3295	(91)
MIT	16.9016	17.2084	17.7635	18.5006	19.1207	19.5783	19.7561	19.7314	19.3943	18.5824	17.6399	16.8748	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.9016	17.2084	17.7635	18.5006	19.1207	19.5783	19.7561	19.7314	19.3943	18.5824	17.6399	16.8748	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9171	0.8916	0.8454	0.7663	0.6574	0.5142	0.3770	0.4206	0.6249	0.8056	0.8918	0.9240	(94)
Useful gains	786.4962	883.9708	973.1133	1015.6741	946.0111	733.3459	513.3520	525.4617	698.6613	767.1636	750.5491	751.9450	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2405.7688	2340.5054	2133.3159	1782.1404	1371.8857	901.5644	571.5621	600.7975	966.7862	1475.7319	1964.4500	2381.4837	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													

	1204.7388	978.7913	863.1907	551.8558	316.8507	0.0000	0.0000	0.0000	0.0000	527.1748	874.0087	1212.3768 (98)
Space heating												6528.9875 (98)
Space heating per m2											(98) / (4) =	61.4609 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												175.1000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3728.7193 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1204.7388	978.7913	863.1907	551.8558	316.8507	0.0000	0.0000	0.0000	0.0000	527.1748	874.0087	1212.3768	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	688.0290	558.9899	492.9701	315.1660	180.9541	0.0000	0.0000	0.0000	0.0000	301.0707	499.1483	692.3911	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	204.3175	160.4666	139.4495	85.2913	49.7972	33.0229	28.1867	58.8765	90.7447	143.3845	179.7504	203.2790	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	116.6862	91.6428	79.6399	48.7100	28.4393	18.8595	16.0975	33.6245	51.8245	81.8872	102.6559	116.0931	(219)
Water heating fuel used												786.1604	(219)
Annual totals kWh/year													
Space heating fuel - main system												3728.7193	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 12.8150, total flow = 37.0000, SFP = 0.3464)													
mechanical ventilation fans (SFP = 0.3464)												113.6721	(230a)
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												193.6721	(231)
Electricity for lighting (calculated in Appendix L)												422.8324	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3404.1447	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3728.7193	13.1900	491.8181	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	786.1604	13.1900	103.6946	(247)
Mechanical ventilation fans	113.6721	13.1900	14.9933	(249)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	422.8324	13.1900	55.7716	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			449.0067	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):			0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =		1.2470 (257)
SAP value			82.6044
SAP rating (Section 12)			83 (258)
SAP band			B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3728.7193	0.5190	1935.2053	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	786.1604	0.5190	408.0172	(264)
Space and water heating			2343.2226	(265)
Pumps and fans	193.6721	0.5190	100.5158	(267)
Energy for lighting	422.8324	0.5190	219.4500	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			1766.7511	(272)
CO2 emissions per m2			16.6300	(273)
EI value			84.3454	
EI rating			84	(274)
EI band			B	

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.1800 (1b)	x	2.7000 (2b)	=	111.1860 (1b) - (3b)	
First floor	40.3200 (1c)	x	2.7000 (2c)	=	108.8640 (1c) - (3c)	
Second floor	24.7300 (1d)	x	1.9800 (2d)	=	48.9654 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.2300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.0154 (5)	

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		8.0000	
Infiltration rate		0.4000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.2000	4.1000	3.9000	3.9000	3.4000	3.6000	3.4000	3.4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0500	1.0250	0.9750	0.9750	0.8500	0.9000	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.3655	0.3570	0.3485	0.3315	0.3315	0.2890	0.3060	0.2890	0.2890	0.3145	0.3060	0.3400	(22b)

Mechanical extract ventilation - decentralised
If mechanical ventilation: 0.5000 (23a)

Effective ac	0.6155	0.6070	0.5985	0.5815	0.5815	0.5390	0.5560	0.5390	0.5390	0.5645	0.5560	0.5900	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.60)			19.2000	1.5038	28.8722			(27)
Opening Type 2			2.2100	3.0000	6.6300			(26)
Opening Type 3 (Uw = 1.60)			1.3100	1.5038	1.9699			(27a)
Heat Loss Floor 1			41.1800	0.1900	7.8242			(28a)
Wall 1	124.7400	21.4100	103.3300	0.2800	28.9324			(29a)
Wall 2	11.3400		11.3400	0.4800	5.4432			(29a)
Wall 3	20.8000		20.8000	0.1700	3.5360			(29a)
External Roof 1	33.6300	1.3100	32.3200	0.1800	5.8176			(30)
External Roof 2	5.4000		5.4000	0.1500	0.8100			(30)
External Roof 3	15.5900		15.5900	0.1600	2.4944			(30)
Total net area of external elements Aum(A, m2)			252.6800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.3299			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (Default value 0.150 * total exposed area) 37.9020 (36)
Total fabric heat loss (33) + (36) = 130.2319 (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	54.6411	53.8865	53.1319	51.6227	51.6227	47.8498	49.3589	47.8498	47.8498	50.1135	49.3589	52.3773	(38)
Heat transfer coeff	184.8730	184.1184	183.3638	181.8546	181.8546	178.0817	179.5909	178.0817	178.0817	180.3454	179.5909	182.6092	(39)

