Building Regulation Compliance

Property Reference: 501 Linton House
Survey Reference: 501 design
Property: 501, London

Issued on Date: 01.Nov.2016
Prop Type Ref:

SAP Rating:	82 B	**CO2 Emissions (t/year):**	2.33	**DER:**	16.13 Pass	**TER:**	21.80	**Percentage DER<TER:**	26.02 %
Environmental:	84 B	**General Requirements Compliance:**	Pass	**DFEE:**	51.00 Pass	**TFEE:**	55.11	**Percentage DFEE<TFEE:**	7.45 %

CfSH Results **Version:** November 2010 - June 2014 Addendum **ENE1 Credits:** 3.5 **ENE2 Credits:** 0.0 **ENE7 Credits:** 0 **CfSH Level:** 4

Surveyor: Mike Ovenden, Tel: 01908 850109 Surveyor ID: H824-0001
Address: Dudley Hill, Shenley Church End, Milton Keynes, Buckinghamshire, MK5 6LL
Client: Synergy, 3

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)

1a TER and DER

Fuel for main heating:	Electricity	
Fuel factor:	1.55 (electricity)	
Target Carbon Dioxide Emission Rate (TER)	21.80 kg/m^2	
Dwelling Carbon Dioxide Emission Rate (DER)	16.13 kg/m^2	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	55.11 kWh/m^2	
Dwelling Fabric Energy Efficiency (DFEE)	51.00 kWh/m^2	OK

2 Fabric U-values

Element	Average	Highest	
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings and curtain wall	0.93 (max. 2.00)	0.93 (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

4 Heating efficiency

Main heating system:	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system:	None	

5 Cylinder insulation

Hot water storage	Nominal cylinder loss: 1.82 kWh/day Permitted by DBSCG 2.10	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

7 Low energy lights

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

8 Mechanical ventilation

Continuous supply and extract system		
Specific fan power:	0.75	

Maximum	1.5	OK
MVHR efficiency:	78%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based On:		
Overshading:	Average	
Windows facing East:	68.23 m^2, No overhang	
Windows facing South:	24.57 m^2, No overhang	
Air change rate:	8.00 ach	
Blinds/curtains:	None	

10 Key features

Party wall U-value	0.00 W/m^2K
Party wall U-value	0.00 W/m^2K
Roof U-value	0.10 W/m^2K
Roof U-value	0.10 W/m^2K
Window U-value	0.93 W/m^2K
Thermal bridging y-value	0.026 W/m^2K
Photovoltaic array	

Full SAP Calculation Printout

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Survey Reference: 501 design
Property: 501, London

Issued on Date: 01.Nov.2016
Prop Type Ref:

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Client: Synergy, 3

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 '501 design'
SAP2012 - 9.92 input data (DesignData) -

SAP2012 Input Data (Flat)	01/11/2016
FullRefNo:	501 design
Regs Region:	England
SAP Region:	Thames Valley
Postcode:	
DwellingOrientation:	North
Property Type:	Flat, End-Terrace
Storeys:	2
Date Built:	2016
Sheltered Sides:	2
Sunlight Shade:	Average or unknown
Measurements	Perimeter, Floor Area, Storey Height
1st Storey:	30.97, 148.51, 2.6
2nd Storey:	15.77, 29.82, 2.85
Living Area:	51.23 m2, fraction: 28.7%
Thermal Mass:	Simple calculation
Thermal Mass Simple:	Low
Thermal MassValue:	100
External Walls	Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1	21.03, 80.51, 0, Other, CurtainWalling, 0, 0.93, Calculate
External Wall 2	11.64, 44.96, 0, Other, CurtainWalling, 0, 0.93, Gross
Party Walls	Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1	84.77, 20, PartyWallSteelFrame, Solid, 0, 0
Party Wall 2	27.6, 20, PartyWallSteelFrame, Solid, 0, 0
External Roofs	Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
penthouse roof	118.69, 118.69, 0, Other, 0.1
garden room roof	29.82, 29.82, 0, Other, 0.1
Heat Loss Floors	Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
penthouse floor	148.51, 0, Other, Ground Floor - Solid, 0, 0.15
Description	Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Opening Type 1	Manufacturer, Window, Double Low-E Soft 0.05, , , 0.36, , 1,
Openings	Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
1	Window, External Wall 1, East, , None, 0, , 0, 0, 0, 7.29,
2	Window, External Wall 1, East, , None, 0, , 0, 0, 0, 7.29,
3	Window, External Wall 1, East, , None, 0, , 0, 0, 0, 7.29,
4	Window, External Wall 1, East, , None, 0, , 0, 0, 0, 7.29,
5	Window, External Wall 1, East, , None, 0, , 0, 0, 0, 7.29,
6	Window, External Wall 1, East, , None, 0, , 0, 0, 0, 7.64,
1gh	Window, External Wall 2, East, , None, 0, , 0, 0, 0, 24.14,
7	Window, External Wall 1, South, , None, 0, , 0, 0, 0, 4.32,
8	Window, External Wall 1, South, , None, 0, , 0, 0, 0, 7.29,
9	Window, External Wall 1, South, , None, 0, , 0, 0, 0, 3.78,
2gh	Window, External Wall 2, South, , None, 0, , 0, 0, 0, 9.18,
Conservatory:	None
Draught Proofing:	100
Draught Lobby:	No
Thermal Bridges	
Bridging:	Calculate Bridges
Y	0.026
List of Bridges	Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
0.	External wall, E1 Steel lintel with perforated steel base plate, , No, 0, 0, 0, 0.00,
1.	External wall, E2 Other lintels (including other steel lintels), , No, 0, 0, 0, 0.00,
2.	External wall, E3 Sill, , No, 0, 0, 0, 0.00,
3.	External wall, E4 Jamb, , No, 0, 0, 0, 0.00,
4.	External wall, E5 Ground floor (normal), Table K1 - Approved, No, 30.97, 0.16, 0.16, 4.96,
5.	External wall, E19 Ground floor (inverted), , No, 0, 0, 0, 0.00,
6.	External wall, E20 Exposed floor (normal), , No, 0, 0, 0, 0.00,
7.	External wall, E21 Exposed floor (inverted), , No, 0, 0, 0, 0.00,
8.	External wall, E22 Basement floor, , No, 0, 0, 0, 0.00,
9.	External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 15.77, 0.07, 0.07, 1.10,
10.	External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 30.97, 0.07, 0.07, 2.17,
11.	External wall, E8 Balcony within a dwelling, wall insulation continuous, , No, 0, 0, 0, 0.00,
12.	External wall, E9 Balcony between dwellings, wall insulation continuous, , No, 0, 0, 0, 0.00,
13.	External wall, E23 Balcony within or between dwellings, balcony support penetrates wall insulation , , No, 0, 0, 0, 0.00,
14.	External wall, E10 Eaves (insulation at ceiling level), , No, 0, 0, 0, 0.00,
15.	External wall, E24 Eaves (insulation at ceiling level - inverted), , No, 0, 0, 0, 0.00,
16.	External wall, E11 Eaves (insulation at rafter level), , No, 0, 0, 0, 0.00,
17.	External wall, E12 Gable (insulation at ceiling level), , No, 0, 0, 0, 0.00,
18.	External wall, E13 Gable (insulation at rafter level), , No, 0, 0, 0, 0.00,
19.	External wall, E14 Flat roof, Table K1 - Default, Yes, 15.77, 0.08, 0.08, 1.26,
20.	External wall, E15 Flat roof with parapet, , No, 0, 0, 0, 0.00,
21.	External wall, E16 Corner (normal), Table K1 - Approved, Yes, 10.9, 0.09, 0.09, 0.98,
22.	External wall, E17 Corner (inverted - internal area greater than external area), , No, 0, 0, 0, 0.00,
23.	External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 10.9, 0.06, 0.06, 0.65,
24.	External wall, E25 Staggered party wall between dwellings, , No, 0, 0, 0, 0.00,
25.	Party wall, P1 Party wall - Ground floor, , No, 0, 0, 0, 0.00,
26.	Party wall, P6 Party wall - Ground floor (inverted), , No, 0, 0, 0, 0.00,

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    27.                     Party wall, P2 Party wall - Intermediate floor within a dwelling, , No, 0, 0, 0, 0.00,
    28.                     Party wall, P3 Party wall - Intermediate floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
    29.                     Party wall, P7 Party Wall - Exposed floor (normal), , No, 0, 0, 0, 0.00,
    30.                     Party wall, P8 Party Wall - Exposed floor (inverted), , No, 0, 0, 0, 0.00,
    31.                     Party wall, P4 Party wall - Roof (insulation at ceiling level), , No, 0, 0, 0, 0.00,
    32.                     Party wall, P5 Party wall - Roof (insulation at rafter level), , No, 0, 0, 0, 0.00,
    33.                     External roof, R1 Head of roof window, , No, 0, 0, 0, 0.00,
    34.                     External roof, R2 Sill of roof window, , No, 0, 0, 0, 0.00,
    35.                     External roof, R3 Jamb of roof window, , No, 0, 0, 0, 0.00,
    36.                     External roof, R4 Ridge (vaulted ceiling), , No, 0, 0, 0, 0.00,
    37.                     External roof, R5 Ridge (inverted), , No, 0, 0, 0, 0.00,
    38.                     External roof, R6 Flat ceiling, , No, 0, 0, 0, 0.00,
    39.                     External roof, R7 Flat ceiling (inverted), , No, 0, 0, 0, 0.00,
    40.                     External roof, R8 Roof to wall (rafter), , No, 0, 0, 0, 0.00,
    41.                     External roof, R9 Roof to wall (flat ceiling), , No, 0, 0, 0, 0.00,
Pressure Test:               True
Designed q50:                5
AsBuilt q50:                 15
Property Tested:             False
Mechanical Ventilation
    MV System Present        Yes
    Windows In Hot Weather   Windows fully open
    Cross Ventilation        Yes
    Night Ventilation        No
    Air Change Rate          8.00
    Approved Installation    Yes
    DataType                 Database
    Type                     Balanced mechanical ventilation with heat recovery
    Database Ref Number      500320
    Configuration            3
    HR Duct Insulated        No
    ManufacturerSFP          0.75
    DuctType                 Rigid
    HR Efficiency            78
    Wet Rooms                3
Chimneys MHS:                0
Chimneys SHS:                0
Chimneys Other:              0
Chimneys Total:              0
Open Flues MHS:              0
Open Flues SHS:              0
Open Flues Other:            0
Open Flues Total:            0
Intermittent Fans:           0
Passive Vents:               0
Flueless Gas Fires:          0
Cooling System
    Cooled Area              178.33
    Data Source              SAP table
    Type                     Split or Multi-Split
    Class                    A
    Control                  On/Off
Light Fittings:              52
LEL Fittings:                52
Percentage of LEL Fittings:  100
External Lights Fitted:      Yes
External LELs Fitted:        Yes
Electricity Tariff:          Standard
Main Heating 1
    Description              ashp
    Percentage               100
    MHS                      Electricity PET Heat pump air-to-water
    SAP Code                 224
    Boiler Efficiency Type   SAP Table
    Efficiency               170
    Controls by PCDF         0
    MHS Controls             CHD Time and temperature zone control
    Boiler Interlock         No
    Ctrl SAP Code            2207
    MCS Installation CertificateNo
    Pumped                   Pump in heated space
    Heat Pump Age            2013 or later
    Heat Emitter             Radiators and Underfloor
    Flow Temperature         <= 35°C
    Under Floor Heating      Yes - Pipes in thin screed
Main Heating 2               None
Heating Systems Interaction  Each system heats separate parts of dwelling
Smoke Control Area           Unknown
Community Heating            None
Secondary Heating            None
Water Heating
    Type                     MainHeating1
    WHS                      HWP From main heating 1
    Low Water Usage          Yes
    SAP Code                 901
    Showers in Property      Non-electric only
    Suplementary Immersion   No
    Hot Water Cylinder
    Cylinder Type            HotWaterCylinder
    Cylinder Insulation Type Foam
    Cylinder Volume          180.00
    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 = 1.64, Orientation = South, Elevation = 30°, Overshading = None Or Little, , Connected to Dwelling = Yes
Wind Turbine                 None
Terrain Type:                Urban
Small Scale Hydro            None
Special Features             None


