elmhurst energy



SAP Calculations

Client: Mildren Homes Ltd

Project: Dog Kennel Farm, Telegraph Road
West End, Hampshire, SO30 3EH

Contact: Scott Spearing
BEAT Solutions
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EXCELLENCE IN ENERGY ASSESSMENT

BEAT Solutions Ltd
Unit 2, Barley Business Park
Duncan Road, Park Gate
Southampton, Hampshire
SO31 1ZT

Property Reference: SAP-0704 Plot 11
Survey Reference: Rev C

Issued on Date: 05.Oct.2016
Prop Type Ref:

Property: Plot 11, Telegraph Road, West End, Southampton, Hampshire, SO30 3EH

SAP Rating:	89 B	**CO2 Emissions (t/year):**	1.79	**DER:**	11.26 Pass	**TER:**	15.42	**Percentage DER<TER:**	27.00 %
Environmental:	88 B	**General Requirements Compliance:**	Pass	**DFEE:**	59.11 Pass	**TFEE:**	62.25	**Percentage DFEE<TFEE:**	5.05 %

CfSH Results **Version:** November 2010 - June 2014 Addendum **ENE1 Credits:** 3.6 **ENE2 Credits:** 3.1 **ENE7 Credits:** 1 **CfSH Level:** 4

Surveyor:	Scott Spearing, Tel: 01489 565920	Surveyor ID:	A808-0004
Address:	Duncan Road, Park Gate, Southampton, Hampshire, SO31 1ZT		
Client:	Mildren Homes Ltd, MILDREN HOMES		

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.06r08
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

ENE 1 calculation

Total floor area	230.27 m2
DER	11.26 kgCO2/yr/m2
TER	15.42 kgCO2/yr/m2
CO2 emissions offset from additional allowable electricity generation	0.00 kgCO2/yr/m2 (ZC7)
Residual CO2 emissions offset from biofuel CHP	0.00 kgCO2/yr/m2 (ZC5)
Total CO2 emissions offset from SAP Section 16 allowances	0.00 kgCO2/yr/m2
DER accounting for SAP Section 16 allowances	11.26 kgCO2/yr/m2
% reduction DER/TER	27.00 %
CfSH ENE1 credits achieved	3.6
CfSH ENE1 level achieved	4

ENE 2 calculation

Dwelling type	House, Detached
Fabric energy efficiency (F.E.E.)	59.11
CfSH ENE2 credits achieved	3.1
CfSH ENE1 and 2 overall level achieved	4

ENE 7 calculation

Standard case CO2 emissions

Total floor area	230.27 m2	
DER	19.46 kgCO2/yr/m2	
CO2 emissions from electrical appliances	10.27 kgCO2/yr/m2	(ZC2)
CO2 emissions from cooking	0.83 kgCO2/yr/m2	(ZC3)
Standard case total CO2 emissions	30.56 kgCO2/yr/m2	(ZC4)
Net Standard case CO2 emissions	30.56 kgCO2/yr/m2	(ZC8)

Actual case CO2 emissions

DER	14.92 kgCO2/yr/m2	
CO2 emissions from electrical appliances	10.27 kgCO2/yr/m2	(ZC2)
CO2 emissions from cooking	0.83 kgCO2/yr/m2	(ZC3)
Actual case total CO2 emissions	26.02 kgCO2/yr/m2	(ZC4)
CO2 emissions from Biomass	0.00 kgCO2/yr/m2	(ZC5)
CO2 reduction from additional allowable electricity generation	0.00 kgCO2/yr/m2	(ZC7)
Net Actual case CO2 emissions	26.02 kgCO2/yr/m2	(ZC8)
% improvement in net actual/net standard case CO2 emissions	15 %	
ENE7 credits achieved	1	

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Unit 2, Barley Business Park
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Full SAP Calculation Printout

Property Reference: SAP-0704 Plot 11
Survey Reference: Rev C
Issued on Date: 05.Oct.2016
Prop Type Ref:

Property: Plot 11, Telegraph Road, West End, Southampton, Hampshire, SO30 3EH

SAP Rating:	89 B	**CO2 Emissions (t/year):**	1.79	**DER:**	11.26 Pass	**TER:**	15.42	**Percentage DER<TER:**	27.00 %
Environmental:	88 B	**General Requirements Compliance:**	Pass	**DFEE:**	59.11 Pass	**TFEE:**	62.25	**Percentage DFEE<TFEE:**	5.05 %

CfSH Results **Version:** November 2010 - June 2014 Addendum **ENE1 Credits:** 3.6 **ENE2 Credits:** 3.1 **ENE7 Credits:** 1 **CfSH Level:** 4

Surveyor: Scott Spearing, Tel: 01489 565920 Surveyor ID: A808-0004
Address: Duncan Road, Park Gate, Southampton, Hampshire, SO31 1ZT
Client: Mildren Homes Ltd, MILDREN HOMES

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.06r08
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

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


```
SAP2012 Input Data (House)     05/10/2016

FullRefNo:                     Rev C

Regs Region:                   England
SAP Region:                    Southern England
Postcode:                      SO30 3EH
DwellingOrientation:           North West
Property Type:                 House, Detached
Storeys:                       2
Date Built:                    2016
Sheltered Sides:               2
Sunlight Shade:                Average or unknown
Measurements                   Perimeter, Floor Area, Storey Height
    1st Storey:               41.33, 90.58, 2.7
    2nd Storey:               54.84, 139.69, 2.7
Living Area:                   59.71 m2, fraction: 25.9%
Thermal Mass:                  Precise calculation
External Walls                 Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall                  189.18, 254.97, 60, CavityWallPlasterOnDabsAACblock, Cavity, 0, 0.25, Gross
Retaining Wall                 22.62, 22.62, 60, CavityWallPlasterOnDabsAACblock, Cavity, 0, 0.25, Gross
Internal Walls                 Area, Kappa
Internal Wall - Timber         233.21, 9
External Roofs                 Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    Pitched Roof              52.51, 52.51, 9, Plasterboard, insulated at ceiling level, 0.16
    Flat Roof                 40.06, 40.06, 9, Plasterboard, insulated flat roof, 0.09
    Sloping Roof              45.93, 45.93, 9, Plasterboard, insulated slope, 0.16
Internal Ceilings              Area, Kappa, Construction, Element
    Internal Ceiling          90.58, 18, Plasterboard ceiling, carpeted chipboard floor
Heat Loss Floors               Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
    Heat Loss Floor           139.69, 75, Suspended concrete floor, carpeted, Ground Floor - Solid, 0, 0.12
Internal Floors                Area, Kappa, Construction, Element
    Internal Floor            90.58, 18, Plasterboard ceiling, carpeted chipboard floor
Description                    Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    External Doors            Manufacturer, Solid Door, , , , , , ,
    Windows                   Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    Front Door                Solid Door, External Wall, North West, , , , , 0, 0, 0, 1.95,
    Front Elevation           Window, External Wall, North West, , None, 0, , 0, 0, 0, 17.03,
    Rear Elevation            Window, External Wall, South East, , None, 0, , 0, 0, 0, 18.55,
    Side Elevation            Window, External Wall, North East, , None, 0, , 0, 0, 0, 11.87,
    Side Gable                Window, External Wall, North East, , None, 0, , 0, 0, 0, 1.28,
    Side Gable                Window, External Wall, South West, , None, 0, , 0, 0, 0, 1.28,
    Side Elevation            Window, External Wall, South West, , None, 0, , 0, 0, 0, 13.83,
Conservatory:                  None
Draught Proofing:              100
Draught Lobby:                 No
Thermal Bridges
    Bridging:                 Calculate Bridges
    Y                         0.07
    List of Bridges           Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
    0.                        External wall, E2 Other lintels (including other steel lintels), Table K1 - Approved, Yes, 37.57, 0.3, 0.3, 11.27,
    1.                        External wall, E3 Sill, Table K1 - Approved, Yes, 36.64, 0.04, 0.04, 1.47,
    2.                        External wall, E4 Jamb, Table K1 - Approved, No, 71.44, 0.05, 0.05, 3.57,
    3.                        External wall, E5 Ground floor (normal), Table K1 - Approved, Yes, 41.33, 0.16, 0.16, 6.61,
    4.                        External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 54.84, 0.07, 0.07, 3.84,
    5.                        External wall, E8 Balcony within a dwelling, wall insulation continuous, Table K1 - Approved, No, 4.51, 0, 0, 0.00,
    6.                        External wall, E10 Eaves (insulation at ceiling level), Table K1 - Approved, No, 12.43, 0.06, 0.06, 0.75,
    7.                        External wall, E11 Eaves (insulation at rafter level), Table K1 - Approved, No, 19.14, 0.04, 0.04, 0.77,
    8.                        External wall, E12 Gable (insulation at ceiling level), Table K1 - Approved, No, 12.71, 0.24, 0.24, 3.05,
    9.                        External wall, E13 Gable (insulation at rafter level), Table K1 - Approved, No, 9.6, 0.04, 0.04, 0.38,
    10.                       External wall, E15 Flat roof with parapet, Table K1 - Default, No, 9.28, 0.56, 0.56, 5.20,
    11.                       External wall, E16 Corner (normal), Table K1 - Approved, No, 42.6, 0.09, 0.09, 3.83,
    12.                       External wall, E17 Corner (inverted - internal area greater than external area), Table K1 - Approved, No, 22.8, -0.09, -0.09, -2.05,
Pressure Test:                 True
Designed q50:                  5
AsBuilt q50:                   15
Property Tested:               False
Mechanical Ventilation         None
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:             6
Passive Vents:                 0
```

