Submitted to
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29 George Street Richmond, London TW9 1HY

Energy Statement

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1 Introduction

29 George Street, Richmond was first constructed c.1900 and is a Building of Townscape Merit, adjacent to a listed building and is located within the Central Richmond Conservation Area 17. It is now the subject of planning application which seeks a material change of use from ancillary retail space to 9 flats, hereafter referred to as the residential units.

The location, site, current uses and proposals are described in detail within the Design and Access Statement which accompanied the planning application. To aid the reader of this report a short summary of this is provided below.

The site fronts onto George Street to the north with rear vehicular and delivery access from the south on Paradise Road. On the east is Wellington Yard, an access alleyway to neighbouring retail properties leads from George Street. The western boundary is made up of Church Court and Church Walk a pedestrian route linking George Street and Paradise Road.

The buildings on the site are made up of the four storey frontages to George Street, Wellington Yard and Church Court; and a late Victorian building originally constructed as a family department store.

Figure 1: Site Photographs of 29 George Street, Views from Petersham Road

The late Victorian building is designated a Building of Townscape Merit and the facades were retained in the early 1990's when the site was developed as a Tesco Metro store. This development created a two storey brick and stone building to the rear of the four storey

George Street building, utilising traditional fenestration patterns using arches, friezes and cornices to reflect and blend with neighbouring properties.

The proposed 9 one bedroom residential units are all within the four storey Building of Townscape Merit on George Street. This currently accommodates retail use by Tesco at ground floor with an entrance lobby to the first floor bookmaker, Coral. The first floor is subdivided to create the Coral tenancy, with the remaining area occupied by Tesco offices.

The retail uses are serviced by an enclosed and secured service road and yard, also known as Wellington Yard, which is accessed off Paradise Road. This service road is in shared use with the residential properties known as St James Cottages.

The second floor is linked to the Tesco offices by a staircase and is utilised as ancillary space. The staircase is also used for roof access to the adjacent plant areas. The third floor within the roof space is empty and void with maintenance access only.

The proposed 9 one bedroom residential units will occupy the area currently used by Tesco on the second and third floors and the void roof space at third floor. All the residential units are contained within the existing George Street frontages and have been planned around the existing windows. The accommodation schedule is contained in Table 1.

Table 1: Proposed accommodation schedule for 29 George Street

Floor	Residential Unit	Number of bedrooms	Gross Internal Floor Area (m^2)
2	2.01	1	55.6
2	2.02	1	50.0
2	2.03	1	50.0
2	2.04	1	50.0
2	2.05	1	55.0
3	3.01	1	56.7
3	3.02	1	51.0
3	3.03	1	51.0
3	3.04	1	56.7

The principles of Sustainable Development are addressed by legislation and policy at all levels of Government, and are widely recognised as a fundamental consideration for all current and future development. The National Planning Policy Framework (NPPF) came

into effect on 27th March 2012 and introduced a presumption in favour of sustainable development.

Paragraph 95 says:

> *"when setting any local requirements for a building's sustainability, the local planning authorities should do so in a way that is consistent with the Government's zero carbon buildings policy and adopt nationally described standards".*

The NPPF states that, from 27th March 2013:

> *"due weight should be given to relevant policies in existing plans according to their degree of consistency with this framework (the closer the policies in the plan are to the policies in the Framework, the greater the weight that may be given)".*

The Deregulation Act 2015 section 42 states:

> *"Amendment of Planning and Energy Act 2008 In the Planning and Energy Act 2008, in section 1 (energy policies), after subsection (1) insert — "(1A) Subsection (1)(c) does not apply to development in England that consists of the construction or adaptation of buildings to provide dwellings or the carrying out of any work on dwellings."*

The explanatory notes say:

> *"It is a corollary of the restriction of technical housing standards to those found in building regulations that an amendment is made to the Planning and Energy Act 2008. Section 1(1)(c) of that Act provides that local planning authorities may include in their plans requirements that development in their area meets higher standards of energy efficiency than are required by building regulations. This is inconsistent with the consolidation of technical standards for housing in building regulations, and the amendment will disapply the provision in England in relation to development that consists of the construction or alteration of buildings to provide dwellings, or the carrying out of any work on dwellings."*

On the 10th July 2015 the Chancellor of the Exchequer Presented to Parliament, and published, 'Fixing the foundations: Creating a more prosperous nation'. Para 9.17 is titled improving the planning process, which states:

> *"The government will therefore: repeat its successful target from the previous Parliament to reduce net regulation on housebuilders. The government does not intend to proceed with the zero carbon Allowable Solutions carbon offsetting scheme, or the proposed 2016 increase in on-site energy efficiency standards, but will keep energy efficiency standards under review, recognising that existing measures to increase energy efficiency of new buildings should be allowed time to become established."*

On-site energy and carbon standards therefore remain with Part L of the Building Regulations 2010.

The material weight of adopted policies reflects their degree of conformity with the NPPF, including paragraph 95, the Deregulation Act 2015 and Governments statements.

This energy statement for 29 George Street has been produced in accordance with the Governments adopted nationally described standards and guidance that accords with it.

The Governments approved Standard Assessment Procedure (SAP) calculations have been used to calculate the regulated carbon emissions for the residential units in line with Building Regulations Part L1B 2010 as these are the applicable Regulations for the material change of use to dwellings and are the adopted nationally described standards as set out in the NPPF paragraph 95.

Building Regulations L1B 2010 state:

> *"Where an existing thermal element is part of a building subject to a material change of use; reasonable provision would be to upgrade those thermal elements whose U-value is worse than the threshold value given".*

The Governments Planning Portal website states the Part L requirements do not apply to buildings which fall into certain categories, including:

> *"Certain buildings which are listed, in conservation areas or are included in the schedule of monuments - where compliance with the energy efficiency requirements would unacceptably alter their character or appearance."*

Figure 2: Site Photograph of 29 George Street, View from Petersham Road

Figure 3: Site Photograph of 29 George Street, View from Petersham Road

Figure 4: Site Photograph of 29 George Street, View from George Street

2 Baseline

SAP calculations were produced for the residential units, in accordance with the current SAP guidance for existing/change of use dwellings, to establish a Building Regulations Part L compliant baseline.

In accordance with the Government's SAP requirement, a Site visit took place on the 24th August to determine the approximate age of the building and building services and the building's construction. A copy of the Site Visit Report is contained in Appendix 1.

The outputs from the SAP calculations (contained in Appendix 2) form the baseline energy demand and CO_2 emissions, and the results are contained in Table 2.1. The baseline energy demand is automatically converted to CO_2 emissions within the SAP calculations and no further conversion is therefore required.

Table 2.1: Baseline Outputs from SAP Calculations

Residential Unit	**Baseline Energy Demand** (kWh/year)	**Baseline Regulated CO_2 Emissions** (kg/$C0_2$/year)
2.01	45,899	7,760
2.02	30,346	5,130
2.03	30,830	5,212
2.04	30,346	5,130
2.05	45,388	7,673
3.01	28,260	4,778
3.02	22,423	3,791
3.03	22,423	3,791
3.04	28,351	4,793
Total	**284,267**	**48,057**

TA residential units ability to stabilise its temperature so that it looses less heat in winter and gains less heat in summer is influenced by the area of the spaces which its floors, ceilings and walls adjoin. As Table 2.2 shows, units 2.01, 2.02, 2.03, 2.04 and 2.05 which

are above the non-domestic spaces and therefore have adjoining floors, have considerably higher baseline energy demand, and associated CO_2 emissions, per square meter.

Table 2.2: Energy Demand and CO_2 Emissions per square meter

Residential Unit	Baseline Energy Demand (kWh/m²/year)	Baseline Regulated CO_2 Emissions ($kg/C0_2/m^2$/year)
2.01	825.52	139.56
2.02	606.92	102.60
2.03	616.61	104.24
2.04	606.92	102.60
2.05	825.24	139.51
3.01	498.41	84.26
3.02	439.67	74.33
3.03	439.67	74.33
3.04	500.02	84.53

As Table 2.2 also shows, the residential units with greater areas of external walls (i.e. 2.01, 2.05, 3.01 and 3.04) also have a higher baseline energy demand, and associated carbon emissions, per square meter.

3 Energy Efficiency

Energy efficiency measures, including improved building fabric and efficiency building services can be used to reduce the predicted energy demand and the predicted CO_2 emissions for the 9 one bedroom residential units.

The Architects state that changing the windows within the four storey George Street building of Townscape Merit within the Central Richmond Conservation Area would have an impact on the character and/or appearance of the building; therefore secondary glazing is proposed. As set out by the Government, Part L1B requirements do not therefore apply to the windows. The current and proposed u-values for the proposed residential units are contained in Table 3.1.

Table 3.1: U-values for the proposed 9 one bedroom residential units

Building Element	**U-value Before Change of Use** (w/m²K)	**Proposed U-value** (w/m²K)
Floor	1.20	0.25
Roof	0.50	0.18
External Walls	2.30	0.30
Walls to Corridors	0.30	0.30
Party Walls	0.00	0.00
Windows	4.80	2.40
Doors	1.40	1.40

All of the proposed u-values contained in Table 3.1 accords with Building Regulations Part L1B.

Once the opportunities to improve the building fabric have been explored, the next stage is to consider the efficiency of the equipment.

Each apartment will be provided with efficient mains gas boilers to provide space and hot water heating. The carbon emissions associated with the use of efficient gas boilers are far lower than for those powered by electricity. The site is within an Air Quality Management Area and the proposed boilers with have low average dry NOx emissions of less than 40mg/kWh.

5% of the electricity used to power a traditional tungsten filament light bulb is converted into visible light. The residential units will be provided with low energy internal lamps, such as compact fluorescent or LED fittings which use c80% less electricity than equivalent traditional bulbs.

Energy efficient space and security lighting will be provided to all external and communal areas. The external and communal lighting will have either PIR sensors, pressure sensitive time switches or daylight sensors to reduce the opportunity for artificial light to be provided when not required.

To aid the home user further each flat will be provided with a Home Users Guide which will provide information on how to operate the flat efficiently and effectively. A copy of the EU Energy Efficiency leaflet will be included within the Home Users Guide to encourage the use of efficient white goods.

The improvements to the building envelope and the energy efficiency equipment and measures result in an improvement to the baseline as set out in Table 3.2.

Table 3.2: SAP Outputs for Residual Energy and CO_2 Emissions		
Residential Unit	**Energy Demand** (kWh/year)	**Regulated CO_2 Emissions** ($kg/C0_2$/year)
2.01	11,558	2,038
2.02	8,539	1,504
2.03	8,780	1,546
2.04	8,539	1,504
2.05	11,429	2,015
3.01	9,153	1,612
3.02	7,986	1,405
3.03	7,986	1,405
3.04	9,347	1,646
Total	**83,317**	**14,675**

4 Supplying Energy Efficiently

The London Heat Map indicates there is no existing or emerging district system for the 9 residential units to connect into.

As the proposals are: for 9 residential units with a total gross internal area of 476²; there is no existing or emerging district system; and the surrounding area consists of an established conservation area, there is no requirement to make provision for future connection.

The consideration of whether or not on-site Combined Heat and Power (CHP) is an appropriate energy solution for a development will depend on the type and size of the development. GLA Guidance for Preparing Energy Statements states “small residential developments (e.g. containing fewer than 500 apartments) … *it is generally not economic to install CHP*”. CHP is therefore not proposed for the 9 one bedroom residential units.

5 On-site Generation

Whilst the consideration of renewable energy is not required to accord with the material weight of the applicable policies it is good practice to consider the options to enable informal decision to be made.

As it is not proposed to undertake ground works, the site is not adjacent to a water body and it is within an established Conservation area the use of ground source heat pumps, hydropower and wind power are not appropriate.

There is insufficient space within the Site to store and meet the health and safety requirements for biomass and biofuel. It is also unlikely that their use could accord with the air quality requirements as the site is within an Air Quality Management Area.

The roof area of the Building of Township Merit on George Street is not proposed to be altered as a result of the proposals for the 9 residential units due to its location next to a listed building and with Central Richmond Conservation Area 17.

6 Conclusion

All calculations were undertaken using the Governments adopted nationally described standards. The building envelope will be enhanced, energy efficient specification and measures have been incoorporated and the results of these measures are shown in Table 6.

Table 6: SAP Outputs for total Baseline and Residual CO_2 Emissions

	CO_2 Emissions ($kg/C0_2/year$)	**Percentage Improvement** %
Total Baseline Emissions (Pre Development)	48,057	-
Total Residual Emissions (Post Development)	14,675	69%

As Table 6 shows the pre and post development carbon emissions will be reduced by 69%.

Appendix 1 – Site Visit Report

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Site Visit Report
For
Building Regulations Part L1B Calculations

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1 Introduction

This report has been produced to accompany the Energy Statement undertaken by AECOM for the material change of use from ancillary retail space to 9 residential units 29 George Street, Richmond.

The Standard Assessment Procedure (SAP) is the Governments adopted methodology for calculating predicted energy use and predicted carbon emissions from dwellings. The SAP Appendix S methodology relates to existing buildings and has been used to complete the baseline calculations for the Energy Statement.

In line with the SAP requirements, a site survey was undertaken on 24th August 2015 to determine the approximate age of the building, the building services and the building construction. The evidence collected from the site visit will be used alongside the SAP guidance to create a complete set of data inputs for use within the baseline SAP calculations.

2 Building Information

29 George Street, Richmond was first constructed c.1900 and is located within the Central Richmond Conservation Area 17. Refurbishment works were undertaken on the building façade in 1990 together with the addition of internal separating floors and the mansard roof structure. It is now the subject of planning application 15/2993/FUL which seeks a material change of use from ancillary retail space to 9 flats, hereafter referred to as the residential units.

Based on 'Table S1: Age Bands' from the SAP guidance, the following age bands can be assigned:

- Existing Building – Age Band 'A'
- Separating Floors and Roof Construction – Age Band 'G'

Figure 1 - SAP2012 Table S1: Age Bands based on Year of Construction

S2 Age bands

A set of age bands is defined according to Table S1 for the purposes of assigning U-values and other data.

Table S1 : Age bands

	Years of construction			
Age band	**England & Wales**	**Scotland**	**Northern Ireland**	**Park home (UK)**
A	before 1900	before 1919	before 1919	-
B	1900-1929	1919-1929	1919-1929	-
C	1930-1949	1930-1949	1930-1949	-
D	1950-1966	1950-1964	1950-1973	-
E	1967-1975	1965-1975	1974-1977	-
F	1976-1982	1976-1983	1978-1985	before 1983
G	1983-1990	1984-1991	1986-1991	1983-1995
H	1991-1995	1992-1998	1992-1999	(not applicable)
I	1996-2002	1999-2002	2000-2006	1996-2005
J	2003-2006	2003-2007	(not applicable)	(not applicable)
K	2007-2011	2008-2011	2007-2013	2006 onwards
L	2012 onwards	2012 onwards	2014 onwards	(not applicable)

3 Building Fabric

3.1 External Walls

The site visit indicated that the existing wall (Age Band 'A') construction is solid limestone/sandstone.

Figure 2 - Site Photographs

Figure 3 - Proposed First Floor Plan showing External Walls

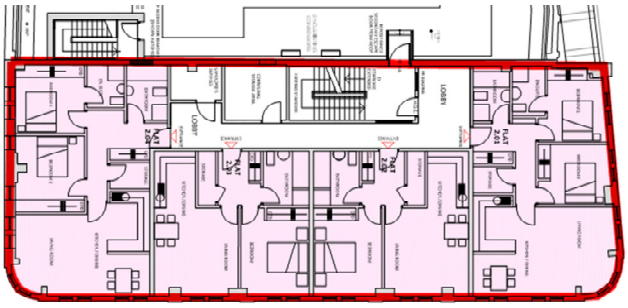

Figure 4 - SAP2012 Table S3: Wall Thickness

Table S3 : Wall thickness (mm)

Age band	A	B	C	D	E	F	G	H	I,	J, K, L
Wall type										
Stone*	500	500	500	500	450	420	420	420	450	450
Solid brick	220	220	220	220	240	250	270	270	300	300
Cavity**	250	250	250	250	250	260	270	270	300	300
Timber frame	150	150	150	250	270	270	270	270	300	300
Cob	540	540	540	540	540	540	560	560	590	590
System build	250	250	250	250	250	300	300	300	300	300
Park home						50	50		75	100

* If in Scotland add 200 mm for bands A and B, and 100 mm for other bands

** If in Scotland add 50 mm

Figure 5 - SAP2012 Table S6: Wall U-values

Table S6 : Wall U-values – England and Wales

Age band	A	B	C	D	E	F	G	H	I	J	K	L
Wall type												
Stone: granite or whinstone as built	a	a	a	a	1.7 b	1.0	0.60	0.60	0.45	0.35	0.30	0.28
Stone: sandstone or limestone as built	a	a	a	a	1.7 b	1.0	0.60	0.60	0.45	0.35	0.30	0.28

a See equations in S5.1.1

Following the SAP guidance, the u-value can be calculated from the following formula:

Figure 6 - SAP2012 Section 5.1.1

S5.1.1 U-values of uninsulated stone walls, age bands A to E

Granite or whinstone: U = 3.3 – 0.002 × thickness of wall in mm
Sandstone or limestone: U = 3.0 – 0.002 × thickness of wall in mm

U-value = 3.0 – 0.02 x thickness of wall (in mm)

U-value = 3.0 – 0.02 x 500

U-value = 2.30 W/m²K

3.2 Corridor Walls

These walls will be constructed as part of the change of use construction works and were therefore not present during the site visit; the Building Regulations Part L1B 2013 limiting value (Table 3) of 0.30 has been used. To ensure the efficiency measures incorporated are reflected as accurately as possible, the u-value of 0.30 has been used throughout all revisions of the SAP calculations.

Figure 7 - Proposed First Floor Plan showing Corridor Walls

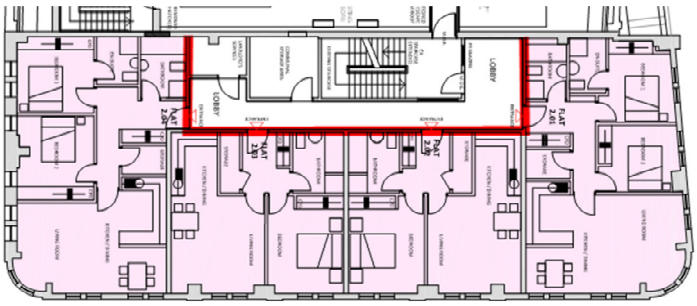

Figure 8 - Building Regulations Part L1B 2010, Table 3: Minimum Standards for Retained Thermal Elements

Table 3 **Upgrading retained thermal elements**		
Element[1]	**(a) Threshold U-value W/(m²·K)[8]**	**(b) Improved U-value W/(m²·K)[8]**
Wall – cavity insulation[2]	0.70	0.55
Wall – external or internal insulation[3]	0.70	0.30

U-value 0.30 W/m²K

3.3 Party Walls

These walls will be constructed as part of the change of use construction works and were therefore not present during the site visit; the SAP guidance from Table S8B has been followed. To ensure the efficiency measures incorporated are reflected as accurately as possible, the u-value of 0.00 has been used throughout all revisions of the SAP calculations.