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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED
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Top-floor flat, total floor area 178 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 21.80 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.13 kg/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.1 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)51.0 kWh/m²OK

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2 Fabric U-values

Element	Average	Highest	
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings and curtain wall	0.93 (max. 2.00)	0.93 (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

---

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

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage: Nominal cylinder loss: 1.82 kWh/day
Permitted by DBSCG 2.10 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

---

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

---

8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.75
Maximum 1.5 OK
MVHR efficiency: 78%
Minimum: 70% OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 68.23 m², No overhang
Windows facing South: 24.57 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

---

10 Key features
Party wall U-value 0.00 W/m²K
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Roof U-value 0.10 W/m²K
Window U-value 0.93 W/m²K
Thermal bridging y-value 0.026 W/m²K
Photovoltaic array

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	148.5100 (1b)	x	2.6000 (2b)	=	386.1260 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	178.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		471.1130	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.2500	(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) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	54.6000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.4979	0.4926	0.4873	0.4608	0.4554	0.4289	0.4289	0.4236	0.4395	0.4554	0.4661	0.4767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 0.93)			92.8000	0.8966	83.2086			(27)
penthouse floor			148.5100	0.1500	22.2765			(28a)
External Wall 1	80.5100	59.4800	21.0300	0.9300	19.5579			(29a)
External Wall 2	44.9600	33.3200	11.6400	0.9300	10.8252			(29a)
penthouse roof	118.6900		118.6900	0.1000	11.8690			(30)
garden room roof	29.8200		29.8200	0.1000	2.9820			(30)
Total net area of external elements Aum(A, m2)			422.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		150.7192			(33)
Party Wall 1			84.7700	0.0000	0.0000			(32)
Party Wall 2			27.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.1236 (36)
Total fabric heat loss (33) + (36) =	161.8428 (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	77.4130	76.5871	75.7612	71.6316	70.8056	66.6760	66.6760	65.8501	68.3279	70.8056	72.4575	74.1093	(38)
Heat transfer coeff	239.2558	238.4299	237.6040	233.4744	232.6485	228.5189	228.5189	227.6930	230.1707	232.6485	234.3003	235.9522	(39)

Average = Sum(39)m / 12 = 233.2679 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3416	1.3370	1.3324	1.3092	1.3046	1.2814	1.2814	1.2768	1.2907	1.3046	1.3139	1.3231	(40)
HLP (average)												1.3081	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9736 (42)
Average daily hot water use (litres/day)	104.8234 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.3058	111.1128	106.9199	102.7270	98.5340	94.3411	94.3411	98.5340	102.7270	106.9199	111.1128	115.3058	(44)
Energy conte	170.9951	149.5534	154.3258	134.5449	129.0991	111.4027	103.2310	118.4590	119.8738	139.7014	152.4950	165.5997	(45)
Energy content (annual)											Total = Sum(45)m =	1649.2809	(45)
Distribution loss (46)m = 0.15 x (45)m	25.6493	22.4330	23.1489	20.1817	19.3649	16.7104	15.4846	17.7689	17.9811	20.9552	22.8742	24.8400	(46)

Water storage loss:	
Store volume	180.0000 (47)
b) If manufacturer declared loss factor is not known :	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115 (51)
Volume factor from Table 2a	0.8736 (52)
Temperature factor from Table 2b	0.5400 (53)

Enter (49) or (54) in (55) 0.9805 (55)
Total storage loss
30.3965 27.4549 30.3965 29.4160 30.3965 29.4160 30.3965 30.3965 29.4160 30.3965 29.4160 30.3965 (56)
If cylinder contains dedicated solar storage
30.3965 27.4549 30.3965 29.4160 30.3965 29.4160 30.3965 30.3965 29.4160 30.3965 29.4160 30.3965 (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
224.6540 198.0195 207.9846 186.4729 182.7580 163.3306 156.8898 172.1179 171.8018 193.3603 204.4229 219.2586 (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
224.6540 198.0195 207.9846 186.4729 182.7580 163.3306 156.8898 172.1179 171.8018 193.3603 204.4229 219.2586 (64)
Total per year (kWh/year) = Sum(64)m = 2281.0710 (64)
Heat gains from water heating, kWh/month
99.7830 88.4994 94.2404 86.2786 85.8525 78.5838 77.2514 82.3147 81.4004 89.3778 92.2469 97.9890 (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	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	31.1985	27.7103	22.5355	17.0608	12.7532	10.7668	11.6339	15.1221	20.2969	25.7716	30.0792	32.0656	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	349.9527	353.5841	344.4331	324.9516	300.3597	277.2468	261.8059	258.1745	267.3256	286.8071	311.3989	334.5118	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	(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)													
	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	(71)
Water heating gains (Table 5)													
	134.1169	131.6955	126.6672	119.8313	115.3932	109.1441	103.8325	110.6381	113.0561	120.1315	128.1207	131.7056	(72)
Total internal gains													
	585.8724	583.5942	564.2401	532.4480	499.1103	467.7619	447.8766	454.5390	471.2829	503.3144	540.2032	568.8874	(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	
East	68.2300	19.6403	0.3600	1.0000	0.7700	334.3170	(76)
South	24.5700	46.7521	0.3600	1.0000	0.7700	286.5772	(78)

Solar gains	620.8942	1123.3346	1674.8920	2246.5000	2629.1943	2648.2753	2538.2204	2254.5486	1877.1686	1282.2469	756.5457	522.5551	(83)
Total gains	1206.7666	1706.9287	2239.1320	2778.9479	3128.3047	3116.0372	2986.0970	2709.0876	2348.4515	1785.5613	1296.7489	1091.4425	(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	20.7042	20.7760	20.8482	21.2169	21.2923	21.6770	21.6770	21.7557	21.5215	21.2923	21.1421	20.9941	
alpha	2.3803	2.3851	2.3899	2.4145	2.4195	2.4451	2.4451	2.4504	2.4348	2.4195	2.4095	2.3996	
util living area													
	0.9589	0.9141	0.8372	0.7129	0.5697	0.4270	0.3207	0.3626	0.5620	0.8056	0.9316	0.9668	(86)
MIT	18.8877	19.2801	19.7781	20.2883	20.6173	20.7958	20.8562	20.8439	20.6978	20.1897	19.4323	18.8266	(87)
Th 2	19.8084	19.8120	19.8156	19.8336	19.8372	19.8554	19.8554	19.8590	19.8481	19.8372	19.8300	19.8228	(88)
util rest of house													
	0.9524	0.9014	0.8146	0.6765	0.5188	0.3615	0.2428	0.2806	0.4927	0.7698	0.9193	0.9614	(89)
MIT 2	17.0007	17.5633	18.2648	18.9698	19.3929	19.6166	19.6752	19.6701	19.5129	18.8662	17.8027	16.9218	(90)
Living area fraction									fLA = Living area / (4) =			0.2873	(91)
MIT	17.5428	18.0565	18.6996	19.3485	19.7447	19.9554	20.0145	20.0073	19.8533	19.2464	18.2709	17.4690	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.5428	18.0565	18.6996	19.3485	19.7447	19.9554	20.0145	20.0073	19.8533	19.2464	18.2709	17.4690	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9353	0.8776	0.7895	0.6598	0.5145	0.3675	0.2540	0.2917	0.4930	0.7484	0.8978	0.9466	(94)
Useful gains	1128.6950	1498.0375	1767.7697	1833.5776	1609.3676	1145.0367	758.4086	790.1131	1157.8426	1336.3507	1164.1908	1033.1138	(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													
	3168.4115	3136.8986	2898.6652	2439.4641	1871.5771	1223.8021	780.2783	821.3573	1324.2413	2011.5812	2617.3362	3130.8462	(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													
	1517.5491	1101.3146	841.3862	436.2383	195.0839	0.0000	0.0000	0.0000	0.0000	502.3714	1046.2647	1560.7129	(98)
Space heating												7200.9211	(98)
Space heating per m2										(98) / (4) =		40.3798	(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	2148.0774	1691.0397	1730.4664	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8724	0.9100	0.8895	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1874.0477	1538.8358	1539.1894	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3760.5366	3605.7111	3284.2529	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	1358.2720	1537.7553	1298.3273	0.0000	0.0000	0.0000	0.0000	(104)

Space cooling 4194.3546 (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	339.5680	384.4388	324.5818	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling 1048.5886 (107)
Space cooling per m2 5.8800 (108)

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 %) 170.0000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4235.8359 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.0000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1517.5491	1101.3146	841.3862	436.2383	195.0839	0.0000	0.0000	0.0000	0.0000	502.3714	1046.2647	1560.7129	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	892.6759	647.8321	494.9331	256.6108	114.7552	0.0000	0.0000	0.0000	0.0000	295.5126	615.4498	918.0664	(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

224.6540	198.0195	207.9846	186.4729	182.7580	163.3306	156.8898	172.1179	171.8018	193.3603	204.4229	219.2586	(64)

Efficiency of water heater 170.0000 (216)

(217)m 170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)

Fuel for water heating, kWh/month

132.1494	116.4821	122.3439	109.6899	107.5047	96.0768	92.2881	101.2458	101.0599	113.7413	120.2488	128.9756	(219)

Water heating fuel used 1341.8064 (219)
Space cooling fuel requirement

(221)m 0.0000	0.0000	0.0000	0.0000	0.0000	84.8920	96.1097	81.1455	0.0000	0.0000	0.0000	0.0000	(221)

Cooling 262.1472 (221)
Annual totals kWh/year
Space heating fuel - main system 4235.8359 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375)
mechanical ventilation fans (SFP = 0.9375) 538.8355 (230a)
central heating pump 30.0000 (230c)
Total electricity for the above, kWh/year 568.8355 (231)
Electricity for lighting (calculated in Appendix L) 550.9759 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.64 * 1080 * 1.00) = -1416.3363 -1416.3363 (233)
Total delivered energy for all uses 5543.2646 (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	4235.8359	0.5190	2198.3988	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1341.8064	0.5190	696.3975	(264)
Space and water heating			2894.7964	(265)
Space cooling	262.1472	0.5190	136.0544	(266)
Pumps and fans	568.8355	0.5190	295.2256	(267)
Energy for lighting	550.9759	0.5190	285.9565	(268)
Energy saving/generation technologies				
PV Unit	-1416.3363	0.5190	-735.0785	(269)
Total CO2, kg/year			2876.9543	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.1300	(273)

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

DER		16.1300	ZC1
Total Floor Area	TFA	178.3300	
Assumed number of occupants	N	2.9736	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		11.6287	ZC2
CO2 emissions from cooking, equation (L16)		1.0675	ZC3
Total CO2 emissions		28.8262	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		28.8262	ZC8

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	148.5100 (1b)	x	2.6000 (2b)	=	386.1260 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	178.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		471.1130	(5)

