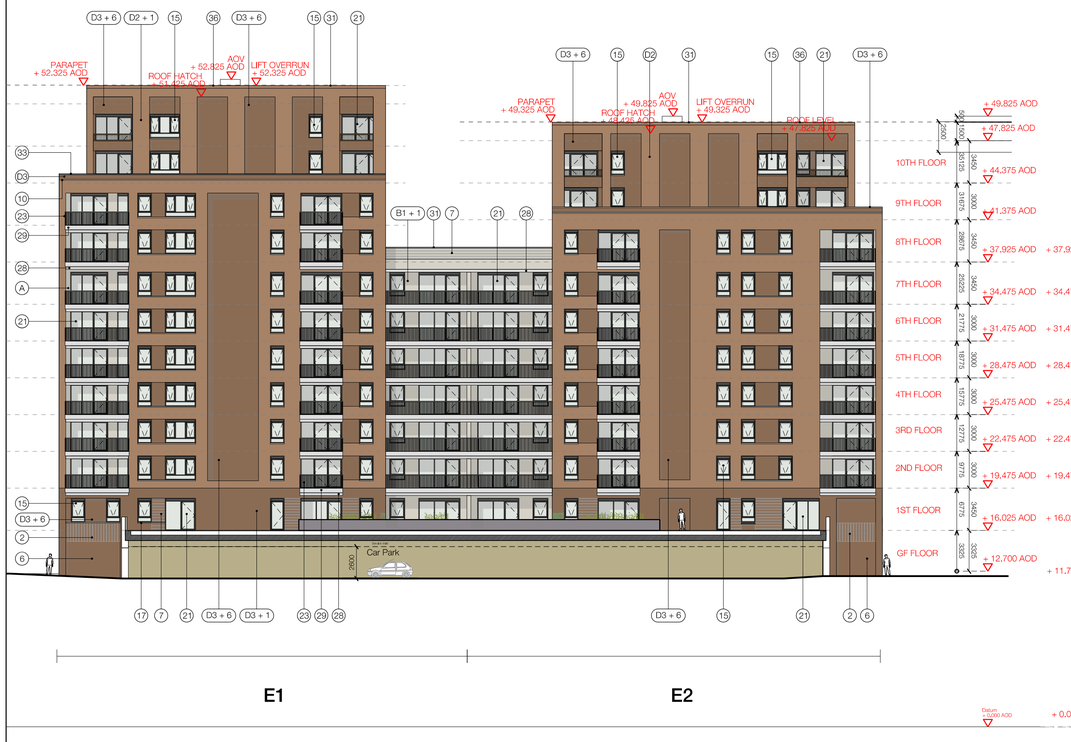


01 **Section/Elevation E-E (west elevations of E2 & E3)**
Scale 1:250

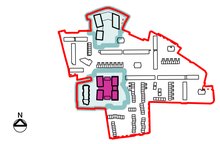
02 **Section/Elevation F- F (east elevations of E1 and E4)**
Scale 1:250

General Notes

DO NOT SCALE. All dimensions must be checked on site, errors are to be reported.

Contractors must ensure that cross referenced drawings and specifications noted on these drawings are checked on a regular basis to ensure that the latest revisions are used.

Key Plan



Material key (Building E)

A. Brick type A (White brick)
B. Brick type B (Buff)
B1. Brick type B1 (Buff 1)
B2. Brick type B2 (Buff 2)
B3. Brick type B3 (Buff 3)
B4. Brick type B4 (Buff 4)
C. Brick type C (Dark plinth)
D. Brick type D (Red brick)
D1. Brick type D1 (Red 1)
D2. Brick type D2 (Red 2)
D3. Brick type D3 (Red 3)
D4. Brick type D4 (Red 4)
D5. Brick type D5 (Red 5)

1. Stretcher bond brickwork
2. Soldier course brickwork
3. Stack bond brickwork
4. Bonded soldier course brickwork
5. Projecting stepped basketweave brickwork
6. Recessed brickwork
7. Rusticated brickwork
8. Projecting header brickwork pattern
9. Striped band brickwork

10. Precast string course
11. Precast entrance canopy and surround

12. PPC metal cladding system, mid bronze-coloured.
13. Diamond pattern PPC perforated mid bronze-coloured metal canopy system
14. PPC dark bronze-coloured metal surround to double height entrances.