Figure 9 - Proposed First Floor Plan showing Party Walls

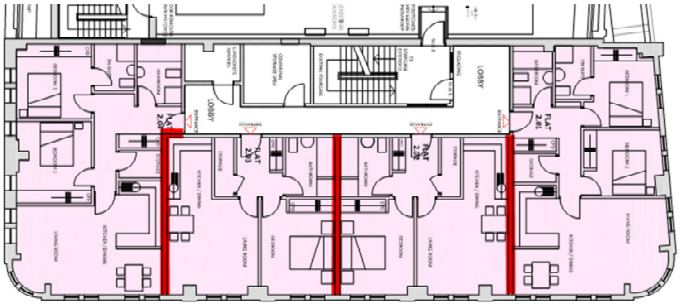

Figure 10 - SAP2012 Table S8B: U-values for Party Walls

Table S8B : U-values of party walls

Party wall type	Party wall U-value
Solid masonry / timber frame / system built	0.0
Cavity masonry unfilled	0.5
Cavity masonry filled	0.2
Unable to determine, house or bungalow	0.25
Unable to determine, flat or maisonette	0.0

U-value: 0.00 W/m²K

3.4 Exposed Floors

The site visit indicated that the existing exposed floors (Age Band 'G') were of solid Concrete construction, no insulation was seen during the site visit.

Figure 11 - Site Photographs


Figure 12 - SAP2012 Table S12: Exposed/Semi-exposed Floor U-values

Table S12 : Exposed/Semi-exposed floor U-values

Age band	U-value (W/m²K)			
	Insulation unknown or as built	Insulated 50 mm	Insulated 100 mm	Insulated 150 mm
A to G	1.20	0.50 (1)	0.30	0.22
H or I	0.51	0.50 (1)	0.30	0.22
J	0.25	0.25	0.25	0.22
K	0.22	0.22	0.22	0.22
L	0.22 (2)	0.22 (2)	0.22 (2)	0.22 (2)

Following the SAP guidance, the u-value of 1.20 can be used.

U-value = 1.20 W/m²K

3.5 Roof

The site visit indicated that the existing roof (Age Band 'G') was a pitched 'room in roof' style roof with tile finish.

Figure 13 - Site Photographs


Figure 14 - SAP2012 Table S10: Assumed Roof U-values

Table S10 : Assumed roof U-values when Table S9 does not apply

Age band	Assumed Roof U-value (W/m²K) [a]						
	Pitched, slates or tiles, insulation between joists or unknown	Pitched, slates or tiles, insulation at rafters	Flat roof [b]	Room-in-roof, slates or tiles	Thatched roof [c]	Thatched roof, room-in-roof	Park home
A, B, C, D	2.3 (none)	2.3 [1]	2.3 [1]	2.3 [1]	0.35	0.25	-
E	1.5 (12 mm)	1.5 [1]	1.5 [1]	1.5 [1]	0.35	0.25	-
F	0.68 (50 mm)	0.68 [1]	0.68 [1]	0.80 [1]	0.35	0.25	1.7
G	0.40 (100 mm)	0.40 [1]	0.40 [1]	0.50 [1]	0.35	0.25	0.6
H	0.30 (150 mm)	0.35 [1]	0.35 [1]	0.35 [1]	0.35	0.25	-
I	0.26 (150 mm)	0.35 [1]	0.35 [1]	0.35 [1]	0.35	0.25	0.35
J	0.16 (270 mm)	0.20	0.25	0.30	0.30	0.25	-
K	0.16 (270 mm)	0.20	0.25 [2]	0.25 [2]	0.25 [2]	0.25 [2]	0.30
L	0.16 [3] (270 mm)	0.18	0.18	0.18	0.18	0.18	-

Following the SAP guidance, the u-value of 0.50 can be used.

U-value = 0.50 W/m²K

3.6 Windows

The site visit indicated that timber framed single glazed windows were provided throughout.

Figure 15 - Site Photographs

Figure 16 - SAP2012 Table S14: Window Characteristics

Table S14 : Window characteristics

Glazing	Installed	Glazing gap	U-value (window)	U-value** (roof window)	g-value
Single	any	-	4.8	5.1	0.85

Following the SAP guidance, the u-value of 4.80 can be used.

U-value = 4.80 W/m²K

3.7 Doors

The site visit indicated that the doors open onto unheated corridors / stairwells.

Figure 17 - Site Photographs

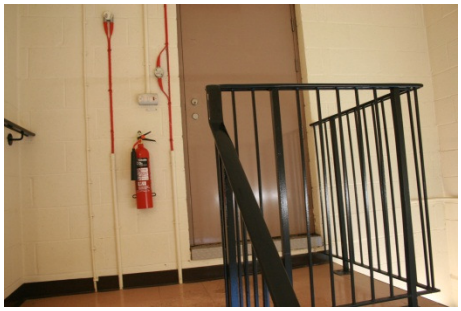

Figure 18 - Proposed First Floor Plan showing Doors

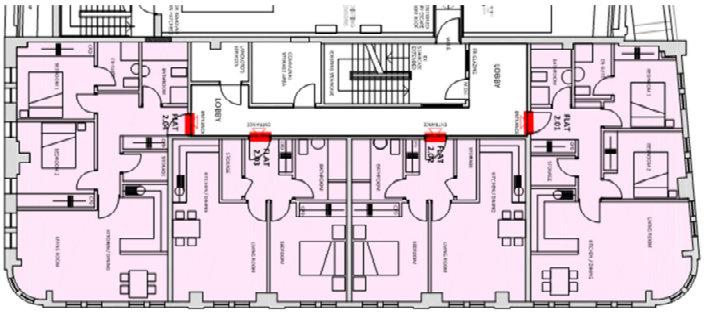

Figure 19 - SAP2012 Table S15A: Doors

Table S15A : Doors

Door opens to	Age band	Door U-value
Outside	A to J	3.0
	K	2.0
	L	E&W and N.I: 1.8 Scotland: 1.6
Unheated corridor or stairwell	any	1.4
Heated corridor or stairwell		(omitted from data collection)

Following the SAP guidance, the u-value of 1.40 can be used.

U-value – 1.40 W/m²K

3.8 Thermal Bridging

Following the SAP guidance, the thermal bridging y-value of 0.15 can be used.

Figure 20 - SAP2012 Table S13: Thermal Bridging

Table S13 : Thermal bridging

	Thermal bridging factor y (W/m²K)	
Age band	**Not park home**	**Park home**
A to I	0.15	0.15
J	0.11	0.15
K, L	0.08	0.15

3.9 Thermal Mass

Following the SAP guidance, the thermal mass value of 250 kJ/m²K can be used.

Figure 21 - SAP2012 Section S5.9: Thermal Mass

S5.9 Thermal Mass

The thermal mass parameter is taken as 250 kJ/m²K.

3.10 Air Permeability

No air permeability testing has been undertaken, therefore no air permeability has been entered in the SAP calculations.

4 Building Services

4.1 Space Heating System

The site visit indicated that electric fan heaters were provided throughout.

Figure 22 - Site Photograph

4.2 Water Heating System

During the site visit, no water heating system was present.

Figure 23 - SAP2012 Section 10.6: No Water Heating System

S10.6 No water heating system

Where no water heating system is present, the calculation is done for an electric immersion heater. If the electric meter is dual the immersion heater is also dual, but is a single immersion otherwise (including unknown meter). The calculation is done for a cylinder defined by the first row of Table S17 and the first row of Table S18.

Figure 24 - SAP2012 Table S17: Cylinder Size

Table S17 : Cylinder size

Descriptor	Indicative size range	Size to be used in SAP calculation *
Inaccessible		if off-peak electric dual immersion: 210 litres if from solid fuel boiler: 160 litres otherwise: 110 litres
Normal	up to 130 litres	110 litres
Medium	131 – 170 litres	160 litres
Large	> 170 litres	210 litres
* Actual size to be used if present in the data set (in conjunction with solar panel data)		

Figure 25 - SAP2012 Table S18: Heating and Hot Water Parameters

Table S18 : Heating and hot water parameters

Parameter	Value
Hot water cylinder insulation if not accessible	Age band of main property A to F: 12 mm loose jacket Age band of main property G, H: 25 mm foam Age band of main property I to L: 38 mm foam
Cylinderstat if no access	No cylinderstat (but see also 9.4.9)
Cylinder heat exchanger area (required for some database heat pumps)	1.0 m^2
Insulation of primary pipework	Age bands A to J: none Age band K. L: full

Following the SAP guidance, an electric immersion heater and a 110 litre cylinder with a 12mm loose insulation jacket can be used.

4.3 Internal Lighting

The proposed light fittings will be provided as part of the change of use construction works and were therefore not present during the site visit. To ensure the efficiency measures incorporated are reflected as accurately as possible, 100% low energy lighting has been provided throughout all revisions of the SAP calculations.

Figure 26 - Site Photographs

4.4 Renewable Technology

No renewable technologies were present during the site visit.

Appendix 2 – SAP Calculation Outputs

Baseline SAP Calculation Outputs

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	21/12/2015
Address	Flat 2.01 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		55.60	(1a) x	2.50	(2a) =	139.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	55.60	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	139.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		2	x 10 = 20	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.14	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	15.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.22	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.76	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.76	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.65	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.83	0.81	0.80	0.71	0.70	0.62	0.62	0.60	0.65	0.70	0.73	0.76	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.84	0.83	0.82	0.76	0.74	0.69	0.69	0.68	0.71	0.74	0.77	0.79	(24d)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.84	0.83	0.82	0.76	0.74	0.69	0.69	0.68	0.71	0.74	0.77	0.79	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			11.90	x	4.03	=	47.92			(27)
Ground floor			55.60	x	1.20	=	66.72			(28a)
External wall			39.25	x	2.30	=	90.28			(29a)
Party wall			25.25	x	0.00	=	0.00			(32)
External wall			10.25	x	0.30	=	3.08			(29a)
Total area of external elements ∑A, m²			119.10							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	210.93 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.87 (36)
Total fabric heat loss	(33) + (36) =	228.79 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
38.65	38.04	37.44	34.63	34.11	31.66	31.66	31.21	32.60	34.11	35.17	36.28	(38)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
267.45	266.84	266.24	263.43	262.90	260.46	260.46	260.00	261.40	262.90	263.97	265.08	

Average = ∑(39)1...12/12 = 263.43 (39)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
4.81	4.80	4.79	4.74	4.73	4.68	4.68	4.68	4.70	4.73	4.75	4.77	

Average = ∑(40)1...12/12 = 4.74 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.85	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	82.37	(43)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
90.61	87.32	84.02	80.73	77.43	74.14	74.14	77.43	80.73	84.02	87.32	90.61	

∑(44)1...12 = 988.48 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
134.37	117.52	121.27	105.73	101.45	87.54	81.12	93.09	94.20	109.78	119.83	130.13	

∑(45)1...12 = 1296.05 (45)

Distribution loss 0.15 x (45)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
20.16	17.63	18.19	15.86	15.22	13.13	12.17	13.96	14.13	16.47	17.98	19.52	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel 110.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.08	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	5.16	(54)
Enter (50) or (54) in (55)	5.16	(55)

Water storage loss calculated for each month (55) x (41)m

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

294.38	262.04	281.28	260.57	261.45	242.39	241.13	253.09	249.04	269.78	274.68	290.14	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

294.38	262.04	281.28	260.57	261.45	242.39	241.13	253.09	249.04	269.78	274.68	290.14	

∑(64)1...12 = 3179.97 (64)

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

172.68	154.69	168.33	159.03	161.74	152.98	154.98	158.96	155.20	164.51	163.72	171.27	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	111.30	111.30	111.30	111.30	111.30	111.30	111.30	111.30	111.30	111.30	111.30	111.30	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	36.05	32.02	26.04	19.71	14.73	12.44	13.44	17.47	23.45	29.78	34.75	37.05	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	241.39	243.89	237.58	224.14	207.18	191.24	180.59	178.08	184.39	197.83	214.80	230.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.98	47.98	47.98	47.98	47.98	47.98	47.98	47.98	47.98	47.98	47.98	47.98	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	(71)
Water heating gains (Table 5)	232.10	230.20	226.25	220.87	217.39	212.48	208.30	213.65	215.55	221.11	227.39	230.20	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	594.62	591.19	574.95	549.81	524.38	501.24	487.41	494.29	508.48	533.80	562.02	583.07	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	7.14	x	19.64	x 0.9 x	0.85	x	0.70	=	57.82	(80)
NorthWest	0.77	x	2.38	x	11.28	x 0.9 x	0.85	x	0.70	=	11.07	(81)

North	0.77	x	2.38	x	10.63	x 0.9 x	0.85	x	0.70	=	10.44	(74)

Solar gains in watts ∑(74)m...(82)m

79.33	155.59	260.77	392.80	495.92	514.90	487.18	408.15	306.88	185.50	98.90	65.29	(83)

Total gains - internal and solar (73)m + (83)m

673.95	746.78	835.72	942.61	1020.30	1016.14	974.59	902.43	815.35	719.30	660.92	648.37	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)												
0.98	0.97	0.96	0.93	0.89	0.81	0.72	0.75	0.87	0.95	0.97	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)												
17.15	17.38	17.90	18.65	19.43	20.13	20.54	20.47	19.88	18.90	17.92	17.12	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)												
18.12	18.12	18.12	18.13	18.13	18.14	18.14	18.15	18.14	18.13	18.13	18.13	(88)
Utilisation factor for gains for rest of dwelling n2,m												
0.97	0.96	0.94	0.90	0.81	0.63	0.37	0.43	0.75	0.91	0.96	0.97	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)												
15.04	15.27	15.78	16.52	17.25	17.86	18.10	18.08	17.68	16.78	15.81	15.01	(90)

Living area fraction Living area ÷ (4) = 0.58 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

16.25	16.49	17.00	17.74	18.51	19.17	19.50	19.45	18.95	18.00	17.02	16.23	(92)

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

16.55	16.79	17.30	18.04	18.81	19.47	19.80	19.75	19.25	18.30	17.32	16.53	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm												
0.96	0.95	0.94	0.90	0.84	0.74	0.61	0.65	0.81	0.91	0.95	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m												
649.70	713.02	782.18	846.97	852.76	747.62	597.15	590.35	662.16	656.62	629.43	626.74	(95)
Monthly average external temperature from Table U1												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]												
3277.18	3172.23	2875.51	2408.44	1867.99	1267.85	834.72	872.25	1345.85	2024.75	2697.97	3267.11	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m												
1954.85	1652.59	1557.44	1124.26	755.33	0.00	0.00	0.00	0.00	1017.89	1489.35	1964.43	

∑(98)1...5, 10...12 = 11516.13 (98)

Space heating requirement kWh/m²/year (98) ÷ (4) 207.12 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 100.00 (206)

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

Space heating fuel (main system 1), kWh/month

1954.85	1652.59	1557.44	1124.26	755.33	0.00	0.00	0.00	0.00	1017.89	1489.35	1964.43

∑(211)1...5, 10...12 = 11516.13 (211)

Water heating

Efficiency of water heater

100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

(217)

Water heating fuel, kWh/month

294.38	262.04	281.28	260.57	261.45	242.39	241.13	253.09	249.04	269.78	274.68	290.14

∑(219a)1...12 = 3179.97 (219)

Annual totals

Space heating fuel - main system 1	11516.13	
Water heating fuel	3179.97	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
Total electricity for the above, kWh/year	0.00	(231)
Electricity for lighting (Appendix L)	254.63	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	14950.73	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	11516.13	x	13.19	x 0.01 =	1518.98	(240)
Water heating	3179.97	x	13.19	x 0.01 =	419.44	(247)
Electricity for lighting	254.63	x	13.19	x 0.01 =	33.59	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	1972.00	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	8.23	(257)
SAP value	6.22	
SAP rating (section 13)	6	(258)
SAP band	G	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	11516.13	x	0.52	=	5976.87	(261)
Water heating	3179.97	x	0.52	=	1650.40	(264)
Space and water heating				(261) + (262) + (263) + (264) =	7627.27	(265)
Electricity for lighting	254.63	x	0.52	=	132.15	(268)
Total CO_2, kg/year				(265)...(271) =	7759.43	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	139.56	(273)
EI value					20.71	
EI rating (section 14)					21	(274)
EI band					F	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	11516.13	x	3.07	=	35354.51	(261)

Water heating	3179.97	x	3.07	=	9762.49	(264)
Space and water heating			(261) + (262) + (263) + (264) =		45117.00	(265)
Electricity for lighting	254.63	x	3.07	=	781.72	(268)
Primary energy kWh/year					45898.73	(272)
Dwelling primary energy rate kWh/m2/year					825.52	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	21/12/2015
Address	Flat 2.02 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		2	x 10 = 20	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.16	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	31.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.19	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.75	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.75	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.58	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.74	0.72	0.71	0.64	0.62	0.55	0.55	0.54	0.58	0.62	0.65	0.68	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.77	0.76	0.75	0.70	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(24d)

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

0.77	0.76	0.75	0.70	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			4.76	x	4.03	=	19.17			(27)
Ground floor			50.00	x	1.20	=	60.00			(28a)
External wall			10.64	x	2.30	=	24.47			(29a)
Party wall			42.00	x	0.00	=	0.00			(32)
External wall			10.50	x	0.30	=	3.15			(29a)
Total area of external elements ∑A, m²			78.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	109.73 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.70 (36)
Total fabric heat loss	(33) + (36) =	121.43 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	31.89	31.45	31.03	29.01	28.63	26.88	26.88	26.56	27.56	28.63	29.40	30.19	(38)
Heat transfer coefficient, W/K (37)m + (38)m	153.32	152.88	152.46	150.44	150.06	148.31	148.31	147.99	148.99	150.06	150.83	151.62	

Average = ∑(39)1...12/12 = 150.44 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	3.07	3.06	3.05	3.01	3.00	2.97	2.97	2.96	2.98	3.00	3.02	3.03	

Average = ∑(40)1...12/12 = 3.01 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	78.25	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	86.08	82.95	79.82	76.69	73.56	70.43	70.43	73.56	76.69	79.82	82.95	86.08	

∑(44)1...12 = 939.03 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	127.65	111.64	115.21	100.44	96.37	83.16	77.06	88.43	89.49	104.29	113.84	123.62	

∑(45)1...12 = 1231.22 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	19.15	16.75	17.28	15.07	14.46	12.47	11.56	13.26	13.42	15.64	17.08	18.54	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.08	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	5.16	(54)
Enter (50) or (54) in (55)	5.16	(55)

Water storage loss calculated for each month (55) x (41)m

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

287.65	256.16	275.21	255.28	256.38	238.01	237.07	248.44	244.33	264.29	268.68	283.63	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

287.65	256.16	275.21	255.28	256.38	238.01	237.07	248.44	244.33	264.29	268.68	283.63	

∑(64)1...12 = 3115.14 (64)

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

170.45	152.74	166.31	157.27	160.05	151.53	153.63	157.41	153.63	162.68	161.73	169.11	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.34	33.17	26.97	20.42	15.26	12.89	13.92	18.10	24.29	30.85	36.00	38.38	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	229.10	227.29	223.53	218.43	215.12	210.45	206.49	211.57	213.37	218.66	224.62	227.30	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	566.82	563.12	547.43	523.54	499.63	478.07	465.45	472.42	486.17	510.23	536.80	556.36	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	4.76	x	10.63	x 0.9 x	0.85	x	0.70	=	20.87	(74)