2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.2500 (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) =	0.2125 (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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Balanced mechanical ventilation with heat recovery	
If mechanical ventilation:	0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	54.6000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.4979	0.4926	0.4873	0.4608	0.4554	0.4289	0.4289	0.4236	0.4395	0.4554	0.4661	0.4767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 0.93)			92.8000	0.8966	83.2086			(27)
penthouse floor			148.5100	0.1500	22.2765			(28a)
External Wall 1	80.5100	59.4800	21.0300	0.9300	19.5579			(29a)
External Wall 2	44.9600	33.3200	11.6400	0.9300	10.8252			(29a)
penthouse roof	118.6900		118.6900	0.1000	11.8690			(30)
garden room roof	29.8200		29.8200	0.1000	2.9820			(30)
Total net area of external elements Aum(A, m2)			422.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		150.7192			(33)
Party Wall 1			84.7700	0.0000	0.0000			(32)
Party Wall 2			27.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.1236 (36)
Total fabric heat loss (33) + (36) =	161.8428 (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	77.4130	76.5871	75.7612	71.6316	70.8056	66.6760	66.6760	65.8501	68.3279	70.8056	72.4575	74.1093	(38)
Heat transfer coeff	239.2558	238.4299	237.6040	233.4744	232.6485	228.5189	228.5189	227.6930	230.1707	232.6485	234.3003	235.9522	(39)

Average = Sum(39)m / 12 = 233.2679 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3416	1.3370	1.3324	1.3092	1.3046	1.2814	1.2814	1.2768	1.2907	1.3046	1.3139	1.3231	(40)
HLP (average)												1.3081	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9736 (42)
Average daily hot water use (litres/day)	104.8234 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.3058	111.1128	106.9199	102.7270	98.5340	94.3411	94.3411	98.5340	102.7270	106.9199	111.1128	115.3058	(44)
Energy conte	170.9951	149.5534	154.3258	134.5449	129.0991	111.4027	103.2310	118.4590	119.8738	139.7014	152.4950	165.5997	(45)
Energy content (annual)											Total = Sum(45)m =	1649.2809	(45)
Distribution loss (46)m = 0.15 x (45)m	25.6493	22.4330	23.1489	20.1817	19.3649	16.7104	15.4846	17.7689	17.9811	20.9552	22.8742	24.8400	(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)

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
238.7857 210.7837 222.1164 200.1487 196.8897 177.0065 171.0216 186.2496 185.4776 207.4920 218.0988 233.3903 (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
238.7857 210.7837 222.1164 200.1487 196.8897 177.0065 171.0216 186.2496 185.4776 207.4920 218.0988 233.3903 (64)
Total per year (kWh/year) = Sum(64)m = 2447.4604 (64)
Heat gains from water heating, kWh/month
111.0884 98.7107 105.5458 97.2192 97.1579 89.5244 88.5568 93.6201 92.3411 100.6832 103.1876 109.2944 (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	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
31.1985 27.7103 22.5355 17.0608 12.7532 10.7668 11.6339 15.1221 20.2969 25.7716 30.0792 32.0656 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
349.9527 353.5841 344.4331 324.9516 300.3597 277.2468 261.8059 258.1745 267.3256 286.8071 311.3989 334.5118 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
37.8681 37.8681 37.8681 37.8681 37.8681 37.8681 37.8681 37.8681 37.8681 37.8681 37.8681 37.8681 (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)
-118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 (71)
Water heating gains (Table 5)
149.3123 146.8909 141.8626 135.0267 130.5886 124.3395 119.0279 125.8335 128.2515 135.3269 143.3161 146.9010 (72)
Total internal gains
601.0678 598.7895 579.4354 547.6434 514.3057 482.9573 463.0720 469.7344 486.4782 518.5098 555.3986 584.0828 (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	
East	68.2300	19.6403	0.3600	1.0000	0.7700	334.3170	(76)
South	24.5700	46.7521	0.3600	1.0000	0.7700	286.5772	(78)

Solar gains	620.8942	1123.3346	1674.8920	2246.5000	2629.1943	2648.2753	2538.2204	2254.5486	1877.1686	1282.2469	756.5457	522.5551	(83)
Total gains	1221.9620	1722.1241	2254.3274	2794.1433	3143.5000	3131.2326	3001.2924	2724.2830	2363.6469	1800.7567	1311.9443	1106.6379	(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	20.7042	20.7760	20.8482	21.2169	21.2923	21.6770	21.6770	21.7557	21.5215	21.2923	21.1421	20.9941	
alpha	2.3803	2.3851	2.3899	2.4145	2.4195	2.4451	2.4451	2.4504	2.4348	2.4195	2.4095	2.3996	
util living area	0.9579	0.9127	0.8355	0.7110	0.5678	0.4254	0.3193	0.3608	0.5595	0.8032	0.9301	0.9658	(86)
MIT	18.3459	18.8671	19.5284	20.2040	20.6398	20.8748	20.9548	20.9383	20.7462	20.0745	19.0693	18.2636	(87)
Th 2	19.8084	19.8120	19.8156	19.8336	19.8372	19.8554	19.8554	19.8590	19.8481	19.8372	19.8300	19.8228	(88)
util rest of house	0.9512	0.8999	0.8128	0.6746	0.5169	0.3600	0.2417	0.2791	0.4903	0.7671	0.9176	0.9603	(89)
MIT 2	17.4145	17.9248	18.5608	19.1994	19.5823	19.7847	19.8376	19.8330	19.6913	19.1073	18.1436	17.3432	(90)
Living area fraction									fLA = Living area / (4) =			0.2873	(91)
MIT	17.6821	18.1955	18.8388	19.4880	19.8861	20.0978	20.1585	20.1505	19.9943	19.3852	18.4095	17.6076	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6821	18.1955	18.8388	19.4880	19.8861	20.0978	20.1585	20.1505	19.9943	19.3852	18.4095	17.6076	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9351	0.8780	0.7909	0.6627	0.5192	0.3743	0.2627	0.3007	0.4997	0.7509	0.8979	0.9462	(94)
Useful gains	1142.5989	1511.9589	1782.8436	1851.7001	1632.1036	1172.0822	788.5737	819.1664	1181.0183	1352.1487	1177.9962	1047.0978	(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	3201.7369	3170.0497	2931.7421	2472.0336	1904.4831	1256.3624	813.1844	853.9667	1356.7031	2043.8555	2649.8308	3163.5585	(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	1531.9987	1114.2370	854.7805	446.6401	202.6503	0.0000	0.0000	0.0000	0.0000	514.6299	1059.7209	1574.6467	(98)

Space heating 7299.3041 (98)
Space heating per m2 (98) / (4) = 40.9314 (99)

8c. Space cooling requirement

Not applicable

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

DER		15.5900 ZC1
Total Floor Area	TFA	178.3300
Assumed number of occupants	N	2.9736
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		11.6287 ZC2
CO2 emissions from cooking, equation (L16)		1.0675 ZC3
Total CO2 emissions		28.2862 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	28.2862	ZC8

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	148.5100 (1b)	x	2.6000 (2b)	=	386.1260 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	178.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		471.1130	(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) =	0.0849	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3349	(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) =	0.2847	(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	0.3630	0.3558	0.3487	0.3131	0.3060	0.2704	0.2704	0.2633	0.2847	0.3060	0.3203	0.3345	(22b)
Effective ac	0.5659	0.5633	0.5608	0.5490	0.5468	0.5366	0.5366	0.5347	0.5405	0.5468	0.5513	0.5559	(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 Opening Type Curtain (Uw = 1.50)			44.5800	1.4151	63.0849			(27)
penthouse floor			148.5100	0.1300	19.3063			(28a)
External Wall 1	80.5100	28.5700	51.9400	0.1800	9.3492			(29a)
External Wall 2	44.9600	16.0100	28.9500	0.1800	5.2110			(29a)
penthouse roof	118.6900		118.6900	0.1300	15.4297			(30)
garden room roof	29.8200		29.8200	0.1300	3.8766			(30)
Total net area of external elements Aum(A, m2)			422.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		116.2577			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		10.0197 (36)
Total fabric heat loss	(33) + (36) =	126.2774 (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	87.9739	87.5763	87.1865	85.3558	85.0133	83.4187	83.4187	83.1235	84.0329	85.0133	85.7062	86.4306	(38)
Heat transfer coeff	214.2513	213.8537	213.4639	211.6332	211.2907	209.6962	209.6962	209.4009	210.3103	211.2907	211.9836	212.7080	(39)
Average = Sum(39)m / 12 =												211.6315	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2014	1.1992	1.1970	1.1868	1.1848	1.1759	1.1759	1.1742	1.1793	1.1848	1.1887	1.1928	(40)
HLP (average)												1.1867	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9736 (42)
Average daily hot water use (litres/day)	104.8234 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.3058	111.1128	106.9199	102.7270	98.5340	94.3411	94.3411	98.5340	102.7270	106.9199	111.1128	115.3058	(44)
Energy conte	170.9951	149.5534	154.3258	134.5449	129.0991	111.4027	103.2310	118.4590	119.8738	139.7014	152.4950	165.5997	(45)
Energy content (annual)										Total = Sum(45)m =		1649.2809	(45)
Distribution loss (46)m = 0.15 x (45)m	25.6493	22.4330	23.1489	20.1817	19.3649	16.7104	15.4846	17.7689	17.9811	20.9552	22.8742	24.8400	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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	220.2378	194.0307	203.5684	182.1991	178.3417	159.0569	152.4736	167.7017	167.5280	188.9440	200.1492	214.8423	(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	220.2378	194.0307	203.5684	182.1991	178.3417	159.0569	152.4736	167.7017	167.5280	188.9440	200.1492	214.8423	(64)
Total per year (kWh/year) = Sum(64)m =												2229.0736	(64)
Heat gains from water heating, kWh/month	96.2500	85.3083	90.7075	82.8595	82.3196	75.1647	73.7184	78.7818	77.9814	85.8448	88.8279	94.4560	(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	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	31.1985	27.7103	22.5355	17.0608	12.7532	10.7668	11.6339	15.1221	20.2969	25.7716	30.0792	32.0656	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	349.9527	353.5841	344.4331	324.9516	300.3597	277.2468	261.8059	258.1745	267.3256	286.8071	311.3989	334.5118	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	(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)													
	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	(71)
Water heating gains (Table 5)													
	129.3683	126.9469	121.9186	115.0827	110.6446	104.3955	99.0839	105.8895	108.3075	115.3829	123.3721	126.9570	(72)
Total internal gains													
	581.1238	578.8455	559.4914	527.6994	494.3617	463.0133	443.1280	449.7904	466.5342	498.5658	535.4546	564.1388	(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	
East	32.7700	19.6403	0.6300	0.7000	0.7700	196.6960	(76)
South	11.8100	46.7521	0.6300	0.7000	0.7700	168.7417	(78)