15. PPC metal faced outward opening top-hung reversible window. Dark bronze-coloured. Single, double or triple paned windows as drawn.
16. Integrated ventilation panel with PPC metal perforated screen
17. Precast sill
18. Brick sill
19. Metal sill flashing

20. PPC metal perforated screen door
21. PPC metal faced dark bronze-coloured external door system
22. Timber faced external door system

23. PPC metal balcony balustrade. Metal flats. 40mm metal flats @ 100mm centres, 675mm brick balustrade topped with metal pickets. 10mm square rods @ 100mm centres.
24. PPC perforated metal balustrade. Nom. 50% free area. Refer to DAS Volume 2 Chapter 6 for perforation pattern.
25. 1500mm high balcony balustrade (wind mitigation)

26. PPC metal, dark bronze-coloured fascia and soffit
27. PPC metal, mid bronze-coloured fascia and soffit
28. PPC metal, light bronze-coloured fascia and soffit

29. Rendered soffit to match brickwork colour

30. Brick on-edge coping
31. Metal coping
32. Precast coping
33. Brick parapet
34. Metal parapet
35. Bio-diverse roof with PV panels

36. Decorative PPC dark bronze-coloured metal entrance gates.
37. Free standing brick wall

Scale 1:250 @ A1

0 1 2 3 4 5m 10m 15m 20m

Issue Record		By	Chk	Date
P03	For Information	LR	NE	23.10.2020
P02	For Information	NS	NE	16.10.2020
P01	For Information	CW	NE	27.02.2020