Solar gains in watts ∑(74)m...(82)m

20.87	39.88	67.77	108.86	146.65	156.99	146.57	116.28	81.49	47.48	25.75	17.40	(83)

Total gains - internal and solar (73)m + (83)m

587.69	603.00	615.20	632.40	646.27	635.06	612.01	588.70	567.65	557.71	562.54	573.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.98	0.97	0.95	0.92	0.84	0.74	0.77	0.89	0.95	0.97	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	18.24	18.39	18.75	19.29	19.87	20.42	20.72	20.68	20.26	19.55	18.83	18.23	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	18.72	18.72	18.73	18.75	18.75	18.77	18.77	18.77	18.76	18.75	18.74	18.73	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.97	0.97	0.96	0.93	0.87	0.71	0.47	0.52	0.79	0.92	0.96	0.98	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	16.44	16.59	16.95	17.49	18.05	18.53	18.72	18.71	18.41	17.75	17.04	16.43	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	17.41	17.56	17.92	18.46	19.03	19.55	19.80	19.77	19.41	18.73	18.01	17.40	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	17.71	17.86	18.22	18.76	19.33	19.85	20.10	20.07	19.71	19.03	18.31	17.70	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.96	0.95	0.93	0.88	0.79	0.66	0.69	0.84	0.93	0.96	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	569.35	581.61	587.02	588.64	570.61	500.39	402.59	406.22	476.91	516.54	538.97	556.97	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	2055.86	1981.79	1786.75	1484.06	1145.65	778.54	519.13	543.34	835.90	1264.34	1690.07	2047.11	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1105.96	940.92	892.60	644.70	427.83	0.00	0.00	0.00	0.00	556.36	828.79	1108.66	

∑(98)1...5, 10...12 = 6505.83 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 130.12 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 100.00 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	1105.96	940.92	892.60	644.70	427.83	0.00	0.00	0.00	0.00	556.36	828.79	1108.66

∑(211)1...5, 10...12 =	6505.83	(211)

Water heating

Efficiency of water heater

100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	(217)

Water heating fuel, kWh/month

287.65	256.16	275.21	255.28	256.38	238.01	237.07	248.44	244.33	264.29	268.68	283.63

∑(219a)1...12 =	3115.14	(219)

Annual totals

Space heating fuel - main system 1	6505.83	
Water heating fuel	3115.14	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
Total electricity for the above, kWh/year	0.00	(231)
Electricity for lighting (Appendix L)	263.79	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	9884.76	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	6505.83	x	13.19	x 0.01 =	858.12	(240)
Water heating	3115.14	x	13.19	x 0.01 =	410.89	(247)
Electricity for lighting	263.79	x	13.19	x 0.01 =	34.79	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	1303.80	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	5.76	(257)
SAP value	24.95	
SAP rating (section 13)	25	(258)
SAP band	F	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	6505.83	x	0.52	=	3376.53	(261)
Water heating	3115.14	x	0.52	=	1616.76	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4993.28	(265)
Electricity for lighting	263.79	x	0.52	=	136.91	(268)
Total CO_2, kg/year				(265)...(271) =	5130.19	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	102.60	(273)
EI value					35.42	
EI rating (section 14)					35	(274)
EI band					F	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	6505.83	x	3.07	=	19972.90	(261)
Water heating	3115.14	x	3.07	=	9563.47	(264)
Space and water heating			(261) + (262) + (263) + (264) =		29536.37	(265)

Electricity for lighting	263.79	x	3.07	=	809.84	(268)
Primary energy kWh/year					30346.21	(272)
Dwelling primary energy rate kWh/m2/year					606.92	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	21/12/2015
Address	Flat 2.03 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		2	x 10 = 20	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.16	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	31.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.19	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.75	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.75	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.58	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.74	0.72	0.71	0.64	0.62	0.55	0.55	0.54	0.58	0.62	0.65	0.68	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.77	0.76	0.75	0.70	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(24d)

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

0.77	0.76	0.75	0.70	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			4.76	x	4.03	=	19.17			(27)
Ground floor			50.00	x	1.20	=	60.00			(28a)
External wall			10.64	x	2.30	=	24.47			(29a)
Party wall			35.00	x	0.00	=	0.00			(32)
External wall			17.50	x	0.30	=	5.25			(29a)
Total area of external elements ∑A, m²			85.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	111.83 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		12.75 (36)
Total fabric heat loss	(33) + (36) =	124.58 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	31.89	31.45	31.03	29.01	28.63	26.88	26.88	26.56	27.56	28.63	29.40	30.19	(38)
Heat transfer coefficient, W/K (37)m + (38)m	156.47	156.03	155.61	153.59	153.21	151.46	151.46	151.14	152.14	153.21	153.98	154.77	

Average = ∑(39)1...12/12 = 153.59 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	3.13	3.12	3.11	3.07	3.06	3.03	3.03	3.02	3.04	3.06	3.08	3.10	

Average = ∑(40)1...12/12 = 3.07 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	78.25 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	86.08	82.95	79.82	76.69	73.56	70.43	70.43	73.56	76.69	79.82	82.95	86.08	

∑(44)1...12 = 939.03 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	127.65	111.64	115.21	100.44	96.37	83.16	77.06	88.43	89.49	104.29	113.84	123.62	

∑(45)1...12 = 1231.22 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	19.15	16.75	17.28	15.07	14.46	12.47	11.56	13.26	13.42	15.64	17.08	18.54	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.08	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	5.16	(54)
Enter (50) or (54) in (55)	5.16	(55)

Water storage loss calculated for each month (55) x (41)m

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

287.65	256.16	275.21	255.28	256.38	238.01	237.07	248.44	244.33	264.29	268.68	283.63	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

287.65	256.16	275.21	255.28	256.38	238.01	237.07	248.44	244.33	264.29	268.68	283.63	

∑(64)1...12 = 3115.14 (64)

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

170.45	152.74	166.31	157.27	160.05	151.53	153.63	157.41	153.63	162.68	161.73	169.11	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.34	33.17	26.97	20.42	15.26	12.89	13.92	18.10	24.29	30.85	36.00	38.38	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	229.10	227.29	223.53	218.43	215.12	210.45	206.49	211.57	213.37	218.66	224.62	227.30	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	566.82	563.12	547.43	523.54	499.63	478.07	465.45	472.42	486.17	510.23	536.80	556.36	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	4.76	x	10.63	x 0.9 x	0.85	x	0.70	=	20.87	(74)

Solar gains in watts ∑(74)m...(82)m

20.87	39.88	67.77	108.86	146.65	156.99	146.57	116.28	81.49	47.48	25.75	17.40	(83)

Total gains - internal and solar (73)m + (83)m

587.69	603.00	615.20	632.40	646.27	635.06	612.01	588.70	567.65	557.71	562.54	573.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.98	0.97	0.95	0.92	0.85	0.75	0.77	0.89	0.95	0.97	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	18.19	18.34	18.70	19.25	19.84	20.40	20.71	20.66	20.24	19.52	18.79	18.18	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	18.69	18.69	18.69	18.71	18.72	18.74	18.74	18.74	18.73	18.72	18.71	18.70	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.97	0.97	0.96	0.93	0.87	0.71	0.47	0.52	0.79	0.92	0.96	0.98	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	16.37	16.52	16.88	17.44	18.00	18.49	18.69	18.67	18.37	17.70	16.98	16.37	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	17.35	17.51	17.87	18.42	19.00	19.52	19.78	19.75	19.38	18.68	17.95	17.34	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	17.65	17.81	18.17	18.72	19.30	19.82	20.08	20.05	19.68	18.98	18.25	17.64	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.96	0.95	0.93	0.88	0.79	0.66	0.69	0.84	0.93	0.96	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	569.27	581.54	587.00	588.77	571.12	501.69	404.58	407.98	477.66	516.67	538.93	556.89	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	2089.08	2013.82	1815.51	1507.97	1163.78	790.64	526.78	551.41	848.85	1284.53	1717.54	2080.61	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1130.74	962.49	914.01	661.83	440.94	0.00	0.00	0.00	0.00	571.28	848.60	1133.65	

∑(98)1...5, 10...12 = 6663.54 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 133.27 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 100.00 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	1130.74	962.49	914.01	661.83	440.94	0.00	0.00	0.00	0.00	571.28	848.60	1133.65

∑(211)1...5, 10...12 =	6663.54	(211)

Water heating

Efficiency of water heater

100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	(217)

Water heating fuel, kWh/month

287.65	256.16	275.21	255.28	256.38	238.01	237.07	248.44	244.33	264.29	268.68	283.63

∑(219a)1...12 =	3115.14	(219)

Annual totals

Space heating fuel - main system 1	6663.54	
Water heating fuel	3115.14	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
Total electricity for the above, kWh/year	0.00	(231)
Electricity for lighting (Appendix L)	263.79	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	10042.47	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	6663.54	x	13.19	x 0.01 =	878.92	(240)
Water heating	3115.14	x	13.19	x 0.01 =	410.89	(247)
Electricity for lighting	263.79	x	13.19	x 0.01 =	34.79	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	1324.60	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	5.86	(257)
SAP value	24.12	
SAP rating (section 13)	24	(258)
SAP band	F	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	6663.54	x	0.52	=	3458.38	(261)
Water heating	3115.14	x	0.52	=	1616.76	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5075.14	(265)
Electricity for lighting	263.79	x	0.52	=	136.91	(268)
Total CO_2, kg/year				(265)...(271) =	5212.04	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	104.24	(273)
EI value					34.77	
EI rating (section 14)					35	(274)
EI band					F	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	6663.54	x	3.07	=	20457.08	(261)
Water heating	3115.14	x	3.07	=	9563.47	(264)
Space and water heating			(261) + (262) + (263) + (264) =		30020.55	(265)

Electricity for lighting	263.79	x	3.07	=	809.84	(268)
Primary energy kWh/year					30830.39	(272)
Dwelling primary energy rate kWh/m2/year					616.61	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	21/12/2015
Address	Flat 2.04 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		2	x 10 = 20	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.16	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	31.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.19	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.75	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.75	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.58	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.74	0.72	0.71	0.64	0.62	0.55	0.55	0.54	0.58	0.62	0.65	0.68	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.77	0.76	0.75	0.70	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(24d)

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

0.77	0.76	0.75	0.70	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			4.76	x	4.03	=	19.17			(27)
Ground floor			50.00	x	1.20	=	60.00			(28a)
External wall			10.64	x	2.30	=	24.47			(29a)
Party wall			42.00	x	0.00	=	0.00			(32)
External wall			10.50	x	0.30	=	3.15			(29a)
Total area of external elements ∑A, m²			78.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	109.73 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.70 (36)
Total fabric heat loss	(33) + (36) =	121.43 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31.89	31.45	31.03	29.01	28.63	26.88	26.88	26.56	27.56	28.63	29.40	30.19	(38)

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

153.32	152.88	152.46	150.44	150.06	148.31	148.31	147.99	148.99	150.06	150.83	151.62	

Average = ∑(39)1...12/12 = 150.44 (39)

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

3.07	3.06	3.05	3.01	3.00	2.97	2.97	2.96	2.98	3.00	3.02	3.03	

Average = ∑(40)1...12/12 = 3.01 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	78.25	(43)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
86.08	82.95	79.82	76.69	73.56	70.43	70.43	73.56	76.69	79.82	82.95	86.08	

∑(44)1...12 = 939.03 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

127.65	111.64	115.21	100.44	96.37	83.16	77.06	88.43	89.49	104.29	113.84	123.62	

∑(45)1...12 = 1231.22 (45)

Distribution loss 0.15 x (45)m

19.15	16.75	17.28	15.07	14.46	12.47	11.56	13.26	13.42	15.64	17.08	18.54	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.08	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	5.16	(54)
Enter (50) or (54) in (55)	5.16	(55)

Water storage loss calculated for each month (55) x (41)m

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

287.65	256.16	275.21	255.28	256.38	238.01	237.07	248.44	244.33	264.29	268.68	283.63	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

287.65	256.16	275.21	255.28	256.38	238.01	237.07	248.44	244.33	264.29	268.68	283.63	

∑(64)1...12 = 3115.14 (64)

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

170.45	152.74	166.31	157.27	160.05	151.53	153.63	157.41	153.63	162.68	161.73	169.11	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.34	33.17	26.97	20.42	15.26	12.89	13.92	18.10	24.29	30.85	36.00	38.38	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	229.10	227.29	223.53	218.43	215.12	210.45	206.49	211.57	213.37	218.66	224.62	227.30	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	566.82	563.12	547.43	523.54	499.63	478.07	465.45	472.42	486.17	510.23	536.80	556.36	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	4.76	x	10.63	x 0.9 x	0.85	x	0.70	=	20.87	(74)

Solar gains in watts ∑(74)m...(82)m

20.87	39.88	67.77	108.86	146.65	156.99	146.57	116.28	81.49	47.48	25.75	17.40	(83)

Total gains - internal and solar (73)m + (83)m

587.69	603.00	615.20	632.40	646.27	635.06	612.01	588.70	567.65	557.71	562.54	573.76	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.98	0.97	0.95	0.92	0.84	0.74	0.77	0.89	0.95	0.97	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	18.24	18.39	18.75	19.29	19.87	20.42	20.72	20.68	20.26	19.55	18.83	18.23	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	18.72	18.72	18.73	18.75	18.75	18.77	18.77	18.77	18.76	18.75	18.74	18.73	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.97	0.97	0.96	0.93	0.87	0.71	0.47	0.52	0.79	0.92	0.96	0.98	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	16.44	16.59	16.95	17.49	18.05	18.53	18.72	18.71	18.41	17.75	17.04	16.43	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	17.41	17.56	17.92	18.46	19.03	19.55	19.80	19.77	19.41	18.73	18.01	17.40	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	17.71	17.86	18.22	18.76	19.33	19.85	20.10	20.07	19.71	19.03	18.31	17.70	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.96	0.95	0.93	0.88	0.79	0.66	0.69	0.84	0.93	0.96	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	569.35	581.61	587.02	588.64	570.61	500.39	402.59	406.22	476.91	516.54	538.97	556.97	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	2055.86	1981.79	1786.75	1484.06	1145.65	778.54	519.13	543.34	835.90	1264.34	1690.07	2047.11	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1105.96	940.92	892.60	644.70	427.83	0.00	0.00	0.00	0.00	556.36	828.79	1108.66	

∑(98)1...5, 10...12 = 6505.83 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 130.12 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 100.00 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	1105.96	940.92	892.60	644.70	427.83	0.00	0.00	0.00	0.00	556.36	828.79	1108.66

∑(211)1...5, 10...12 =	6505.83	(211)

Water heating

Efficiency of water heater

100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	(217)

Water heating fuel, kWh/month

287.65	256.16	275.21	255.28	256.38	238.01	237.07	248.44	244.33	264.29	268.68	283.63

∑(219a)1...12 =	3115.14	(219)

Annual totals

Space heating fuel - main system 1	6505.83	
Water heating fuel	3115.14	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
Total electricity for the above, kWh/year	0.00	(231)
Electricity for lighting (Appendix L)	263.79	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	9884.76	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	6505.83	x	13.19	x 0.01 =	858.12	(240)
Water heating	3115.14	x	13.19	x 0.01 =	410.89	(247)
Electricity for lighting	263.79	x	13.19	x 0.01 =	34.79	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	1303.80	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	5.76	(257)
SAP value	24.95	
SAP rating (section 13)	25	(258)
SAP band	F	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	6505.83	x	0.52	=	3376.53	(261)
Water heating	3115.14	x	0.52	=	1616.76	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4993.28	(265)
Electricity for lighting	263.79	x	0.52	=	136.91	(268)
Total CO_2, kg/year				(265)...(271) =	5130.19	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	102.60	(273)
EI value					35.42	
EI rating (section 14)					35	(274)
EI band					F	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	6505.83	x	3.07	=	19972.90	(261)
Water heating	3115.14	x	3.07	=	9563.47	(264)
Space and water heating			(261) + (262) + (263) + (264) =		29536.37	(265)

Electricity for lighting	263.79	x	3.07	=	809.84	(268)
Primary energy kWh/year					30346.21	(272)
Dwelling primary energy rate kWh/m2/year					606.92	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	21/12/2015
Address	Flat 2.05 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		55.00	(1a) x	2.50	(2a) =	137.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	55.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	137.50	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.15 (8)

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

Number of storeys in the dwelling		1	(9)
Additional infiltration			0.00 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0.35 (11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0.00 (12)
If no draught lobby, enter 0.05, else enter 0			0.05 (13)
Percentage of windows and doors draught proofed		15.00	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0.22 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0.77 (16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.77 (18)
Number of sides on which the dwelling is sheltered			2 (19)
Shelter factor	1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.65 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.83	0.81	0.80	0.72	0.70	0.62	0.62	0.60	0.65	0.70	0.73	0.76	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

0.84	0.83	0.82	0.76	0.74	0.69	0.69	0.68	0.71	0.74	0.77	0.79

(24d)

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

0.84	0.83	0.82	0.76	0.74	0.69	0.69	0.68	0.71	0.74	0.77	0.79

(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			11.90	x	4.03	=	47.92			(27)
Ground floor			55.00	x	1.20	=	66.00			(28a)
External wall			39.25	x	2.30	=	90.28			(29a)
Party wall			25.25	x	0.00	=	0.00			(32)
External wall			10.25	x	0.30	=	3.08			(29a)
Total area of external elements ∑A, m²			118.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	210.21 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.78 (36)
Total fabric heat loss	(33) + (36) =	227.98 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
38.30	37.69	37.10	34.31	33.79	31.36	31.36	30.91	32.29	33.79	34.84	35.95	(38)

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

266.28	265.68	265.08	262.29	261.77	259.34	259.34	258.89	260.28	261.77	262.83	263.93	

Average = ∑(39)1...12/12 = 262.29 (39)

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

4.84	4.83	4.82	4.77	4.76	4.72	4.72	4.71	4.73	4.76	4.78	4.80	

Average = ∑(40)1...12/12 = 4.77 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.84	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	81.93	(43)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
90.13	86.85	83.57	80.30	77.02	73.74	73.74	77.02	80.30	83.57	86.85	90.13	

∑(44)1...12 = 983.21 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

133.66	116.90	120.63	105.17	100.91	87.08	80.69	92.59	93.70	109.20	119.20	129.44	

∑(45)1...12 = 1289.14 (45)

Distribution loss 0.15 x (45)m

20.05	17.53	18.09	15.77	15.14	13.06	12.10	13.89	14.05	16.38	17.88	19.42	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.08	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	5.16	(54)
Enter (50) or (54) in (55)	5.16	(55)

Water storage loss calculated for each month (55) x (41)m

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

293.66	261.42	280.63	260.01	260.91	241.92	240.69	252.60	248.54	269.20	274.04	289.44	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

293.66	261.42	280.63	260.01	260.91	241.92	240.69	252.60	248.54	269.20	274.04	289.44	

∑(64)1...12 = 3173.06 (64)