Solar gains	365.4378	661.1346	985.7043	1322.0472	1547.2194	1558.4334	1493.6752	1326.7674	1104.7266	754.6482	445.2733	307.5616	(83)
Total gains	946.5616	1239.9802	1545.1958	1849.7466	2041.5811	2021.4467	1936.8031	1776.5578	1571.2608	1253.2140	980.7279	871.7004	(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	57.8014	57.9089	58.0146	58.5165	58.6113	59.0570	59.0570	59.1403	58.8845	58.6113	58.4198	58.2208	
alpha	4.8534	4.8606	4.8676	4.9011	4.9074	4.9371	4.9371	4.9427	4.9256	4.9074	4.8947	4.8814	
util living area													
	0.9988	0.9955	0.9827	0.9339	0.8145	0.6315	0.4699	0.5298	0.7966	0.9717	0.9969	0.9992	(86)
MIT	19.6265	19.8472	20.1766	20.5641	20.8418	20.9657	20.9934	20.9885	20.8955	20.4873	19.9704	19.5878	(87)
Th 2	19.9189	19.9206	19.9224	19.9306	19.9322	19.9393	19.9393	19.9407	19.9366	19.9322	19.9290	19.9258	(88)
util rest of house													
	0.9984	0.9940	0.9766	0.9111	0.7581	0.5401	0.3600	0.4141	0.7153	0.9577	0.9956	0.9990	(89)
MIT 2	18.0838	18.4072	18.8852	19.4333	19.7852	19.9180	19.9371	19.9362	19.8571	19.3407	18.5939	18.0321	(90)
Living area fraction									fLA = Living area / (4) =			0.2873	(91)
MIT	18.5270	18.8208	19.2562	19.7581	20.0888	20.2189	20.2405	20.2385	20.1554	19.6701	18.9894	18.4790	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5270	18.8208	19.2562	19.7581	20.0888	20.2189	20.2405	20.2385	20.1554	19.6701	18.9894	18.4790	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9917	0.9715	0.9067	0.7672	0.5652	0.3917	0.4475	0.7339	0.9531	0.9940	0.9984	(94)
Useful gains	944.3222	1229.6715	1501.2229	1677.2202	1566.2288	1142.6141	758.7218	794.9770	1153.1063	1194.4961	974.8015	870.2961	(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	3048.1525	2977.0233	2722.9840	2297.9411	1772.4651	1178.2706	763.4057	803.7883	1273.5144	1916.4281	2520.3481	3037.2548	(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	1565.2497	1174.2204	908.9903	446.9190	153.4399	0.0000	0.0000	0.0000	0.0000	537.1174	1112.7935	1612.2173	(98)
Space heating												7510.9475	(98)
Space heating per m2											(98) / (4) =	42.1182	(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												8033.0990	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1565.2497	1174.2204	908.9903	446.9190	153.4399	0.0000	0.0000	0.0000	0.0000	537.1174	1112.7935	1612.2173	(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)													

	1674.0639	1255.8507	972.1821	477.9883	164.1068	0.0000	0.0000	0.0000	0.0000	574.4571	1190.1535	1724.2966 (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												
	220.2378	194.0307	203.5684	182.1991	178.3417	159.0569	152.4736	167.7017	167.5280	188.9440	200.1492	214.8423 (64)
Efficiency of water heater												79.8000 (216)
(217)m	89.0276	88.8113	88.3328	87.1170	84.4158	79.8000	79.8000	79.8000	79.8000	87.4486	88.6872	89.0952 (217)
Fuel for water heating, kWh/month												
	247.3816	218.4752	230.4561	209.1430	211.2659	199.3194	191.0697	210.1525	209.9349	216.0629	225.6799	241.1378 (219)
Water heating fuel used												2610.0790 (219)
Annual totals kWh/year												
Space heating fuel - main system												8033.0990 (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)												550.9759 (232)
Total delivered energy for all uses												11269.1538 (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	8033.0990	0.2160	1735.1494	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2610.0790	0.2160	563.7771	(264)
Space and water heating			2298.9264	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	550.9759	0.5190	285.9565	(268)
Total CO2, kg/m2/year			2623.8079	(272)
Emissions per m2 for space and water heating			12.8914	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.6035	(272b)
Emissions per m2 for pumps and fans			0.2183	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.8914 * 1.55) + 1.6035 + 0.2183, rounded to 2 d.p.			21.8000	(273)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	148.5100 (1b)	x	2.6000 (2b)	=	386.1260 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	178.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		471.1130	(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) =	0.0849	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3349	(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) =	0.2847	(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	0.3630	0.3558	0.3487	0.3131	0.3060	0.2704	0.2704	0.2633	0.2847	0.3060	0.3203	0.3345	(22b)
Effective ac	0.5659	0.5633	0.5608	0.5490	0.5468	0.5366	0.5366	0.5347	0.5405	0.5468	0.5513	0.5559	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 0.93)			92.8000	0.8966	83.2086			(27)
penthouse floor			148.5100	0.1500	22.2765			(28a)
External Wall 1	80.5100	59.4800	21.0300	0.9300	19.5579			(29a)
External Wall 2	44.9600	33.3200	11.6400	0.9300	10.8252			(29a)
penthouse roof	118.6900		118.6900	0.1000	11.8690			(30)
garden room roof	29.8200		29.8200	0.1000	2.9820			(30)
Total net area of external elements Aum(A, m2)			422.4900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	150.7192			(33)
Party Wall 1			84.7700	0.0000	0.0000			(32)
Party Wall 2			27.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.1236 (36)
Total fabric heat loss	(33) + (36) =	161.8428 (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	87.9739	87.5763	87.1865	85.3558	85.0133	83.4187	83.4187	83.1235	84.0329	85.0133	85.7062	86.4306	(38)
Heat transfer coeff	249.8168	249.4191	249.0293	247.1986	246.8561	245.2616	245.2616	244.9663	245.8758	246.8561	247.5490	248.2734	(39)
Average = Sum(39)m / 12 =												247.1970	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4009	1.3986	1.3965	1.3862	1.3843	1.3753	1.3753	1.3737	1.3788	1.3843	1.3882	1.3922	(40)
HLP (average)												1.3862	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9736 (42)
Average daily hot water use (litres/day)	104.8234 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.3058	111.1128	106.9199	102.7270	98.5340	94.3411	94.3411	98.5340	102.7270	106.9199	111.1128	115.3058	(44)
Energy conte	170.9951	149.5534	154.3258	134.5449	129.0991	111.4027	103.2310	118.4590	119.8738	139.7014	152.4950	165.5997	(45)
Energy content (annual)										Total = Sum(45)m =		1649.2809	(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	36.3365	31.7801	32.7942	28.5908	27.4336	23.6731	21.9366	25.1725	25.4732	29.6865	32.4052	35.1899	(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	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	(66)

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

	31.1985	27.7103	22.5355	17.0608	12.7532	10.7668	11.6339	15.1221	20.2969	25.7716	30.0792	32.0656	(67)

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

	349.9527	353.5841	344.4331	324.9516	300.3597	277.2468	261.8059	258.1745	267.3256	286.8071	311.3989	334.5118	(68)

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

	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	(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)

	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	(71)

Water heating gains (Table 5)

	48.8393	47.2918	44.0783	39.7094	36.8731	32.8793	29.4847	33.8341	35.3794	39.9013	45.0072	47.2983	(72)
Total internal gains													
	497.5948	496.1905	478.6511	449.3261	417.5902	388.4971	370.5287	374.7350	390.6062	420.0842	454.0897	481.4801	(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	
East	68.2300	19.6403	0.3600	1.0000	0.7700	334.3170	(76)
South	24.5700	46.7521	0.3600	1.0000	0.7700	286.5772	(78)

Solar gains	620.8942	1123.3346	1674.8920	2246.5000	2629.1943	2648.2753	2538.2204	2254.5486	1877.1686	1282.2469	756.5457	522.5551	(83)
Total gains	1118.4890	1619.5250	2153.5431	2695.8261	3046.7845	3036.7724	2908.7491	2629.2836	2267.7748	1702.3311	1210.6354	1004.0352	(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	19.8290	19.8606	19.8917	20.0390	20.0668	20.1973	20.1973	20.2216	20.1468	20.0668	20.0106	19.9522	
alpha	2.3219	2.3240	2.3261	2.3359	2.3378	2.3465	2.3465	2.3481	2.3431	2.3378	2.3340	2.3301	
util living area													
	0.9651	0.9240	0.8522	0.7357	0.5967	0.4573	0.3474	0.3930	0.5944	0.8272	0.9416	0.9723	(86)
MIT	18.1496	18.6763	19.3611	20.0668	20.5573	20.8317	20.9361	20.9130	20.6764	19.9259	18.8705	18.0471	(87)
Th 2	19.7627	19.7644	19.7661	19.7739	19.7754	19.7823	19.7823	19.7836	19.7796	19.7754	19.7724	19.7693	(88)
util rest of house													
	0.9594	0.9122	0.8305	0.6992	0.5435	0.3852	0.2593	0.3006	0.5211	0.7926	0.9306	0.9676	(89)
MIT 2	17.1913	17.7074	18.3676	19.0303	19.4626	19.6882	19.7578	19.7477	19.5803	18.9269	17.9118	17.0946	(90)
Living area fraction										fLA = Living area / (4) =		0.2873	(91)
MIT	17.4666	17.9858	18.6530	19.3280	19.7771	20.0167	20.0963	20.0825	19.8952	19.2139	18.1872	17.3682	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4666	17.9858	18.6530	19.3280	19.7771	20.0167	20.0963	20.0825	19.8952	19.2139	18.1872	17.3682	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9445	0.8905	0.8071	0.6844	0.5436	0.3997	0.2828	0.3243	0.5286	0.7737	0.9115	0.9549	(94)
Useful gains	1056.4530	1442.1771	1738.1142	1845.0472	1656.1352	1213.9076	822.4973	852.6447	1198.8157	1317.1764	1103.4848	958.7109	(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													
	3289.2335	3263.8383	3026.4484	2577.7947	1993.8797	1328.5154	857.5046	902.0880	1424.8967	2126.4002	2744.6265	3269.3184	(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													
	1661.1887	1224.1563	958.5207	527.5782	251.2819	0.0000	0.0000	0.0000	0.0000	602.0626	1181.6221	1719.0920	(98)
Space heating												8125.5025	(98)
Space heating per m2											(98) / (4) =	45.5644	(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	2305.4589	1814.9357	1861.7439	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8427	0.8857	0.8604	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1942.7017	1607.5614	1601.9322	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3684.2718	3531.3632	3207.4489	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	1253.9304	1431.3086	1194.5044	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												3879.7434	(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	313.4826	357.8271	298.6261	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												969.9359	(107)
Space cooling per m2												5.4390	(108)
Energy for space heating												45.5644	(99)
Energy for space cooling												5.4390	(108)
Total												51.0034	(109)
Dwelling Fabric Energy Efficiency (DFEE)												51.0	(109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	148.5100 (1b)	x	2.6000 (2b)	=	386.1260 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	178.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	471.1130	(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) =	0.0849	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3349	(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) =	0.2847	(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	0.3630	0.3558	0.3487	0.3131	0.3060	0.2704	0.2704	0.2633	0.2847	0.3060	0.3203	0.3345	(22b)
Effective ac	0.5659	0.5633	0.5608	0.5490	0.5468	0.5366	0.5366	0.5347	0.5405	0.5468	0.5513	0.5559	(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 Opening Type Curtain (Uw = 1.50)			44.5800	1.4151	63.0849			(27)
penthouse floor			148.5100	0.1300	19.3063			(28a)
External Wall 1	80.5100	28.5700	51.9400	0.1800	9.3492			(29a)
External Wall 2	44.9600	16.0100	28.9500	0.1800	5.2110			(29a)
penthouse roof	118.6900		118.6900	0.1300	15.4297			(30)
garden room roof	29.8200		29.8200	0.1300	3.8766			(30)
Total net area of external elements Aum(A, m2)			422.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		116.2577			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.0197	(36)
Total fabric heat loss	(33) + (36) = 126.2774	(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	87.9739	87.5763	87.1865	85.3558	85.0133	83.4187	83.4187	83.1235	84.0329	85.0133	85.7062	86.4306	(38)
Heat transfer coeff	214.2513	213.8537	213.4639	211.6332	211.2907	209.6962	209.6962	209.4009	210.3103	211.2907	211.9836	212.7080	(39)
Average = Sum(39)m / 12 =												211.6315	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2014	1.1992	1.1970	1.1868	1.1848	1.1759	1.1759	1.1742	1.1793	1.1848	1.1887	1.1928	(40)
HLP (average)												1.1867	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9736	(42)
Average daily hot water use (litres/day)	104.8234	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.3058	111.1128	106.9199	102.7270	98.5340	94.3411	94.3411	98.5340	102.7270	106.9199	111.1128	115.3058	(44)
Energy conte	170.9951	149.5534	154.3258	134.5449	129.0991	111.4027	103.2310	118.4590	119.8738	139.7014	152.4950	165.5997	(45)
Energy content (annual)										Total = Sum(45)m =		1649.2809	(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	36.3365	31.7801	32.7942	28.5908	27.4336	23.6731	21.9366	25.1725	25.4732	29.6865	32.4052	35.1899	(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	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	148.6809	(66)