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Flueless Gas Fires:           0
Cooling System                None
Light Fittings:               15
LEL Fittings:                 15
Percentage of LEL Fittings:   100
External Lights Fitted:       No
External LELs Fitted:         No
Electricity Tariff:           Standard
Main Heating 1
    Description               Gas Boiler
    Percentage                100
    Sedbuk ID                 17493
    Fuel Type                 Mains gas
    MHS                       Mains gas BGB Post 98 Regular condens. with auto ign.
    SAP Code                  102
    Boiler Efficiency Type    Split Efficiences
    Efficiency Winter         90
    Efficiency Summer         79.3
    Controls by PCDF          0
    MHS Controls              CBI Time and temperature zone control
    Boiler Interlock          Yes
    Compensator               0
    Delayed Start Stat        Yes
    Ctrl SAP Code             2110
    Flue Type                 Balanced
    Fan Assisted Flue         Yes
    Pumped                    Pump in heated space
    Heat Pump Age             2013 or later
    Heat Emitter              Radiators and Underfloor
    Flow Temperature          36° - 45°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
    SHS                       RWM - Wood Logs RWM Closed room heater
    SAP Code                  633
    Hetas Approved System     True
    Efficiency                65
Water Heating
    Type                      MainHeating1
    WHS                       HWP From main heating 1
    Low Water Usage           Yes
    SAP Code                  901
    Showers in Property       Non-electric only
    Hot Water Cylinder
    Cylinder Type             HotWaterCylinder
    Cylinder Insulation Type  MeasuredLoss
    Loss Factor               2.75
    Cylinder Volume           300.00
    Cylinder Stat             Yes
    Pipeworks Insulated       Fully insulated primary pipework
    Cylinder in Heated Space  Yes
    Separate Time Control     Yes
Flue Gas Heat Recovery System None
Waste Water Heat Recovery     none
PV Unit
Type                          One Dwelling
PVUnit 1                      Cells Peak = 1.89, Orientation = Horizontal, Elevation = Horizontal, Overshading = None Or Little, , Connected to Dwelling = Yes
PVUnit 2                      Cells Peak = 0.95, Orientation = Horizontal, Elevation = Horizontal, Overshading = Modest, , Connected to Dwelling = Yes
Wind Turbine                  None
Terrain Type:                 Urban
Small Scale Hydro             None
Special Features              None
```

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Detached House, total floor area 230 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:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.42 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.26 kg/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)62.2 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)59.1 kWh/m²OK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.14 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.41 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---

3 Air permeability
Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 30i System Compact ErP

Efficiency: 89.0% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: Room heaters - Wood Logs

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Closed room heater
Efficiency: 65%
Minimum: 65% OK

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5 Cylinder insulation
Hot water storage Measured cylinder loss: 2.75 kWh/day
Permitted by DBSCG 2.86 OK
Primary pipework insulated: Yes OK

---

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

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock Yes OK

---

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---

8 Mechanical ventilation
Not applicable

---

9 Summertime temperature
Overheating risk (Southern England): Not significant OK
Based on:
Overshading: Average
Windows facing North East: 13.15 m², No overhang
Windows facing South East: 18.55 m², No overhang
Windows facing South West: 15.11 m², No overhang
Windows facing North West: 17.03 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

---

10 Key features
Roof U-value 0.09 W/m²K
Floor U-value 0.12 W/m²K
Secondary heating (wood logs)
Secondary heating fuel: wood logs
Photovoltaic array

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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	90.5800 (1b)	x	2.7000 (2b)	=	244.5660	(1b) - (3b)
First floor	139.6900 (1c)	x	2.7000 (2c)	=	377.1630	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	230.2700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	621.7290	(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							6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.0965	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3465	(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) =	0.2945	(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	0.3755	0.3682	0.3608	0.3240	0.3166	0.2798	0.2798	0.2724	0.2945	0.3166	0.3313	0.3461	(22b)
Effective ac	0.5705	0.5678	0.5651	0.5525	0.5501	0.5391	0.5391	0.5371	0.5434	0.5501	0.5549	0.5599	(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	
External Doors			1.9500	1.8000	3.5100			(26)
Windows (Uw = 1.40)			63.8400	1.3258	84.6364			(27)
Heat Loss Floor			139.6900	0.1200	16.7628	75.0000	10476.7500	(28a)
External Wall	254.9700	65.7900	189.1800	0.2500	47.2950	60.0000	11350.8000	(29a)
Retaining Wall	22.6200		22.6200	0.2500	5.6550	60.0000	1357.2000	(29a)
Pitched Roof	52.5100		52.5100	0.1600	8.4016	9.0000	472.5900	(30)
Flat Roof	40.0600		40.0600	0.0900	3.6054	9.0000	360.5400	(30)
Sloping Roof	45.9300		45.9300	0.1600	7.3488	9.0000	413.3700	(30)
Total net area of external elements Aum(A, m2)			555.7800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		177.2150			(33)
Internal Wall - Timber			233.2100			9.0000	2098.8900	(32c)
Internal Floor			90.5800			18.0000	1630.4400	(32d)
Internal Ceiling			90.5800			18.0000	1630.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	29791.0200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		129.3743 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		38.6848 (36)
Total fabric heat loss	(33) + (36) =	215.8998 (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	117.0518	116.4900	115.9394	113.3531	112.8692	110.6166	110.6166	110.1995	111.4843	112.8692	113.8481	114.8715	(38)
Heat transfer coeff	332.9515	332.3898	331.8391	329.2529	328.7690	326.5164	326.5164	326.0993	327.3841	328.7690	329.7479	330.7713	(39)
Average = Sum(39)m / 12 =												329.2505	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4459	1.4435	1.4411	1.4299	1.4278	1.4180	1.4180	1.4162	1.4217	1.4278	1.4320	1.4364	(40)
HLP (average)												1.4298	(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	3.0413 (42)
Average daily hot water use (litres/day)	106.4304 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.0735	112.8162	108.5590	104.3018	100.0446	95.7874	95.7874	100.0446	104.3018	108.5590	112.8162	117.0735	(44)
Energy conte	173.6166	151.8462	156.6916	136.6076	131.0782	113.1105	104.8135	120.2751	121.7115	141.8430	154.8328	168.1384	(45)
Energy content (annual)											Total = Sum(45)m =	1674.5649	(45)
Distribution loss (46)m = 0.15 x (45)m	26.0425	22.7769	23.5037	20.4911	19.6617	16.9666	15.7220	18.0413	18.2567	21.2765	23.2249	25.2208	(46)

Water storage loss:	
Store volume	300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	2.7500 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	1.4850 (55)
Total storage loss	

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	46.0350	41.5800	46.0350	44.5500	46.0350	44.5500	46.0350	46.0350	44.5500	46.0350	44.5500	46.0350 (56)
If cylinder contains dedicated solar storage												
	46.0350	41.5800	46.0350	44.5500	46.0350	44.5500	46.0350	46.0350	44.5500	46.0350	44.5500	46.0350 (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												
	242.9140	214.4374	225.9890	203.6696	200.3756	180.1725	174.1109	189.5725	188.7735	211.1404	221.8948	237.4358 (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												
	242.9140	214.4374	225.9890	203.6696	200.3756	180.1725	174.1109	189.5725	188.7735	211.1404	221.8948	237.4358 (64)
								Total per year (kWh/year) = Sum(64)m =				2490.4859 (64)
Heat gains from water heating, kWh/month												
	113.1654	100.5618	107.5379	99.0716	99.0214	91.2588	90.2884	95.4294	94.1187	102.6007	105.1315	111.3439 (65)

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	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	35.5690	31.5921	25.6924	19.4508	14.5397	12.2750	13.2636	17.2405	23.1402	29.3818	34.2929	36.5576	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	398.9762	403.1163	392.6834	370.4728	342.4359	316.0852	298.4813	294.3412	304.7742	326.9848	355.0216	381.3723	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	(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)													
	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	(71)
Water heating gains (Table 5)													
	152.1041	149.6455	144.5402	137.5995	133.0933	126.7484	121.3554	128.2653	130.7204	137.9042	146.0160	149.6558	(72)
Total internal gains													
	658.2685	655.9732	634.5352	599.1423	561.6881	526.7279	504.7195	511.4662	530.2540	565.8900	606.9497	639.2050	(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	
Northeast	13.1500	11.2829	0.6300	0.7000	0.7700	45.3440	(75)
Southeast	18.5500	36.7938	0.6300	0.7000	0.7700	208.5887	(77)
Southwest	15.1100	36.7938	0.6300	0.7000	0.7700	169.9070	(79)
Northwest	17.0300	11.2829	0.6300	0.7000	0.7700	58.7231	(81)

Solar gains	482.5628	856.5498	1263.7847	1719.7878	2066.7761	2113.6184	2012.0403	1743.7252	1420.2122	971.4259	584.2940	408.8999	(83)
Total gains	1140.8313	1512.5230	1898.3198	2318.9301	2628.4642	2640.3463	2516.7598	2255.1914	1950.4662	1537.3159	1191.2437	1048.1048	(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	24.8543	24.8963	24.9376	25.1335	25.1705	25.3442	25.3442	25.3766	25.2770	25.1705	25.0958	25.0181	
alpha	2.6570	2.6598	2.6625	2.6756	2.6780	2.6896	2.6896	2.6918	2.6851	2.6780	2.6731	2.6679	
util living area													
	0.9881	0.9749	0.9474	0.8862	0.7806	0.6392	0.5088	0.5696	0.7797	0.9317	0.9797	0.9905	(86)
MIT	18.8826	19.1344	19.5268	20.0184	20.4400	20.7160	20.8286	20.8015	20.5621	19.9915	19.3397	18.8386	(87)
Th 2	19.7283	19.7302	19.7320	19.7405	19.7421	19.7496	19.7496	19.7510	19.7467	19.7421	19.7389	19.7355	(88)
util rest of house													
	0.9857	0.9697	0.9362	0.8610	0.7303	0.5521	0.3860	0.4464	0.7088	0.9114	0.9746	0.9885	(89)
MIT 2	16.9072	17.2739	17.8407	18.5413	19.1103	19.4532	19.5653	19.5472	19.2878	18.5210	17.5812	16.8479	(90)
Living area fraction										fLA = Living area / (4) =		0.2593	(91)
MIT	17.4194	17.7563	18.2779	18.9244	19.4551	19.7807	19.8929	19.8724	19.6182	18.9023	18.0372	17.3641	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2694	17.6063	18.1279	18.7744	19.3051	19.6307	19.7429	19.7224	19.4682	18.7523	17.8872	17.2141	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9784	0.9572	0.9170	0.8367	0.7097	0.5428	0.3853	0.4432	0.6897	0.8895	0.9636	0.9824	(94)
Useful gains	1116.2046	1447.7723	1740.6920	1940.3622	1865.3544	1433.0572	969.7035	999.5953	1345.1639	1367.3721	1147.9089	1029.7042	(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													
	4318.1901	4223.4535	3858.6018	3251.1588	2500.3131	1642.6024	1026.1962	1083.4382	1757.4590	2680.2379	3557.0402	4304.6810	(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													
	2382.2772	1865.2578	1575.7248	943.7735	472.4093	0.0000	0.0000	0.0000	0.0000	976.7721	1734.5745	2436.5828	(98)
Space heating												12387.3720	(98)
Space heating per m2											(98) / (4) =	53.7950	(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)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)

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Space heating requirement 12065.6221 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2382.2772	1865.2578	1575.7248	943.7735	472.4093	0.0000	0.0000	0.0000	0.0000	976.7721	1734.5745	2436.5828	(98)
Space heating efficiency (main heating system 1)													