Title
Building E
Section Elevations E-E, F-F

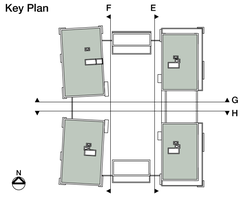
Project
Cambridge Road

Scale
1:250 @ A1 1:500 @ A3

Status
For Information

Drawing Number **Revision**
503-PTA-EZ-ZZ-DR-A-1921 **P03**

Key Plan



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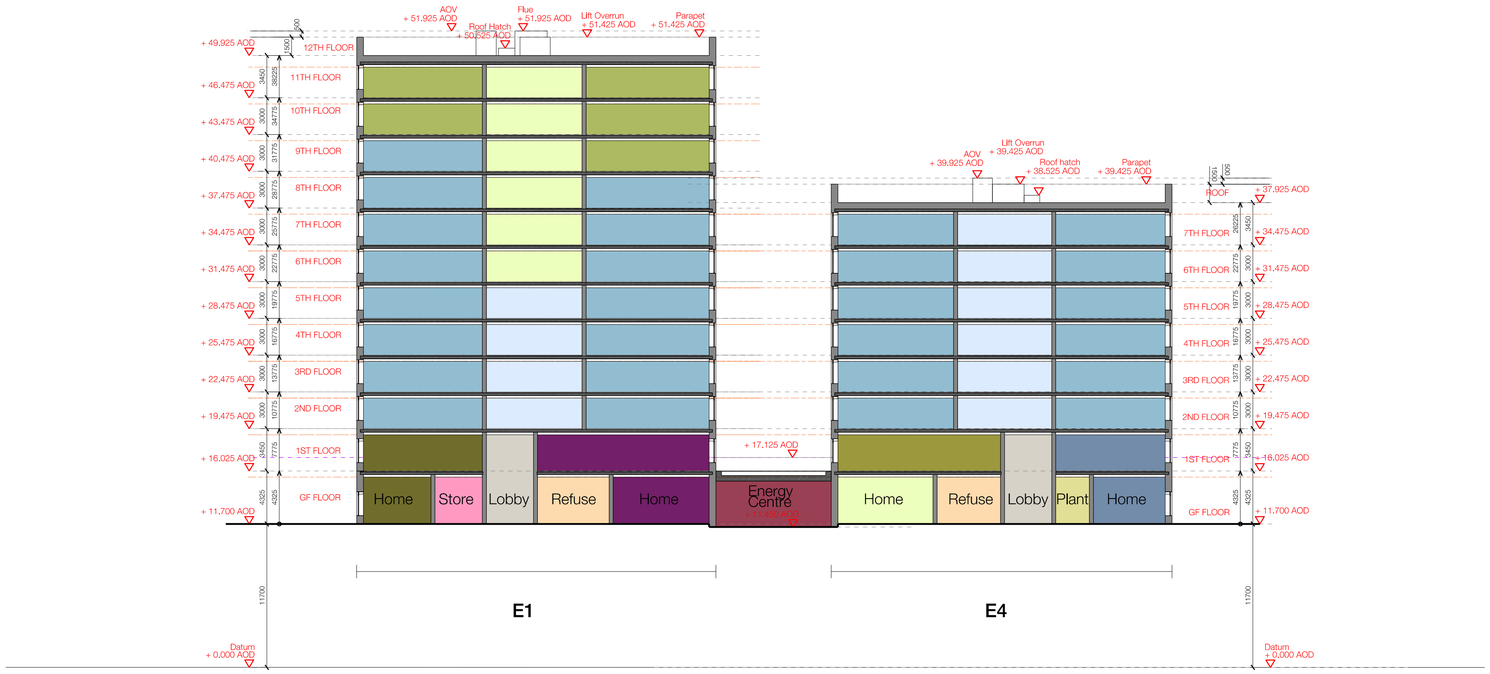
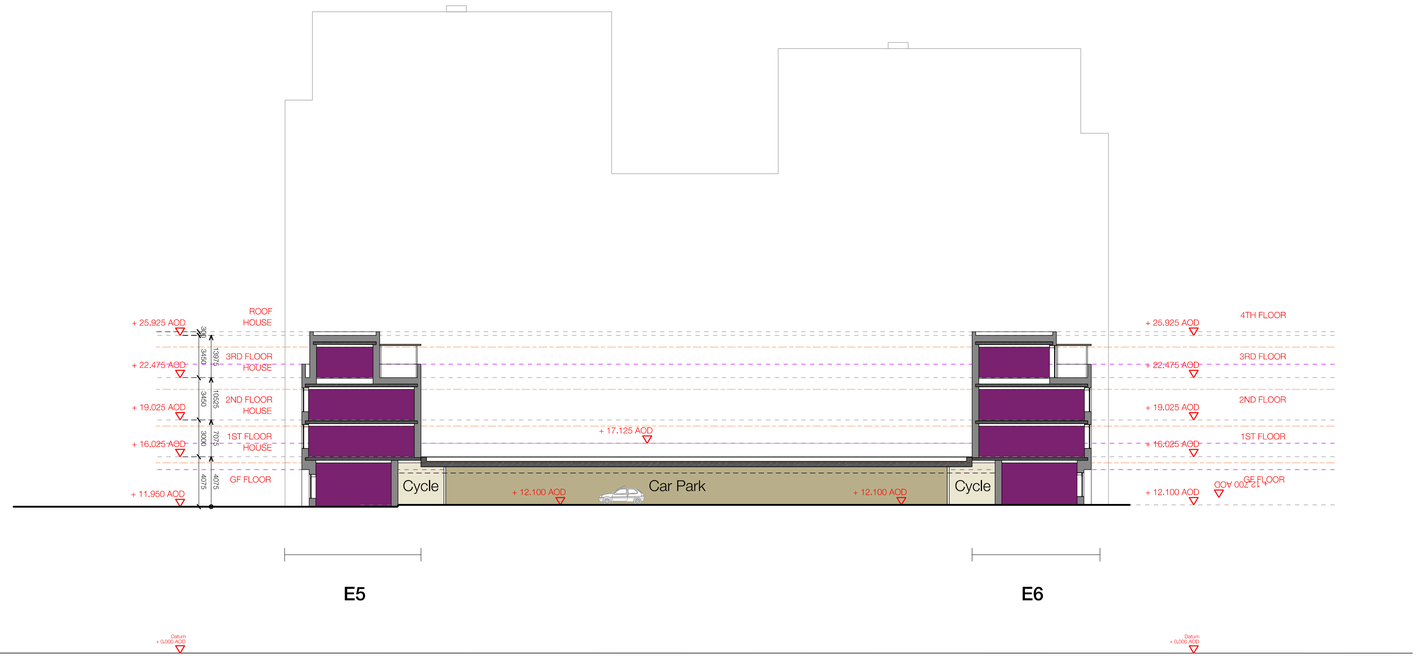