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

	31.1985	27.7103	22.5355	17.0608	12.7532	10.7668	11.6339	15.1221	20.2969	25.7716	30.0792	32.0656	(67)

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

	349.9527	353.5841	344.4331	324.9516	300.3597	277.2468	261.8059	258.1745	267.3256	286.8071	311.3989	334.5118	(68)

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

	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	37.8681	(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)

	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	(71)

Water heating gains (Table 5)

	48.8393	47.2918	44.0783	39.7094	36.8731	32.8793	29.4847	33.8341	35.3794	39.9013	45.0072	47.2983	(72)

Total internal gains

	497.5948	496.1905	478.6511	449.3261	417.5902	388.4971	370.5287	374.7350	390.6062	420.0842	454.0897	481.4801	(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	
East	32.7700	19.6403	0.6300	0.7000	0.7700	196.6960	(76)
South	11.8100	46.7521	0.6300	0.7000	0.7700	168.7417	(78)

Solar gains	365.4378	661.1346	985.7043	1322.0472	1547.2194	1558.4334	1493.6752	1326.7674	1104.7266	754.6482	445.2733	307.5616	(83)
Total gains	863.0326	1157.3251	1464.3554	1771.3733	1964.8096	1946.9305	1864.2039	1701.5024	1495.3328	1174.7324	899.3630	789.0417	(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	57.8014	57.9089	58.0146	58.5165	58.6113	59.0570	59.0570	59.1403	58.8845	58.6113	58.4198	58.2208	
alpha	4.8534	4.8606	4.8676	4.9011	4.9074	4.9371	4.9371	4.9427	4.9256	4.9074	4.8947	4.8814	
util living area	0.9992	0.9967	0.9860	0.9429	0.8308	0.6510	0.4871	0.5508	0.8185	0.9779	0.9979	0.9995	(86)
MIT	19.5831	19.8049	20.1377	20.5341	20.8259	20.9609	20.9923	20.9864	20.8810	20.4512	19.9284	19.5447	(87)
Th 2	19.9189	19.9206	19.9224	19.9306	19.9322	19.9393	19.9393	19.9407	19.9366	19.9322	19.9290	19.9258	(88)
util rest of house	0.9990	0.9955	0.9810	0.9224	0.7764	0.5585	0.3738	0.4317	0.7402	0.9666	0.9970	0.9993	(89)
MIT 2	18.6227	18.8453	19.1764	19.5642	19.8203	19.9225	19.9375	19.9370	19.8734	19.4945	18.9758	18.5898	(90)
Living area fraction										fLA = Living area / (4) =		0.2873	(91)
MIT	18.8986	19.1210	19.4526	19.8428	20.1091	20.2208	20.2405	20.2385	20.1629	19.7693	19.2494	18.8642	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8986	19.1210	19.4526	19.8428	20.1091	20.2208	20.2405	20.2385	20.1629	19.7693	19.2494	18.8642	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9986	0.9943	0.9782	0.9204	0.7864	0.5843	0.4065	0.4662	0.7589	0.9644	0.9962	0.9991	(94)
Useful gains	861.8249	1150.7559	1432.3654	1630.4229	1545.1164	1137.5328	757.8858	793.2445	1134.8570	1132.8544	895.9606	788.3228	(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	3127.7707	3041.2157	2764.9029	2315.8608	1776.7747	1178.6557	763.4043	803.7812	1275.0803	1937.3975	2575.4820	3119.1836	(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	1685.8637	1270.3890	991.4079	493.5153	172.3537	0.0000	0.0000	0.0000	0.0000	598.5801	1209.2554	1734.1605	(98)
Space heating												8155.5255	(98)
Space heating per m2											(98) / (4) =	45.7328	(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	1971.1438	1551.7515	1591.4466	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9032	0.9492	0.9265	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1780.3078	1472.9376	1474.4566	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2410.4306	2310.4662	2123.0293	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	453.6884	623.1213	482.5381	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1559.3478	(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	113.4221	155.7803	120.6345	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												389.8370	(107)
Space cooling per m2												2.1860	(108)
Energy for space heating												45.7328	(99)
Energy for space cooling												2.1860	(108)
Total												47.9188	(109)
Target Fabric Energy Efficiency (TFEE)												55.1	(109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	148.5100 (1b)	x	2.6000 (2b)	=	386.1260 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	178.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		471.1130	(5)

2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.2500 (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) =	0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2231	0.2125	0.2125	0.1966	0.1966	0.1753	0.1806	0.1700	0.1753	0.1859	0.1859	0.2019	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	54.6000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.4501	0.4395	0.4395	0.4236	0.4236	0.4023	0.4076	0.3970	0.4023	0.4129	0.4129	0.4289	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 0.93)			92.8000	0.8966	83.2086			(27)
penthouse floor			148.5100	0.1500	22.2765			(28a)
External Wall 1	80.5100	59.4800	21.0300	0.9300	19.5579			(29a)
External Wall 2	44.9600	33.3200	11.6400	0.9300	10.8252			(29a)
penthouse roof	118.6900		118.6900	0.1000	11.8690			(30)
garden room roof	29.8200		29.8200	0.1000	2.9820			(30)
Total net area of external elements Aum(A, m2)			422.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		150.7192			(33)
Party Wall 1			84.7700	0.0000	0.0000			(32)
Party Wall 2			27.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.1236 (36)
Total fabric heat loss (33) + (36) =	161.8428 (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	69.9797	68.3279	68.3279	65.8501	65.8501	62.5464	63.3724	61.7205	62.5464	64.1983	64.1983	66.6760	(38)
Heat transfer coeff	231.8226	230.1707	230.1707	227.6930	227.6930	224.3893	225.2152	223.5634	224.3893	226.0411	226.0411	228.5189	(39)
Average = Sum(39)m / 12 =												227.1423	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3000	1.2907	1.2907	1.2768	1.2768	1.2583	1.2629	1.2536	1.2583	1.2675	1.2675	1.2814	(40)
HLP (average)												1.2737	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9736 (42)
Average daily hot water use (litres/day)	104.8234 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.3058	111.1128	106.9199	102.7270	98.5340	94.3411	94.3411	98.5340	102.7270	106.9199	111.1128	115.3058	(44)
Energy conte	170.9951	149.5534	154.3258	134.5449	129.0991	111.4027	103.2310	118.4590	119.8738	139.7014	152.4950	165.5997	(45)
Energy content (annual)											Total = Sum(45)m =	1649.2809	(45)
Distribution loss (46)m = 0.15 x (45)m	25.6493	22.4330	23.1489	20.1817	19.3649	16.7104	15.4846	17.7689	17.9811	20.9552	22.8742	24.8400	(46)

Water storage loss:	
Store volume	180.0000 (47)
b) If manufacturer declared loss factor is not known :	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115 (51)
Volume factor from Table 2a	0.8736 (52)
Temperature factor from Table 2b	0.5400 (53)

Enter (49) or (54) in (55) 0.9805 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	30.3965	27.4549	30.3965	29.4160	30.3965	29.4160	30.3965	30.3965	29.4160	30.3965	29.4160	30.3965	(56)
If cylinder contains dedicated solar storage	30.3965	27.4549	30.3965	29.4160	30.3965	29.4160	30.3965	30.3965	29.4160	30.3965	29.4160	30.3965	(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	224.6540	198.0195	207.9846	186.4729	182.7580	163.3306	156.8898	172.1179	171.8018	193.3603	204.4229	219.2586	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from w/h	224.6540	198.0195	207.9846	186.4729	182.7580	163.3306	156.8898	172.1179	171.8018	193.3603	204.4229	219.2586	(64)

Total per year (kWh/year) = Sum(64)m = 2281.0710 (64)

RHI water heating demand 2281 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	99.7830	88.4994	94.2404	86.2786	85.8525	78.5838	77.2514	82.3147	81.4004	89.3778	92.2469	97.9890	(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	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	77.9963	69.2757	56.3388	42.6521	31.8829	26.9169	29.0847	37.8053	50.7422	64.4289	75.1981	80.1641	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	522.3174	527.7375	514.0792	485.0023	448.2980	413.8011	390.7551	385.3351	398.9934	428.0702	464.7745	499.2714	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153	(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)	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	(71)
Water heating gains (Table 5)	134.1169	131.6955	126.6672	119.8313	115.3932	109.1441	103.8325	110.6381	113.0561	120.1315	128.1207	131.7056	(72)
Total internal gains	852.7184	846.9963	815.3729	765.7734	713.8618	668.1498	641.9600	652.0662	681.0794	730.9183	786.3811	829.4289	(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	
East	68.2300	22.3313	0.3600	1.0000	0.7700	380.1241	(76)
South	24.5700	50.9848	0.3600	1.0000	0.7700	312.5229	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	692.6470	1128.2216	1663.1929	2302.2619	2629.0445	2836.2239	2687.9995	2438.3087	2021.5628	1375.4357	864.7555	577.2370	(83)
Total gains	1545.3654	1975.2179	2478.5657	3068.0353	3342.9064	3504.3738	3329.9595	3090.3749	2702.6422	2106.3540	1651.1366	1406.6658	(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	21.3681	21.5215	21.5215	21.7557	21.7557	22.0760	21.9950	22.1575	22.0760	21.9146	21.9146	21.6770	
alpha	2.4245	2.4348	2.4348	2.4504	2.4504	2.4717	2.4663	2.4772	2.4717	2.4610	2.4610	2.4451	
util living area	0.9256	0.8769	0.7862	0.6387	0.4810	0.3069	0.2061	0.2267	0.4370	0.7142	0.8773	0.9374	(86)
MIT	19.2786	19.5914	20.0434	20.4820	20.7371	20.8579	20.8829	20.8812	20.8045	20.4432	19.8154	19.2270	(87)
Th 2	19.8409	19.8481	19.8481	19.8590	19.8590	19.8737	19.8700	19.8773	19.8737	19.8663	19.8663	19.8554	(88)
util rest of house	0.9144	0.8597	0.7582	0.5972	0.4256	0.2420	0.1324	0.1491	0.3643	0.6674	0.8568	0.9277	(89)
MIT 2	17.5825	18.0276	18.6526	19.2399	19.5525	19.6927	19.7082	19.7151	19.6469	19.2176	18.3666	17.5195	(90)

Living area fraction fLA = Living area / (4) = 0.2873 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	18.0697	18.4769	19.0522	19.5968	19.8928	20.0275	20.0456	20.0501	19.9794	19.5697	18.7828	18.0100	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	18.0697	18.4769	19.0522	19.5968	19.8928	20.0275	20.0456	20.0501	19.9794	19.5697	18.7828	18.0100	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8922	0.8348	0.7363	0.5869	0.4273	0.2511	0.1441	0.1613	0.3714	0.6537	0.8329	0.9072	(94)
Useful gains	1378.7336	1648.9828	1824.8550	1800.5651	1428.5146	879.9680	479.6908	498.3444	1003.8134	1376.8230	1375.1988	1276.1676	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	3006.6717	2963.8742	2681.9874	2207.8817	1569.4438	903.7171	483.2317	503.0458	1072.4502	1801.4722	2437.3656	2950.1808	(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	1211.1859	883.6070	637.7065	293.2680	104.8514	0.0000	0.0000	0.0000	0.0000	315.9390	764.7601	1245.4658	(98)