	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)													
	2320.3998	1816.8095	1534.7969	919.2599	460.1389	0.0000	0.0000	0.0000	0.0000	951.4014	1689.5207	2373.2949	(211)
Water heating requirement													
	366.5042	286.9627	242.4192	145.1959	72.6784	0.0000	0.0000	0.0000	0.0000	150.2726	266.8576	374.8589	(215)

Water heating

Water heating requirement													
	242.9140	214.4374	225.9890	203.6696	200.3756	180.1725	174.1109	189.5725	188.7735	211.1404	221.8948	237.4358	(64)
Efficiency of water heater												79.3000	(216)
(217)m	88.7809	88.6452	88.3612	87.7111	86.2712	79.3000	79.3000	79.3000	79.3000	87.7081	88.5137	88.8290	(217)
Fuel for water heating, kWh/month													
	273.6106	241.9052	255.7559	232.2051	232.2623	227.2037	219.5598	239.0573	238.0498	240.7309	250.6898	267.2952	(219)
Water heating fuel used												2918.3258	(219)

Annual totals kWh/year
Space heating fuel - main system 12065.6221 (211)
Space heating fuel - secondary 1905.7495 (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) 628.1600 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.89 * 951 * 1.00) = -1437.3314 -2015.3059
PV Unit 1 (0.80 * 0.95 * 951 * 0.80) = -577.9745 -2015.3059 (233)
Total delivered energy for all uses 15577.5515 (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	12065.6221	0.2160	2606.1744	(261)
Space heating - secondary	1905.7495	0.0190	36.2092	(263)
Water heating (other fuel)	2918.3258	0.2160	630.3584	(264)
Space and water heating			3272.7420	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	628.1600	0.5190	326.0150	(268)
Energy saving/generation technologies				
PV Unit	-2015.3059	0.5190	-1045.9438	(269)
Total CO2, kg/year			2591.7383	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.2600	(273)

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

DER		11.2600	ZC1
Total Floor Area	TFA	230.2700	
Assumed number of occupants	N	3.0413	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		10.2673	ZC2
CO2 emissions from cooking, equation (L16)		0.8338	ZC3
Total CO2 emissions		22.3611	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		22.3611	ZC8

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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	90.5800 (1b)	x	2.7000 (2b)	=	244.5660	(1b) - (3b)
First floor	139.6900 (1c)	x	2.7000 (2c)	=	377.1630	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	230.2700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	621.7290	(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							6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.0965	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3465	(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) =	0.2945	(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	0.3755	0.3682	0.3608	0.3240	0.3166	0.2798	0.2798	0.2724	0.2945	0.3166	0.3313	0.3461	(22b)
Effective ac	0.5705	0.5678	0.5651	0.5525	0.5501	0.5391	0.5391	0.5371	0.5434	0.5501	0.5549	0.5599	(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	
External Doors			1.9500	1.8000	3.5100			(26)
Windows (Uw = 1.40)			63.8400	1.3258	84.6364			(27)
Heat Loss Floor			139.6900	0.1200	16.7628	75.0000	10476.7500	(28a)
External Wall	254.9700	65.7900	189.1800	0.2500	47.2950	60.0000	11350.8000	(29a)
Retaining Wall	22.6200		22.6200	0.2500	5.6550	60.0000	1357.2000	(29a)
Pitched Roof	52.5100		52.5100	0.1600	8.4016	9.0000	472.5900	(30)
Flat Roof	40.0600		40.0600	0.0900	3.6054	9.0000	360.5400	(30)
Sloping Roof	45.9300		45.9300	0.1600	7.3488	9.0000	413.3700	(30)
Total net area of external elements Aum(A, m2)			555.7800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		177.2150			(33)
Internal Wall - Timber			233.2100			9.0000	2098.8900	(32c)
Internal Floor			90.5800			18.0000	1630.4400	(32d)
Internal Ceiling			90.5800			18.0000	1630.4400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		29791.0200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							129.3743	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							38.6848	(36)
Total fabric heat loss					(33) + (36) =		215.8998	(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	117.0518	116.4900	115.9394	113.3531	112.8692	110.6166	110.6166	110.1995	111.4843	112.8692	113.8481	114.8715	(38)
Heat transfer coeff	332.9515	332.3898	331.8391	329.2529	328.7690	326.5164	326.5164	326.0993	327.3841	328.7690	329.7479	330.7713	(39)
Average = Sum(39)m / 12 =												329.2505	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4459	1.4435	1.4411	1.4299	1.4278	1.4180	1.4180	1.4162	1.4217	1.4278	1.4320	1.4364	(40)
HLP (average)												1.4298	(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		3.0413 (42)
Average daily hot water use (litres/day)		106.4304 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.0735	112.8162	108.5590	104.3018	100.0446	95.7874	95.7874	100.0446	104.3018	108.5590	112.8162	117.0735	(44)
Energy conte	173.6166	151.8462	156.6916	136.6076	131.0782	113.1105	104.8135	120.2751	121.7115	141.8430	154.8328	168.1384	(45)
Energy content (annual)											Total = Sum(45)m =	1674.5649	(45)
Distribution loss (46)m = 0.15 x (45)m	26.0425	22.7769	23.5037	20.4911	19.6617	16.9666	15.7220	18.0413	18.2567	21.2765	23.2249	25.2208	(46)

Water storage loss:		
Store volume		150.0000 (47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.0191 (51)
Volume factor from Table 2a		0.9283 (52)
Temperature factor from Table 2b		0.5400 (53)

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Enter (49) or (54) in (55) 1.4364 (55)
Total storage loss
44.5282 40.2190 44.5282 43.0918 44.5282 43.0918 44.5282 44.5282 43.0918 44.5282 43.0918 44.5282 (56)
If cylinder contains dedicated solar storage
44.5282 40.2190 44.5282 43.0918 44.5282 43.0918 44.5282 44.5282 43.0918 44.5282 43.0918 44.5282 (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
241.4072 213.0764 224.4822 202.2114 198.8688 178.7143 172.6041 188.0656 187.3153 209.6336 220.4366 235.9290 (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
241.4072 213.0764 224.4822 202.2114 198.8688 178.7143 172.6041 188.0656 187.3153 209.6336 220.4366 235.9290 (64)
Total per year (kWh/year) = Sum(64)m = 2472.7445 (64)
Heat gains from water heating, kWh/month
111.9600 99.4730 106.3324 97.9051 97.8160 90.0923 89.0830 94.2239 92.9521 101.3953 103.9649 110.1385 (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	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
35.5690 31.5921 25.6924 19.4508 14.5397 12.2750 13.2636 17.2405 23.1402 29.3818 34.2929 36.5576 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
398.9762 403.1163 392.6834 370.4728 342.4359 316.0852 298.4813 294.3412 304.7742 326.9848 355.0216 381.3723 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
38.2064 38.2064 38.2064 38.2064 38.2064 38.2064 38.2064 38.2064 38.2064 38.2064 38.2064 38.2064 (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)
-121.6512 -121.6512 -121.6512 -121.6512 -121.6512 -121.6512 -121.6512 -121.6512 -121.6512 -121.6512 -121.6512 -121.6512 (71)
Water heating gains (Table 5)
150.4838 148.0253 142.9199 135.9792 131.4731 125.1282 119.7352 126.6451 129.1002 136.2840 144.3957 148.0356 (72)
Total internal gains
656.6483 654.3530 632.9149 597.5220 560.0679 525.1076 503.0993 509.8460 528.6338 564.2698 605.3295 637.5847 (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	
Northeast	13.1500	11.2829	0.6300	0.7000	0.7700	45.3440	(75)
Southeast	18.5500	36.7938	0.6300	0.7000	0.7700	208.5887	(77)
Southwest	15.1100	36.7938	0.6300	0.7000	0.7700	169.9070	(79)
Northwest	17.0300	11.2829	0.6300	0.7000	0.7700	58.7231	(81)

Solar gains	482.5628	856.5498	1263.7847	1719.7878	2066.7761	2113.6184	2012.0403	1743.7252	1420.2122	971.4259	584.2940	408.8999	(83)
Total gains	1139.2111	1510.9028	1896.6996	2317.3099	2626.8440	2638.7261	2515.1396	2253.5712	1948.8460	1535.6957	1189.6235	1046.4846	(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	24.8543	24.8963	24.9376	25.1335	25.1705	25.3442	25.3442	25.3766	25.2770	25.1705	25.0958	25.0181	
alpha	2.6570	2.6598	2.6625	2.6756	2.6780	2.6896	2.6896	2.6918	2.6851	2.6780	2.6731	2.6679	
util living area	0.9882	0.9749	0.9475	0.8863	0.7808	0.6395	0.5090	0.5699	0.7800	0.9318	0.9797	0.9905	(86)
MIT	18.3104	18.6461	19.1692	19.8243	20.3865	20.7542	20.9044	20.8681	20.5489	19.7882	18.9191	18.2513	(87)
Th 2	19.7283	19.7302	19.7320	19.7405	19.7421	19.7496	19.7496	19.7510	19.7467	19.7421	19.7389	19.7355	(88)
util rest of house	0.9857	0.9697	0.9363	0.8612	0.7305	0.5523	0.3862	0.4467	0.7091	0.9115	0.9747	0.9886	(89)
MIT 2	17.2938	17.6277	18.1439	18.7819	19.3001	19.6127	19.7148	19.6983	19.4618	18.7634	17.9075	17.2399	(90)
Living area fraction									fLA = Living area / (4) =			0.2593	(91)
MIT	17.5574	17.8918	18.4097	19.0522	19.5818	19.9087	20.0233	20.0016	19.7437	19.0291	18.1699	17.5022	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.5574	17.8918	18.4097	19.0522	19.5818	19.9087	20.0233	20.0016	19.7437	19.0291	18.1699	17.5022	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9796	0.9593	0.9210	0.8444	0.7231	0.5645	0.4151	0.4737	0.7089	0.8964	0.9658	0.9834	(94)
Useful gains	1115.9238	1449.4455	1746.8191	1956.8103	1899.5702	1489.5844	1043.9366	1067.5203	1381.6068	1376.6529	1148.9124	1029.1056	(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	4414.0828	4318.3370	3952.1159	3342.6525	2591.3043	1733.3705	1117.7482	1174.4864	1847.6566	2771.2318	3650.2610	4399.9705	(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	2453.8302	1927.8951	1640.7408	997.8064	514.6501	0.0000	0.0000	0.0000	0.0000	1037.5667	1800.9709	2507.9235	(98)

Space heating 12881.3837 (98)
Space heating per m2 (98) / (4) = 55.9403 (99)

8c. Space cooling requirement

Not applicable

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES
DER 14.9200 ZC1
Total Floor Area TFA 230.2700
Assumed number of occupants N 3.0413
CO2 emission factor in Table 12 for electricity displaced from grid EF 0.5190
CO2 emissions from appliances, equation (L14) 10.2673 ZC2
CO2 emissions from cooking, equation (L16) 0.8338 ZC3

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Total CO2 emissions	26.0211	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	26.0211	ZC8

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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	90.5800 (1b)	x	2.7000 (2b)	=	244.5660 (1b) - (3b)	
First floor	139.6900 (1c)	x	2.7000 (2c)	=	377.1630 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	230.2700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	621.7290	(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) =	0.0643	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3143	(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) =	0.2672	(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	0.3407	0.3340	0.3273	0.2939	0.2872	0.2538	0.2538	0.2471	0.2672	0.2872	0.3006	0.3139	(22b)
Effective ac	0.5580	0.5558	0.5536	0.5432	0.5412	0.5322	0.5322	0.5305	0.5357	0.5412	0.5452	0.5493	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			55.6300	1.3258	73.7519			(27)
Heat Loss Floor			139.6900	0.1300	18.1597			(28a)
External Wall	254.9700	57.5800	197.3900	0.1800	35.5302			(29a)
Retaining Wall	22.6200		22.6200	0.1800	4.0716			(29a)
Pitched Roof	52.5100		52.5100	0.1300	6.8263			(30)
Flat Roof	40.0600		40.0600	0.1300	5.2078			(30)
Sloping Roof	45.9300		45.9300	0.1300	5.9709			(30)
Total net area of external elements Aum(A, m2)			555.7800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		151.4684			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.9161 (36)
Total fabric heat loss	(33) + (36) =	175.3845 (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	114.4904	114.0281	113.5750	111.4466	111.0484	109.1947	109.1947	108.8514	109.9087	111.0484	111.8540	112.6962	(38)
Heat transfer coeff	289.8749	289.4126	288.9595	286.8311	286.4329	284.5792	284.5792	284.2359	285.2932	286.4329	287.2385	288.0807	(39)
Average = Sum(39)m / 12 =												286.8292	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2588	1.2568	1.2549	1.2456	1.2439	1.2358	1.2358	1.2344	1.2390	1.2439	1.2474	1.2511	(40)
HLP (average)												1.2456	(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	3.0413 (42)