01 **Section C-C**
Scale 1:250



02 **Section D-D**
Scale 1:250

General Notes

DO NOT SCALE. All dimensions must be checked on site, errors are to be reported.

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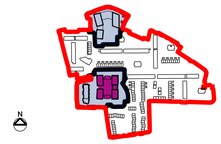
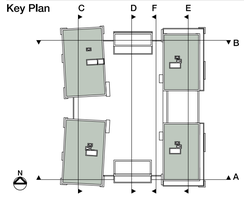
Key Plan



Key Plan



Scale 1:250 @ A1

0 1 2 3 4 5m 10m 15m 20m

Issue Record	By	Chk	Date
P02 For Information	CW	NE	23.10.2020
P01 For Information	EP	NE	14.10.2020

Title
Building E
Sections C-C & D-D

Project
Cambridge Road

Scale
1:250 @ A1 1:500 @ A3

Status
For Information

Drawing Number **Revision**
503-PTA-EZ-ZZ-DR-A-1931 **P02**

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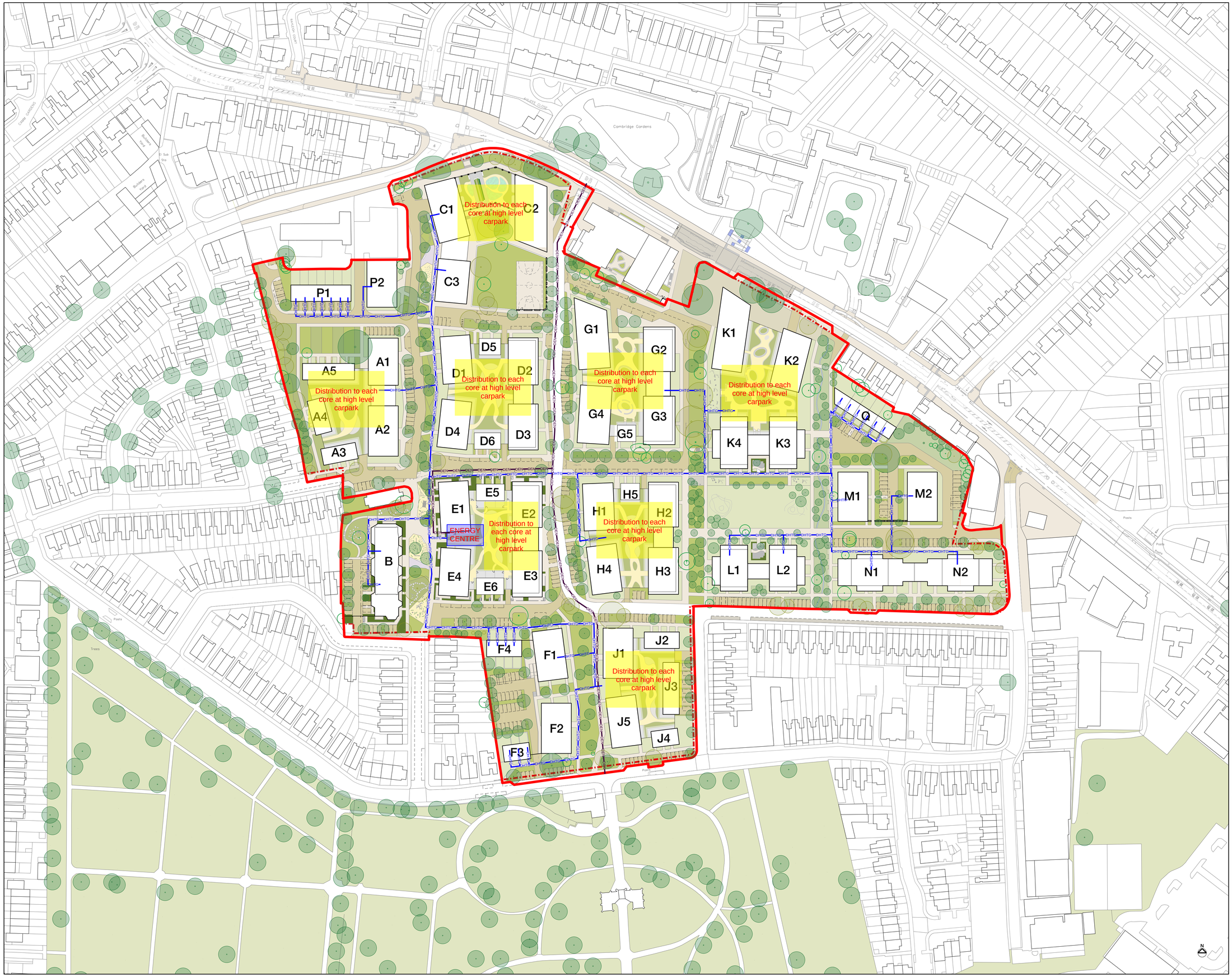
Appendix H Preferred energy strategy - Indicative Energy Centre Layouts, Connection, Heat network Layout