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

172.44	154.48	168.11	158.84	161.56	152.83	154.83	158.79	155.03	164.31	163.51	171.04	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	110.24	110.24	110.24	110.24	110.24	110.24	110.24	110.24	110.24	110.24	110.24	110.24	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	35.70	31.71	25.79	19.52	14.59	12.32	13.31	17.30	23.23	29.49	34.42	36.69	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	239.08	241.56	235.31	222.00	205.20	189.41	178.86	176.38	182.63	195.94	212.74	228.53	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.86	47.86	47.86	47.86	47.86	47.86	47.86	47.86	47.86	47.86	47.86	47.86	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	(71)
Water heating gains (Table 5)	231.78	229.89	225.96	220.61	217.14	212.26	208.11	213.43	215.32	220.85	227.09	229.89	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	591.17	587.77	571.67	546.75	521.55	498.60	484.89	491.72	505.79	530.89	558.87	579.73	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	7.14	x	19.64	x 0.9 x	0.85	x	0.70	=	57.82	(76)
NorthEast	0.77	x	2.38	x	11.28	x 0.9 x	0.85	x	0.70	=	11.07	(75)

North	0.77	x	2.38	x	10.63	x 0.9 x	0.85	x	0.70	=	10.44	(74)	

Solar gains in watts ∑(74)m...(82)m

79.33	155.59	260.77	392.80	495.92	514.90	487.18	408.15	306.88	185.50	98.90	65.29

(83)

Total gains - internal and solar (73)m + (83)m

670.50	743.36	832.44	939.55	1017.47	1013.50	972.07	899.87	812.66	716.39	657.77	645.02

(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.96	0.93	0.89	0.81	0.72	0.75	0.87	0.95	0.97	0.98

(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

17.14	17.37	17.89	18.64	19.42	20.13	20.54	20.47	19.88	18.90	17.91	17.11

(87)

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

18.11	18.11	18.12	18.13	18.13	18.14	18.14	18.14	18.13	18.13	18.12	18.12

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.96	0.94	0.90	0.81	0.63	0.37	0.43	0.74	0.91	0.96	0.97

(89)

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

15.03	15.26	15.77	16.51	17.25	17.85	18.09	18.07	17.68	16.77	15.80	15.00

(90)

Living area fraction Living area ÷ (4) = 0.55 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

16.18	16.41	16.93	17.67	18.43	19.09	19.43	19.38	18.88	17.93	16.95	16.15

(92)

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

16.48	16.71	17.23	17.97	18.73	19.39	19.73	19.68	19.18	18.23	17.25	16.45

(93)

8. Space heating requirement

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

Utilisation factor for gains, ηm

0.96	0.95	0.93	0.90	0.83	0.73	0.60	0.65	0.81	0.91	0.95	0.97

(94)

Useful gains, ηmGm, W (94)m x (84)m

645.91	709.09	778.04	842.29	846.96	739.74	586.20	580.65	656.34	652.58	625.78	623.08

(95)

Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20

(96)

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

3242.63	3138.41	2843.48	2379.17	1841.32	1243.52	811.12	848.88	1321.54	1997.31	2666.85	3232.80

(97)

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

1931.96	1632.51	1536.68	1106.55	739.80	0.00	0.00	0.00	0.00	1000.48	1469.57	1941.63

∑(98)1...5, 10...12 = 11359.18 (98)

Space heating requirement kWh/m²/year (98) ÷ (4) = 206.53 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 100.00 (206)

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

Space heating fuel (main system 1), kWh/month

1931.96	1632.51	1536.68	1106.55	739.80	0.00	0.00	0.00	0.00	1000.48	1469.57	1941.63

∑(211)1...5, 10...12 = 11359.18 (211)

Water heating

Efficiency of water heater

100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

(217)

Water heating fuel, kWh/month

293.66	261.42	280.63	260.01	260.91	241.92	240.69	252.60	248.54	269.20	274.04	289.44

∑(219a)1...12 = 3173.06 (219)

Annual totals

Space heating fuel - main system 1	11359.18	
Water heating fuel	3173.06	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
Total electricity for the above, kWh/year	0.00	(231)
Electricity for lighting (Appendix L)	252.20	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	14784.44	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	11359.18	x	13.19	x 0.01 =	1498.28	(240)
Water heating	3173.06	x	13.19	x 0.01 =	418.53	(247)
Electricity for lighting	252.20	x	13.19	x 0.01 =	33.27	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	1950.07	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	8.19	(257)
SAP value	6.49	
SAP rating (section 13)	6	(258)
SAP band	G	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	11359.18	x	0.52	=	5895.42	(261)
Water heating	3173.06	x	0.52	=	1646.82	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7542.23	(265)
Electricity for lighting	252.20	x	0.52	=	130.89	(268)
Total CO_2, kg/year				(265)...(271) =	7673.13	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	139.51	(273)
EI value					20.93	
EI rating (section 14)					21	(274)
EI band					F	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	11359.18	x	3.07	=	34872.69	(261)

Water heating	3173.06	x	3.07	=	9741.29	(264)
Space and water heating			(261) + (262) + (263) + (264) =		44613.98	(265)
Electricity for lighting	252.20	x	3.07	=	774.26	(268)
Primary energy kWh/year					45388.24	(272)
Dwelling primary energy rate kWh/m2/year					825.24	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	26/08/2015
Address	Flat 3.01 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		56.70	(1a) x	2.50	(2a) =	141.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	56.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	141.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		2	x 10 = 20	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.14	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	23.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.20	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.75	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.75	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.63	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.81	0.79	0.78	0.70	0.68	0.60	0.60	0.59	0.63	0.68	0.71	0.74	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

0.83	0.81	0.80	0.74	0.73	0.68	0.68	0.67	0.70	0.73	0.75	0.78	(24d)

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

0.83	0.81	0.80	0.74	0.73	0.68	0.68	0.67	0.70	0.73	0.75	0.78	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			7.00	x	4.03	=	28.19			(27)
External wall			55.40	x	0.50	=	27.70			(29a)
Party wall			15.50	x	0.00	=	0.00			(32)
External wall			7.50	x	0.30	=	2.25			(29a)
Roof			56.70	x	0.50	=	28.35			(30)
Total area of external elements ∑A, m²			128.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	89.43 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		19.31 (36)
Total fabric heat loss	(33) + (36) =	108.73 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)													
	38.64	38.05	37.47	34.74	34.23	31.86	31.86	31.42	32.77	34.23	35.26	36.34	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	147.37	146.78	146.20	143.47	142.96	140.59	140.59	140.15	141.50	142.96	143.99	145.07	
									Average = ∑(39)1...12/12 =			143.47	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	2.60	2.59	2.58	2.53	2.52	2.48	2.48	2.47	2.50	2.52	2.54	2.56	
									Average = ∑(40)1...12/12 =			2.53	(40)
Number of days in month (Table 1a)													
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.89	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	83.17	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
	91.49	88.16	84.84	81.51	78.18	74.86	74.86	78.18	81.51	84.84	88.16	91.49	
										∑(44)1...12 =		998.09	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	135.68	118.67	122.45	106.76	102.44	88.39	81.91	93.99	95.12	110.85	121.00	131.40	
										∑(45)1...12 =		1308.65	(45)
Distribution loss 0.15 x (45)m													
	20.35	17.80	18.37	16.01	15.37	13.26	12.29	14.10	14.27	16.63	18.15	19.71	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.08	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	5.16	(54)
Enter (50) or (54) in (55)	5.16	(55)

Water storage loss calculated for each month (55) x (41)m

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

295.68	263.19	282.46	261.60	262.44	243.24	241.91	254.00	249.96	270.85	275.84	291.40	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

295.68	263.19	282.46	261.60	262.44	243.24	241.91	254.00	249.96	270.85	275.84	291.40	

∑(64)1...12 = 3192.57 (64)

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

173.12	155.07	168.72	159.37	162.06	153.27	155.24	159.26	155.50	164.86	164.11	171.69	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.41	35.01	28.47	21.55	16.11	13.60	14.70	19.10	25.64	32.56	38.00	40.51	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.60	248.15	241.73	228.06	210.80	194.58	183.74	181.19	187.61	201.29	218.55	234.77	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	(71)
Water heating gains (Table 5)	232.68	230.76	226.77	221.35	217.83	212.87	208.65	214.05	215.97	221.59	227.93	230.77	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	603.65	599.87	582.92	556.91	530.69	507.00	493.04	500.30	515.18	541.38	570.42	592.00	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	4.20	x	36.79	x 0.9 x	0.85	x	0.70	=	63.72	(79)
NorthWest	0.77	x	2.80	x	11.28	x 0.9 x	0.85	x	0.70	=	13.03	(81)

Solar gains in watts ∑(74)m...(82)m

76.75	135.05	196.28	262.46	311.57	317.05	302.45	264.63	219.01	152.36	92.71	65.17

(83)

Total gains - internal and solar (73)m + (83)m

680.40	734.92	779.20	819.37	842.25	824.04	795.49	764.93	734.19	693.74	663.13	657.16

(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.98	0.97	0.96	0.93	0.88	0.77	0.64	0.68	0.84	0.94	0.97	0.98

(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

18.65	18.84	19.20	19.71	20.22	20.65	20.86	20.83	20.52	19.89	19.20	18.64

(87)

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

18.96	18.97	18.98	19.00	19.01	19.03	19.03	19.04	19.02	19.01	19.00	18.99

(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.96	0.94	0.90	0.81	0.63	0.41	0.45	0.72	0.90	0.96	0.97

(89)

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

17.00	17.19	17.55	18.06	18.53	18.90	19.01	19.00	18.80	18.24	17.57	17.00

(90)

Living area fraction Living area ÷ (4) = 0.49 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

17.81	18.00	18.36	18.88	19.36	19.76	19.92	19.91	19.65	19.06	18.38	17.81

(92)

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

18.11	18.30	18.66	19.18	19.66	20.06	20.22	20.21	19.95	19.36	18.68	18.11

(93)

8. Space heating requirement

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

Utilisation factor for gains, ηm

0.97	0.96	0.94	0.91	0.84	0.71	0.56	0.60	0.78	0.91	0.95	0.97

(94)

Useful gains, ηmGm, W (94)m x (84)m

658.55	704.63	733.60	742.21	706.24	588.93	447.09	457.18	574.97	629.02	632.65	637.94

(95)

Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20

(96)

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

2035.69	1967.23	1777.99	1474.70	1138.62	767.83	509.11	533.29	827.53	1251.68	1667.20	2018.04

(97)

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

1024.59	848.46	777.03	527.39	321.69	0.00	0.00	0.00	0.00	463.26	744.88	1026.79

∑(98)1...5, 10...12 = 5734.09 (98)

Space heating requirement kWh/m²/year (98) ÷ (4) = 101.13 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 100.00 (206)

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

Space heating fuel (main system 1), kWh/month

1024.59	848.46	777.03	527.39	321.69	0.00	0.00	0.00	0.00	463.26	744.88	1026.79

∑(211)1...5, 10...12 = 5734.09 (211)

Water heating

Efficiency of water heater

100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

(217)

Water heating fuel, kWh/month

295.68	263.19	282.46	261.60	262.44	243.24	241.91	254.00	249.96	270.85	275.84	291.40

∑(219a)1...12 = 3192.57 (219)

Annual totals

Space heating fuel - main system 1	5734.09	
Water heating fuel	3192.57	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
Total electricity for the above, kWh/year	0.00	(231)
Electricity for lighting (Appendix L)	278.43	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	9205.09	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	5734.09	x	13.19	x 0.01 =	756.33	(240)
Water heating	3192.57	x	13.19	x 0.01 =	421.10	(247)
Electricity for lighting	278.43	x	13.19	x 0.01 =	36.72	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	1214.15	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	5.01	(257)
SAP value	32.28	
SAP rating (section 13)	32	(258)
SAP band	F	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	5734.09	x	0.52	=	2975.99	(261)
Water heating	3192.57	x	0.52	=	1656.95	(264)
Space and water heating				(261) + (262) + (263) + (264) =	4632.94	(265)
Electricity for lighting	278.43	x	0.52	=	144.50	(268)
Total CO_2, kg/year				(265)...(271) =	4777.44	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	84.26	(273)
EI value					41.17	
EI rating (section 14)					41	(274)
EI band					E	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	5734.09	x	3.07	=	17603.67	(261)
Water heating	3192.57	x	3.07	=	9801.20	(264)

Space and water heating				(261) + (262) + (263) + (264) =		27404.86	(265)
Electricity for lighting	278.43	x	3.07	=		854.77	(268)
Primary energy kWh/year						28259.64	(272)
Dwelling primary energy rate kWh/m2/year						498.41	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	26/08/2015
Address	Flat 3.02 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.00	(1a) x	2.50	(2a) =	127.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		2	x 10 = 20	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.16	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	38.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.17	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.73	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.73	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.62	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.79	0.78	0.76	0.68	0.67	0.59	0.59	0.57	0.62	0.67	0.70	0.73	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.81	0.80	0.79	0.73	0.72	0.67	0.67	0.67	0.69	0.72	0.74	0.77	(24d)

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

0.81	0.80	0.79	0.73	0.72	0.67	0.67	0.67	0.69	0.72	0.74	0.77	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			3.36	x	4.03	=	13.53			(27)
External wall			19.04	x	0.50	=	9.52			(29a)
Party wall			33.25	x	0.00	=	0.00			(32)
External wall			19.25	x	0.30	=	5.78			(29a)
Roof			51.00	x	0.50	=	25.50			(30)
Total area of external elements ∑A, m²			94.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	57.27 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.21 (36)
Total fabric heat loss	(33) + (36) =	71.48 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
34.24	33.72	33.22	30.86	30.42	28.36	28.36	27.98	29.16	30.42	31.31	32.25	(38)

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

105.71	105.20	104.70	102.34	101.90	99.84	99.84	99.46	100.63	101.90	102.79	103.72	

Average = ∑(39)1...12/12 = 102.34 (39)

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

2.07	2.06	2.05	2.01	2.00	1.96	1.96	1.95	1.97	2.00	2.02	2.03	

Average = ∑(40)1...12/12 = 2.01 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.72	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	78.99	(43)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
86.89	83.73	80.57	77.41	74.25	71.09	71.09	74.25	77.41	80.57	83.73	86.89	

∑(44)1...12 = 947.87 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

128.85	112.70	116.29	101.39	97.28	83.95	77.79	89.26	90.33	105.27	114.91	124.79	

∑(45)1...12 = 1242.81 (45)

Distribution loss 0.15 x (45)m

19.33	16.90	17.44	15.21	14.59	12.59	11.67	13.39	13.55	15.79	17.24	18.72	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel 110.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.08	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	5.16	(54)
Enter (50) or (54) in (55)	5.16	(55)

Water storage loss calculated for each month (55) x (41)m

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

288.86	257.22	276.30	256.23	257.29	238.79	237.79	249.27	245.17	265.28	269.75	284.79	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

288.86	257.22	276.30	256.23	257.29	238.79	237.79	249.27	245.17	265.28	269.75	284.79	

∑(64)1...12 = 3126.73 (64)

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

170.85	153.09	166.67	157.58	160.35	151.79	153.87	157.68	153.91	163.01	162.08	169.49	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	40.87	36.30	29.52	22.35	16.71	14.11	15.24	19.81	26.59	33.76	39.41	42.01	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.63	225.95	220.10	207.65	191.94	177.17	167.30	164.98	170.83	183.28	198.99	213.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains (Table 5)	229.63	227.81	224.02	218.87	215.52	210.81	206.81	211.94	213.76	219.09	225.11	227.82	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	575.56	571.49	555.07	530.30	505.60	483.52	470.78	478.16	492.61	517.56	544.94	565.01	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	3.36	x	11.28	x 0.9 x	0.85	x	0.70	=	15.63	(81)

Solar gains in watts ∑(74)m...(82)m

15.63	31.82	57.33	94.15	126.55	134.92	126.22	100.62	69.86	38.89	19.67	12.77	(83)

Total gains - internal and solar (73)m + (83)m

591.19	603.31	612.40	624.45	632.15	618.44	597.00	578.78	562.46	556.45	564.61	577.78	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.98	0.97	0.95	0.89	0.78	0.64	0.67	0.84	0.94	0.97	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.13	19.26	19.54	19.97	20.39	20.75	20.91	20.89	20.65	20.14	19.60	19.14	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.29	19.29	19.30	19.33	19.33	19.36	19.36	19.37	19.35	19.33	19.32	19.31	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.97	0.97	0.96	0.92	0.84	0.66	0.44	0.48	0.75	0.91	0.96	0.98	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	17.70	17.82	18.11	18.55	18.94	19.25	19.34	19.34	19.18	18.72	18.19	17.72	(90)

Living area fraction — Living area ÷ (4) = 0.41 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	18.29	18.41	18.69	19.13	19.54	19.87	19.99	19.98	19.78	19.31	18.77	18.30	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.59	18.71	18.99	19.43	19.84	20.17	20.29	20.28	20.08	19.61	19.07	18.60	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.97	0.95	0.92	0.86	0.73	0.56	0.60	0.80	0.92	0.96	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	573.52	582.44	583.73	576.70	543.66	450.52	336.66	346.43	447.36	509.36	540.32	561.74	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1510.26	1453.24	1308.18	1077.77	829.27	556.26	368.27	385.88	602.02	917.85	1230.20	1493.88	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	696.93	585.18	538.99	360.77	212.49	0.00	0.00	0.00	0.00	303.91	496.71	693.51	

∑(98)1...5, 10...12 = 3888.50 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 76.25 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 100.00 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	696.93	585.18	538.99	360.77	212.49	0.00	0.00	0.00	0.00	303.91	496.71	693.51

∑(211)1...5, 10...12 =	3888.50	(211)

Water heating

Efficiency of water heater

100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

(217)

Water heating fuel, kWh/month

288.86	257.22	276.30	256.23	257.29	238.79	237.79	249.27	245.17	265.28	269.75	284.79

∑(219a)1...12 =	3126.73	(219)

Annual totals

Space heating fuel - main system 1	3888.50	
Water heating fuel	3126.73	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
Total electricity for the above, kWh/year	0.00	(231)
Electricity for lighting (Appendix L)	288.73	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	7303.96	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3888.50	x	13.19	x 0.01 =	512.89	(240)
Water heating	3126.73	x	13.19	x 0.01 =	412.42	(247)
Electricity for lighting	288.73	x	13.19	x 0.01 =	38.08	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	963.39	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	4.21	(257)
SAP value	41.40	
SAP rating (section 13)	41	(258)
SAP band	E	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3888.50	x	0.52	=	2018.13	(261)
Water heating	3126.73	x	0.52	=	1622.77	(264)
Space and water heating			(261) + (262) + (263) + (264) =		3640.90	(265)
Electricity for lighting	288.73	x	0.52	=	149.85	(268)
Total CO_2, kg/year				(265)...(271) =	3790.75	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	74.33	(273)
EI value					48.34	
EI rating (section 14)					48	(274)
EI band					E	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3888.50	x	3.07	=	11937.70	(261)
Water heating	3126.73	x	3.07	=	9599.05	(264)
Space and water heating			(261) + (262) + (263) + (264) =		21536.75	(265)

Electricity for lighting	288.73	x	3.07	=	886.39	(268)
Primary energy kWh/year					22423.14	(272)
Dwelling primary energy rate kWh/m2/year					439.67	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	26/08/2015
Address	Flat 3.03 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.00	(1a) x	2.50	(2a) =	127.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		2	x 10 = 20	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.16	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	38.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.17	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.73	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.73	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.62	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.79	0.78	0.76	0.68	0.67	0.59	0.59	0.57	0.62	0.67	0.70	0.73	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.81	0.80	0.79	0.73	0.72	0.67	0.67	0.67	0.69	0.72	0.74	0.77	(24d)