Average daily hot water use (litres/day)	106.4304 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.0735	112.8162	108.5590	104.3018	100.0446	95.7874	95.7874	100.0446	104.3018	108.5590	112.8162	117.0735	(44)
Energy conte	173.6166	151.8462	156.6916	136.6076	131.0782	113.1105	104.8135	120.2751	121.7115	141.8430	154.8328	168.1384	(45)
Energy content (annual)										Total = Sum(45)m =		1674.5649	(45)
Distribution loss (46)m = 0.15 x (45)m	26.0425	22.7769	23.5037	20.4911	19.6617	16.9666	15.7220	18.0413	18.2567	21.2765	23.2249	25.2208	(46)

Water storage loss:	
Store volume	300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	2.1127 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	1.1409 (55)

Total storage loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(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)

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Total heat required for water heating calculated for each month

	232.2454	204.8012	215.3204	193.3451	189.7070	169.8481	163.4423	178.9039	178.4491	200.4719	211.5703	226.7672 (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

	232.2454	204.8012	215.3204	193.3451	189.7070	169.8481	163.4423	178.9039	178.4491	200.4719	211.5703	226.7672 (64)

Total per year (kWh/year) = Sum(64)m = 2364.8719 (64)

Heat gains from water heating, kWh/month

	104.6306	92.8529	99.0030	90.8121	90.4866	82.9993	81.7535	86.8945	85.8591	94.0659	96.8719	102.8091 (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	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	(66)

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

	35.5690	31.5921	25.6924	19.4508	14.5397	12.2750	13.2636	17.2405	23.1402	29.3818	34.2929	36.5576 (67)

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

	398.9762	403.1163	392.6834	370.4728	342.4359	316.0852	298.4813	294.3412	304.7742	326.9848	355.0216	381.3723 (68)

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

	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064 (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)

	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512 (71)

Water heating gains (Table 5)

	140.6325	138.1739	133.0686	126.1279	121.6217	115.2768	109.8838	116.7937	119.2488	126.4326	134.5444	138.1842 (72)

Total internal gains

	646.7969	644.5016	623.0636	587.6707	550.2165	515.2563	493.2479	499.9946	518.7824	554.4184	595.4781	627.7334 (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	
Northeast	11.4600	11.2829	0.6300	0.7000	0.7700	39.5165	(75)
Southeast	16.1700	36.7938	0.6300	0.7000	0.7700	181.8264	(77)
Southwest	13.1700	36.7938	0.6300	0.7000	0.7700	148.0924	(79)
Northwest	14.8300	11.2829	0.6300	0.7000	0.7700	51.1370	(81)

Solar gains	420.5723	746.5015	1101.3774	1498.7210	1801.0571	1841.8569	1753.3475	1519.5624	1237.6827	846.6083	509.2322	356.3739 (83)
Total gains	1067.3692	1391.0031	1724.4410	2086.3917	2351.2737	2357.1132	2246.5954	2019.5571	1756.4651	1401.0267	1104.7103	984.1073 (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	55.1651	55.2532	55.3398	55.7505	55.8280	56.1917	56.1917	56.2595	56.0510	55.8280	55.6714	55.5087	
alpha	4.6777	4.6835	4.6893	4.7167	4.7219	4.7461	4.7461	4.7506	4.7367	4.7219	4.7114	4.7006	
util living area	0.9993	0.9976	0.9908	0.9617	0.8725	0.7058	0.5414	0.6159	0.8692	0.9848	0.9983	0.9996	(86)
MIT	19.4906	19.6910	20.0069	20.4131	20.7544	20.9367	20.9856	20.9744	20.8227	20.3587	19.8419	19.4557	(87)
Th 2	19.8732	19.8748	19.8764	19.8837	19.8850	19.8914	19.8914	19.8926	19.8890	19.8850	19.8823	19.8794	(88)
util rest of house	0.9991	0.9967	0.9873	0.9466	0.8240	0.6091	0.4131	0.4828	0.7993	0.9765	0.9976	0.9994	(89)
MIT 2	17.8536	18.1477	18.6087	19.1935	19.6460	19.8501	19.8863	19.8823	19.7434	19.1265	18.3741	17.8068	(90)
Living area fraction									fLA = Living area / (4) =			0.2593	(91)
MIT	18.2781	18.5479	18.9712	19.5097	19.9335	20.1319	20.1714	20.1655	20.0233	19.4460	18.7547	18.2344	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2781	18.5479	18.9712	19.5097	19.9335	20.1319	20.1714	20.1655	20.0233	19.4460	18.7547	18.2344	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9986	0.9951	0.9833	0.9401	0.8265	0.6317	0.4466	0.5174	0.8094	0.9718	0.9964	0.9990	(94)
Useful gains	1065.8354	1384.1937	1695.6374	1961.3676	1943.2482	1488.8909	1003.3068	1044.9861	1421.6030	1361.5220	1100.7148	983.1357	(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	4051.9013	3949.8675	3603.6833	3043.2029	2358.3314	1574.2641	1016.3422	1070.2807	1689.8741	2533.7962	3347.6798	4043.0319	(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	2221.6331	1724.1328	1419.5862	778.9214	308.8219	0.0000	0.0000	0.0000	0.0000	872.1720	1617.8148	2276.5628	(98)

Space heating 11219.6448 (98)

Space heating per m2 (98) / (4) = 48.7239 (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 11999.6201 (211)

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

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	2221.6331	1724.1328	1419.5862	778.9214	308.8219	0.0000	0.0000	0.0000	0.0000	872.1720	1617.8148	2276.5628 (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)												
	2376.0781	1843.9923	1518.2740	833.0710	330.2908	0.0000	0.0000	0.0000	0.0000	932.8042	1730.2832	2434.8265 (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

	232.2454	204.8012	215.3204	193.3451	189.7070	169.8481	163.4423	178.9039	178.4491	200.4719	211.5703	226.7672 (64)
Efficiency of water heater												79.8000 (216)
(217)m	89.3659	89.2297	88.9296	88.1496	86.1065	79.8000	79.8000	79.8000	79.8000	88.2875	89.1180	89.4140 (217)
Fuel for water heating, kWh/month												
	259.8814	229.5213	242.1247	219.3376	220.3167	212.8422	204.8150	224.1903	223.6204	227.0670	237.4046	253.6150 (219)
Water heating fuel used												2754.7362 (219)
Annual totals kWh/year												
Space heating fuel - main system												11999.6201 (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)	628.1600 (232)
Total delivered energy for all uses	15457.5164 (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	11999.6201	0.2160	2591.9179 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2754.7362	0.2160	595.0230 (264)
Space and water heating			3186.9410 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	628.1600	0.5190	326.0150 (268)
Total CO2, kg/m2/year			3551.8810 (272)
Emissions per m2 for space and water heating			13.8400 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.4158 (272b)
Emissions per m2 for pumps and fans			0.1690 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.8400 * 1.00) + 1.4158 + 0.1690, rounded to 2 d.p.			15.4200 (273)

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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	90.5800 (1b)	x	2.7000 (2b)	=	244.5660 (1b) - (3b)	
First floor	139.6900 (1c)	x	2.7000 (2c)	=	377.1630 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	230.2700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	621.7290	(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) =	0.0643	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3143	(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) =	0.2672	(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	0.3407	0.3340	0.3273	0.2939	0.2872	0.2538	0.2538	0.2471	0.2672	0.2872	0.3006	0.3139	(22b)
Effective ac	0.5580	0.5558	0.5536	0.5432	0.5412	0.5322	0.5322	0.5305	0.5357	0.5412	0.5452	0.5493	(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	
External Doors			1.9500	1.8000	3.5100			(26)
Windows (Uw = 1.40)			63.8400	1.3258	84.6364			(27)
Heat Loss Floor			139.6900	0.1200	16.7628	75.0000	10476.7500	(28a)
External Wall	254.9700	65.7900	189.1800	0.2500	47.2950	60.0000	11350.8000	(29a)
Retaining Wall	22.6200		22.6200	0.2500	5.6550	60.0000	1357.2000	(29a)
Pitched Roof	52.5100		52.5100	0.1600	8.4016	9.0000	472.5900	(30)
Flat Roof	40.0600		40.0600	0.0900	3.6054	9.0000	360.5400	(30)
Sloping Roof	45.9300		45.9300	0.1600	7.3488	9.0000	413.3700	(30)
Total net area of external elements Aum(A, m2)			555.7800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		177.2150			(33)
Internal Wall - Timber			233.2100			9.0000	2098.8900	(32c)
Internal Floor			90.5800			18.0000	1630.4400	(32d)
Internal Ceiling			90.5800			9.0000	815.2200	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		28975.8000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							125.8340	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							38.6848	(36)
Total fabric heat loss					(33) + (36) =		215.8998	(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	114.4904	114.0281	113.5750	111.4466	111.0484	109.1947	109.1947	108.8514	109.9087	111.0484	111.8540	112.6962	(38)
Heat transfer coeff	330.3902	329.9279	329.4747	327.3464	326.9482	325.0944	325.0944	324.7511	325.8085	326.9482	327.7537	328.5959	(39)
Average = Sum(39)m / 12 =												327.3445	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4348	1.4328	1.4308	1.4216	1.4198	1.4118	1.4118	1.4103	1.4149	1.4198	1.4233	1.4270	(40)
HLP (average)												1.4216	(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		3.0413 (42)
Average daily hot water use (litres/day)		106.4304 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.0735	112.8162	108.5590	104.3018	100.0446	95.7874	95.7874	100.0446	104.3018	108.5590	112.8162	117.0735	(44)
Energy conte	173.6166	151.8462	156.6916	136.6076	131.0782	113.1105	104.8135	120.2751	121.7115	141.8430	154.8328	168.1384	(45)
Energy content (annual)											Total = Sum(45)m =	1674.5649	(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)

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Heat gains from water heating, kWh/month

36.8935	32.2673	33.2970	29.0291	27.8541	24.0360	22.2729	25.5584	25.8637	30.1416	32.9020	35.7294 (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	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	(66)

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

	35.5690	31.5921	25.6924	19.4508	14.5397	12.2750	13.2636	17.2405	23.1402	29.3818	34.2929	36.5576	(67)

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

	398.9762	403.1163	392.6834	370.4728	342.4359	316.0852	298.4813	294.3412	304.7742	326.9848	355.0216	381.3723	(68)

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

	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	(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)

	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	(71)

Water heating gains (Table 5)

	49.5881	48.0168	44.7540	40.3182	37.4383	33.3833	29.9367	34.3528	35.9218	40.5130	45.6972	48.0234	(72)

Total internal gains

	552.7525	551.3445	531.7490	498.8610	463.0332	430.3628	410.3008	414.5537	432.4554	465.4988	503.6309	534.5725	(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	
Northeast	13.1500	11.2829	0.6300	0.7000	0.7700	45.3440	(75)
Southeast	18.5500	36.7938	0.6300	0.7000	0.7700	208.5887	(77)
Southwest	15.1100	36.7938	0.6300	0.7000	0.7700	169.9070	(79)
Northwest	17.0300	11.2829	0.6300	0.7000	0.7700	58.7231	(81)

Solar gains	482.5628	856.5498	1263.7847	1719.7878	2066.7761	2113.6184	2012.0403	1743.7252	1420.2122	971.4259	584.2940	408.8999	(83)
Total gains	1035.3153	1407.8943	1795.5337	2218.6488	2529.8092	2543.9812	2422.3411	2158.2789	1852.6676	1436.9247	1087.9249	943.4724	(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	24.3616	24.3957	24.4293	24.5881	24.6181	24.7584	24.7584	24.7846	24.7042	24.6181	24.5576	24.4946	
alpha	2.6241	2.6264	2.6286	2.6392	2.6412	2.6506	2.6506	2.6523	2.6469	2.6412	2.6372	2.6330	
util living area	0.9899	0.9773	0.9509	0.8916	0.7883	0.6497	0.5204	0.5835	0.7917	0.9379	0.9825	0.9921	(86)
MIT	18.2205	18.5637	19.0986	19.7688	20.3499	20.7337	20.8943	20.8540	20.5140	19.7249	18.8359	18.1576	(87)
Th 2	19.7368	19.7383	19.7398	19.7468	19.7482	19.7543	19.7543	19.7554	19.7519	19.7482	19.7455	19.7427	(88)
util rest of house	0.9878	0.9727	0.9406	0.8676	0.7395	0.5636	0.3972	0.4604	0.7236	0.9195	0.9782	0.9904	(89)
MIT 2	17.2142	17.5556	18.0840	18.7374	19.2756	19.6038	19.7149	19.6957	19.4403	18.7108	17.8337	17.1555	(90)
Living area fraction										fLA = Living area / (4) =		0.2593	(91)
MIT	17.4751	17.8170	18.3471	19.0048	19.5542	19.8968	20.0207	19.9960	19.7187	18.9738	18.0935	17.4154	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4751	17.8170	18.3471	19.0048	19.5542	19.8968	20.0207	19.9960	19.7187	18.9738	18.0935	17.4154	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9823	0.9628	0.9254	0.8502	0.7308	0.5745	0.4256	0.4866	0.7214	0.9043	0.9699	0.9859	(94)