Average = Sum(39)m / 12 = 181.0371 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7403	1.7332	1.7261	1.7119	1.7119	1.6764	1.6906	1.6764	1.6764	1.6977	1.6906	1.7190	(40)
HLP (average)												1.7042	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7902 (42)
Average daily hot water use (litres/day) 100.4673 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5140	106.4953	102.4766	98.4579	94.4392	90.4205	90.4205	94.4392	98.4579	102.4766	106.4953	110.5140	(44)
Energy conte	163.8890	143.3384	147.9124	128.9536	123.7341	106.7731	98.9410	113.5362	114.8922	133.8958	146.1577	158.7178	(45)
Energy content (annual)										Total = Sum(45)m =		1580.7412	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5834	21.5008	22.1869	19.3430	18.5601	16.0160	14.8411	17.0304	17.2338	20.0844	21.9237	23.8077	(46)

Water storage loss:
Store volume 125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9180 (55)

Total storage loss

	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580 (56)

If cylinder contains dedicated solar storage

	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580 (57)
Primary loss	37.2980	33.6885	35.0601	25.2664	16.7841	15.8817	16.4111	17.9030	27.4320	35.0601	36.0948	37.2980 (59)

Total heat required for water heating calculated for each month

	229.6450	202.7309	211.4305	181.7600	168.9761	150.1948	143.8101	159.8972	169.8642	197.4138	209.7925	224.4738 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1117.3717 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1877.1845 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.1875 (H8)
Utilisation factor	0.5692 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	100.4673 (H14)
Volume ratio Veff/V	0.7465 (H15)
Solar storage volume factor	0.9415 (H16)
Solar input	-884.5663 (H17)

Solar input	-26.8138	-40.2066	-68.8048	-95.2656	-114.5952	-120.3077	-118.4067	-106.0626	-83.0662	-56.1605	-32.8532	-22.0234 (63)

Solar input (sum of months) = Sum(63)m = -884.5663 (63)

Output from w/h

	202.8312	162.5242	142.6256	86.4944	54.3810	29.8871	25.4034	53.8346	86.7980	141.2534	176.9393	202.4504 (64)

Total per year (kWh/year) = Sum(64)m = 1365.4225 (64)

Heat gains from water heating, kWh/month

	107.0979	95.1740	99.9953	85.1222	77.3352	70.2394	68.7932	74.8396	82.1793	95.3348	99.5053	105.3784 (65)

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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	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	167.4120	(66)

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

	59.8563	53.1638	43.2357	32.7322	24.4677	20.6567	22.3203	29.0127	38.9408	49.4443	57.7088	61.5199 (67)

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

	397.0508	401.1710	390.7883	368.6850	340.7834	314.5598	297.0409	292.9208	303.3034	325.4068	353.3084	379.5319 (68)

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

	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314	54.5314 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)

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

	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080	-111.6080 (71)

Water heating gains (Table 5)

	143.9488	141.6280	134.4023	118.2252	103.9452	97.5548	92.4639	100.5909	114.1379	128.1382	138.2018	141.6377 (72)

Total internal gains

	714.1913	709.2982	681.7618	632.9778	582.5317	546.1067	525.1605	535.8598	569.7175	616.3247	662.5544	696.0249 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.2000	11.5683	0.7200	0.7000	0.7700	4.8486	(74)
East	18.0000	21.5704	0.7200	0.7000	0.7700	135.6105	(76)
South	1.3100	29.0000	0.7200	0.7000	1.0000	17.2323	(82)

Solar gains	157.6914	278.5330	464.2402	705.0441	846.4422	927.8264	879.9502	771.0888	594.9254	362.0738	203.3798	127.1094	(83)
Total gains	871.8827	987.8312	1146.0021	1338.0219	1428.9740	1473.9331	1405.1107	1306.9486	1164.6429	978.3985	865.9342	823.1342	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.9614	16.0268	16.0928	16.2263	16.2263	16.5701	16.4309	16.5701	16.5701	16.3621	16.4309	16.1593	
alpha	2.0641	2.0685	2.0729	2.0818	2.0818	2.1047	2.0954	2.1047	2.1047	2.0908	2.0954	2.0773	
util living area	0.9394	0.9209	0.8743	0.7882	0.6596	0.4627	0.2990	0.3382	0.6111	0.8230	0.9131	0.9449	(86)
MIT	18.7086	18.9084	19.3993	19.9503	20.4272	20.7460	20.8422	20.8320	20.6068	20.0245	19.3088	18.6897	(87)
Th 2	19.5121	19.5171	19.5222	19.5323	19.5323	19.5578	19.5476	19.5578	19.5578	19.5425	19.5476	19.5272	(88)
util rest of house	0.9282	0.9064	0.8499	0.7451	0.5831	0.3394	0.1322	0.1679	0.5000	0.7756	0.8941	0.9346	(89)
MIT 2	16.5836	16.8695	17.5650	18.3258	18.9406	19.3045	19.3586	19.3662	19.1829	18.4562	17.4624	16.5644	(90)
Living area fraction									fLA = Living area / (4) =			0.3295	(91)
MIT	17.2837	17.5412	18.1693	18.8610	19.4304	19.7794	19.8474	19.8491	19.6520	18.9729	18.0707	17.2647	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.2837	17.5412	18.1693	18.8610	19.4304	19.7794	19.8474	19.8491	19.6520	18.9729	18.0707	17.2647	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9049	0.8803	0.8213	0.7214	0.5770	0.3601	0.1686	0.2047	0.5084	0.7523	0.8681	0.9125	(94)
Useful gains	788.9382	869.5739	941.2531	965.1991	824.5467	530.7528	236.9341	267.5633	592.0619	736.0547	751.6809	751.1063	(95)
Ext temp.	5.4000	5.9000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.6000	12.1000	8.4000	5.4000	(96)
Heat loss rate W	2196.9755	2143.3672	1883.0243	1538.6789	1078.4719	584.0030	241.9788	275.8695	721.5928	1239.4968	1736.7753	2166.5963	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