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

0.81	0.80	0.79	0.73	0.72	0.67	0.67	0.67	0.69	0.72	0.74	0.77	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			3.36	x	4.03	=	13.53			(27)
External wall			19.04	x	0.50	=	9.52			(29a)
Party wall			33.25	x	0.00	=	0.00			(32)
External wall			19.25	x	0.30	=	5.78			(29a)
Roof			51.00	x	0.50	=	25.50			(30)
Total area of external elements ∑A, m²			94.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	57.27 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.21 (36)
Total fabric heat loss	(33) + (36) =	71.48 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
34.24	33.72	33.22	30.86	30.42	28.36	28.36	27.98	29.16	30.42	31.31	32.25	(38)

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

105.71	105.20	104.70	102.34	101.90	99.84	99.84	99.46	100.63	101.90	102.79	103.72	

Average = ∑(39)1...12/12 = 102.34 (39)

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

2.07	2.06	2.05	2.01	2.00	1.96	1.96	1.95	1.97	2.00	2.02	2.03	

Average = ∑(40)1...12/12 = 2.01 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.72	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	78.99	(43)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
86.89	83.73	80.57	77.41	74.25	71.09	71.09	74.25	77.41	80.57	83.73	86.89	

∑(44)1...12 = 947.87 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

128.85	112.70	116.29	101.39	97.28	83.95	77.79	89.26	90.33	105.27	114.91	124.79	

∑(45)1...12 = 1242.81 (45)

Distribution loss 0.15 x (45)m

19.33	16.90	17.44	15.21	14.59	12.59	11.67	13.39	13.55	15.79	17.24	18.72	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel 110.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.08	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	5.16	(54)
Enter (50) or (54) in (55)	5.16	(55)

Water storage loss calculated for each month (55) x (41)m

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

288.86	257.22	276.30	256.23	257.29	238.79	237.79	249.27	245.17	265.28	269.75	284.79	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

288.86	257.22	276.30	256.23	257.29	238.79	237.79	249.27	245.17	265.28	269.75	284.79	

∑(64)1...12 = 3126.73 (64)

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

170.85	153.09	166.67	157.58	160.35	151.79	153.87	157.68	153.91	163.01	162.08	169.49	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	40.87	36.30	29.52	22.35	16.71	14.11	15.24	19.81	26.59	33.76	39.41	42.01	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.63	225.95	220.10	207.65	191.94	177.17	167.30	164.98	170.83	183.28	198.99	213.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains (Table 5)	229.63	227.81	224.02	218.87	215.52	210.81	206.81	211.94	213.76	219.09	225.11	227.82	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	575.56	571.49	555.07	530.30	505.60	483.52	470.78	478.16	492.61	517.56	544.94	565.01	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	3.36	x	11.28	x 0.9 x	0.85	x	0.70	=	15.63	(81)

Solar gains in watts ∑(74)m...(82)m

15.63	31.82	57.33	94.15	126.55	134.92	126.22	100.62	69.86	38.89	19.67	12.77	(83)

Total gains - internal and solar (73)m + (83)m

591.19	603.31	612.40	624.45	632.15	618.44	597.00	578.78	562.46	556.45	564.61	577.78	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.98	0.97	0.95	0.89	0.78	0.64	0.67	0.84	0.94	0.97	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.13	19.26	19.54	19.97	20.39	20.75	20.91	20.89	20.65	20.14	19.60	19.14	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.29	19.29	19.30	19.33	19.33	19.36	19.36	19.37	19.35	19.33	19.32	19.31	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.97	0.97	0.96	0.92	0.84	0.66	0.44	0.48	0.75	0.91	0.96	0.98	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	17.70	17.82	18.11	18.55	18.94	19.25	19.34	19.34	19.18	18.72	18.19	17.72	(90)

Living area fraction — Living area ÷ (4) = 0.41 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	18.29	18.41	18.69	19.13	19.54	19.87	19.99	19.98	19.78	19.31	18.77	18.30	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.59	18.71	18.99	19.43	19.84	20.17	20.29	20.28	20.08	19.61	19.07	18.60	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.97	0.95	0.92	0.86	0.73	0.56	0.60	0.80	0.92	0.96	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	573.52	582.44	583.73	576.70	543.66	450.52	336.66	346.43	447.36	509.36	540.32	561.74	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1510.26	1453.24	1308.18	1077.77	829.27	556.26	368.27	385.88	602.02	917.85	1230.20	1493.88	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	696.93	585.18	538.99	360.77	212.49	0.00	0.00	0.00	0.00	303.91	496.71	693.51	

∑(98)1...5, 10...12 = 3888.50 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 76.25 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 100.00 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	696.93	585.18	538.99	360.77	212.49	0.00	0.00	0.00	0.00	303.91	496.71	693.51

∑(211)1...5, 10...12 =	3888.50	(211)

Water heating

Efficiency of water heater

100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

(217)

Water heating fuel, kWh/month

288.86	257.22	276.30	256.23	257.29	238.79	237.79	249.27	245.17	265.28	269.75	284.79

∑(219a)1...12 =	3126.73	(219)

Annual totals

Space heating fuel - main system 1	3888.50	
Water heating fuel	3126.73	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
Total electricity for the above, kWh/year	0.00	(231)
Electricity for lighting (Appendix L)	288.73	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	7303.96	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3888.50	x	13.19	x 0.01 =	512.89	(240)
Water heating	3126.73	x	13.19	x 0.01 =	412.42	(247)
Electricity for lighting	288.73	x	13.19	x 0.01 =	38.08	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	963.39	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	4.21	(257)
SAP value	41.40	
SAP rating (section 13)	41	(258)
SAP band	E	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3888.50	x	0.52	=	2018.13	(261)
Water heating	3126.73	x	0.52	=	1622.77	(264)
Space and water heating			(261) + (262) + (263) + (264) =		3640.90	(265)
Electricity for lighting	288.73	x	0.52	=	149.85	(268)
Total CO_2, kg/year				(265)...(271) =	3790.75	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	74.33	(273)
EI value					48.34	
EI rating (section 14)					48	(274)
EI band					E	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3888.50	x	3.07	=	11937.70	(261)
Water heating	3126.73	x	3.07	=	9599.05	(264)
Space and water heating			(261) + (262) + (263) + (264) =		21536.75	(265)

Electricity for lighting	288.73	x	3.07	=	886.39	(268)
Primary energy kWh/year					22423.14	(272)
Dwelling primary energy rate kWh/m2/year					439.67	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	26/08/2015
Address	Flat 3.04 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		56.70	(1a) x	2.50	(2a) =	141.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	56.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	141.75	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.14 (8)

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

Number of storeys in the dwelling		1	(9)
Additional infiltration			0.00 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0.35 (11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0.00 (12)
If no draught lobby, enter 0.05, else enter 0			0.05 (13)
Percentage of windows and doors draught proofed		27.00	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0.20 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0.74 (16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.74 (18)
Number of sides on which the dwelling is sheltered			2 (19)
Shelter factor	1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.63 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.80	0.78	0.77	0.69	0.67	0.60	0.60	0.58	0.63	0.67	0.70	0.74	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

0.82	0.81	0.79	0.74	0.73	0.68	0.68	0.67	0.70	0.73	0.75	0.77

(24d)

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

0.82	0.81	0.79	0.74	0.73	0.68	0.68	0.67	0.70	0.73	0.75	0.77

(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			5.60	x	4.03	=	22.55			(27)
External wall			56.80	x	0.50	=	28.40			(29a)
Party wall			15.50	x	0.00	=	0.00			(32)
External wall			7.50	x	0.30	=	2.25			(29a)
Roof			56.70	x	0.50	=	28.35			(30)
Total area of external elements ∑A, m²			128.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	84.49 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		19.31 (36)
Total fabric heat loss	(33) + (36) =	103.80 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	38.31	37.73	37.17	34.50	34.00	31.67	31.67	31.24	32.57	34.00	35.01	36.06	(38)
Heat transfer coefficient, W/K (37)m + (38)m	142.11	141.53	140.96	138.29	137.79	135.47	135.47	135.04	136.37	137.79	138.80	139.86	

Average = ∑(39)1...12/12 = 138.29 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	2.51	2.50	2.49	2.44	2.43	2.39	2.39	2.38	2.41	2.43	2.45	2.47	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

Average = ∑(40)1...12/12 = 2.44 (40)

4. Water heating energy requirement

Assumed occupancy, N	1.89 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	83.17 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	91.49	88.16	84.84	81.51	78.18	74.86	74.86	78.18	81.51	84.84	88.16	91.49	

∑(44)1...12 = 998.09 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	135.68	118.67	122.45	106.76	102.44	88.39	81.91	93.99	95.12	110.85	121.00	131.40	

∑(45)1...12 = 1308.65 (45)

Distribution loss 0.15 x (45)m	20.35	17.80	18.37	16.01	15.37	13.26	12.29	14.10	14.27	16.63	18.15	19.71	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.08	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	5.16	(54)
Enter (50) or (54) in (55)	5.16	(55)

Water storage loss calculated for each month (55) x (41)m

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

160.00	144.52	160.00	154.84	160.00	154.84	160.00	160.00	154.84	160.00	154.84	160.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

295.68	263.19	282.46	261.60	262.44	243.24	241.91	254.00	249.96	270.85	275.84	291.40	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

295.68	263.19	282.46	261.60	262.44	243.24	241.91	254.00	249.96	270.85	275.84	291.40	

∑(64)1...12 = 3192.57 (64)

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

173.12	155.07	168.72	159.37	162.06	153.27	155.24	159.26	155.50	164.86	164.11	171.69	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.40	36.77	29.91	22.64	16.92	14.29	15.44	20.07	26.94	34.20	39.92	42.55	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.60	248.15	241.73	228.06	210.80	194.58	183.74	181.19	187.61	201.29	218.55	234.77	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	(71)
Water heating gains (Table 5)	232.68	230.76	226.77	221.35	217.83	212.87	208.65	214.05	215.97	221.59	227.93	230.77	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	605.64	601.64	584.36	558.00	531.50	507.68	493.78	501.26	516.47	543.02	572.34	594.04	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthEast	0.77	x	2.80	x	11.28	x 0.9 x	0.85	x	0.70	=	13.03	(75)
NorthWest	0.77	x	2.80	x	11.28	x 0.9 x	0.85	x	0.70	=	13.03	(81)

Solar gains in watts ∑(74)m...(82)m

26.05	53.03	95.55	156.92	210.92	224.87	210.36	167.70	116.43	64.81	32.78	21.28	(83)

Total gains - internal and solar (73)m + (83)m

631.69	654.67	679.90	714.91	742.42	732.55	704.14	668.96	632.90	607.83	605.12	615.32	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.98	0.98	0.97	0.95	0.90	0.81	0.68	0.72	0.87	0.95	0.98	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	18.67	18.82	19.16	19.67	20.18	20.63	20.84	20.81	20.47	19.85	19.21	18.67	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.02	19.02	19.03	19.06	19.06	19.09	19.09	19.09	19.08	19.06	19.05	19.04	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.98	0.97	0.96	0.93	0.85	0.67	0.45	0.50	0.77	0.92	0.96	0.98	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	17.06	17.21	17.54	18.06	18.54	18.93	19.06	19.05	18.82	18.25	17.61	17.07	(90)

Living area fraction — Living area ÷ (4) = 0.49 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	17.86	18.01	18.34	18.85	19.35	19.77	19.94	19.92	19.64	19.04	18.40	17.86	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.16	18.31	18.64	19.15	19.65	20.07	20.24	20.22	19.94	19.34	18.70	18.16	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.97	0.96	0.93	0.87	0.75	0.60	0.64	0.82	0.93	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	614.62	633.77	649.87	662.57	643.50	549.54	424.22	430.11	521.12	563.46	582.31	599.94	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1969.01	1897.39	1711.37	1417.91	1095.57	740.73	492.98	515.71	795.89	1204.30	1609.97	1952.59	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	1007.67	849.15	789.76	543.85	336.34	0.00	0.00	0.00	0.00	476.79	739.92	1006.37	

∑(98)1...5, 10...12 = 5749.85 (98)

Space heating requirement kWh/m²/year (98) ÷ (4) = 101.41 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 100.00 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month												

1007.67	849.15	789.76	543.85	336.34	0.00	0.00	0.00	0.00	476.79	739.92	1006.37

∑(211)1...5, 10...12 = 5749.85 (211)

Water heating

Efficiency of water heater

100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

(217)

Water heating fuel, kWh/month

295.68	263.19	282.46	261.60	262.44	243.24	241.91	254.00	249.96	270.85	275.84	291.40

∑(219a)1...12 = 3192.57 (219)

Annual totals

Space heating fuel - main system 1	5749.85	
Water heating fuel	3192.57	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
Total electricity for the above, kWh/year	0.00	(231)
Electricity for lighting (Appendix L)	292.48	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	9234.90	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	5749.85	x	13.19	x 0.01 =	758.41	(240)
Water heating	3192.57	x	13.19	x 0.01 =	421.10	(247)
Electricity for lighting	292.48	x	13.19	x 0.01 =	38.58	(250)
Additional standing charges					0.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	1218.08	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	5.03	(257)
SAP value	32.11	
SAP rating (section 13)	32	(258)
SAP band	F	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	5749.85	x	0.52	=	2984.17	(261)
Water heating	3192.57	x	0.52	=	1656.95	(264)
Space and water heating				(261) + (262) + (263) + (264) =	4641.12	(265)
Electricity for lighting	292.48	x	0.52	=	151.80	(268)
Total CO_2, kg/year				(265)...(271) =	4792.91	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	84.53	(273)
EI value					41.04	
EI rating (section 14)					41	(274)
EI band					E	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	5749.85	x	3.07	=	17652.04	(261)
Water heating	3192.57	x	3.07	=	9801.20	(264)

Space and water heating				(261) + (262) + (263) + (264) =	27453.24	(265)
Electricity for lighting	292.48	x	3.07	=	897.91	(268)
Primary energy kWh/year					28351.15	(272)
Dwelling primary energy rate kWh/m2/year					500.02	(273)

SAP Calculations after Efficiency Measures

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	21/12/2015
Address	Flat 2.01 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		55.60	(1a) x	2.50	(2a) =	139.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	55.60	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	139.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		2	x 10 = 20	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.14	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	15.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.22	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.76	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.76	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.65	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.83	0.81	0.80	0.71	0.70	0.62	0.62	0.60	0.65	0.70	0.73	0.76	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

0.84	0.83	0.82	0.76	0.74	0.69	0.69	0.68	0.71	0.74	0.77	0.79

(24d)

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

0.84	0.83	0.82	0.76	0.74	0.69	0.69	0.68	0.71	0.74	0.77	0.79

(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			11.90	x	4.03	=	47.92			(27)
Ground floor			55.60	x	0.25	=	13.90			(28a)
External wall			49.50	x	0.30	=	14.85			(29a)
Party wall			25.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			119.10							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	79.61 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.87 (36)
Total fabric heat loss	(33) + (36) =	97.47 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	38.65	38.04	37.44	34.63	34.11	31.66	31.66	31.21	32.60	34.11	35.17	36.28	(38)
Heat transfer coefficient, W/K (37)m + (38)m	136.13	135.52	134.92	132.11	131.58	129.14	129.14	128.68	130.08	131.58	132.65	133.76	

Average = ∑(39)1...12/12 = 132.11 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	2.45	2.44	2.43	2.38	2.37	2.32	2.32	2.31	2.34	2.37	2.39	2.41	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

Average = ∑(40)1...12/12 = 2.38 (40)

4. Water heating energy requirement

Assumed occupancy, N	1.85 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	78.25 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	86.08	82.95	79.82	76.69	73.56	70.43	70.43	73.56	76.69	79.82	82.95	86.08	

∑(44)1...12 = 939.05 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	127.65	111.65	115.21	100.44	96.38	83.17	77.07	88.43	89.49	104.29	113.84	123.63	
Distribution loss 0.15 x (45)m	19.15	16.75	17.28	15.07	14.46	12.47	11.56	13.27	13.42	15.64	17.08	18.54	(46)

∑(45)1...12 = 1231.24 (45)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.83	(54)
Enter (50) or (54) in (55)	0.83	(55)

Water storage loss calculated for each month (55) x (41)m

25.77	23.27	25.77	24.94	25.77	24.94	25.77	25.77	24.94	25.77	24.94	25.77	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

25.77	23.27	25.77	24.94	25.77	24.94	25.77	25.77	24.94	25.77	24.94	25.77	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

43.87	38.18	40.68	37.82	37.48	34.73	35.89	37.48	37.82	40.68	40.91	43.87	(61)

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

197.29	173.10	181.65	163.20	159.63	142.83	138.72	151.69	152.25	170.74	179.69	193.26	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

197.29	173.10	181.65	163.20	159.63	142.83	138.72	151.69	152.25	170.74	179.69	193.26	

∑(64)1...12 = 2004.04 (64)

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

53.41	46.67	48.48	42.85	41.42	36.34	34.60	38.78	39.21	44.85	48.08	52.07	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	111.30	111.30	111.30	111.30	111.30	111.30	111.30	111.30	111.30	111.30	111.30	111.30	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	36.05	32.02	26.04	19.71	14.73	12.44	13.44	17.47	23.45	29.78	34.75	37.05	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	241.39	243.89	237.58	224.14	207.18	191.24	180.59	178.08	184.39	197.83	214.80	230.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.98	47.98	47.98	47.98	47.98	47.98	47.98	47.98	47.98	47.98	47.98	47.98	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	-74.20	(71)
Water heating gains (Table 5)	71.79	69.45	65.16	59.52	55.67	50.47	46.50	52.12	54.46	60.28	66.78	69.99	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	437.31	433.44	416.86	391.45	365.67	342.23	328.61	335.75	350.39	375.97	404.41	425.86	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	7.14	x	19.64	x 0.9 x	0.85	x	0.70	=	57.82	(80)
NorthWest	0.77	x	2.38	x	11.28	x 0.9 x	0.85	x	0.70	=	11.07	(81)
North	0.77	x	2.38	x	10.63	x 0.9 x	0.85	x	0.70	=	10.44	(74)

Solar gains in watts ∑(74)m...(82)m

79.33	155.59	260.77	392.80	495.92	514.90	487.18	408.15	306.88	185.50	98.90	65.29	(83)

Total gains - internal and solar (73)m + (83)m

516.64	589.03	677.63	784.25	861.58	857.13	815.79	743.90	657.26	561.47	503.31	491.15	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)												
0.99	0.98	0.97	0.93	0.86	0.74	0.60	0.66	0.85	0.96	0.98	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)												
18.59	18.81	19.22	19.80	20.33	20.73	20.89	20.86	20.53	19.85	19.14	18.58	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)												
19.05	19.06	19.06	19.09	19.10	19.13	19.13	19.13	19.12	19.10	19.09	19.08	(88)
Utilisation factor for gains for rest of dwelling n2,m												
0.99	0.98	0.96	0.90	0.79	0.59	0.38	0.44	0.75	0.93	0.98	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)												
16.05	16.37	16.96	17.80	18.51	18.97	19.10	19.09	18.79	17.89	16.87	16.05	(90)

Living area fraction — Living area ÷ (4) = 0.58 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

17.51	17.77	18.26	18.96	19.56	19.98	20.13	20.11	19.79	19.02	18.18	17.50	(92)