Useful gains	1016.9994	1355.5355	1661.6093	1886.3672	1848.6979	1461.5399	1030.9231	1050.2220	1336.5928	1299.3719	1055.2249	930.1572	(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	4352.9314	4261.6746	3903.3311	3307.7817	2567.9171	1721.9504	1112.0493	1167.8098	1830.6352	2737.7964	3603.1762	4342.5193	(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	2481.9334	1952.9254	1667.8410	1023.4184	535.0991	0.0000	0.0000	0.0000	0.0000	1070.1878	1834.5249	2538.7974	(98)
Space heating												13104.7276	(98)
Space heating per m2											(98) / (4) =	56.9103	(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	3055.8876	2405.6987	2468.1087	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7340	0.7982	0.7544	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2242.8877	1920.3306	1861.8266	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3123.4176	2977.4402	2672.0043	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	633.9815	786.4895	602.7722	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												2023.2432	(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	158.4954	196.6224	150.6931	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												505.8108	(107)
Space cooling per m2												2.1966	(108)
Energy for space heating												56.9103	(99)
Energy for space cooling												2.1966	(108)
Total												59.1069	(109)

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Dwelling Fabric Energy Efficiency (DFEE) 59.1 (109)

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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	90.5800 (1b)	x	2.7000 (2b)	=	244.5660 (1b) - (3b)	
First floor	139.6900 (1c)	x	2.7000 (2c)	=	377.1630 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	230.2700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		621.7290	(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) =	0.0643	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3143	(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) =	0.2672	(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	0.3407	0.3340	0.3273	0.2939	0.2872	0.2538	0.2538	0.2471	0.2672	0.2872	0.3006	0.3139	(22b)
Effective ac	0.5580	0.5558	0.5536	0.5432	0.5412	0.5322	0.5322	0.5305	0.5357	0.5412	0.5452	0.5493	(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			1.9500	1.0000	1.9500			(26)
TER Opening Type (Uw = 1.40)			55.6300	1.3258	73.7519			(27)
Heat Loss Floor			139.6900	0.1300	18.1597			(28a)
External Wall	254.9700	57.5800	197.3900	0.1800	35.5302			(29a)
Retaining Wall	22.6200		22.6200	0.1800	4.0716			(29a)
Pitched Roof	52.5100		52.5100	0.1300	6.8263			(30)
Flat Roof	40.0600		40.0600	0.1300	5.2078			(30)
Sloping Roof	45.9300		45.9300	0.1300	5.9709			(30)
Total net area of external elements Aum(A, m2)			555.7800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		151.4684			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.9161 (36)
Total fabric heat loss	(33) + (36) =	175.3845 (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	114.4904	114.0281	113.5750	111.4466	111.0484	109.1947	109.1947	108.8514	109.9087	111.0484	111.8540	112.6962	(38)
Heat transfer coeff	289.8749	289.4126	288.9595	286.8311	286.4329	284.5792	284.5792	284.2359	285.2932	286.4329	287.2385	288.0807	(39)
Average = Sum(39)m / 12 =												286.8292	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2588	1.2568	1.2549	1.2456	1.2439	1.2358	1.2358	1.2344	1.2390	1.2439	1.2474	1.2511	(40)
HLP (average)												1.2456	(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	3.0413 (42)
Average daily hot water use (litres/day)	106.4304 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.0735	112.8162	108.5590	104.3018	100.0446	95.7874	95.7874	100.0446	104.3018	108.5590	112.8162	117.0735	(44)
Energy conte	173.6166	151.8462	156.6916	136.6076	131.0782	113.1105	104.8135	120.2751	121.7115	141.8430	154.8328	168.1384	(45)
Energy content (annual)										Total = Sum(45)m =		1674.5649	(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	36.8935	32.2673	33.2970	29.0291	27.8541	24.0360	22.2729	25.5584	25.8637	30.1416	32.9020	35.7294	(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	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	152.0640	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	35.5690	31.5921	25.6924	19.4508	14.5397	12.2750	13.2636	17.2405	23.1402	29.3818	34.2929	36.5576	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	398.9762	403.1163	392.6834	370.4728	342.4359	316.0852	298.4813	294.3412	304.7742	326.9848	355.0216	381.3723	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	38.2064	(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)													
	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	(71)
Water heating gains (Table 5)													
	49.5881	48.0168	44.7540	40.3182	37.4383	33.3833	29.9367	34.3528	35.9218	40.5130	45.6972	48.0234	(72)
Total internal gains													
	552.7525	551.3445	531.7490	498.8610	463.0332	430.3628	410.3008	414.5537	432.4554	465.4988	503.6309	534.5725	(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	
Northeast	11.4600	11.2829	0.6300	0.7000	0.7700	39.5165	(75)
Southeast	16.1700	36.7938	0.6300	0.7000	0.7700	181.8264	(77)
Southwest	13.1700	36.7938	0.6300	0.7000	0.7700	148.0924	(79)
Northwest	14.8300	11.2829	0.6300	0.7000	0.7700	51.1370	(81)

Solar gains	420.5723	746.5015	1101.3774	1498.7210	1801.0571	1841.8569	1753.3475	1519.5624	1237.6827	846.6083	509.2322	356.3739	(83)
Total gains	973.3248	1297.8460	1633.1264	1997.5820	2264.0903	2272.2197	2163.6483	1934.1162	1670.1381	1312.1071	1012.8631	890.9464	(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	55.1651	55.2532	55.3398	55.7505	55.8280	56.1917	56.1917	56.2595	56.0510	55.8280	55.6714	55.5087	
alpha	4.6777	4.6835	4.6893	4.7167	4.7219	4.7461	4.7461	4.7506	4.7367	4.7219	4.7114	4.7006	
util living area													
	0.9996	0.9982	0.9926	0.9673	0.8850	0.7242	0.5597	0.6379	0.8860	0.9882	0.9988	0.9997	(86)
MIT	19.4531	19.6542	19.9719	20.3833	20.7353	20.9294	20.9835	20.9704	20.8039	20.3254	19.8054	19.4185	(87)
Th 2	19.8732	19.8748	19.8764	19.8837	19.8850	19.8914	19.8914	19.8926	19.8890	19.8850	19.8823	19.8794	(88)
util rest of house													
	0.9994	0.9975	0.9898	0.9539	0.8393	0.6277	0.4283	0.5025	0.8210	0.9817	0.9983	0.9996	(89)
MIT 2	18.4569	18.6589	18.9764	19.3846	19.7069	19.8595	19.8874	19.8843	19.7765	19.3351	18.8161	18.4271	(90)
Living area fraction										fLA = Living area / (4) =		0.2593	(91)
MIT	18.7152	18.9170	19.2345	19.6436	19.9736	20.1369	20.1716	20.1659	20.0429	19.5919	19.0727	18.6842	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7152	18.9170	19.2345	19.6436	19.9736	20.1369	20.1716	20.1659	20.0429	19.5919	19.0727	18.6842	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9992	0.9967	0.9876	0.9503	0.8435	0.6508	0.4628	0.5381	0.8318	0.9793	0.9978	0.9994	(94)
Useful gains	972.5057	1293.5966	1612.7962	1898.3160	1909.7996	1478.8739	1001.2717	1040.6515	1389.2849	1284.8888	1010.6077	890.4526	(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													
	4178.6022	4056.6871	3679.7584	3081.5914	2369.8269	1575.6904	1016.4050	1070.4052	1695.4598	2575.5704	3439.0082	4172.6089	(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													
	2385.3358	1856.7968	1537.8199	851.9583	342.2603	0.0000	0.0000	0.0000	0.0000	960.2671	1748.4483	2441.9243	(98)
Space heating												12124.8109	(98)
Space heating per m2											(98) / (4) =	52.6548	(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	2675.0440	2105.8857	2160.1926	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8451	0.9085	0.8680	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2260.6010	1913.1954	1875.1124	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2805.7742	2675.0720	2409.9959	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	392.5248	566.8362	397.9533	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1357.3142	(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	98.1312	141.7090	99.4883	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												339.3286	(107)
Space cooling per m2												1.4736	(108)
Energy for space heating												52.6548	(99)
Energy for space cooling												1.4736	(108)
Total												54.1284	(109)
Target Fabric Energy Efficiency (TFEE)												62.2	(109)

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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	90.5800 (1b)	x	2.7000 (2b)	=	244.5660 (1b) - (3b)	
First floor	139.6900 (1c)	x	2.7000 (2c)	=	377.1630 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	230.2700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		621.7290	(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							6 * 10 =		60.0000	(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) =	60.0000 / (5) =	0.0965	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3465	(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) =	0.2945	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.7000	4.4000	4.4000	4.0000	4.1000	3.9000	3.9000	3.8000	3.8000	4.1000	4.0000	4.1000	(22)
Wind factor	1.1750	1.1000	1.1000	1.0000	1.0250	0.9750	0.9750	0.9500	0.9500	1.0250	1.0000	1.0250	(22a)
Adj infilt rate	0.3461	0.3240	0.3240	0.2945	0.3019	0.2872	0.2872	0.2798	0.2798	0.3019	0.2945	0.3019	(22b)
Effective ac	0.5599	0.5525	0.5525	0.5434	0.5456	0.5412	0.5412	0.5391	0.5391	0.5456	0.5434	0.5456	(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	
External Doors			1.9500	1.8000	3.5100			(26)
Windows (Uw = 1.40)			63.8400	1.3258	84.6364			(27)
Heat Loss Floor			139.6900	0.1200	16.7628	75.0000	10476.7500	(28a)
External Wall	254.9700	65.7900	189.1800	0.2500	47.2950	60.0000	11350.8000	(29a)
Retaining Wall	22.6200		22.6200	0.2500	5.6550	60.0000	1357.2000	(29a)
Pitched Roof	52.5100		52.5100	0.1600	8.4016	9.0000	472.5900	(30)
Flat Roof	40.0600		40.0600	0.0900	3.6054	9.0000	360.5400	(30)
Sloping Roof	45.9300		45.9300	0.1600	7.3488	9.0000	413.3700	(30)
Total net area of external elements Aum(A, m2)			555.7800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		177.2150			(33)
Internal Wall - Timber			233.2100			9.0000	2098.8900	(32c)
Internal Floor			90.5800			18.0000	1630.4400	(32d)
Internal Ceiling			90.5800			18.0000	1630.4400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		29791.0200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							129.3743	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							38.6848	(36)
Total fabric heat loss					(33) + (36) =		215.8998	(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	114.8715	113.3531	113.3531	111.4843	111.9348	111.0449	111.0449	110.6166	110.6166	111.9348	111.4843	111.9348	(38)
Heat transfer coeff	330.7713	329.2529	329.2529	327.3841	327.8346	326.9447	326.9447	326.5164	326.5164	327.8346	327.3841	327.8346	(39)

Average = Sum(39)m / 12 = 327.8726 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4364	1.4299	1.4299	1.4217	1.4237	1.4198	1.4198	1.4180	1.4180	1.4237	1.4217	1.4237	(40)
HLP (average)												1.4239	(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 3.0413 (42)
Average daily hot water use (litres/day) 106.4304 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.0735	112.8162	108.5590	104.3018	100.0446	95.7874	95.7874	100.0446	104.3018	108.5590	112.8162	117.0735	(44)
Energy conte	173.6166	151.8462	156.6916	136.6076	131.0782	113.1105	104.8135	120.2751	121.7115	141.8430	154.8328	168.1384	(45)
Energy content (annual)											Total = Sum(45)m =	1674.5649	(45)
Distribution loss (46)m = 0.15 x (45)m	26.0425	22.7769	23.5037	20.4911	19.6617	16.9666	15.7220	18.0413	18.2567	21.2765	23.2249	25.2208	(46)

Water storage loss:
Store volume 300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.7500 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.4850 (55)
Total storage loss

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	46.0350	41.5800	46.0350	44.5500	46.0350	44.5500	46.0350	46.0350	44.5500	46.0350	44.5500	46.0350 (56)
If cylinder contains dedicated solar storage												
	46.0350	41.5800	46.0350	44.5500	46.0350	44.5500	46.0350	46.0350	44.5500	46.0350	44.5500	46.0350 (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												