Space heating 5456.7837 (98)

RHI space heating demand 5457 (98)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	148.5100 (1b)	x	2.6000 (2b)	=	386.1260 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	178.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		471.1130	(5)

2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.2500 (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) =	0.2125 (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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 54.6000 (23c)

Effective ac	0.4979	0.4926	0.4873	0.4608	0.4554	0.4289	0.4289	0.4236	0.4395	0.4554	0.4661	0.4767	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 0.93)			92.8000	0.8966	83.2086			(27)
penthouse floor			148.5100	0.1500	22.2765			(28a)
External Wall 1	80.5100	59.4800	21.0300	0.9300	19.5579			(29a)
External Wall 2	44.9600	33.3200	11.6400	0.9300	10.8252			(29a)
penthouse roof	118.6900		118.6900	0.1000	11.8690			(30)
garden room roof	29.8200		29.8200	0.1000	2.9820			(30)
Total net area of external elements Aum(A, m2)			422.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		150.7192			(33)
Party Wall 1			84.7700	0.0000	0.0000			(32)
Party Wall 2			27.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.1236 (36)
Total fabric heat loss (33) + (36) = 161.8428 (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	77.4130	76.5871	75.7612	71.6316	70.8056	66.6760	66.6760	65.8501	68.3279	70.8056	72.4575	74.1093	(38)
Heat transfer coeff	239.2558	238.4299	237.6040	233.4744	232.6485	228.5189	228.5189	227.6930	230.1707	232.6485	234.3003	235.9522	(39)

Average = Sum(39)m / 12 = 233.2679 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3416	1.3370	1.3324	1.3092	1.3046	1.2814	1.2814	1.2768	1.2907	1.3046	1.3139	1.3231	(40)
HLP (average)												1.3081	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9736 (42)
Average daily hot water use (litres/day) 104.8234 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.3058	111.1128	106.9199	102.7270	98.5340	94.3411	94.3411	98.5340	102.7270	106.9199	111.1128	115.3058	(44)
Energy conte	170.9951	149.5534	154.3258	134.5449	129.0991	111.4027	103.2310	118.4590	119.8738	139.7014	152.4950	165.5997	(45)
Energy content (annual)											Total = Sum(45)m =	1649.2809	(45)
Distribution loss (46)m = 0.15 x (45)m	25.6493	22.4330	23.1489	20.1817	19.3649	16.7104	15.4846	17.7689	17.9811	20.9552	22.8742	24.8400	(46)

Water storage loss:
Store volume 180.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0115 (51)
Volume factor from Table 2a 0.8736 (52)
Temperature factor from Table 2b 0.5400 (53)

Enter (49) or (54) in (55) 0.9805 (55)

Total storage loss

	30.3965	27.4549	30.3965	29.4160	30.3965	29.4160	30.3965	30.3965	29.4160	30.3965	29.4160	30.3965 (56)

If cylinder contains dedicated solar storage

	30.3965	27.4549	30.3965	29.4160	30.3965	29.4160	30.3965	30.3965	29.4160	30.3965	29.4160	30.3965 (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

	224.6540	198.0195	207.9846	186.4729	182.7580	163.3306	156.8898	172.1179	171.8018	193.3603	204.4229	219.2586 (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

	224.6540	198.0195	207.9846	186.4729	182.7580	163.3306	156.8898	172.1179	171.8018	193.3603	204.4229	219.2586 (64)

Total per year (kWh/year) = Sum(64)m = 2281.0710 (64)

Heat gains from water heating, kWh/month

	99.7830	88.4994	94.2404	86.2786	85.8525	78.5838	77.2514	82.3147	81.4004	89.3778	92.2469	97.9890 (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	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	(66)

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

	77.9963	69.2757	56.3388	42.6521	31.8829	26.9169	29.0847	37.8053	50.7422	64.4289	75.1981	80.1641 (67)

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

	522.3174	527.7375	514.0792	485.0023	448.2980	413.8011	390.7551	385.3351	398.9934	428.0702	464.7745	499.2714 (68)

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

	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153	55.8153 (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)

	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447	-118.9447 (71)

Water heating gains (Table 5)

	134.1169	131.6955	126.6672	119.8313	115.3932	109.1441	103.8325	110.6381	113.0561	120.1315	128.1207	131.7056 (72)

Total internal gains

	852.7184	846.9963	815.3729	765.7734	713.8618	668.1498	641.9600	652.0662	681.0794	730.9183	786.3811	829.4289 (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	
East	68.2300	19.6403	0.3600	1.0000	0.7700	334.3170	(76)
South	24.5700	46.7521	0.3600	1.0000	0.7700	286.5772	(78)

Solar gains	620.8942	1123.3346	1674.8920	2246.5000	2629.1943	2648.2753	2538.2204	2254.5486	1877.1686	1282.2469	756.5457	522.5551	(83)
Total gains	1473.6126	1970.3309	2490.2648	3012.2734	3343.0562	3316.4252	3180.1804	2906.6149	2558.2481	2013.1653	1542.9268	1351.9840	(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	20.7042	20.7760	20.8482	21.2169	21.2923	21.6770	21.6770	21.7557	21.5215	21.2923	21.1421	20.9941	
alpha	2.3803	2.3851	2.3899	2.4145	2.4195	2.4451	2.4451	2.4504	2.4348	2.4195	2.4095	2.3996	
util living area													
	0.9392	0.8892	0.8088	0.6841	0.5443	0.4056	0.3030	0.3409	0.5293	0.7694	0.9056	0.9488	(86)
MIT	19.0475	19.4154	19.8766	20.3449	20.6440	20.8061	20.8604	20.8500	20.7223	20.2684	19.5668	18.9879	(87)
Th 2	19.8084	19.8120	19.8156	19.8336	19.8372	19.8554	19.8554	19.8590	19.8481	19.8372	19.8300	19.8228	(88)
util rest of house													
	0.9300	0.8738	0.7838	0.6467	0.4939	0.3423	0.2288	0.2628	0.4612	0.7303	0.8897	0.9410	(89)
MIT 2	17.2289	17.7524	18.3972	19.0405	19.4224	19.6257	19.6777	19.6741	19.5369	18.9661	17.9909	17.1532	(90)
Living area fraction									fLA = Living area / (4) =			0.2873	(91)
MIT	17.7513	18.2302	18.8222	19.4152	19.7733	19.9648	20.0175	20.0119	19.8774	19.3403	18.4436	17.6802	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7513	18.2302	18.8222	19.4152	19.7733	19.9648	20.0175	20.0119	19.8774	19.3403	18.4436	17.6802	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9091	0.8485	0.7596	0.6320	0.4910	0.3485	0.2395	0.2736	0.4631	0.7111	0.8658	0.9219	(94)
Useful gains	1339.6096	1671.7566	1891.7147	1903.6502	1641.2758	1155.8763	761.7892	795.3180	1184.6351	1431.5405	1335.9397	1246.4516	(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													
	3218.3117	3178.3074	2927.8058	2455.0329	1878.2471	1225.9561	780.9583	822.4008	1329.7961	2033.4088	2657.8105	3180.6920	(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													
	1397.7544	1012.4021	770.8518	396.9955	176.3066	0.0000	0.0000	0.0000	0.0000	447.7900	951.7470	1439.0748	(98)
Space heating												6592.9223	(98)
Space heating per m2											(98) / (4) =	36.9703	(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	2148.0774	1691.0397	1730.4664	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8724	0.9100	0.8895	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1874.0477	1538.8358	1539.1894	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3760.5366	3605.7111	3284.2529	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	1358.2720	1537.7553	1298.3273	0.0000	0.0000	0.0000	0.0000	(104)

Space cooling													4194.3546 (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	339.5680	384.4388	324.5818	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling													1048.5886 (107)
Space cooling per m2													5.8800 (108)

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 %)													170.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3878.1896 (211)
Cooling System Energy Efficiency Ratio (see Table 10c)													4.0000 (209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1397.7544	1012.4021	770.8518	396.9955	176.3066	0.0000	0.0000	0.0000	0.0000	447.7900	951.7470	1439.0748 (98)	
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000 (210)	
Space heating fuel (main heating system)													
	822.2085	595.5307	453.4423	233.5268	103.7098	0.0000	0.0000	0.0000	0.0000	263.4059	559.8512	846.5146 (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													
	224.6540	198.0195	207.9846	186.4729	182.7580	163.3306	156.8898	172.1179	171.8018	193.3603	204.4229	219.2586 (64)	
Efficiency of water heater													170.0000 (216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000 (217)	
Fuel for water heating, kWh/month													
	132.1494	116.4821	122.3439	109.6899	107.5047	96.0768	92.2881	101.2458	101.0599	113.7413	120.2488	128.9756 (219)	
Water heating fuel used													1341.8064 (219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	84.8920	96.1097	81.1455	0.0000	0.0000	0.0000	0.0000 (221)	
Cooling													262.1472 (221)
Annual totals kWh/year													
Space heating fuel - main system													3878.1896 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375)													
mechanical ventilation fans (SFP = 0.9375)													538.8355 (230a)
central heating pump													30.0000 (230c)
Total electricity for the above, kWh/year													568.8355 (231)
Electricity for lighting (calculated in Appendix L)													550.9759 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.64 * 1080 * 1.00) =											-1416.3363		-1416.3363 (233)
Total delivered energy for all uses													5185.6183 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3878.1896	13.1900	511.5332 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1341.8064	13.1900	176.9843 (247)
Space cooling	262.1472	13.1900	34.5772 (248)
Mechanical ventilation fans	538.8355	13.1900	71.0724 (249)
Pumps and fans for heating	30.0000	13.1900	3.9570 (249)
Energy for lighting	550.9759	13.1900	72.6737 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-1416.3363	13.1900	-186.8148 (252)
Total energy cost			683.9831 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.2863 (257)
SAP value		82.0559
SAP rating (Section 12)		82 (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	3878.1896	0.5190	2012.7804 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1341.8064	0.5190	696.3975 (264)
Space and water heating			2709.1779 (265)
Space cooling	262.1472	0.5190	136.0544 (266)
Pumps and fans	568.8355	0.5190	295.2256 (267)
Energy for lighting	550.9759	0.5190	285.9565 (268)
Energy saving/generation technologies			
PV Unit	-1416.3363	0.5190	-735.0785 (269)
Total kg/year			2691.3359 (272)
CO2 emissions per m2			15.0900 (273)
EI value			83.8517
EI rating			84 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.25) / 1.7000 = 8.321, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.25) / 1.7000 = 0.3274, stars = 4
Water heating energy efficiency	13.19 / 1.7000 = 7.759, stars = 2
Water heating environmental impact	0.519 / 1.7000 = 0.3053, stars = 4

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	148.5100 (1b)	x	2.6000 (2b)	=	386.1260 (1b) - (3b)	
First floor	29.8200 (1c)	x	2.8500 (2c)	=	84.9870 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	178.3300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		471.1130	(5)