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

17.36	17.62	18.11	18.81	19.41	19.83	19.98	19.96	19.64	18.87	18.03	17.35	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm												
0.98	0.97	0.95	0.90	0.80	0.65	0.49	0.55	0.78	0.93	0.97	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m												
506.27	571.53	642.70	704.19	693.22	561.26	402.71	409.91	514.00	520.01	488.43	482.61	(95)
Monthly average external temperature from Table U1												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]												
1778.40	1723.94	1566.65	1308.55	1014.29	675.74	436.81	457.81	720.68	1088.13	1449.39	1759.53	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m												
946.47	774.42	687.42	435.14	238.87	0.00	0.00	0.00	0.00	422.68	691.89	950.03	

∑(98)1...5, 10...12 = 5146.92 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 92.57 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 84.00 (206)

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

Space heating fuel (main system 1), kWh/month

1126.75	921.92	818.36	518.02	284.37	0.00	0.00	0.00	0.00	503.19	823.68	1130.99

∑(211)1...5, 10...12 = 6127.28 (211)

Water heating

Efficiency of water heater

82.30	82.20	81.94	81.34	80.15	75.00	75.00	75.00	75.00	81.20	81.97	82.33

(217)

Water heating fuel, kWh/month

239.73	210.59	221.68	200.64	199.17	190.45	184.96	202.25	202.99	210.27	219.20	234.74

∑(219a)1...12 = 2516.68 (219)

Annual totals

Space heating fuel - main system 1	6127.28	
Water heating fuel	2516.68	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	254.63	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	8973.59	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	6127.28	x	3.48	x 0.01 =	213.23	(240)
Water heating	2516.68	x	3.48	x 0.01 =	87.58	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	254.63	x	13.19	x 0.01 =	33.59	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		464.29	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.94	(257)
SAP value	72.96	
SAP rating (section 13)	73	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	6127.28	x	0.22	=	1323.49	(261)
Water heating	2516.68	x	0.22	=	543.60	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1867.10	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	254.63	x	0.52	=	132.15	(268)
Total CO_2, kg/year			(265)...(271) =		2038.17	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		36.66	(273)
EI value					72.85	
EI rating (section 14)					73	(274)
EI band					C	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	6127.28	x	1.22	=	7475.28	(261)
Water heating	2516.68	x	1.22	=	3070.35	(264)
Space and water heating			(261) + (262) + (263) + (264) =		10545.63	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	254.63	x	3.07	=	781.72	(268)
Primary energy kWh/year					11557.60	(272)
Dwelling primary energy rate kWh/m2/year					207.87	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	21/12/2015
Address	Flat 2.02 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0 (6a)
Number of open flues		0	x 20 =	0 (6b)
Number of intermittent fans		2	x 10 =	20 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.16 (8)

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

Number of storeys in the dwelling		1	(9)
Additional infiltration			0.00 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0.35 (11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0.00 (12)
If no draught lobby, enter 0.05, else enter 0			0.05 (13)
Percentage of windows and doors draught proofed		31.00	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0.19 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0.75 (16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.75 (18)
Number of sides on which the dwelling is sheltered			3 (19)
Shelter factor	1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =		0.58 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.74	0.72	0.71	0.64	0.62	0.55	0.55	0.54	0.58	0.62	0.65	0.68	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.77	0.76	0.75	0.70	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(24d)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.77	0.76	0.75	0.70	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			4.76	x	4.03	=	19.17			(27)
Ground floor			50.00	x	0.25	=	12.50			(28a)
External wall			21.14	x	0.30	=	6.34			(29a)
Party wall			42.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			78.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.95 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.70 (36)
Total fabric heat loss	(33) + (36) =	52.65 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31.89	31.45	31.03	29.01	28.63	26.88	26.88	26.56	27.56	28.63	29.40	30.19	(38)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
84.54	84.10	83.68	81.66	81.28	79.53	79.53	79.21	80.21	81.28	82.05	82.84	

Average = ∑(39)1...12/12 = 81.66 (39)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1.69	1.68	1.67	1.63	1.63	1.59	1.59	1.58	1.60	1.63	1.64	1.66	

Average = ∑(40)1...12/12 = 1.63 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.34	(43)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel 110.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.83	(54)
Enter (50) or (54) in (55)	0.83	(55)

Water storage loss calculated for each month (55) x (41)m

25.77	23.27	25.77	24.94	25.77	24.94	25.77	25.77	24.94	25.77	24.94	25.77	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

25.77	23.27	25.77	24.94	25.77	24.94	25.77	25.77	24.94	25.77	24.94	25.77	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

41.67	36.27	38.64	35.93	35.61	32.99	34.09	35.61	35.93	38.64	38.86	41.67	(61)

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

188.71	165.61	173.86	156.28	152.93	136.94	133.07	145.39	145.88	163.48	171.95	184.88	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

188.71	165.61	173.86	156.28	152.93	136.94	133.07	145.39	145.88	163.48	171.95	184.88	

∑(64)1...12 = 1918.97 (64)

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

50.74	44.33	46.05	40.71	39.34	34.52	32.87	36.84	37.25	42.60	45.67	49.47	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.34	33.17	26.97	20.42	15.26	12.89	13.92	18.10	24.29	30.85	36.00	38.38	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	68.20	65.97	61.90	56.54	52.88	47.94	44.17	49.51	51.73	57.26	63.44	66.49	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	408.93	404.80	388.79	364.65	340.39	318.56	306.13	313.36	327.53	351.84	378.61	398.56	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	4.76	x	10.63	x 0.9 x	0.85	x	0.70	=	20.87	(74)

Solar gains in watts ∑(74)m...(82)m

20.87	39.88	67.77	108.86	146.65	156.99	146.57	116.28	81.49	47.48	25.75	17.40	(83)

Total gains - internal and solar (73)m + (83)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
429.80	444.69	456.56	473.51	487.04	475.55	452.70	429.65	409.01	399.32	404.36	415.96	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)												
0.99	0.99	0.98	0.97	0.93	0.82	0.68	0.73	0.90	0.97	0.99	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)												
19.31	19.43	19.69	20.09	20.47	20.80	20.93	20.91	20.68	20.21	19.72	19.32	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)												
19.55	19.55	19.56	19.59	19.59	19.62	19.62	19.63	19.61	19.59	19.58	19.57	(88)
Utilisation factor for gains for rest of dwelling n2,m												
0.99	0.99	0.98	0.95	0.89	0.72	0.51	0.56	0.82	0.95	0.98	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)												
17.38	17.56	17.94	18.52	19.06	19.48	19.60	19.59	19.34	18.71	18.00	17.40	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2												
18.43	18.57	18.88	19.37	19.82	20.19	20.32	20.30	20.06	19.52	18.93	18.44	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate												
18.28	18.42	18.73	19.22	19.67	20.04	20.17	20.15	19.91	19.37	18.78	18.29	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm												
0.99	0.98	0.97	0.95	0.89	0.76	0.58	0.63	0.84	0.95	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m												
423.50	436.61	444.21	449.25	433.28	360.00	264.67	271.36	345.16	379.20	395.58	410.57	(95)
Monthly average external temperature from Table U1												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]												
1181.60	1137.39	1023.64	842.51	648.20	432.56	283.58	297.12	466.26	712.68	958.32	1166.94	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m												
564.02	470.92	431.09	283.15	159.90	0.00	0.00	0.00	0.00	248.11	405.17	562.74	

∑(98)1...5, 10...12 = 3125.10 (98)

Space heating requirement kWh/m²/year (98) ÷ (4) = 62.50 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 84.00 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month												
671.45	560.62	513.21	337.08	190.36	0.00	0.00	0.00	0.00	295.36	482.35	669.93	

∑(211)1...5, 10...12 = 3720.36 (211)

Water heating

Efficiency of water heater

81.55	81.46	81.20	80.56	79.35	75.00	75.00	75.00	75.00	80.18	81.10	81.58

(217)

Water heating fuel, kWh/month

231.41	203.31	214.11	193.99	192.74	182.58	177.43	193.85	194.50	203.90	212.02	226.63

∑(219a)1...12 = 2426.47 (219)

Annual totals

Space heating fuel - main system 1	3720.36	
Water heating fuel	2426.47	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	263.79	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	6485.62	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3720.36	x	3.48	x 0.01 =	129.47	(240)
Water heating	2426.47	x	3.48	x 0.01 =	84.44	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	263.79	x	13.19	x 0.01 =	34.79	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		378.60	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.67	(257)
SAP value	76.65	
SAP rating (section 13)	77	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3720.36	x	0.22	=	803.60	(261)
Water heating	2426.47	x	0.22	=	524.12	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1327.72	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	263.79	x	0.52	=	136.91	(268)
Total CO_2, kg/year				(265)...(271) =	1503.55	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	30.07	(273)
EI value					78.79	
EI rating (section 14)					79	(274)
EI band					C	

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

	Energy kWh/year	Primary factor	Primary Energy kWh/year

Space heating - main system 1	3720.36	x	1.22	=	4538.84	(261)
Water heating	2426.47	x	1.22	=	2960.30	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7499.13	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	263.79	x	3.07	=	809.84	(268)
Primary energy kWh/year					8539.22	(272)
Dwelling primary energy rate kWh/m2/year					170.78	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	21/12/2015
Address	Flat 2.03 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		2	x 10 = 20	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.16	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	31.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.19	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.75	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.75	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.58	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.74	0.72	0.71	0.64	0.62	0.55	0.55	0.54	0.58	0.62	0.65	0.68	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

0.77	0.76	0.75	0.70	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(24d)

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

0.77	0.76	0.75	0.70	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			4.76	x	4.03	=	19.17			(27)
Ground floor			50.00	x	0.25	=	12.50			(28a)
External wall			28.14	x	0.30	=	8.44			(29a)
Party wall			35.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			85.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	43.05 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		12.75 (36)
Total fabric heat loss	(33) + (36) =	55.80 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	31.89	31.45	31.03	29.01	28.63	26.88	26.88	26.56	27.56	28.63	29.40	30.19	(38)
Heat transfer coefficient, W/K (37)m + (38)m	87.69	87.25	86.83	84.81	84.43	82.68	82.68	82.36	83.36	84.43	85.20	85.99	

Average = ∑(39)1...12/12 = 84.81 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.75	1.75	1.74	1.70	1.69	1.65	1.65	1.65	1.67	1.69	1.70	1.72	

Average = ∑(40)1...12/12 = 1.70 (40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.34 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

Distribution loss 0.15 x (45)m	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.83	(54)
Enter (50) or (54) in (55)	0.83	(55)

Water storage loss calculated for each month (55) x (41)m

25.77	23.27	25.77	24.94	25.77	24.94	25.77	25.77	24.94	25.77	24.94	25.77	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

25.77	23.27	25.77	24.94	25.77	24.94	25.77	25.77	24.94	25.77	24.94	25.77	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

41.67	36.27	38.64	35.93	35.61	32.99	34.09	35.61	35.93	38.64	38.86	41.67	(61)

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

188.71	165.61	173.86	156.28	152.93	136.94	133.07	145.39	145.88	163.48	171.95	184.88	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

188.71	165.61	173.86	156.28	152.93	136.94	133.07	145.39	145.88	163.48	171.95	184.88	

∑(64)1...12 = 1918.97 (64)

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

50.74	44.33	46.05	40.71	39.34	34.52	32.87	36.84	37.25	42.60	45.67	49.47	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.34	33.17	26.97	20.42	15.26	12.89	13.92	18.10	24.29	30.85	36.00	38.38	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	68.20	65.97	61.90	56.54	52.88	47.94	44.17	49.51	51.73	57.26	63.44	66.49	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	408.93	404.80	388.79	364.65	340.39	318.56	306.13	313.36	327.53	351.84	378.61	398.56	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	4.76	x	10.63	x 0.9 x	0.85	x	0.70	=	20.87	(74)

Solar gains in watts ∑(74)m...(82)m

20.87	39.88	67.77	108.86	146.65	156.99	146.57	116.28	81.49	47.48	25.75	17.40	(83)

Total gains - internal and solar (73)m + (83)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
429.80	444.69	456.56	473.51	487.04	475.55	452.70	429.65	409.01	399.32	404.36	415.96	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)												
0.99	0.99	0.98	0.97	0.93	0.83	0.70	0.74	0.90	0.97	0.99	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)												
19.24	19.37	19.63	20.03	20.43	20.77	20.92	20.89	20.65	20.16	19.66	19.24	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)												
19.50	19.51	19.51	19.54	19.55	19.57	19.57	19.58	19.56	19.55	19.54	19.53	(88)
Utilisation factor for gains for rest of dwelling n2,m												
0.99	0.99	0.98	0.96	0.89	0.73	0.52	0.57	0.83	0.95	0.98	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)												
17.25	17.43	17.82	18.42	18.98	19.41	19.54	19.54	19.27	18.61	17.88	17.27	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.33	18.48	18.79	19.29	19.76	20.15	20.29	20.27	20.01	19.45	18.84	18.34	(92)

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

18.18	18.33	18.64	19.14	19.61	20.00	20.14	20.12	19.86	19.30	18.69	18.19	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm												
0.99	0.98	0.97	0.95	0.89	0.77	0.60	0.64	0.85	0.95	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m												
423.45	436.58	444.28	449.72	434.93	364.11	269.96	276.19	347.31	379.58	395.59	410.52	(95)
Monthly average external temperature from Table U1												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]												
1216.92	1171.52	1054.37	868.31	668.00	446.15	292.37	306.34	480.49	734.40	987.69	1202.66	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m												
590.34	493.88	453.91	301.38	173.40	0.00	0.00	0.00	0.00	263.99	426.31	589.35	

∑(98)1...5, 10...12 = 3292.56 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 65.85 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 84.00 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month												
702.78	587.95	540.37	358.79	206.43	0.00	0.00	0.00	0.00	314.27	507.51	701.61	

∑(211)1...5, 10...12 = 3919.72 (211)

Water heating

Efficiency of water heater

81.63	81.54	81.30	80.69	79.53	75.00	75.00	75.00	75.00	80.31	81.20	81.66

(217)

Water heating fuel, kWh/month

231.18	203.09	213.85	193.67	192.30	182.58	177.43	193.85	194.50	203.56	211.76	226.40

∑(219a)1...12 = 2424.18 (219)

Annual totals

Space heating fuel - main system 1	3919.72	
Water heating fuel	2424.18	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	263.79	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	6682.69	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3919.72	x	3.48	x 0.01 =	136.41	(240)
Water heating	2424.18	x	3.48	x 0.01 =	84.36	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	263.79	x	13.19	x 0.01 =	34.79	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		385.45	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.70	(257)
SAP value	76.23	
SAP rating (section 13)	76	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3919.72	x	0.22	=	846.66	(261)
Water heating	2424.18	x	0.22	=	523.62	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1370.28	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	263.79	x	0.52	=	136.91	(268)
Total CO_2, kg/year				(265)...(271) =	1546.12	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	30.92	(273)
EI value					78.19	
EI rating (section 14)					78	(274)
EI band					C	

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

	Energy kWh/year	Primary factor	Primary Energy kWh/year

Space heating - main system 1	3919.72	x	1.22	=	4782.06	(261)
Water heating	2424.18	x	1.22	=	2957.50	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7739.56	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	263.79	x	3.07	=	809.84	(268)
Primary energy kWh/year					8779.65	(272)
Dwelling primary energy rate kWh/m2/year					175.59	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	21/12/2015
Address	Flat 2.04 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.00	(1a) x	2.50	(2a) =	125.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		2	x 10 = 20	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.16	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	31.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.19	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.75	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.75	(18)
Number of sides on which the dwelling is sheltered		3	(19)
Shelter factor	1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.58	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.74	0.72	0.71	0.64	0.62	0.55	0.55	0.54	0.58	0.62	0.65	0.68	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.77	0.76	0.75	0.70	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(24d)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.77	0.76	0.75	0.70	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			4.76	x	4.03	=	19.17			(27)
Ground floor			50.00	x	0.25	=	12.50			(28a)
External wall			21.14	x	0.30	=	6.34			(29a)
Party wall			42.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			78.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.95 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.70 (36)
Total fabric heat loss	(33) + (36) =	52.65 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	31.89	31.45	31.03	29.01	28.63	26.88	26.88	26.56	27.56	28.63	29.40	30.19	(38)
Heat transfer coefficient, W/K (37)m + (38)m	84.54	84.10	83.68	81.66	81.28	79.53	79.53	79.21	80.21	81.28	82.05	82.84	

Average = ∑(39)1...12/12 = 81.66 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.69	1.68	1.67	1.63	1.63	1.59	1.59	1.58	1.60	1.63	1.64	1.66	

Average = ∑(40)1...12/12 = 1.63 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.69	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.34	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	81.77	78.80	75.83	72.85	69.88	66.91	66.91	69.88	72.85	75.83	78.80	81.77	

∑(44)1...12 = 892.08 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	121.27	106.06	109.45	95.42	91.56	79.01	73.21	84.01	85.01	99.08	108.15	117.44	

∑(45)1...12 = 1169.66 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	18.19	15.91	16.42	14.31	13.73	11.85	10.98	12.60	12.75	14.86	16.22	17.62	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.83	(54)
Enter (50) or (54) in (55)	0.83	(55)

Water storage loss calculated for each month (55) x (41)m

25.77	23.27	25.77	24.94	25.77	24.94	25.77	25.77	24.94	25.77	24.94	25.77	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

25.77	23.27	25.77	24.94	25.77	24.94	25.77	25.77	24.94	25.77	24.94	25.77	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

41.67	36.27	38.64	35.93	35.61	32.99	34.09	35.61	35.93	38.64	38.86	41.67	(61)

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

188.71	165.61	173.86	156.28	152.93	136.94	133.07	145.39	145.88	163.48	171.95	184.88	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

188.71	165.61	173.86	156.28	152.93	136.94	133.07	145.39	145.88	163.48	171.95	184.88	

∑(64)1...12 = 1918.97 (64)

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

50.74	44.33	46.05	40.71	39.34	34.52	32.87	36.84	37.25	42.60	45.67	49.47	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	101.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	37.34	33.17	26.97	20.42	15.26	12.89	13.92	18.10	24.29	30.85	36.00	38.38	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.75	222.03	216.29	204.05	188.61	174.10	164.40	162.12	167.87	180.10	195.54	210.06	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	46.83	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	-67.60	(71)
Water heating gains (Table 5)	68.20	65.97	61.90	56.54	52.88	47.94	44.17	49.51	51.73	57.26	63.44	66.49	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	408.93	404.80	388.79	364.65	340.39	318.56	306.13	313.36	327.53	351.84	378.61	398.56	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
North	0.77	x	4.76	x	10.63	x 0.9 x	0.85	x	0.70	=	20.87	(74)

Solar gains in watts ∑(74)m...(82)m

20.87	39.88	67.77	108.86	146.65	156.99	146.57	116.28	81.49	47.48	25.75	17.40	(83)