	242.9140	214.4374	225.9890	203.6696	200.3756	180.1725	174.1109	189.5725	188.7735	211.1404	221.8948	237.4358 (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												
	242.9140	214.4374	225.9890	203.6696	200.3756	180.1725	174.1109	189.5725	188.7735	211.1404	221.8948	237.4358 (64)
								Total per year (kWh/year) = Sum(64)m =				2490.4859 (64)
RHI water heating demand												2490 (64)
Heat gains from water heating, kWh/month												
	113.1654	100.5618	107.5379	99.0716	99.0214	91.2588	90.2884	95.4294	94.1187	102.6007	105.1315	111.3439 (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	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	88.9226	78.9802	64.2310	48.6270	36.3493	30.6876	33.1590	43.1013	57.8505	73.4545	85.7323	91.3940	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	595.4869	601.6662	586.0946	552.9445	511.0984	471.7690	445.4945	439.3152	454.8868	488.0370	529.8830	569.2124	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	(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)													
	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	(71)
Water heating gains (Table 5)													
	152.1041	149.6455	144.5402	137.5995	133.0933	126.7484	121.3554	128.2653	130.7204	137.9042	146.0160	149.6558	(72)
Total internal gains													
	956.6281	950.4065	914.9804	859.2855	800.6555	749.3195	720.1235	730.7964	763.5723	819.5103	881.7459	930.3768	(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	
Northeast	13.1500	14.6130	0.6300	0.7000	0.7700	58.7270	(75)
Southeast	18.5500	45.0642	0.6300	0.7000	0.7700	255.4743	(77)
Southwest	15.1100	45.0642	0.6300	0.7000	0.7700	208.0979	(79)
Northwest	17.0300	14.6130	0.6300	0.7000	0.7700	76.0549	(81)

Solar gains	598.3541	907.0305	1370.6078	1884.2791	2138.0158	2421.4558	2213.9925	1997.5766	1616.7125	1112.3324	722.7672	479.5818 (83)
Total gains	1554.9822	1857.4371	2285.5882	2743.5647	2938.6714	3170.7753	2934.1160	2728.3731	2380.2848	1931.8427	1604.5130	1409.9586 (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	25.0181	25.1335	25.1335	25.2770	25.2423	25.3110	25.3110	25.3442	25.3442	25.2423	25.2770	25.2423	
alpha	2.6679	2.6756	2.6756	2.6851	2.6828	2.6874	2.6874	2.6896	2.6896	2.6828	2.6851	2.6828	
util living area													
	0.9703	0.9531	0.9089	0.8161	0.6810	0.4770	0.3515	0.3645	0.6273	0.8569	0.9483	0.9759	(86)
MIT	19.2645	19.4522	19.8331	20.2913	20.6306	20.8291	20.8784	20.8772	20.7466	20.3223	19.7380	19.2342	(87)
Th 2	19.7355	19.7405	19.7405	19.7467	19.7452	19.7482	19.7482	19.7496	19.7496	19.7452	19.7467	19.7452	(88)
util rest of house													
	0.9640	0.9434	0.8899	0.7777	0.6127	0.3761	0.2249	0.2297	0.5262	0.8151	0.9352	0.9706	(89)
MIT 2	17.4664	17.7389	18.2799	18.9132	19.3454	19.5580	19.5953	19.5969	19.4908	18.9743	18.1593	17.4297	(90)
Living area fraction									fLA = Living area / (4) =			0.2593	(91)
MIT	17.9326	18.1832	18.6827	19.2706	19.6786	19.8876	19.9280	19.9289	19.8164	19.3238	18.5687	17.8977	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7826	18.0332	18.5327	19.1206	19.5286	19.7376	19.7780	19.7789	19.6664	19.1738	18.4187	17.7477	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9501	0.9254	0.8666	0.7549	0.5994	0.3752	0.2280	0.2330	0.5185	0.7911	0.9160	0.9585	(94)
Useful gains	1477.3377	1718.8899	1980.6581	2071.0543	1761.4865	1189.7863	669.1156	635.8428	1234.2940	1528.3705	1469.7145	1351.4584	(95)
Ext temp.	5.6000	6.0000	7.6000	10.1000	13.1000	15.9000	17.7000	17.8000	15.4000	12.1000	8.6000	5.7000	(96)
Heat loss rate W													
	4029.6602	3961.9510	3599.6126	2953.1886	2107.5279	1254.6825	679.4024	646.1353	1393.0613	2319.0375	3214.4751	3949.6399	(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													
	1898.9280	1507.3371	1204.5021	635.1366	257.4548	0.0000	0.0000	0.0000	0.0000	588.2562	1256.2276	1933.0470	(98)
Space heating												9280.8895	(98)
RHI space heating demand												9281	(98)

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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	90.5800 (1b)	x	2.7000 (2b)	=	244.5660	(1b) - (3b)
First floor	139.6900 (1c)	x	2.7000 (2c)	=	377.1630	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	230.2700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	621.7290	(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							6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.0965	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3465	(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) =	0.2945	(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	0.3755	0.3682	0.3608	0.3240	0.3166	0.2798	0.2798	0.2724	0.2945	0.3166	0.3313	0.3461	(22b)
Effective ac	0.5705	0.5678	0.5651	0.5525	0.5501	0.5391	0.5391	0.5371	0.5434	0.5501	0.5549	0.5599	(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	
External Doors			1.9500	1.8000	3.5100			(26)
Windows (Uw = 1.40)			63.8400	1.3258	84.6364			(27)
Heat Loss Floor			139.6900	0.1200	16.7628	75.0000	10476.7500	(28a)
External Wall	254.9700	65.7900	189.1800	0.2500	47.2950	60.0000	11350.8000	(29a)
Retaining Wall	22.6200		22.6200	0.2500	5.6550	60.0000	1357.2000	(29a)
Pitched Roof	52.5100		52.5100	0.1600	8.4016	9.0000	472.5900	(30)
Flat Roof	40.0600		40.0600	0.0900	3.6054	9.0000	360.5400	(30)
Sloping Roof	45.9300		45.9300	0.1600	7.3488	9.0000	413.3700	(30)
Total net area of external elements Aum(A, m2)			555.7800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		177.2150			(33)
Internal Wall - Timber			233.2100			9.0000	2098.8900	(32c)
Internal Floor			90.5800			18.0000	1630.4400	(32d)
Internal Ceiling			90.5800			18.0000	1630.4400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		29791.0200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							129.3743	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							38.6848	(36)
Total fabric heat loss					(33) + (36) =		215.8998	(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	117.0518	116.4900	115.9394	113.3531	112.8692	110.6166	110.6166	110.1995	111.4843	112.8692	113.8481	114.8715	(38)
Heat transfer coeff	332.9515	332.3898	331.8391	329.2529	328.7690	326.5164	326.5164	326.0993	327.3841	328.7690	329.7479	330.7713	(39)
Average = Sum(39)m / 12 =												329.2505	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4459	1.4435	1.4411	1.4299	1.4278	1.4180	1.4180	1.4162	1.4217	1.4278	1.4320	1.4364	(40)
HLP (average)												1.4298	(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		3.0413 (42)
Average daily hot water use (litres/day)		106.4304 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.0735	112.8162	108.5590	104.3018	100.0446	95.7874	95.7874	100.0446	104.3018	108.5590	112.8162	117.0735	(44)
Energy conte	173.6166	151.8462	156.6916	136.6076	131.0782	113.1105	104.8135	120.2751	121.7115	141.8430	154.8328	168.1384	(45)
Energy content (annual)										Total = Sum(45)m =		1674.5649	(45)
Distribution loss (46)m = 0.15 x (45)m	26.0425	22.7769	23.5037	20.4911	19.6617	16.9666	15.7220	18.0413	18.2567	21.2765	23.2249	25.2208	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.7500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.4850	(55)
Total storage loss													

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	46.0350	41.5800	46.0350	44.5500	46.0350	44.5500	46.0350	46.0350	44.5500	46.0350	44.5500	46.0350 (56)
If cylinder contains dedicated solar storage												
	46.0350	41.5800	46.0350	44.5500	46.0350	44.5500	46.0350	46.0350	44.5500	46.0350	44.5500	46.0350 (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												
	242.9140	214.4374	225.9890	203.6696	200.3756	180.1725	174.1109	189.5725	188.7735	211.1404	221.8948	237.4358 (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												
	242.9140	214.4374	225.9890	203.6696	200.3756	180.1725	174.1109	189.5725	188.7735	211.1404	221.8948	237.4358 (64)
								Total per year (kWh/year) = Sum(64)m =				2490.4859 (64)
Heat gains from water heating, kWh/month												
	113.1654	100.5618	107.5379	99.0716	99.0214	91.2588	90.2884	95.4294	94.1187	102.6007	105.1315	111.3439 (65)

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	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	88.9226	78.9802	64.2310	48.6270	36.3493	30.6876	33.1590	43.1013	57.8505	73.4545	85.7323	91.3940	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	595.4869	601.6662	586.0946	552.9445	511.0984	471.7690	445.4945	439.3152	454.8868	488.0370	529.8830	569.2124	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	(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)													
	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	(71)
Water heating gains (Table 5)													
	152.1041	149.6455	144.5402	137.5995	133.0933	126.7484	121.3554	128.2653	130.7204	137.9042	146.0160	149.6558	(72)
Total internal gains													
	956.6281	950.4065	914.9804	859.2855	800.6555	749.3195	720.1235	730.7964	763.5723	819.5103	881.7459	930.3768	(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	
Northeast	13.1500	11.2829	0.6300	0.7000	0.7700	45.3440	(75)
Southeast	18.5500	36.7938	0.6300	0.7000	0.7700	208.5887	(77)
Southwest	15.1100	36.7938	0.6300	0.7000	0.7700	169.9070	(79)
Northwest	17.0300	11.2829	0.6300	0.7000	0.7700	58.7231	(81)

Solar gains	482.5628	856.5498	1263.7847	1719.7878	2066.7761	2113.6184	2012.0403	1743.7252	1420.2122	971.4259	584.2940	408.8999	(83)
Total gains	1439.1909	1806.9563	2178.7650	2579.0734	2867.4316	2862.9380	2732.1638	2474.5216	2183.7846	1790.9362	1466.0398	1339.2767	(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	24.8543	24.8963	24.9376	25.1335	25.1705	25.3442	25.3442	25.3766	25.2770	25.1705	25.0958	25.0181	
alpha	2.6570	2.6598	2.6625	2.6756	2.6780	2.6896	2.6896	2.6918	2.6851	2.6780	2.6731	2.6679	
util living area													
	0.9794	0.9624	0.9298	0.8619	0.7510	0.6069	0.4770	0.5325	0.7408	0.9071	0.9672	0.9829	(86)
MIT	19.0110	19.2548	19.6303	20.0952	20.4866	20.7388	20.8391	20.8167	20.6065	20.0794	19.4542	18.9655	(87)
Th 2	19.7283	19.7302	19.7320	19.7405	19.7421	19.7496	19.7496	19.7510	19.7467	19.7421	19.7389	19.7355	(88)
util rest of house													
	0.9753	0.9550	0.9155	0.8332	0.6980	0.5199	0.3590	0.4129	0.6655	0.8813	0.9594	0.9794	(89)
MIT 2	17.0932	17.4465	17.9859	18.6431	19.1651	19.4740	19.5715	19.5572	19.3352	18.6398	17.7454	17.0319	(90)
Living area fraction									fLA = Living area / (4) =			0.2593	(91)
MIT	17.5905	17.9154	18.4123	19.0196	19.5078	19.8019	19.9002	19.8838	19.6649	19.0131	18.1885	17.5333	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4405	17.7654	18.2623	18.8696	19.3578	19.6519	19.7502	19.7338	19.5149	18.8631	18.0385	17.3833	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9644	0.9390	0.8939	0.8088	0.6792	0.5124	0.3590	0.4111	0.6490	0.8576	0.9445	0.9699	(94)
Useful gains	1387.9740	1696.7124	1947.6159	2085.9726	1947.6105	1466.9815	980.9482	1017.1911	1417.3106	1535.8974	1384.6321	1298.9579	(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													
	4375.1369	4276.3297	3903.1937	3282.5337	2517.6335	1649.5372	1028.5875	1087.1516	1772.7429	2716.6463	3606.9408	4360.6654	(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													
	2222.4492	1733.5029	1454.9499	861.5240	424.0971	0.0000	0.0000	0.0000	0.0000	878.4772	1600.0623	2277.9104	(98)
Space heating												11452.9730	(98)
Space heating per m2											(98) / (4) =	49.7371	(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)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)

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Space heating requirement 11155.4931 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2222.4492	1733.5029	1454.9499	861.5240	424.0971	0.0000	0.0000	0.0000	0.0000	878.4772	1600.0623	2277.9104	(98)
Space heating efficiency (main heating system 1)													
	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)													
	2164.7233	1688.4768	1417.1590	839.1468	413.0816	0.0000	0.0000	0.0000	0.0000	855.6596	1558.5022	2218.7439	(211)
Water heating requirement													
	341.9153	266.6927	223.8384	132.5422	65.2457	0.0000	0.0000	0.0000	0.0000	135.1503	246.1634	350.4478	(215)
Water heating													
Water heating requirement													
	242.9140	214.4374	225.9890	203.6696	200.3756	180.1725	174.1109	189.5725	188.7735	211.1404	221.8948	237.4358	(64)