2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.2500 (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) =	0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2231	0.2125	0.2125	0.1966	0.1966	0.1753	0.1806	0.1700	0.1753	0.1859	0.1859	0.2019	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	54.6000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.4501	0.4395	0.4395	0.4236	0.4236	0.4023	0.4076	0.3970	0.4023	0.4129	0.4129	0.4289	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 0.93)			92.8000	0.8966	83.2086			(27)
penthouse floor			148.5100	0.1500	22.2765			(28a)
External Wall 1	80.5100	59.4800	21.0300	0.9300	19.5579			(29a)
External Wall 2	44.9600	33.3200	11.6400	0.9300	10.8252			(29a)
penthouse roof	118.6900		118.6900	0.1000	11.8690			(30)
garden room roof	29.8200		29.8200	0.1000	2.9820			(30)
Total net area of external elements Aum(A, m2)			422.4900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		150.7192			(33)
Party Wall 1			84.7700	0.0000	0.0000			(32)
Party Wall 2			27.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.1236 (36)
Total fabric heat loss (33) + (36) =	161.8428 (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	69.9797	68.3279	68.3279	65.8501	65.8501	62.5464	63.3724	61.7205	62.5464	64.1983	64.1983	66.6760	(38)
Heat transfer coeff	231.8226	230.1707	230.1707	227.6930	227.6930	224.3893	225.2152	223.5634	224.3893	226.0411	226.0411	228.5189	(39)
Average = Sum(39)m / 12 =												227.1423	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3000	1.2907	1.2907	1.2768	1.2768	1.2583	1.2629	1.2536	1.2583	1.2675	1.2675	1.2814	(40)
HLP (average)												1.2737	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9736 (42)
Average daily hot water use (litres/day)	104.8234 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.3058	111.1128	106.9199	102.7270	98.5340	94.3411	94.3411	98.5340	102.7270	106.9199	111.1128	115.3058	(44)
Energy conte	170.9951	149.5534	154.3258	134.5449	129.0991	111.4027	103.2310	118.4590	119.8738	139.7014	152.4950	165.5997	(45)
Energy content (annual)											Total = Sum(45)m =	1649.2809	(45)
Distribution loss (46)m = 0.15 x (45)m	25.6493	22.4330	23.1489	20.1817	19.3649	16.7104	15.4846	17.7689	17.9811	20.9552	22.8742	24.8400	(46)

Water storage loss:	
Store volume	180.0000 (47)
b) If manufacturer declared loss factor is not known :	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115 (51)
Volume factor from Table 2a	0.8736 (52)
Temperature factor from Table 2b	0.5400 (53)

Enter (49) or (54) in (55) 0.9805 (55)
Total storage loss
30.3965 27.4549 30.3965 29.4160 30.3965 29.4160 30.3965 30.3965 29.4160 30.3965 29.4160 30.3965 (56)
If cylinder contains dedicated solar storage
30.3965 27.4549 30.3965 29.4160 30.3965 29.4160 30.3965 30.3965 29.4160 30.3965 29.4160 30.3965 (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
224.6540 198.0195 207.9846 186.4729 182.7580 163.3306 156.8898 172.1179 171.8018 193.3603 204.4229 219.2586 (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
224.6540 198.0195 207.9846 186.4729 182.7580 163.3306 156.8898 172.1179 171.8018 193.3603 204.4229 219.2586 (64)
Total per year (kWh/year) = Sum(64)m = 2281.0710 (64)
Heat gains from water heating, kWh/month
99.7830 88.4994 94.2404 86.2786 85.8525 78.5838 77.2514 82.3147 81.4004 89.3778 92.2469 97.9890 (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	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	178.4171	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
77.9963 69.2757 56.3388 42.6521 31.8829 26.9169 29.0847 37.8053 50.7422 64.4289 75.1981 80.1641 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
522.3174 527.7375 514.0792 485.0023 448.2980 413.8011 390.7551 385.3351 398.9934 428.0702 464.7745 499.2714 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
55.8153 55.8153 55.8153 55.8153 55.8153 55.8153 55.8153 55.8153 55.8153 55.8153 55.8153 55.8153 (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)
-118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 -118.9447 (71)
Water heating gains (Table 5)
134.1169 131.6955 126.6672 119.8313 115.3932 109.1441 103.8325 110.6381 113.0561 120.1315 128.1207 131.7056 (72)
Total internal gains
852.7184 846.9963 815.3729 765.7734 713.8618 668.1498 641.9600 652.0662 681.0794 730.9183 786.3811 829.4289 (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	
East	68.2300	22.3313	0.3600	1.0000	0.7700	380.1241	(76)
South	24.5700	50.9848	0.3600	1.0000	0.7700	312.5229	(78)

Solar gains	692.6470	1128.2216	1663.1929	2302.2619	2629.0445	2836.2239	2687.9995	2438.3087	2021.5628	1375.4357	864.7555	577.2370	(83)
Total gains	1545.3654	1975.2179	2478.5657	3068.0353	3342.9064	3504.3738	3329.9595	3090.3749	2702.6422	2106.3540	1651.1366	1406.6658	(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	21.3681	21.5215	21.5215	21.7557	21.7557	22.0760	21.9950	22.1575	22.0760	21.9146	21.9146	21.6770	
alpha	2.4245	2.4348	2.4348	2.4504	2.4504	2.4717	2.4663	2.4772	2.4717	2.4610	2.4610	2.4451	
util living area	0.9256	0.8769	0.7862	0.6387	0.4810	0.3069	0.2061	0.2267	0.4370	0.7142	0.8773	0.9374	(86)
MIT	19.2786	19.5914	20.0434	20.4820	20.7371	20.8579	20.8829	20.8812	20.8045	20.4432	19.8154	19.2270	(87)
Th 2	19.8409	19.8481	19.8481	19.8590	19.8590	19.8737	19.8700	19.8773	19.8737	19.8663	19.8663	19.8554	(88)
util rest of house	0.9144	0.8597	0.7582	0.5972	0.4256	0.2420	0.1324	0.1491	0.3643	0.6674	0.8568	0.9277	(89)
MIT 2	17.5825	18.0276	18.6526	19.2399	19.5525	19.6927	19.7082	19.7151	19.6469	19.2176	18.3666	17.5195	(90)
Living area fraction									fLA = Living area / (4) =			0.2873	(91)
MIT	18.0697	18.4769	19.0522	19.5968	19.8928	20.0275	20.0456	20.0501	19.9794	19.5697	18.7828	18.0100	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0697	18.4769	19.0522	19.5968	19.8928	20.0275	20.0456	20.0501	19.9794	19.5697	18.7828	18.0100	(93)

---
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8922	0.8348	0.7363	0.5869	0.4273	0.2511	0.1441	0.1613	0.3714	0.6537	0.8329	0.9072	(94)
Useful gains	1378.7336	1648.9828	1824.8550	1800.5651	1428.5146	879.9680	479.6908	498.3444	1003.8134	1376.8230	1375.1988	1276.1676	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	3006.6717	2963.8742	2681.9874	2207.8817	1569.4438	903.7171	483.2317	503.0458	1072.4502	1801.4722	2437.3656	2950.1808	(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	1211.1859	883.6070	637.7065	293.2680	104.8514	0.0000	0.0000	0.0000	0.0000	315.9390	764.7601	1245.4658	(98)
Space heating												5456.7837	(98)
Space heating per m2											(98) / (4) =	30.5994	(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.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1795.1142	1373.8127	1386.0928	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9181	0.9460	0.9365	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1648.1666	1299.5659	1298.1432	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3980.2168	3780.7776	3499.0374	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	1679.0761	1846.0215	1637.4653	0.0000	0.0000	0.0000	0.0000	(104)

Space cooling													5162.5629 (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	419.7690	461.5054	409.3663	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling													1290.6407 (107)
Space cooling per m2													7.2374 (108)

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 %)													170.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3209.8728 (211)
Cooling System Energy Efficiency Ratio (see Table 10c)													4.0000 (209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1211.1859	883.6070	637.7065	293.2680	104.8514	0.0000	0.0000	0.0000	0.0000	315.9390	764.7601	1245.4658 (98)	
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000 (210)	
Space heating fuel (main heating system)													
	712.4623	519.7688	375.1215	172.5106	61.6773	0.0000	0.0000	0.0000	0.0000	185.8465	449.8589	732.6270 (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													
	224.6540	198.0195	207.9846	186.4729	182.7580	163.3306	156.8898	172.1179	171.8018	193.3603	204.4229	219.2586 (64)	
Efficiency of water heater													170.0000 (216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000 (217)	
Fuel for water heating, kWh/month													
	132.1494	116.4821	122.3439	109.6899	107.5047	96.0768	92.2881	101.2458	101.0599	113.7413	120.2488	128.9756 (219)	
Water heating fuel used													1341.8064 (219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	104.9423	115.3763	102.3416	0.0000	0.0000	0.0000	0.0000 (221)	
Cooling													322.6602 (221)
Annual totals kWh/year													
Space heating fuel - main system													3209.8728 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9375)													
mechanical ventilation fans (SFP = 0.9375)													538.8355 (230a)
central heating pump													30.0000 (230c)
Total electricity for the above, kWh/year													568.8355 (231)
Electricity for lighting (calculated in Appendix L)													550.9759 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.64 * 1140 * 1.00) =											-1495.8109		-1495.8109 (233)
Total delivered energy for all uses													4498.3399 (238)

10a. Fuel costs - using BEDF prices (401)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3209.8728	15.4400	495.6044 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1341.8064	15.4400	207.1749 (247)
Space cooling	322.6602	15.4400	49.8187 (248)
Mechanical ventilation fans	538.8355	15.4400	83.1962 (249)
Pumps and fans for heating	30.0000	15.4400	4.6320 (249)
Energy for lighting	550.9759	15.4400	85.0707 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-1495.8109	15.4400	-230.9532 (252)
Total energy cost			694.5437 (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	3209.8728	0.5190	1665.9240 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1341.8064	0.5190	696.3975 (264)
Space and water heating			2362.3215 (265)
Space cooling	322.6602	0.5190	167.4606 (266)
Pumps and fans	568.8355	0.5190	295.2256 (267)
Energy for lighting	550.9759	0.5190	285.9565 (268)
Energy saving/generation technologies			
PV Unit	-1495.8109	0.5190	-776.3259 (269)
Total kg/year			2334.6384 (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	3209.8728	3.0700	9854.3094 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1341.8064	3.0700	4119.3458 (264)
Space and water heating			13973.6552 (265)
Space cooling	322.6602	3.0700	990.5668 (266)
Pumps and fans	568.8355	3.0700	1746.3250 (267)
Energy for lighting	550.9759	3.0700	1691.4960 (268)

Energy saving/generation technologies

PV Unit	-1495.8109	3.0700	-4592.1395 (269)
Primary energy kWh/year			13809.9035 (272)
Primary energy kWh/m2/year			77.4402 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 82
Current environmental impact rating: B 84

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Not applicable
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Not applicable
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)

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

Potential energy efficiency rating: B 82
Potential environmental impact rating: B 84

Fuel prices for cost data on this page from database revision number 401 TEST (27 Oct 2016)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£925	£925	£0
Space heating	£583	£583	£0
Space cooling	£50	£50	£0
Water heating	£207	£207	£0
Lighting	£85	£85	£0
Generated (PV)	-£231	-£231	£0
Total cost of fuels	£694	£694	£0
Total cost of uses	£694	£694	£0
Delivered energy	25 kWh/m²	25 kWh/m²	0 kWh/m²
Carbon dioxide emissions	2.3 tonnes	2.3 tonnes	0.0 tonnes
CO2 emissions per m²	13 kg/m²	13 kg/m²	0 kg/m²
Primary energy	77 kWh/m²	77 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