General Notes

DO NOT SCALE. All dimensions must be checked on site, errors are to be reported.

Contractors must ensure that cross referenced drawings and specifications noted on these drawings are checked on a regular basis to ensure that the latest revisions are used.

Key Plan

Client	Countryside Aurora House 71 – 75 Uxbridge Road London W5 5SL
Architect	Patel Taylor 48 Rawstorne Street London EC1V 7ND

Site Boundary

Title boundary

Planning boundary

OHTC—OHTC Cambridge Road - District Heating Network

DEN—DEN RBKUT District Energy Network

Drawing Status: **SKETCH**

Rev	Description	Date	By
P02	RBKUT ADDED TO LAYOUT	Sep' 20	SAS
P01	PRELIMINARY ISSUE	Sep' 20	SAS

AWA BUILDING SERVICES CONSULTANTS
Blackwater House
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E: info@awaconsultants.co.uk
W: www.awaconsultants.co.uk

Contract Title: CAMBRIDGE ROAD

Drawing Title: PROPOSED SITE WIDE DISTRICT HEATING LAYOUT

Drawn	Checked	Scale	Date
SAS	GT	NTS	Sep. 20

EXTERNAL SERVICES

Project No. 19085

Drawing Number: 18089 - SK - DHTG - 21102020

Status: SK

Revision: P02

+11.70m AOD

+11.70m AOD

E0.0 .1
#########
41.55 sqm
####

+11.70m AOD

AOV

LVR

LLR

WR

risers in abeyance

+11.70m AOD

+12.10m AOD

6.8m
1:17 gradient

Water Treatment

Boiler No. 1

Boiler No. 2

Boiler No. 3

Boiler No. 4

Boiler No. 5

Boiler No. 6

Site Wide Heating Pump Base

Plant Replacement Route

RBKUT DEN Plate Heat Exchanger 1

RBKUT DEN Plate Heat Exchanger 2

WM

Gas Meter Room

Control Panel

Area for Control Room

11.70m AOD

1:23

Plant Replacement Route

+11.450m AOD

E0.0 .0
#########
449.46 sqm
####

+ 10.050

Incoming Pipework for DEN + ASHP

Pressurisation Equipment

Electrical Panel

Commercial Sprinkler Pump Set

Commercial Sprinkler Tank

WM

1:17 6.8m gradient

+12.10m AOD

+11.70m AOD

E1.0 .1
#########
36.81 sqm
####

AOV

LLR

risers in abeyance

+11.70m AOD

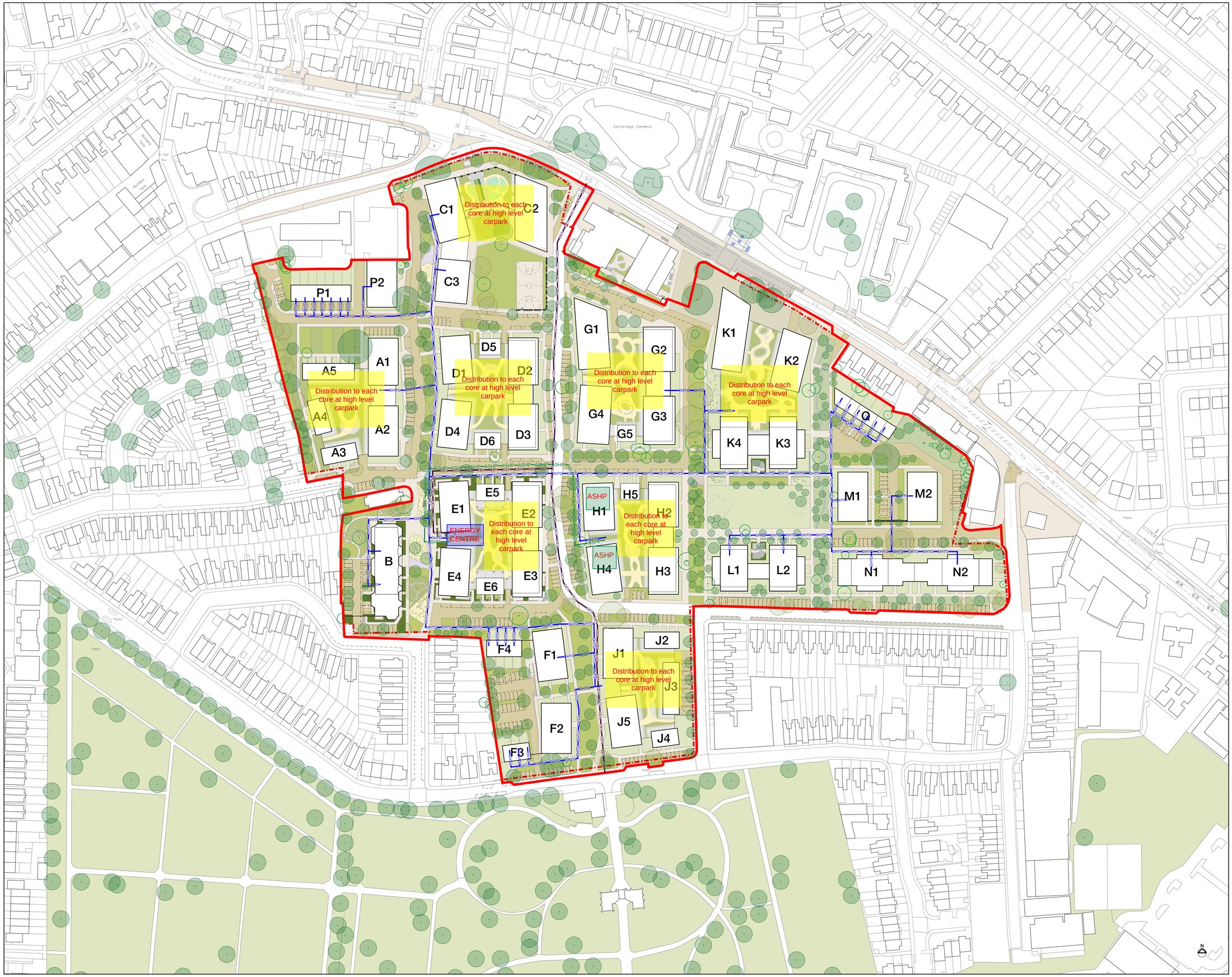
E0.0 .1
#########
59.08 sqm
####

Lockers
E0.0 .1
#########
19.51 sqm
####

E4.0 .1
#########
27.93 sqm

1:43

Appendix I Alternative energy strategy - Indicative Energy Centre Layouts, Connection, Heat network Layout



General Notes

DO NOT SCALE. All dimensions must be checked on site, errors are to be reported.