Efficiency of water heater												79.3000	(216)
(217)m	88.7039	88.5561	88.2475	87.5427	86.0051	79.3000	79.3000	79.3000	79.3000	87.5113	88.4073	88.7570	(217)
Fuel for water heating, kWh/month													
	273.8483	242.1485	256.0856	232.6516	232.9812	227.2037	219.5598	239.0573	238.0498	241.2723	250.9914	267.5123	(219)
Water heating fuel used												2921.3618	(219)
Annual totals kWh/year													
Space heating fuel - main system												11155.4931	(211)
Space heating fuel - secondary												1761.9958	(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)												628.1600	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.89 * 951 * 1.00) =										-1437.3314		-2015.3059	
PV Unit 1 (0.80 * 0.95 * 951 * 0.80) =										-577.9745		-2015.3059	(233)
Total delivered energy for all uses												14526.7049	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	11155.4931	3.4800	388.2112	(240)
Space heating - secondary	1761.9958	4.2300	74.5324	(242)
Water heating (other fuel)	2921.3618	3.4800	101.6634	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	628.1600	13.1900	82.8543	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-2015.3059	13.1900	-265.8189	(252)
Total energy cost			511.3349	(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] =	0.7802	(257)
SAP value		89.1165	
SAP rating (Section 12)		89	(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	11155.4931	0.2160	2409.5865	(261)
Space heating - secondary	1761.9958	0.0190	33.4779	(263)
Water heating (other fuel)	2921.3618	0.2160	631.0142	(264)
Space and water heating			3074.0786	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	628.1600	0.5190	326.0150	(268)
Energy saving/generation technologies				
PV Unit	-2015.3059	0.5190	-1045.9438	(269)
Total kg/year			2393.0749	(272)
CO2 emissions per m2			10.3900	(273)
EI value			88.3506	
EI rating			88	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.25) / 0.9000 = 4.147, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.25) / 0.9000 = 0.2574, stars = 4
Water heating energy efficiency	3.48 / 0.8508 = 4.090, stars = 4
Water heating environmental impact	0.216 / 0.8508 = 0.2539, stars = 4

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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	90.5800 (1b)	x	2.7000 (2b)	=	244.5660	(1b) - (3b)
First floor	139.6900 (1c)	x	2.7000 (2c)	=	377.1630	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	230.2700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	621.7290	(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							6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.0965	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3465	(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) =	0.2945	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.7000	4.4000	4.4000	4.0000	4.1000	3.9000	3.9000	3.8000	3.8000	4.1000	4.0000	4.1000	(22)
Wind factor	1.1750	1.1000	1.1000	1.0000	1.0250	0.9750	0.9750	0.9500	0.9500	1.0250	1.0000	1.0250	(22a)
Adj infilt rate	0.3461	0.3240	0.3240	0.2945	0.3019	0.2872	0.2872	0.2798	0.2798	0.3019	0.2945	0.3019	(22b)
Effective ac	0.5599	0.5525	0.5525	0.5434	0.5456	0.5412	0.5412	0.5391	0.5391	0.5456	0.5434	0.5456	(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	
External Doors			1.9500	1.8000	3.5100			(26)
Windows (Uw = 1.40)			63.8400	1.3258	84.6364			(27)
Heat Loss Floor			139.6900	0.1200	16.7628	75.0000	10476.7500	(28a)
External Wall	254.9700	65.7900	189.1800	0.2500	47.2950	60.0000	11350.8000	(29a)
Retaining Wall	22.6200		22.6200	0.2500	5.6550	60.0000	1357.2000	(29a)
Pitched Roof	52.5100		52.5100	0.1600	8.4016	9.0000	472.5900	(30)
Flat Roof	40.0600		40.0600	0.0900	3.6054	9.0000	360.5400	(30)
Sloping Roof	45.9300		45.9300	0.1600	7.3488	9.0000	413.3700	(30)
Total net area of external elements Aum(A, m2)			555.7800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		177.2150			(33)
Internal Wall - Timber			233.2100			9.0000	2098.8900	(32c)
Internal Floor			90.5800			18.0000	1630.4400	(32d)
Internal Ceiling			90.5800			18.0000	1630.4400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		29791.0200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							129.3743	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							38.6848	(36)
Total fabric heat loss					(33) + (36) =		215.8998	(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	114.8715	113.3531	113.3531	111.4843	111.9348	111.0449	111.0449	110.6166	110.6166	111.9348	111.4843	111.9348	(38)
Heat transfer coeff	330.7713	329.2529	329.2529	327.3841	327.8346	326.9447	326.9447	326.5164	326.5164	327.8346	327.3841	327.8346	(39)
Average = Sum(39)m / 12 =												327.8726	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4364	1.4299	1.4299	1.4217	1.4237	1.4198	1.4198	1.4180	1.4180	1.4237	1.4217	1.4237	(40)
HLP (average)												1.4239	(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	3.0413 (42)
Average daily hot water use (litres/day)	106.4304 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.0735	112.8162	108.5590	104.3018	100.0446	95.7874	95.7874	100.0446	104.3018	108.5590	112.8162	117.0735	(44)
Energy conte	173.6166	151.8462	156.6916	136.6076	131.0782	113.1105	104.8135	120.2751	121.7115	141.8430	154.8328	168.1384	(45)
Energy content (annual)											Total = Sum(45)m =	1674.5649	(45)
Distribution loss (46)m = 0.15 x (45)m	26.0425	22.7769	23.5037	20.4911	19.6617	16.9666	15.7220	18.0413	18.2567	21.2765	23.2249	25.2208	(46)

Water storage loss:	
Store volume	300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	2.7500 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	1.4850 (55)
Total storage loss	

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	46.0350	41.5800	46.0350	44.5500	46.0350	44.5500	46.0350	46.0350	44.5500	46.0350	44.5500	46.0350 (56)
If cylinder contains dedicated solar storage												
	46.0350	41.5800	46.0350	44.5500	46.0350	44.5500	46.0350	46.0350	44.5500	46.0350	44.5500	46.0350 (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												
	242.9140	214.4374	225.9890	203.6696	200.3756	180.1725	174.1109	189.5725	188.7735	211.1404	221.8948	237.4358 (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												
	242.9140	214.4374	225.9890	203.6696	200.3756	180.1725	174.1109	189.5725	188.7735	211.1404	221.8948	237.4358 (64)
								Total per year (kWh/year) = Sum(64)m =				2490.4859 (64)
Heat gains from water heating, kWh/month												
	113.1654	100.5618	107.5379	99.0716	99.0214	91.2588	90.2884	95.4294	94.1187	102.6007	105.1315	111.3439 (65)

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	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	182.4769	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	88.9226	78.9802	64.2310	48.6270	36.3493	30.6876	33.1590	43.1013	57.8505	73.4545	85.7323	91.3940	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	595.4869	601.6662	586.0946	552.9445	511.0984	471.7690	445.4945	439.3152	454.8868	488.0370	529.8830	569.2124	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	56.2890	(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)													
	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	-121.6512	(71)
Water heating gains (Table 5)													
	152.1041	149.6455	144.5402	137.5995	133.0933	126.7484	121.3554	128.2653	130.7204	137.9042	146.0160	149.6558	(72)
Total internal gains													
	956.6281	950.4065	914.9804	859.2855	800.6555	749.3195	720.1235	730.7964	763.5723	819.5103	881.7459	930.3768	(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	
Northeast	13.1500	14.6130	0.6300	0.7000	0.7700	58.7270	(75)
Southeast	18.5500	45.0642	0.6300	0.7000	0.7700	255.4743	(77)
Southwest	15.1100	45.0642	0.6300	0.7000	0.7700	208.0979	(79)
Northwest	17.0300	14.6130	0.6300	0.7000	0.7700	76.0549	(81)

Solar gains	598.3541	907.0305	1370.6078	1884.2791	2138.0158	2421.4558	2213.9925	1997.5766	1616.7125	1112.3324	722.7672	479.5818	(83)
Total gains	1554.9822	1857.4371	2285.5882	2743.5647	2938.6714	3170.7753	2934.1160	2728.3731	2380.2848	1931.8427	1604.5130	1409.9586	(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	25.0181	25.1335	25.1335	25.2770	25.2423	25.3110	25.3110	25.3442	25.3442	25.2423	25.2770	25.2423	
alpha	2.6679	2.6756	2.6756	2.6851	2.6828	2.6874	2.6874	2.6896	2.6896	2.6828	2.6851	2.6828	
util living area													
	0.9703	0.9531	0.9089	0.8161	0.6810	0.4770	0.3515	0.3645	0.6273	0.8569	0.9483	0.9759	(86)
MIT	19.2645	19.4522	19.8331	20.2913	20.6306	20.8291	20.8784	20.8772	20.7466	20.3223	19.7380	19.2342	(87)
Th 2	19.7355	19.7405	19.7405	19.7467	19.7452	19.7482	19.7482	19.7496	19.7496	19.7452	19.7467	19.7452	(88)
util rest of house													
	0.9640	0.9434	0.8899	0.7777	0.6127	0.3761	0.2249	0.2297	0.5262	0.8151	0.9352	0.9706	(89)
MIT 2	17.4664	17.7389	18.2799	18.9132	19.3454	19.5580	19.5953	19.5969	19.4908	18.9743	18.1593	17.4297	(90)
Living area fraction										fLA = Living area / (4) =		0.2593	(91)
MIT	17.9326	18.1832	18.6827	19.2706	19.6786	19.8876	19.9280	19.9289	19.8164	19.3238	18.5687	17.8977	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7826	18.0332	18.5327	19.1206	19.5286	19.7376	19.7780	19.7789	19.6664	19.1738	18.4187	17.7477	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9501	0.9254	0.8666	0.7549	0.5994	0.3752	0.2280	0.2330	0.5185	0.7911	0.9160	0.9585	(94)
Useful gains	1477.3377	1718.8899	1980.6581	2071.0543	1761.4865	1189.7863	669.1156	635.8428	1234.2940	1528.3705	1469.7145	1351.4584	(95)
Ext temp.	5.6000	6.0000	7.6000	10.1000	13.1000	15.9000	17.7000	17.8000	15.4000	12.1000	8.6000	5.7000	(96)
Heat loss rate W													
	4029.6602	3961.9510	3599.6126	2953.1886	2107.5279	1254.6825	679.4024	646.1353	1393.0613	2319.0375	3214.4751	3949.6399	(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													
	1898.9280	1507.3371	1204.5021	635.1366	257.4548	0.0000	0.0000	0.0000	0.0000	588.2562	1256.2276	1933.0470	(98)
Space heating												9280.8895	(98)
Space heating per m2											(98) / (4) =	40.3044	(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)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)

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Space heating requirement 9039.8274 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1898.9280	1507.3371	1204.5021	635.1366	257.4548	0.0000	0.0000	0.0000	0.0000	588.2562	1256.2276	1933.0470	(98)
Space heating efficiency (main heating system 1)													
	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)													
	1849.6052	1468.1854	1173.2164	618.6396	250.7677	0.0000	0.0000	0.0000	0.0000	572.9768	1223.5983	1882.8380	(211)
Water heating requirement													
	292.1428	231.8980	185.3080	97.7133	39.6084	0.0000	0.0000	0.0000	0.0000	90.5010	193.2658	297.3919	(215)
Water heating													
Water heating requirement													
	242.9140	214.4374	225.9890	203.6696	200.3756	180.1725	174.1109	189.5725	188.7735	211.1404	221.8948	237.4358	(64)
Efficiency of water heater												79.3000	(216)
(217)m	88.5137	88.3724	87.9528	86.9190	84.7001	79.3000	79.3000	79.3000	79.3000	86.6660	88.0508	88.5649	(217)
Fuel for water heating, kWh/month													
	274.4366	242.6519	256.9436	234.3210	236.5708	227.2037	219.5598	239.0573	238.0498	243.6254	252.0076	268.0923	(219)
Water heating fuel used												2932.5198	(219)
Annual totals kWh/year													
Space heating fuel - main system												9039.8274	(211)
Space heating fuel - secondary												1427.8292	(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)												628.1600	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.89 * 1081 * 1.00) =										-1635.1736		-2292.7037	
PV Unit 1 (0.80 * 0.95 * 1081 * 0.80) =										-657.5301		-2292.7037	(233)
Total delivered energy for all uses												11810.6327	(238)

10a. Fuel costs - using BEDF prices (398)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	9039.8274	4.2800	386.9046	(240)
Space heating - secondary	1427.8292	4.6500	66.3941	(242)
Water heating (other fuel)	2932.5198	4.2800	125.5118	(247)
Pumps and fans for heating	75.0000	15.4400	11.5800	(249)
Energy for lighting	628.1600	15.4400	96.9879	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit	-2292.7037	15.4400	-353.9934	(252)