Space heating kWh

	1047.5797	855.9891	700.6778	412.9055	188.9203	0.0000	0.0000	0.0000	0.0000	374.5610	709.2679	1053.1246 (98)
Space heating												5343.0260 (98)
Space heating per m2											(98) / (4) =	50.2968 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	175.1000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3051.4141 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1047.5797	855.9891	700.6778	412.9055	188.9203	0.0000	0.0000	0.0000	0.0000	374.5610	709.2679	1053.1246	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	598.2751	488.8573	400.1587	235.8112	107.8928	0.0000	0.0000	0.0000	0.0000	213.9126	405.0645	601.4418	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

Water heating requirement													
	202.8312	162.5242	142.6256	86.4944	54.3810	29.8871	25.4034	53.8346	86.7980	141.2534	176.9393	202.4504	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	115.8373	92.8180	81.4538	49.3971	31.0571	17.0686	14.5079	30.7451	49.5705	80.6701	101.0504	115.6199	(219)
Water heating fuel used												779.7958	(219)

Annual totals kWh/year	
Space heating fuel - main system	3051.4141 (211)
Space heating fuel - secondary	0.0000 (215)
Electricity for pumps and fans:	
(MEVDecentralised, Database: total watage = 12.8150, total flow = 37.0000, SFP = 0.3464)	
mechanical ventilation fans (SFP = 0.3464)	113.6721 (230a)
central heating pump	30.0000 (230c)
pump for solar water heating	50.0000 (230g)
Total electricity for the above, kWh/year	193.6721 (231)
Electricity for lighting (calculated in Appendix L)	422.8324 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV Unit 0 (0.80 * 2.50 * 1117 * 0.80) =	-1787.7948 -1787.7948 (233)
Total delivered energy for all uses	2659.9196 (238)

10a. Fuel costs - using BEDF prices (381)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3051.4141	15.0600	459.5430	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	779.7958	15.0600	117.4373	(247)
Mechanical ventilation fans	113.6721	15.0600	17.1190	(249)
Pumps and fans for heating	30.0000	15.0600	4.5180	(249)
Pump for solar water heating	50.0000	15.0600	7.5300	(249)
Energy for lighting	422.8324	15.0600	63.6786	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1787.7948	15.0600	-269.2419	(252)
Total energy cost			400.5839	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3051.4141	0.5190	1583.6839	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	779.7958	0.5190	404.7140	(264)
Space and water heating			1988.3979	(265)
Pumps and fans	193.6721	0.5190	100.5158	(267)
Energy for lighting	422.8324	0.5190	219.4500	(268)
Energy saving/generation technologies				
PV Unit	-1787.7948	0.5190	-927.8655	(269)
Total kg/year			1380.4983	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3051.4141	3.0700	9367.8412	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	779.7958	3.0700	2393.9733	(264)
Space and water heating			11761.8144	(265)
Pumps and fans	193.6721	3.0700	594.5733	(267)
Energy for lighting	422.8324	3.0700	1298.0954	(268)
Energy saving/generation technologies				
PV Unit	-1787.7948	3.0700	-5488.5299	(269)
Primary energy kWh/year			8165.9532	(272)

Primary energy kWh/m2/year 76.8705 (273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	355.10 (P1)
Transmission heat loss coefficient	130.23 (37)
Summer heat loss coefficient	485.33 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
East	1.000	0.90	1.000	0.900 (P8)
South	1.000	1.00	1.000	1.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	1.2000	81.1852	0.7200	0.7000	0.9000	39.7716
East	18.0000	117.5071	0.7200	0.7000	0.9000	863.4795
South	1.3100	203.0000	0.7200	0.7000	1.0000	120.6258
total:						1023.8770

	Jun	Jul	Aug	
Solar gains	1089	1024	895	(P3)
Internal gains	566	545	554	
Total summer gains	1654	1568	1449	(P5)
Summer gain/loss ratio	3.41	3.23	2.98	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	20.71	22.43	22.08	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	
Assessment of likelihood of high internal temperature:	Medium			