Contractors must ensure that cross referenced drawings and specifications noted on these drawings are checked on a regular basis to ensure that the latest revisions are used.

Key Plan

Client	Countryside Aurora House 71 – 75 Uxbridge Road London W5 5SL
Architect	Patel Taylor 48 Rawstorne Street London EC1V 7ND

Site Boundary

- Title boundary
- Planning boundary
- OHTC—OHTC Cambridge Road - District Heating Network
- DEN—DEN RBKUT District Energy Network
- ASHP—ASHP ASHP Pipe route

Drawing Status: **SKETCH**

Rev	Description	Date	By
P03	ASHP's ADDED	Sep' 20	SAS
P02	RBKUT ADDED TO LAYOUT	Sep' 20	SAS
P01	PRELIMINARY ISSUE	Sep' 20	SAS

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W: www.awaconsultants.co.uk

Contract Title: CAMBRIDGE ROAD

Drawing Title: PROPOSED SITE WIDE DISTRICT HEATING LAYOUT

Drawn	Checked	Scale	Date
SAS	GT	NTS	Sep. 20

EXTERNAL SERVICES

Project No. 18084

Drawing Number: 18089 - SK - DHTG - 21102020

Status: SK

Revision: P03

+11.70m AOD

+11.70m AOD

E0.0 .1
##########
41.55 sqm
####

+11.70m AOD

AOV

LVR

LLR

WR

risers in abeyance

Water Treatment

Boiler No. 1

Boiler No. 2

Boiler No. 3

Boiler No. 4

Boiler No. 5

Boiler No. 6

Plant Replacement Route

ASHP Pump Base

Site Wide Heating Pump Base

Plant Replacement Route

THERMAL STORE 1

THERMAL STORE 2

THERMAL STORE 3

THERMAL STORE 4

THERMAL STORE 5

THERMAL STORE 6

+ 10.050

Gas Meter Room

Control Panel

Area for Control Room

11.70m AOD

1:23

Plant Replacement Route

+11.450m AOD

E0.0 .0
##########
449.46 sqm
####

THERMAL STORE 8

THERMAL STORE 7

Pressurisation Equipment

Incoming Pipework for DEN + ASHP

Electrical Panel

Commercial Sprinkler Pump Set

Commercial Sprinkler Tank

WM

+12.10m AOD

6.8m
1:17 gradient

+12.10m AOD

+11.70m AOD

E1.0 .1
##########
36.81 sqm
####

AOV

LLR

risers in abeyance

+11.70m AOD

Lockers
E0.0 .1
##########
19.51 sqm
####

E4.0 .1
##########
27.93 sqm

+11.70m AOD

E0.0 .1
##########
59.08 sqm
####

1:43

Appendix J CO_2 Emissions Summary – *Be Clean*

The applicant should complete all the light blue cells including information on the 'be clean' energy consumption figures and the 'be clean' DER.