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	EndTerrace Flat
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	No
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	1243.74 (P1)
Transmission heat loss coefficient	161.84 (37)
Summer heat loss coefficient	1405.58 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
East	1.000	0.90	1.000	0.900 (P8)
South	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
East	68.2300	117.5071	0.3600	1.0000	0.9000	2337.9051
South	24.5700	112.2060	0.3600	1.0000	0.9000	803.9124
total:						3141.8176

	Jun	Jul	Aug	
Solar gains	3315	3142	2850	(P3)
Internal gains	665	639	649	
Total summer gains	3980	3781	3499	(P5)
Summer gain/loss ratio	2.83	2.69	2.49	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	20.13	21.89	21.59	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

Predicted Energy Assessment

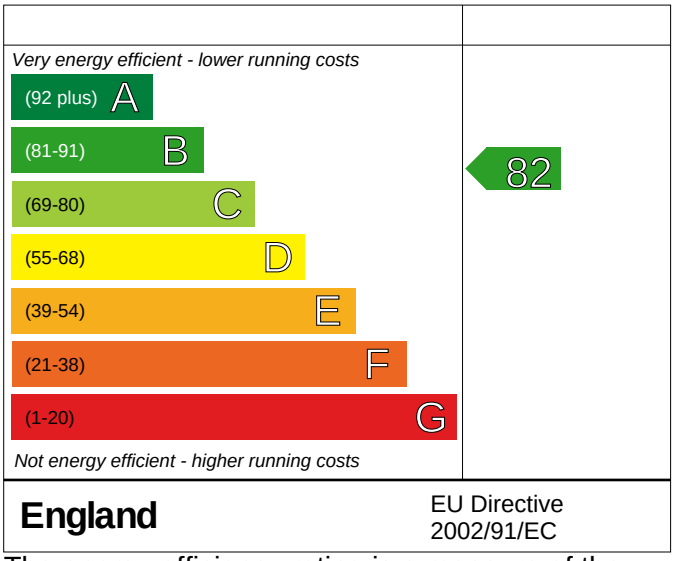
501,
London

Dwelling type:	Flat, End-Terrace
Date of assessment:	01.Nov.2016
Produced by:	Gecko
Total floor area:	178.33 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.

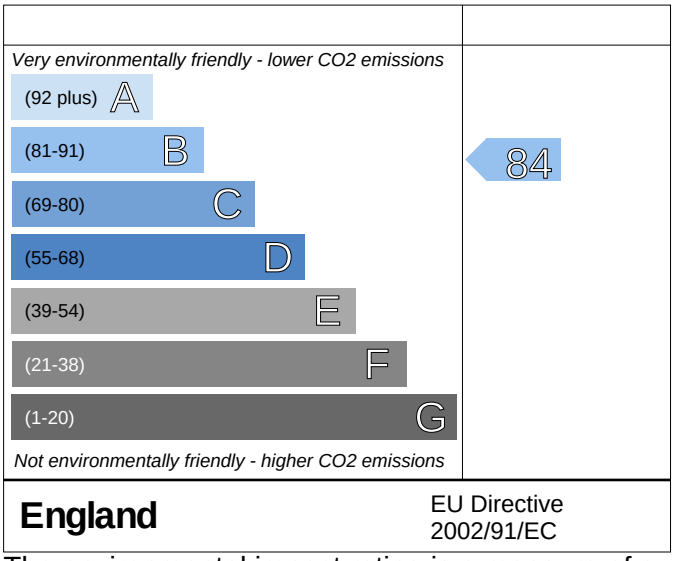
The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

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.

SURVEY NOTES

Property Reference: 501 Linton House
Survey Reference: 501 design
Property: 501, London

Issued on Date: 01.Nov.2016
Prop Type Ref:

SAP Rating:	82 B	**CO2 Emissions (t/year):**	2.33	**DER:**	16.13 Pass	**TER:**	21.80	**Percentage DER<TER:**	26.02 %
Environmental:	84 B	**General Requirements Compliance:**	Pass	**DFEE:**	51.00 Pass	**TFEE:**	55.11	**Percentage DFEE<TFEE:**	7.45 %

CfSH Results **Version:** November 2010 - June 2014 Addendum **ENE1 Credits:** 3.5 **ENE2 Credits:** 0.0 **ENE7 Credits:** 0 **CfSH Level:** 4

Surveyor: Mike Ovenden, Tel: 01908 850109 Surveyor ID: H824-0001
Address: Dudley Hill, Shenley Church End, Milton Keynes, Buckinghamshire, MK5 6LL
Client: Synergy, 3

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 Information

Property Reference: 501 Linton House
Survey Reference: 501 design
Property: 501, London

Issued on Date: 01.Nov.2016
Prop Type Ref:

SAP Rating: 82 B **CO2 Emissions (t/year):** 2.33 **DER:** 16.13 Pass **TER:** 21.80 **Percentage DER<TER:** 26.02 %
Environmental: 84 B **General Requirements Compliance:** Pass **DFEE:** 51.00 Pass **TFEE:** 55.11 **Percentage DFEE<TFEE:** 7.45 %

CfSH Results **Version:** November 2010 - June 2014 Addendum **ENE1 Credits:** 3.5 **ENE2 Credits:** 0.0 **ENE7 Credits:** 0 **CfSH Level:** 4

Surveyor: Mike Ovenden, Tel: 01908 850109 Surveyor ID: H824-0001
Address: Dudley Hill, Shenley Church End, Milton Keynes, Buckinghamshire, MK5 6LL
Client: Synergy, 3

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
1.0 Property Type	Flat, End-Terrace
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:	30.97	148.51	2.60
1st Storey:	15.77	29.82	2.85

7.0 Living Area	51.23
8.0 Thermal Mass Parameter	Simple calculation - Low

9.0 External Walls

Description	Construction	U-Value	Kappa	Gross Area	Nett Area
External Wall 1	Other	0.93		80.51	21.03
External Wall 2	Other	0.93		44.96	11.64

9.1 Party walls

Description	Construction	Kappa	Area
Party Wall 1	Steel frame		84.77
Party Wall 2	Steel frame		27.60

10.0 External Roofs

Description	Construction	U-Value	Kappa	Gross Area	Nett Area
penthouse roof	Other	0.10		118.69	118.69
garden room roof	Other	0.10		29.82	29.82

11.0 HeatLoss Floors

Description	Construction	U-Value	Kappa	Area
penthouse floor	Other	0.15		148.51

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	Solar Trans	Frame Type	Frame Factor	U value
Opening Type 1	Manufacturer	Window	Double Low-E Soft 0.05			0.36		1.00	0.93

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width	Height	Count	Area	Curtain Closed
1	Window	[1] External Wall 1	East	None	0.00					7.29	
2	Window	[1] External Wall 1	East	None	0.00					7.29	
3	Window	[1] External Wall 1	East	None	0.00					7.29	

4	Window	[1] External Wall 1	East	None	0.00	7.29
5	Window	[1] External Wall 1	East	None	0.00	7.29
6	Window	[1] External Wall 1	East	None	0.00	7.64
1gh	Window	[2] External Wall 2	East	None	0.00	24.14
7	Window	[1] External Wall 1	South	None	0.00	4.32
8	Window	[1] External Wall 1	South	None	0.00	7.29
9	Window	[1] External Wall 1	South	None	0.00	3.78
2gh	Window	[2] External Wall 2	South	None	0.00	9.18

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	E5 Ground floor (normal)	30.97	0.160	No
Table K1 - Approved	E6 Intermediate floor within a dwelling	15.77	0.070	Yes
Table K1 - Approved	E7 Party floor between dwellings (in blocks of flats)	30.97	0.070	Yes
Table K1 - Default	E14 Flat roof	15.77	0.080	Yes
Table K1 - Approved	E16 Corner (normal)	10.90	0.090	Yes
Table K1 - Approved	E18 Party wall between dwellings	10.90	0.060	Yes

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 Yes
Approved Installation Yes
Windows open in hot weather Windows fully open
Cross ventilation possible Yes
Night Ventilation No
Air change rate 8.00
Mechanical Ventilation data Type Database
Type Balanced mechanical ventilation with heat recovery
MV Reference Number 500320
Configuration 3
MVHR Duct Insulated No
Manufacturer SFP 0.75
Duct Type Rigid
MVHR Efficiency 78.00
Wet Rooms 3
Brand, Model

20.0 Fans, Open Fireplaces, Flues

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

21.0 Cooling System Yes
Cooled Area 178.33
Data Source SAP table
Cooling Type Split or Multi-Split
Energy Class A
Energy Efficiency Ratio
System Control On/Off

22.0 Lighting
Internal
Total number of light fittings 52
Total number of L.E.L. fittings 52
Percentage of L.E.L. fittings 100.00
External
External lights fitted Yes
Light and motion sensors Yes
23.0 Electricity Tariff Standard

24.0 Heating Systems
Main Heating 1 SAP table

Description	ashp
Percentage of Heat	100 %
Main Heating 2	None
Description	
Percentage of Heat	%
Community Heating	
Secondary Heating	None
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 System	No
Solar Panel	No

25.0 Main Heating 1	
Database Ref. No.	
Fuel Type	
Main Heating	PET
TestMethod	
SAP Code	224
Efficiency (SAP Table) %	170.0
Efficiency (SAP Table) %	
In Winter	
In Summer	
Model Name	
Manufacturer	
Controls	CHD Time and temperature zone control
PCDF Controls	0
Delayed Start Stat	
Sap Code	2207
Burner Control	
Boiler Compensator	
HETAS approved System	
Oil Pump Inside	
FI Case	
FI Water	
Flue Type	
Smoke Control Area	
Fan Assisted Flue	
Is MHS Pumped	Pump in heated space
Heat Emitter	Radiators and Underfloor
Underfloor Heating	Yes - Pipes in thin screed
Flow Temperature	<= 35°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	
Description	
SHS efficiency %	
SAP Code	
HETAS Approved System	
Smoke Control Area	
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	No

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	Foam
Insulation Thickness	
Cylinder Volume	180.00
Loss (kwh/day)	
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
1.64	South	30°	None Or Little

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

Thermal Bridging

Property Reference: 501 Linton House
Survey Reference: 501 design
Property: 501, London

Issued on Date: 01.Nov.2016
Prop Type Ref:

SAP Rating:	82 B	**CO2 Emissions (t/year):**	2.33	**DER:**	16.13 Pass	**TER:**	21.80	**Percentage DER<TER:**	26.02 %
Environmental:	84 B	**General Requirements Compliance:**	Pass	**DFEE:**	51.00 Pass	**TFEE:**	55.11	**Percentage DFEE<TFEE:**	7.45 %

CfSH Results **Version:** November 2010 - June 2014 Addendum **ENE1 Credits:** 3.5 **ENE2 Credits:** 0.0 **ENE7 Credits:** 0 **CfSH Level:** 4

Surveyor: Mike Ovenden, Tel: 01908 850109 Surveyor ID: H824-0001
Address: Dudley Hill, Shenley Church End, Milton Keynes, Buckinghamshire, MK5 6LL
Client: Synergy, 3

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)

	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E5 Ground floor (normal)	Table K1 - Approved	0.160	30.97	4.96	
External wall	E6 Intermediate floor within a dwelling	Table K1 - Approved	0.070	15.77	1.10	
External wall	E7 Party floor between dwellings (in blocks of flats)	Table K1 - Approved	0.070	30.97	2.17	
External wall	E14 Flat roof	Table K1 - Default	0.080	15.77	1.26	
External wall	E16 Corner (normal)	Table K1 - Approved	0.090	10.90	0.98	
External wall	E18 Party wall between dwellings	Table K1 - Approved	0.060	10.90	0.65	

Total W/mK: 11.12
Y-Value W/m2K: 0.026