Total gains - internal and solar (73)m + (83)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
429.80	444.69	456.56	473.51	487.04	475.55	452.70	429.65	409.01	399.32	404.36	415.96	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)												
0.99	0.99	0.98	0.97	0.93	0.82	0.68	0.73	0.90	0.97	0.99	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)												
19.31	19.43	19.69	20.09	20.47	20.80	20.93	20.91	20.68	20.21	19.72	19.32	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)												
19.55	19.55	19.56	19.59	19.59	19.62	19.62	19.63	19.61	19.59	19.58	19.57	(88)
Utilisation factor for gains for rest of dwelling n2,m												
0.99	0.99	0.98	0.95	0.89	0.72	0.51	0.56	0.82	0.95	0.98	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)												
17.38	17.56	17.94	18.52	19.06	19.48	19.60	19.59	19.34	18.71	18.00	17.40	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2												
18.43	18.57	18.88	19.37	19.82	20.19	20.32	20.30	20.06	19.52	18.93	18.44	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate												
18.28	18.42	18.73	19.22	19.67	20.04	20.17	20.15	19.91	19.37	18.78	18.29	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm												
0.99	0.98	0.97	0.95	0.89	0.76	0.58	0.63	0.84	0.95	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m												
423.50	436.61	444.21	449.25	433.28	360.00	264.67	271.36	345.16	379.20	395.58	410.57	(95)
Monthly average external temperature from Table U1												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]												
1181.60	1137.39	1023.64	842.51	648.20	432.56	283.58	297.12	466.26	712.68	958.32	1166.94	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m												
564.02	470.92	431.09	283.15	159.90	0.00	0.00	0.00	0.00	248.11	405.17	562.74	

∑(98)1...5, 10...12 = 3125.10 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 62.50 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 84.00 (206)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month												
671.45	560.62	513.21	337.08	190.36	0.00	0.00	0.00	0.00	295.36	482.35	669.93	

∑(211)1...5, 10...12 = 3720.36 (211)

Water heating

Efficiency of water heater

81.55	81.46	81.20	80.56	79.35	75.00	75.00	75.00	75.00	80.18	81.10	81.58

(217)

Water heating fuel, kWh/month

231.41	203.31	214.11	193.99	192.74	182.58	177.43	193.85	194.50	203.90	212.02	226.63

∑(219a)1...12 = 2426.47 (219)

Annual totals

Space heating fuel - main system 1	3720.36	
Water heating fuel	2426.47	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	263.79	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	6485.62	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3720.36	x	3.48	x 0.01 =	129.47	(240)
Water heating	2426.47	x	3.48	x 0.01 =	84.44	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	263.79	x	13.19	x 0.01 =	34.79	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		378.60	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.67	(257)
SAP value	76.65	
SAP rating (section 13)	77	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3720.36	x	0.22	=	803.60	(261)
Water heating	2426.47	x	0.22	=	524.12	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1327.72	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	263.79	x	0.52	=	136.91	(268)
Total CO_2, kg/year				(265)...(271) =	1503.55	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	30.07	(273)
EI value					78.79	
EI rating (section 14)					79	(274)
EI band					C	

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

	Energy kWh/year	Primary factor	Primary Energy kWh/year

Space heating - main system 1	3720.36	x	1.22	=	4538.84	(261)
Water heating	2426.47	x	1.22	=	2960.30	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7499.13	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	263.79	x	3.07	=	809.84	(268)
Primary energy kWh/year					8539.22	(272)
Dwelling primary energy rate kWh/m2/year					170.78	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	21/12/2015
Address	Flat 2.05 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		55.00	(1a) x	2.50	(2a) =	137.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	55.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	137.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		2	x 10 = 20	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.15	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	15.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.22	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.77	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.77	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.65	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.83	0.81	0.80	0.72	0.70	0.62	0.62	0.60	0.65	0.70	0.73	0.76	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.84	0.83	0.82	0.76	0.74	0.69	0.69	0.68	0.71	0.74	0.77	0.79	(24d)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.84	0.83	0.82	0.76	0.74	0.69	0.69	0.68	0.71	0.74	0.77	0.79	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			11.90	x	4.03	=	47.92			(27)
Ground floor			55.00	x	0.25	=	13.75			(28a)
External wall			49.50	x	0.30	=	14.85			(29a)
Party wall			25.25	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			118.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	79.46 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		17.78 (36)
Total fabric heat loss	(33) + (36) =	97.23 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
38.30	37.69	37.10	34.31	33.79	31.36	31.36	30.91	32.29	33.79	34.84	35.95	(38)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
135.53	134.93	134.33	131.54	131.02	128.59	128.59	128.14	129.53	131.02	132.08	133.18	

Average = ∑(39)1...12/12 = 131.54 (39)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2.46	2.45	2.44	2.39	2.38	2.34	2.34	2.33	2.36	2.38	2.40	2.42	

Average = ∑(40)1...12/12 = 2.39 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.84	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	77.84	(43)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
85.62	82.51	79.39	76.28	73.17	70.05	70.05	73.17	76.28	79.39	82.51	85.62	

∑(44)1...12 = 934.05 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
126.97	111.05	114.60	99.91	95.86	82.72	76.65	87.96	89.01	103.74	113.24	122.97	

∑(45)1...12 = 1224.68 (45)

Distribution loss 0.15 x (45)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
19.05	16.66	17.19	14.99	14.38	12.41	11.50	13.19	13.35	15.56	16.99	18.45	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel 110.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.54	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.83	(54)
Enter (50) or (54) in (55)	0.83	(55)

Water storage loss calculated for each month (55) x (41)m

25.77	23.27	25.77	24.94	25.77	24.94	25.77	25.77	24.94	25.77	24.94	25.77	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

25.77	23.27	25.77	24.94	25.77	24.94	25.77	25.77	24.94	25.77	24.94	25.77	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

43.63	37.98	40.46	37.62	37.29	34.55	35.70	37.29	37.62	40.46	40.69	43.63	(61)

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

196.37	172.30	180.82	162.46	158.92	142.21	138.12	151.02	151.57	169.96	178.86	192.37	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

196.37	172.30	180.82	162.46	158.92	142.21	138.12	151.02	151.57	169.96	178.86	192.37	

∑(64)1...12 = 1994.98 (64)

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

53.13	46.42	48.22	42.62	41.20	36.14	34.41	38.57	39.00	44.61	47.82	51.79	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	110.24	110.24	110.24	110.24	110.24	110.24	110.24	110.24	110.24	110.24	110.24	110.24	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	35.70	31.71	25.79	19.52	14.59	12.32	13.31	17.30	23.23	29.49	34.42	36.69	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	239.08	241.56	235.31	222.00	205.20	189.41	178.86	176.38	182.63	195.94	212.74	228.53	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.86	47.86	47.86	47.86	47.86	47.86	47.86	47.86	47.86	47.86	47.86	47.86	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	-73.49	(71)
Water heating gains (Table 5)	71.41	69.08	64.81	59.20	55.37	50.20	46.25	51.84	54.17	59.96	66.42	69.62	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	433.80	429.96	413.52	388.33	362.78	339.54	326.04	333.13	347.64	373.00	401.19	422.45	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	7.14	x	19.64	x 0.9 x	0.85	x	0.70	=	57.82	(76)
NorthEast	0.77	x	2.38	x	11.28	x 0.9 x	0.85	x	0.70	=	11.07	(75)
North	0.77	x	2.38	x	10.63	x 0.9 x	0.85	x	0.70	=	10.44	(74)

Solar gains in watts ∑(74)m...(82)m

79.33	155.59	260.77	392.80	495.92	514.90	487.18	408.15	306.88	185.50	98.90	65.29	(83)

Total gains - internal and solar (73)m + (83)m

513.13	585.55	674.29	781.13	858.69	854.44	813.21	741.28	654.51	558.50	500.10	487.74	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)												
0.99	0.98	0.97	0.93	0.86	0.73	0.60	0.66	0.85	0.96	0.98	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)												
18.58	18.80	19.21	19.80	20.33	20.73	20.89	20.86	20.53	19.84	19.13	18.57	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)												
19.04	19.05	19.05	19.08	19.09	19.12	19.12	19.12	19.11	19.09	19.08	19.07	(88)
Utilisation factor for gains for rest of dwelling n2,m												
0.99	0.98	0.96	0.90	0.79	0.59	0.38	0.44	0.74	0.93	0.98	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)												
16.03	16.35	16.95	17.79	18.50	18.96	19.09	19.08	18.78	17.88	16.85	16.02	(90)

Living area fraction — Living area ÷ (4) = 0.55 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

17.42	17.68	18.18	18.89	19.50	19.92	20.07	20.05	19.73	18.95	18.09	17.41	(92)

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

17.27	17.53	18.03	18.74	19.35	19.77	19.92	19.90	19.58	18.80	17.94	17.26	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm												
0.98	0.97	0.95	0.90	0.80	0.65	0.49	0.54	0.78	0.92	0.97	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m												
502.55	567.69	638.64	699.58	687.63	554.56	395.09	402.81	508.83	516.21	484.91	479.03	(95)
Monthly average external temperature from Table U1												
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]												
1758.07	1704.52	1549.08	1293.82	1001.88	665.40	427.41	448.43	710.02	1074.51	1432.35	1739.56	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m												
934.11	763.95	677.37	427.86	233.80	0.00	0.00	0.00	0.00	415.37	682.16	937.84	

∑(98)1...5, 10...12 = 5072.45 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 92.23 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) 84.00 (206)

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

Space heating fuel (main system 1), kWh/month

1112.03	909.46	806.39	509.35	278.33	0.00	0.00	0.00	0.00	494.49	812.09	1116.47

∑(211)1...5, 10...12 = 6038.63 (211)

Water heating

Efficiency of water heater

82.28	82.19	81.93	81.31	80.11	75.00	75.00	75.00	75.00	81.17	81.96	82.32

(217)

Water heating fuel, kWh/month

238.65	209.65	220.71	199.79	198.37	189.61	184.16	201.35	202.09	209.39	218.24	233.69

∑(219a)1...12 = 2505.70 (219)

Annual totals

Space heating fuel - main system 1	6038.63	
Water heating fuel	2505.70	
Electricity for pumps, fans and electric keep-hot (Table 4f)		
central heating pump or water pump within warm air heating unit	30.00	(230c)
boiler flue fan	45.00	(230e)
Total electricity for the above, kWh/year	75.00	(231)
Electricity for lighting (Appendix L)	252.20	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	8871.54	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	6038.63	x	3.48	x 0.01 =	210.14	(240)
Water heating	2505.70	x	3.48	x 0.01 =	87.20	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	252.20	x	13.19	x 0.01 =	33.27	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		460.50	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.93	(257)
SAP value	73.02	
SAP rating (section 13)	73	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	6038.63	x	0.22	=	1304.34	(261)
Water heating	2505.70	x	0.22	=	541.23	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1845.58	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	252.20	x	0.52	=	130.89	(268)
Total CO_2, kg/year			(265)...(271) =		2015.39	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		36.64	(273)
EI value					72.99	
EI rating (section 14)					73	(274)
EI band					C	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	6038.63	x	1.22	=	7367.13	(261)
Water heating	2505.70	x	1.22	=	3056.96	(264)
Space and water heating			(261) + (262) + (263) + (264) =		10424.09	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	252.20	x	3.07	=	774.26	(268)
Primary energy kWh/year					11428.60	(272)
Dwelling primary energy rate kWh/m2/year					207.79	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	26/08/2015
Address	Flat 3.01 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		56.70	(1a) x	2.50	(2a) =	141.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	56.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	141.75	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.14	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	23.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.20	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.75	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.75	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.63	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.81	0.79	0.78	0.70	0.68	0.60	0.60	0.59	0.63	0.68	0.71	0.74	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.83	0.81	0.80	0.74	0.73	0.68	0.68	0.67	0.70	0.73	0.75	0.78	(24d)

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

0.83	0.81	0.80	0.74	0.73	0.68	0.68	0.67	0.70	0.73	0.75	0.78	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			7.00	x	2.19	=	15.33			(27)
External wall			55.40	x	0.18	=	9.97			(29a)
Party wall			15.50	x	0.00	=	0.00			(32)
External wall			7.50	x	0.30	=	2.25			(29a)
Roof			56.70	x	0.18	=	10.21			(30)
Total area of external elements ∑A, m²			128.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.70 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		19.31 (36)
Total fabric heat loss	(33) + (36) =	60.00 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
38.64	38.05	37.47	34.74	34.23	31.86	31.86	31.42	32.77	34.23	35.26	36.34	(38)

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

98.64	98.05	97.47	94.74	94.23	91.86	91.86	91.42	92.77	94.23	95.26	96.34	

Average = ∑(39)1...12/12 = 94.74 (39)

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

1.74	1.73	1.72	1.67	1.66	1.62	1.62	1.61	1.64	1.66	1.68	1.70	

Average = ∑(40)1...12/12 = 1.67 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.89	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	79.02	(43)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
86.92	83.76	80.60	77.44	74.27	71.11	71.11	74.27	77.44	80.60	83.76	86.92	

∑(44)1...12 = 948.19 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

128.90	112.73	116.33	101.42	97.31	83.97	77.82	89.29	90.36	105.31	114.95	124.83	

∑(45)1...12 = 1243.22 (45)

Distribution loss 0.15 x (45)m

19.33	16.91	17.45	15.21	14.60	12.60	11.67	13.39	13.55	15.80	17.24	18.72	(46)

Water storage loss calculated for each month (55) x (41)m

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

44.29	38.55	41.07	38.19	37.85	35.07	36.24	37.85	38.19	41.07	41.30	44.29	(61)

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

173.19	151.28	157.40	139.61	135.16	119.04	114.05	127.14	128.55	146.38	156.25	169.12	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

173.19	151.28	157.40	139.61	135.16	119.04	114.05	127.14	128.55	146.38	156.25	169.12	

∑(64)1...12 = 1717.18 (64)

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

53.93	47.12	48.95	43.27	41.82	36.69	34.93	39.15	39.59	45.28	48.55	52.58	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	40.45	35.93	29.22	22.12	16.54	13.96	15.08	19.61	26.32	33.42	39.00	41.58	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.60	248.15	241.73	228.06	210.80	194.58	183.74	181.19	187.61	201.29	218.55	234.77	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	(71)
Water heating gains (Table 5)	72.49	70.12	65.79	60.10	56.21	50.96	46.95	52.62	54.99	60.86	67.43	70.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	447.49	443.15	425.69	399.22	372.49	348.44	334.73	342.37	357.87	384.51	413.92	435.96	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
SouthWest	0.77	x	4.20	x	36.79	x 0.9 x	0.76	x	0.70	=	56.97	(79)
NorthWest	0.77	x	2.80	x	11.28	x 0.9 x	0.76	x	0.70	=	11.65	(81)

Solar gains in watts ∑(74)m...(82)m

68.62	120.75	175.50	234.67	278.58	283.48	270.42	236.61	195.82	136.23	82.90	58.27	(83)

Total gains - internal and solar (73)m + (83)m

516.11	563.91	601.19	633.90	651.07	631.92	605.15	578.99	553.69	520.74	496.82	494.23	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.99	0.99	0.98	0.95	0.89	0.76	0.61	0.65	0.85	0.96	0.98	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.30	19.47	19.76	20.18	20.55	20.84	20.95	20.94	20.74	20.27	19.74	19.30	(87)

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

19.51	19.52	19.53	19.56	19.57	19.60	19.60	19.60	19.59	19.57	19.56	19.54	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.97	0.93	0.84	0.65	0.44	0.49	0.76	0.93	0.98	0.99	(89)

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

17.34	17.59	18.01	18.63	19.14	19.49	19.58	19.58	19.39	18.77	18.00	17.36	(90)

Living area fraction — Living area ÷ (4) = 0.49 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.31	18.52	18.87	19.39	19.83	20.16	20.26	20.25	20.06	19.51	18.86	18.32	(92)

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

18.16	18.37	18.72	19.24	19.68	20.01	20.11	20.10	19.91	19.36	18.71	18.17	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.97	0.96	0.92	0.84	0.69	0.51	0.55	0.78	0.93	0.97	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	506.94	549.49	576.37	584.37	549.54	435.91	308.30	319.27	432.88	482.97	482.96	486.67	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1367.02	1320.28	1191.52	979.80	752.34	496.87	322.19	338.20	538.56	825.47	1106.08	1345.72	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	639.90	517.97	457.67	284.71	150.88	0.00	0.00	0.00	0.00	254.82	448.64	639.14	

∑(98)1...5, 10...12 = 3393.74 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 59.85 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 84.00 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	761.79	616.64	544.84	338.94	179.62	0.00	0.00	0.00	0.00	303.35	534.10	760.88	

∑(211)1...5, 10...12 = 4040.17 (211)

Water heating

Efficiency of water heater

81.91	81.78	81.50	80.81	79.49	75.00	75.00	75.00	75.00	80.48	81.47	81.94	(217)

Water heating fuel, kWh/month

211.45	184.98	193.14	172.76	170.03	158.73	152.07	169.52	171.40	181.89	191.78	206.39	

∑(219a)1...12 =	2164.14	(219)

Annual totals

Space heating fuel - main system 1		4040.17	
Water heating fuel		2164.14	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		285.76	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		6565.07	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4040.17	x	3.48	x 0.01 =	140.60	(240)
Water heating	2164.14	x	3.48	x 0.01 =	75.31	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	285.76	x	13.19	x 0.01 =	37.69	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		383.49	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.58	(257)
SAP value	77.91	
SAP rating (section 13)	78	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	4040.17	x	0.22	=	872.68	(261)
Water heating	2164.14	x	0.22	=	467.45	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1340.13	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	285.76	x	0.52	=	148.31	(268)
Total CO_2, kg/year				(265)...(271) =	1527.37	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	26.94	(273)
EI value					79.88	
EI rating (section 14)					80	(274)
EI band					C	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	4040.17	x	1.22	=	4929.00	(261)
Water heating	2164.14	x	1.22	=	2640.25	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7569.25	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	285.76	x	3.07	=	877.30	(268)

Primary energy kWh/year	8676.80	(272)
Dwelling primary energy rate kWh/m2/year	153.03	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	26/08/2015
Address	Flat 3.02 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.00	(1a) x	2.50	(2a) =	127.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 = 0	(6a)
Number of open flues		0	x 20 = 0	(6b)
Number of intermittent fans		2	x 10 = 20	(7a)
Number of passive vents		0	x 10 = 0	(7b)
Number of flueless gas fires		0	x 40 = 0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.16	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	38.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.17	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.73	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.73	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.62	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.79	0.78	0.76	0.68	0.67	0.59	0.59	0.57	0.62	0.67	0.70	0.73	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.81	0.80	0.79	0.73	0.72	0.67	0.67	0.67	0.69	0.72	0.74	0.77	(24d)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.81	0.80	0.79	0.73	0.72	0.67	0.67	0.67	0.69	0.72	0.74	0.77	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			3.36	x	2.19	=	7.36			(27)
External wall			19.04	x	0.18	=	3.43			(29a)
Party wall			33.25	x	0.00	=	0.00			(32)
External wall			19.25	x	0.30	=	5.78			(29a)
Roof			51.00	x	0.18	=	9.18			(30)
Total area of external elements ∑A, m²			94.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	28.68 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.21 (36)
Total fabric heat loss	(33) + (36) =	42.89 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
34.24	33.72	33.22	30.86	30.42	28.36	28.36	27.98	29.16	30.42	31.31	32.25	(38)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
77.13	76.62	76.11	73.75	73.31	71.26	71.26	70.88	72.05	73.31	74.21	75.14	

Average = ∑(39)1...12/12 = 73.75 (39)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1.51	1.50	1.49	1.45	1.44	1.40	1.40	1.39	1.41	1.44	1.46	1.47	