Total energy cost			425.3850	(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	9039.8274	0.2160	1952.6027	(261)
Space heating - secondary	1427.8292	0.0190	27.1288	(263)
Water heating (other fuel)	2932.5198	0.2160	633.4243	(264)
Space and water heating			2613.1558	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	628.1600	0.5190	326.0150	(268)
Energy saving/generation technologies				
PV Unit	-2292.7037	0.5190	-1189.9132	(269)
Total kg/year			1788.1826	(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	9039.8274	1.2200	11028.5895	(261)
Space heating - secondary	1427.8292	1.0400	1484.9423	(263)
Water heating (other fuel)	2932.5198	1.2200	3577.6742	(264)
Space and water heating			16091.2059	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	628.1600	3.0700	1928.4513	(268)
Energy saving/generation technologies				
PV Unit	-2292.7037	3.0700	-7038.6003	(269)
Primary energy kWh/year			11211.3069	(272)
Primary energy kWh/m2/year			48.6877	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 89
Current environmental impact rating: B 88

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered

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G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	SAP increase too small
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
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
(none)			

Measures omitted - SAP change or cost saving too small:

N	Solar water heating	+ 0.9	-£ 53	-280 kg (15.7%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: B 89
Potential environmental impact rating: B 88

Fuel prices for cost data on this page from database revision number 398 TEST (28 Sep 2016)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£109	£109	£0
Mains gas	£604	£604	£0
Wood	£66	£66	£0
Space heating	£557	£557	£0
Water heating	£126	£126	£0
Lighting	£97	£97	£0
Generated (PV)	-£354	-£354	£0
Total cost of fuels	£425	£425	£0
Total cost of uses	£426	£426	£0
Delivered energy	51 kWh/m²	51 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.8 tonnes	1.8 tonnes	0.0 tonnes
CO2 emissions per m²	8 kg/m²	8 kg/m²	0 kg/m²
Primary energy	49 kWh/m²	49 kWh/m²	0 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

No improvements selected / applicable

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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

No improvements selected / applicable

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	129.4 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	1641.36 (P1)
Transmission heat loss coefficient	215.90 (37)
Summer heat loss coefficient	1857.26 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (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 East	13.1500	106.0502	0.6300	0.7000	0.9000	498.1509
South East	18.5500	127.3119	0.6300	0.7000	0.9000	843.5996
South West	15.1100	127.3119	0.6300	0.7000	0.9000	687.1585
North West	17.0300	106.0502	0.6300	0.7000	0.9000	645.1338
total:						2674.0428

	Jun	Jul	Aug	
Solar gains	2879	2674	2360	(P3)
Internal gains	746	717	728	
Total summer gains	3626	3391	3088	(P5)
Summer gain/loss ratio	1.95	1.83	1.66	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 129.4)	1.09	1.09	1.09	
Threshold temperature	18.45	20.22	20.06	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

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Predicted Energy Assessment

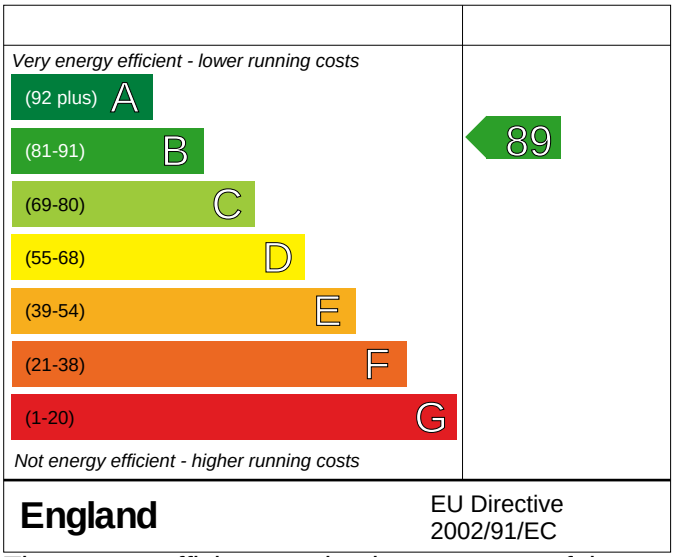
Plot 11, Telegraph Road,
West End,
Southampton,
Hampshire,
SO30 3EH

Dwelling type:	House, Detached
Date of assessment:	05.Oct.2016
Produced by:	BEAT Solutions
Total floor area:	230.27 m^2

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

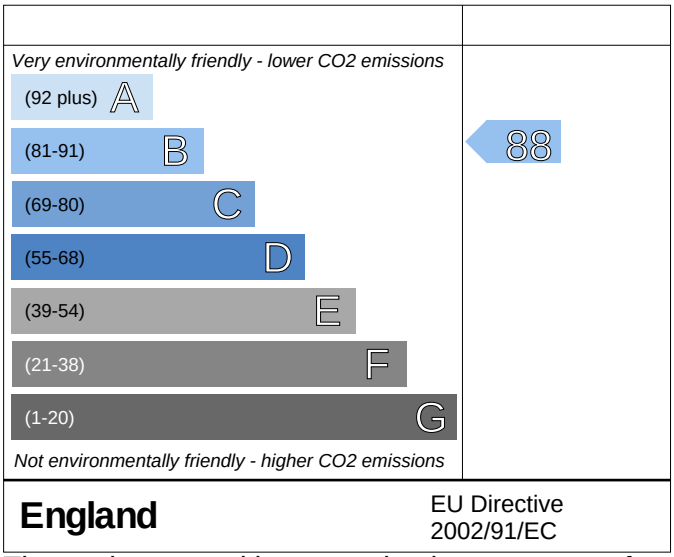
The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO2) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

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BEAT Solutions Ltd
Unit 2, Barley Business Park
Duncan Road, Park Gate
Southampton, Hampshire
SO31 1ZT

Summary Information

Property Reference: SAP-0704 Plot 11 **Issued on Date:** 05.Oct.2016
Survey Reference: Rev C **Prop Type Ref:**

Property: Plot 11, Telegraph Road, West End, Southampton, Hampshire, SO30 3EH

SAP Rating: 89 B **CO2 Emissions (t/year):** 1.79 **DER:** 11.26 Pass **TER:** 15.42 **Percentage DER<TER:** 27.00 %
Environmental: 88 B **General Requirements Compliance:** Pass **DFEE:** 59.11 Pass **TFEE:** 62.25 **Percentage DFEE<TFEE:** 5.05 %

CfSH Results **Version:** November 2010 - June 2014 Addendum **ENE1 Credits:** 3.6 **ENE2 Credits:** 3.1 **ENE7 Credits:** 1 **CfSH Level:** 4

Surveyor: Scott Spearing, Tel: 01489 565920 Surveyor ID: A808-0004
Address: Duncan Road, Park Gate, Southampton, Hampshire, SO31 1ZT
Client: Mildren Homes Ltd, MILDREN HOMES

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.06r08
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

SUMMARY FOR INPUT DATA FOR New Build (As Designed)

Orientation	North West
1.0 Property Type	House, Detached
2.0 Number of Storeys	2
3.0 Date Built	2016
3.0 Property Age Band	
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	41.33	90.58	2.70
1st Storey:	54.84	139.69	2.70

7.0 Living Area	59.71
8.0 Thermal Mass Parameter	Precise calculation

9.0 External Walls

Description	Construction	U-Value	Kappa	Gross Area	Nett Area
External Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.25	60.00	254.97	189.18
Retaining Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.25	60.00	22.62	22.62

9.2 Internal Walls

Description	Construction	Kappa	Area
Internal Wall - Timber	Plasterboard on timber frame	9.00	233.21

10.0 External Roofs

Description	Construction	U-Value	Kappa	Gross Area	Nett Area
Pitched Roof	Plasterboard, insulated at ceiling level	0.16	9.00	52.51	52.51
Flat Roof	Plasterboard, insulated flat roof	0.09	9.00	40.06	40.06
Sloping Roof	Plasterboard, insulated slope	0.16	9.00	45.93	45.93

10.2 Internal Ceilings

Description	Construction	Kappa	Area
Internal Ceiling	Plasterboard ceiling, carpeted chipboard floor	9.00	90.58

11.0 HeatLoss Floors

Description	Construction	U-Value	Kappa	Area
Heat Loss Floor	Suspended concrete floor, carpeted	0.12	75.00	139.69

11.2 Internal Floors

Description	Construction	Kappa	Area
Internal Floor	Plasterboard ceiling, carpeted chipboard floor	18.00	90.58

12.0 Opening Types

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Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	Solar Trans	Frame Type	Frame Factor	U value
External Doors	Manufacturer	Solid Door							1.80
Windows	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.40

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width	Height	Count	Area	Curtain Closed
Front Door	Solid Door	[1] External Wall	North West							1.95	
Front Elevation	Window	[1] External Wall	North West	None	0.00					17.03	
Rear Elevation	Window	[1] External Wall	South East	None	0.00					18.55	
Side Elevation	Window	[1] External Wall	North East	None	0.00					11.87	
Side Gable	Window	[1] External Wall	North East	None	0.00					1.28	
Side Gable	Window	[1] External Wall	South West	None	0.00					1.28	
Side Elevation	Window	[1] External Wall	South West	None	0.00					13.83	

14.0 Conservatory: None
15.0 Draught Proofing: 100
16.0 Draught Lobby: No

17.0 Thermal Bridging: Calculate Bridges

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported
Table K1 - Approved	E2 Other lintels (including other steel lintels)	37.57	0.300	Yes
Table K1 - Approved	E3 Sill	36.64	0.040	Yes
Table K1 - Approved	E4 Jamb	71.44	0.050	No
Table K1 - Approved	E5 Ground floor (normal)	41.33	0.160	Yes
Table K1 - Approved	E6 Intermediate floor within a dwelling	54.84	0.070	Yes
Table K1 - Approved	E8 Balcony within a dwelling, wall insulation continuous	4.51	0.000	No
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	12.43	0.060	No
Table K1 - Approved	E11 Eaves (insulation at rafter level)	19.14	0.040	No
Table K1 - Approved	E12 Gable (insulation at ceiling level)	12.71	0.240	No
Table K1 - Approved	E13 Gable (insulation at rafter level)	9.60	0.040	No
Table K1 - Default	E15 Flat roof with parapet	9.28	0.560	No
Table K1 - Approved	E16 Corner (normal)	42.60	0.090	No
Table K1 - Approved	E17 Corner (inverted - internal area greater than external area)	22.80	-0.090	No

18.0 Pressure Testing: Yes
- Designed q50: 5.00
- Property Tested ?
- As Built q50
- Same As Designed ?

19.0 Mechanical Ventilation
- Mechanical Ventilation System Present: No
- Approved Installation
- Windows open in hot weather: Windows fully open
- Cross ventilation possible: Yes
- Night Ventilation: Yes
- Air change rate: 8.00
- Mechanical Ventilation data Type
- Type
- MV Reference Number
- Configuration
- MVHR Duct Insulated
- Manufacturer SFP
- Duct Type
- MVHR Efficiency
- Wet Rooms
- Brand, Model

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0	0	0	0
Number of open flues	0	0	0	0
Number of intermittent fans				6
Number of passive vents				0
Number of flueless gas fires				0

21.0 Cooling System: No

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22.0 Lighting	
Internal	
Total number of light fittings	15
Total number of L.E.L. fittings	15
Percentage of L.E.L. fittings	100.00
External	
External lights fitted	No
Light and motion sensors	
23.0 Electricity Tariff	Standard
24.0 Heating Systems	
Main Heating 1	Database
Description	Gas Boiler
Percentage of Heat	100 %
Main Heating 2	None
Description	
Percentage of Heat	%
Community Heating	
Secondary Heating	SAP table
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery	No
Instantaneous System 1	
Waste Water Heat Recovery	No
Instantaneous System 2	
Waste Water Heat Recovery Storage	No
System	
Solar Panel	No
25.0 Main Heating 1	
Database Ref. No.	17493
Fuel Type	Mains gas
Main Heating	BGB
TestMethod	
SAP Code	102
Efficiency (Split Efficiences) %	
Efficiency (Split Efficiences) %	
In Winter	90.0
In Summer	79.3
Model Name	
Manufacturer	
Controls	CBI Time and temperature zone control
PCDF Controls	0
Delayed Start Stat	Yes
Sap Code	2110
Burner Control	
Boiler Compensator	
HETAS approved System	
Oil Pump Inside	
FI Case	
FI Water	
Flue Type	Balanced
Smoke Control Area	
Fan Assisted Flue	Yes
Is MHS Pumped	Pump in heated space
Heat Emitter	Radiators and Underfloor
Underfloor Heating	Yes - Pipes in thin screed
Flow Temperature	36° - 45°C
Electric CPSU Temperature	
Combi boiler type	
Combi keep hot type	
Combi store type	
27.0 Community Heating	
Space Community Heating	
PCDF Index	
Distribution Loss	
Distribution Loss Value	
Controls	
SAP Code	
Water Community Heating	
PCDF Index	
Distribution Loss	
Distribution Loss Value	
Charging Linked To Heat Use	
28.0 Secondary Heating	RWM
Description	Wood Logs RWM Closed room heater
SHS efficiency %	65.00
SAP Code	633

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HETAS Approved System	Yes
Smoke Control Area	Unknown
Test Method	
Manufacturer	
Model Name	
29.0 Water Heating	HWP From main heating 1
Water use <= 125 litres/person/day	Yes
SAP Code	901
Immersion Heater	
Summer Immersion	
Suplementary Immersion	
Immersion Only Heating Hot Water	
29.1 Flue Gas Heat Recovery System	
Database ID	
Brand Model	
Details	
29.2 Waste Water Heat Recovery System	
Total rooms with shower and/or bath	
30.0 Hot Water Cylinder	Hot Water Cylinder
Cylinder Stat	Yes
Cylinder In Heated Space	Yes
Independent Time Control	Yes
Insulation Type	Measured Loss
Insulation Thickness	
Cylinder Volume	300.00
Loss (kwh/day)	2.75
Pipes insulation	Fully insulated primary pipework
In Airing Cupboard	
31.0 Solar Panel	
Solar Panel Area	
Area Type	
Panel Type	
n0, a1, a2, A/G ratio	
Orientation	
Elevation	
Overshading	
Solar Storage Volume	
Pump electrically powered	
Combined Cylinder	
32.0 Thermal Store	None
Thermal Store Pipework	
33.0 Photovoltaic Unit	One Dwelling
Apportioned KWh/Year	

PV Cells kW Peak	Orientation	Elevation	Overshading
1.89	Horizontal	Horizontal	None Or Little
0.95	Horizontal	Horizontal	Modest

34.0 Wind Turbines	
Terrain Type	Urban
Wind Turbines	
Count	
Apportioned Kwh/year	
Rotor Diameter	
Hub Height	
35.0 Small-scale Hydro	
Electricity Generated	
Description	
Apportioned kWh/Year	

Recommendations

None

Further measures to achieve even higher standards

None

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