Average = ∑(40)1...12/12 = 1.45 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.72	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	75.04	(43)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54	

∑(44)1...12 = 900.48 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
122.41	107.06	110.48	96.32	92.42	79.75	73.90	84.80	85.81	100.01	109.17	118.55	

∑(45)1...12 = 1180.67 (45)

Distribution loss 0.15 x (45)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15.00	16.37	17.78	(46)

Water storage loss calculated for each month (55) x (41)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

42.06	36.61	39.00	36.27	35.95	33.31	34.42	35.95	36.27	39.00	39.23	42.06	(61)

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

164.47	143.67	149.48	132.58	128.36	113.06	108.32	120.75	122.08	139.01	148.39	160.61	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

164.47	143.67	149.48	132.58	128.36	113.06	108.32	120.75	122.08	139.01	148.39	160.61	

∑(64)1...12 = 1630.78 (64)

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

51.22	44.75	46.48	41.09	39.72	34.84	33.18	37.18	37.60	43.00	46.10	49.93	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.70	37.04	30.12	22.80	17.04	14.39	15.55	20.21	27.13	34.44	40.20	42.86	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.63	225.95	220.10	207.65	191.94	177.17	167.30	164.98	170.83	183.28	198.99	213.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains (Table 5)	68.84	66.59	62.48	57.07	53.38	48.39	44.59	49.98	52.22	57.80	64.03	67.11	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	418.59	414.01	397.13	371.95	346.79	324.38	311.87	319.60	334.60	359.95	387.65	408.16	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	3.36	x	11.28	x 0.9 x	0.76	x	0.70	=	13.98	(81)

Solar gains in watts ∑(74)m...(82)m

13.98	28.45	51.26	84.18	113.15	120.64	112.85	89.97	62.46	34.77	17.59	11.41	(83)

Total gains - internal and solar (73)m + (83)m

432.57	442.46	448.39	456.13	459.95	445.01	424.72	409.56	397.06	394.72	405.24	419.57	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.99	0.99	0.99	0.97	0.93	0.82	0.67	0.71	0.89	0.97	0.99	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.52	19.62	19.85	20.21	20.55	20.84	20.95	20.94	20.75	20.34	19.90	19.53	(87)

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

19.68	19.69	19.69	19.73	19.73	19.77	19.77	19.77	19.75	19.73	19.72	19.71	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.99	0.98	0.96	0.89	0.73	0.51	0.56	0.82	0.95	0.98	0.99	(89)

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

17.76	17.92	18.26	18.80	19.28	19.65	19.75	19.74	19.54	18.98	18.35	17.80	(90)

Living area fraction — Living area ÷ (4) = 0.41 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.48	18.62	18.92	19.38	19.80	20.14	20.24	20.24	20.04	19.54	18.99	18.51	(92)

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

18.33	18.47	18.77	19.23	19.65	19.99	20.09	20.09	19.89	19.39	18.84	18.36	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.97	0.95	0.89	0.75	0.56	0.60	0.83	0.95	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	426.25	434.58	436.60	433.36	409.70	332.78	237.98	246.41	329.53	373.77	396.23	414.15	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1082.36	1039.84	933.53	762.09	583.12	384.16	248.89	261.26	417.11	644.37	870.82	1064.05	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	488.15	406.74	369.72	236.69	129.03	0.00	0.00	0.00	0.00	201.33	341.71	483.53	

∑(98)1...5, 10...12 = 2656.88 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 52.10 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 84.00 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	581.13	484.21	440.14	281.77	153.60	0.00	0.00	0.00	0.00	239.67	406.80	575.63	

∑(211)1...5, 10...12 = 3162.95 (211)

Water heating

Efficiency of water heater	81.53	81.45	81.19	80.53	79.26	75.00	75.00	75.00	75.00	80.08	81.05	81.56	(217)
Water heating fuel, kWh/month	201.72	176.40	184.10	164.64	161.96	150.74	144.42	160.99	162.77	173.60	183.08	196.92	

∑(219a)1...12 = 2061.35 (219)

Annual totals

Space heating fuel - main system 1		3162.95	
Water heating fuel		2061.35	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		294.55	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5593.85	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3162.95	x	3.48	x 0.01 =	110.07	(240)
Water heating	2061.35	x	3.48	x 0.01 =	71.73	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	294.55	x	13.19	x 0.01 =	38.85	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		350.55	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.53	(257)
SAP value	78.61	
SAP rating (section 13)	79	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3162.95	x	0.22	=	683.20	(261)
Water heating	2061.35	x	0.22	=	445.25	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1128.45	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	294.55	x	0.52	=	152.87	(268)
Total CO_2, kg/year				(265)...(271) =	1320.25	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	25.89	(273)
EI value					81.57	
EI rating (section 14)					82	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3162.95	x	1.22	=	3858.80	(261)
Water heating	2061.35	x	1.22	=	2514.84	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6373.64	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	294.55	x	3.07	=	904.28	(268)
Primary energy kWh/year					7508.17	(272)

Dwelling primary energy rate kWh/m2/year	147.22	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	26/08/2015
Address	Flat 3.03 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.00	(1a) x	2.50	(2a) =	127.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.50	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) = 0.16	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	38.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.17	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.73	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.73	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.62	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.79	0.78	0.76	0.68	0.67	0.59	0.59	0.57	0.62	0.67	0.70	0.73	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.81	0.80	0.79	0.73	0.72	0.67	0.67	0.67	0.69	0.72	0.74	0.77	(24d)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.81	0.80	0.79	0.73	0.72	0.67	0.67	0.67	0.69	0.72	0.74	0.77	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			3.36	x	2.19	=	7.36			(27)
External wall			19.04	x	0.18	=	3.43			(29a)
Party wall			33.25	x	0.00	=	0.00			(32)
External wall			19.25	x	0.30	=	5.78			(29a)
Roof			51.00	x	0.18	=	9.18			(30)
Total area of external elements ∑A, m²			94.75							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	28.68 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.21 (36)
Total fabric heat loss	(33) + (36) =	42.89 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
34.24	33.72	33.22	30.86	30.42	28.36	28.36	27.98	29.16	30.42	31.31	32.25	(38)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
77.13	76.62	76.11	73.75	73.31	71.26	71.26	70.88	72.05	73.31	74.21	75.14	

Average = ∑(39)1...12/12 = 73.75 (39)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1.51	1.50	1.49	1.45	1.44	1.40	1.40	1.39	1.41	1.44	1.46	1.47	

Average = ∑(40)1...12/12 = 1.45 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.72	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	75.04	(43)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
82.54	79.54	76.54	73.54	70.54	67.54	67.54	70.54	73.54	76.54	79.54	82.54	

∑(44)1...12 = 900.48 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
122.41	107.06	110.48	96.32	92.42	79.75	73.90	84.80	85.81	100.01	109.17	118.55	

∑(45)1...12 = 1180.67 (45)

Distribution loss 0.15 x (45)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
18.36	16.06	16.57	14.45	13.86	11.96	11.08	12.72	12.87	15.00	16.37	17.78	(46)

Water storage loss calculated for each month (55) x (41)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

42.06	36.61	39.00	36.27	35.95	33.31	34.42	35.95	36.27	39.00	39.23	42.06	(61)

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

164.47	143.67	149.48	132.58	128.36	113.06	108.32	120.75	122.08	139.01	148.39	160.61	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

164.47	143.67	149.48	132.58	128.36	113.06	108.32	120.75	122.08	139.01	148.39	160.61	

∑(64)1...12 = 1630.78 (64)

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

51.22	44.75	46.48	41.09	39.72	34.84	33.18	37.18	37.60	43.00	46.10	49.93	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	103.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.70	37.04	30.12	22.80	17.04	14.39	15.55	20.21	27.13	34.44	40.20	42.86	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.63	225.95	220.10	207.65	191.94	177.17	167.30	164.98	170.83	183.28	198.99	213.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	47.04	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	-68.78	(71)
Water heating gains (Table 5)	68.84	66.59	62.48	57.07	53.38	48.39	44.59	49.98	52.22	57.80	64.03	67.11	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	418.59	414.01	397.13	371.95	346.79	324.38	311.87	319.60	334.60	359.95	387.65	408.16	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthWest	0.77	x	3.36	x	11.28	x 0.9 x	0.76	x	0.70	=	13.98	(81)

Solar gains in watts ∑(74)m...(82)m

13.98	28.45	51.26	84.18	113.15	120.64	112.85	89.97	62.46	34.77	17.59	11.41	(83)

Total gains - internal and solar (73)m + (83)m

432.57	442.46	448.39	456.13	459.95	445.01	424.72	409.56	397.06	394.72	405.24	419.57	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

0.99	0.99	0.99	0.97	0.93	0.82	0.67	0.71	0.89	0.97	0.99	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.52	19.62	19.85	20.21	20.55	20.84	20.95	20.94	20.75	20.34	19.90	19.53	(87)

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

19.68	19.69	19.69	19.73	19.73	19.77	19.77	19.77	19.75	19.73	19.72	19.71	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.99	0.98	0.96	0.89	0.73	0.51	0.56	0.82	0.95	0.98	0.99	(89)

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

17.76	17.92	18.26	18.80	19.28	19.65	19.75	19.74	19.54	18.98	18.35	17.80	(90)

Living area fraction — Living area ÷ (4) = 0.41 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.48	18.62	18.92	19.38	19.80	20.14	20.24	20.24	20.04	19.54	18.99	18.51	(92)

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

18.33	18.47	18.77	19.23	19.65	19.99	20.09	20.09	19.89	19.39	18.84	18.36	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.97	0.95	0.89	0.75	0.56	0.60	0.83	0.95	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	426.25	434.58	436.60	433.36	409.70	332.78	237.98	246.41	329.53	373.77	396.23	414.15	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1082.36	1039.84	933.53	762.09	583.12	384.16	248.89	261.26	417.11	644.37	870.82	1064.05	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	488.15	406.74	369.72	236.69	129.03	0.00	0.00	0.00	0.00	201.33	341.71	483.53	

∑(98)1...5, 10...12 = 2656.88 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 52.10 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 84.00 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	581.13	484.21	440.14	281.77	153.60	0.00	0.00	0.00	0.00	239.67	406.80	575.63	

∑(211)1...5, 10...12 = 3162.95 (211)

Water heating

Efficiency of water heater

81.53	81.45	81.19	80.53	79.26	75.00	75.00	75.00	75.00	80.08	81.05	81.56	(217)

Water heating fuel, kWh/month

201.72	176.40	184.10	164.64	161.96	150.74	144.42	160.99	162.77	173.60	183.08	196.92	

∑(219a)1...12 = 2061.35 (219)

Annual totals

Space heating fuel - main system 1		3162.95	
Water heating fuel		2061.35	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		294.55	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5593.85	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3162.95	x	3.48	x 0.01 =	110.07	(240)
Water heating	2061.35	x	3.48	x 0.01 =	71.73	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	294.55	x	13.19	x 0.01 =	38.85	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		350.55	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.53	(257)
SAP value	78.61	
SAP rating (section 13)	79	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3162.95	x	0.22	=	683.20	(261)
Water heating	2061.35	x	0.22	=	445.25	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1128.45	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	294.55	x	0.52	=	152.87	(268)
Total CO_2, kg/year				(265)...(271) =	1320.25	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	25.89	(273)
EI value					81.57	
EI rating (section 14)					82	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3162.95	x	1.22	=	3858.80	(261)
Water heating	2061.35	x	1.22	=	2514.84	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6373.64	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	294.55	x	3.07	=	904.28	(268)
Primary energy kWh/year					7508.17	(272)

Dwelling primary energy rate kWh/m2/year	147.22	(273)

SAP Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Tom Sheldrake	Assessor number	6658
Client		Last modified	26/08/2015
Address	Flat 3.04 29 George Street, London, TW9		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		56.70	(1a) x	2.50	(2a) =	141.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	56.70	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	141.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		2	x 10 =	20	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.14	(8)

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

Number of storeys in the dwelling	1		(9)
Additional infiltration		0.00	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.35	(11)
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.00	(12)
If no draught lobby, enter 0.05, else enter 0		0.05	(13)
Percentage of windows and doors draught proofed	27.00		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0.20	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0.74	(16)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.74	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.63	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.80	0.78	0.77	0.69	0.67	0.60	0.60	0.58	0.63	0.67	0.70	0.74	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	N/A	(23c)

d) natural ventilation or whole house positive input ventilation from loft

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.82	0.81	0.79	0.74	0.73	0.68	0.68	0.67	0.70	0.73	0.75	0.77	(24d)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.82	0.81	0.79	0.74	0.73	0.68	0.68	0.67	0.70	0.73	0.75	0.77	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.40	=	2.94			(26)
Window			5.60	x	2.19	=	12.26			(27)
External wall			56.80	x	0.18	=	10.22			(29a)
Party wall			15.50	x	0.00	=	0.00			(32)
External wall			7.50	x	0.30	=	2.25			(29a)
Roof			56.70	x	0.18	=	10.21			(30)
Total area of external elements ∑A, m²			128.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	37.88 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		19.31 (36)
Total fabric heat loss	(33) + (36) =	57.19 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
38.31	37.73	37.17	34.50	34.00	31.67	31.67	31.24	32.57	34.00	35.01	36.06	(38)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
95.50	94.92	94.35	91.69	91.19	88.86	88.86	88.43	89.76	91.19	92.20	93.25	

Average = ∑(39)1...12/12 = 91.68 (39)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1.68	1.67	1.66	1.62	1.61	1.57	1.57	1.56	1.58	1.61	1.63	1.64	

Average = ∑(40)1...12/12 = 1.62 (40)

Number of days in month (Table 1a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	1.89	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	79.02	(43)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
86.92	83.76	80.60	77.44	74.27	71.11	71.11	74.27	77.44	80.60	83.76	86.92	

∑(44)1...12 = 948.19 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
128.90	112.73	116.33	101.42	97.31	83.97	77.82	89.29	90.36	105.31	114.95	124.83	

∑(45)1...12 = 1243.22 (45)

Distribution loss 0.15 x (45)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
19.33	16.91	17.45	15.21	14.60	12.60	11.67	13.39	13.55	15.80	17.24	18.72	(46)

Water storage loss calculated for each month (55) x (41)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

Combi loss for each month from Table 3a, 3b or 3c

44.29	38.55	41.07	38.19	37.85	35.07	36.24	37.85	38.19	41.07	41.30	44.29	(61)

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

173.19	151.28	157.40	139.61	135.16	119.04	114.05	127.14	128.55	146.38	156.25	169.12	(62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Output from water heater for each month (kWh/month) (62)m + (63)m

173.19	151.28	157.40	139.61	135.16	119.04	114.05	127.14	128.55	146.38	156.25	169.12	

∑(64)1...12 = 1717.18 (64)

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

53.93	47.12	48.95	43.27	41.82	36.69	34.93	39.15	39.59	45.28	48.55	52.58	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	113.22	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	42.46	37.71	30.67	23.22	17.36	14.65	15.83	20.58	27.62	35.07	40.94	43.64	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.60	248.15	241.73	228.06	210.80	194.58	183.74	181.19	187.61	201.29	218.55	234.77	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	48.21	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	-75.48	(71)
Water heating gains (Table 5)	72.49	70.12	65.79	60.10	56.21	50.96	46.95	52.62	54.99	60.86	67.43	70.67	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	449.50	444.93	427.14	400.32	373.31	349.14	335.48	343.35	359.17	386.17	415.86	438.03	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
NorthEast	0.77	x	2.80	x	11.28	x 0.9 x	0.76	x	0.70	=	11.65	(75)
NorthWest	0.77	x	2.80	x	11.28	x 0.9 x	0.76	x	0.70	=	11.65	(81)

Solar gains in watts ∑(74)m...(82)m

23.29	47.42	85.43	140.30	188.59	201.06	188.09	149.94	104.10	57.95	29.31	19.02	(83)

Total gains - internal and solar (73)m + (83)m

472.79	492.35	512.57	540.62	561.90	550.19	523.56	493.29	463.27	444.12	445.17	457.05	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85)

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

Utilisation factor for gains for living area n1,m (see Table 9a)

	0.99	0.99	0.98	0.97	0.92	0.81	0.67	0.72	0.89	0.97	0.99	0.99 (86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

	19.30	19.43	19.69	20.10	20.49	20.81	20.94	20.92	20.69	20.21	19.72	19.31 (87)

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

	19.55	19.56	19.57	19.60	19.61	19.64	19.64	19.64	19.63	19.61	19.59	19.58 (88)

Utilisation factor for gains for rest of dwelling n2,m

	0.99	0.99	0.98	0.95	0.88	0.71	0.50	0.55	0.82	0.96	0.98	0.99 (89)

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

	17.37	17.55	17.94	18.56	19.10	19.51	19.62	19.61	19.37	18.72	18.00	17.40 (90)

Living area fraction — Living area ÷ (4) = 0.49 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

	18.32	18.48	18.81	19.32	19.79	20.15	20.27	20.26	20.02	19.45	18.85	18.34 (92)

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

	18.17	18.33	18.66	19.17	19.64	20.00	20.12	20.11	19.87	19.30	18.70	18.19 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.97	0.95	0.88	0.74	0.56	0.61	0.84	0.95	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	466.36	483.85	498.80	511.70	495.56	407.35	294.84	302.68	388.54	422.26	436.12	451.58	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1324.78	1274.68	1147.11	941.80	723.95	479.98	312.62	327.65	517.76	793.76	1069.34	1304.74	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	638.67	531.44	482.34	309.67	169.92	0.00	0.00	0.00	0.00	276.39	455.92	634.74	

∑(98)1...5, 10...12 = 3499.10 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 61.71 (99)

9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

Fraction of space heat from main system(s) — 1 - (201) = 1.00 (202)

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 84.00 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	760.32	632.66	574.21	368.66	202.29	0.00	0.00	0.00	0.00	329.04	542.76	755.65	

∑(211)1...5, 10...12 = 4165.59 (211)

Water heating

Efficiency of water heater

	81.90	81.82	81.59	80.98	79.76	75.00	75.00	75.00	75.00	80.65	81.50	81.93 (217)

Water heating fuel, kWh/month

	211.45	184.89	192.91	172.40	169.46	158.73	152.07	169.52	171.40	181.50	191.71	206.42

∑(219a)1...12 =	2162.47	(219)

Annual totals

Space heating fuel - main system 1		4165.59	
Water heating fuel		2162.47	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		299.95	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		6703.00	(238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4165.59	x	3.48	x 0.01 =	144.96	(240)
Water heating	2162.47	x	3.48	x 0.01 =	75.25	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	299.95	x	13.19	x 0.01 =	39.56	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		389.67	(255)

11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.61	(257)
SAP value	77.55	
SAP rating (section 13)	78	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	4165.59	x	0.22	=	899.77	(261)
Water heating	2162.47	x	0.22	=	467.09	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1366.86	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	299.95	x	0.52	=	155.67	(268)
Total CO_2, kg/year			(265)...(271) =		1561.46	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		27.54	(273)
EI value					79.43	
EI rating (section 14)					79	(274)
EI band					C	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	4165.59	x	1.22	=	5082.02	(261)
Water heating	2162.47	x	1.22	=	2638.21	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7720.23	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	299.95	x	3.07	=	920.83	(268)

Primary energy kWh/year	8871.31	(272)
Dwelling primary energy rate kWh/m2/year	156.46	(273)

Appendix 3 – Limitations

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