SAP 2012 CO2 PERFORMANCE

SAP10 CO2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m^2)	Number of units	Total area represented by model (m^2)	VALIDATION CHECK		REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE CLEAN' SAP DER WORKSHEET									REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)								REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)									
				Calculated DER 2012 (kgCO2 / m2)	DER Worksheet DER 2012 (kgCO2 / m2)	Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP if applicable	Fuel type CHP if applicable	Total Electricity generated by CHP (-) if applicable	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
					DER Sheet (Row 384)	DER Sheet [Row 307b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) ÷ (Row 362 x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) × (Row 361 ÷ 362)]	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315																	
1B2P - Ground Flo	*51.12*	*17*	*869.04*	**14.6**	**14.6**	*18.60502793*	*Natural Gas*	*22.34201117*	*Natural Gas*	*1036.603543*	*Grid Electricity*		*246.61*	*139.9376*		**4**	**5**	**538**		**128**	**73**		**747**	**4**	**5**	**242**		**57**	**33**		**340**	**6.7**
1B2P - Mid Floor	*50.88*	*131*	*6665.28*	**13.6**	**13.6**	*14.66335196*	*Natural Gas*	*22.3027933*	*Natural Gas*	*935.8243714*	*Grid Electricity*		*247.99*	*135.8947*		**3**	**5**	**486**		**129**	**71**		**693**	**3**	**5**	**218**		**58**	**32**		**315**	**6.2**
1B2P - Top Floor B	*50.32*	*17*	*855.44*	**14.2**	**14.2**	*16.34122905*	*Natural Gas*	*22.21106145*	*Natural Gas*	*975.9787714*	*Grid Electricity*		*244.38*	*136.1843*		**4**	**5**	**507**		**127**	**71**		**712**	**3**	**5**	**227**		**57**	**32**		**324**	**6.4**
2B3P - Top Floor B	*64.62*	*53*	*3424.86*	**16.2**	**16.2**	*34.91698324*	*Natural Gas*	*24.48379888*	*Natural Gas*	*1503.773229*	*Grid Electricity*		*290.39*	*200.9837*		**8**	**5**	**780**		**151**	**104**		**1,048**	**7**	**5**	**350**		**68**	**47**		**477**	**7.4**
2B4P - Mid Floor	*73.74*	*106*	*7816.44*	**12.1**	**12.1**	*21.03877095*	*Natural Gas*	*25.73094972*	*Natural Gas*	*1184.008886*	*Grid Electricity*		*325.11*	*190.8589*		**5**	**6**	**615**		**169**	**99**		**892**	**4**	**5**	**276**		**76**	**44**		**406**	**5.5**
2B4P - Mid Floor B	*74*	*106*	*7844*	**11.9**	**11.9**	*19.35486034*	*Natural Gas*	*25.76312849*	*Natural Gas*	*1142.194114*	*Grid Electricity*		*324.98*	*209.6606*		**4**	**6**	**593**		**169**	**109**		**880**	**4**	**5**	**266**		**76**	**49**		**400**	**5.4**
3B4P - Top Floor	*72.42*	*4*	*289.68*	**13.4**	**13.4**	*27.1498324*	*Natural Gas*	*25.56446927*	*Natural Gas*	*1334.5002*	*Grid Electricity*		*320.59*	*193.5093*		**6**	**6**	**693**		**166**	**100**		**971**	**6**	**5**	**311**		**75**	**45**		**442**	**6.1**
3B5P - Ground Flo	*104.07*	*4*	*416.28*	**12.6**	**12.6**	*41.70871508*	*Natural Gas*	*28.17843575*	*Natural Gas*	*1769.243143*	*Grid Electricity*		*425.01*	*300.609*		**9**	**6**	**918**		**221**	**156**		**1,310**	**9**	**6**	**412**		**99**	**70**		**596**	**5.7**
3B6P - Top Floor	*94.73*	*7*	*663.11*	**12.9**	**12.9**	*37.58782123*	*Natural Gas*	*27.68391061*	*Natural Gas*	*1652.400514*	*Grid Electricity*		*408.17*	*275.1082*		**8**	**6**	**858**		**212**	**143**		**1,226**	**8**	**6**	**385**		**95**	**64**		**558**	**5.9**
4P8P - Duplex	*129.44*	*7*	*906.08*	**10.9**	**10.9**	*41.91553073*	*Natural Gas*	*28.84134078*	*Natural Gas*	*1791.260743*	*Grid Electricity*		*476.33*	*413.7074*		**9**	**6**	**930**		**247**	**215**		**1,407**	**9**	**6**	**417**		**111**	**96**		**640**	**4.9**
Sum	**29,750**	**452**	**29,750**	**13.0**	**-**	**9,479**	**N/A**	**11,046**	**N/A**	**519,605**	**N/A**	**0**	**134,308**	**82,402**	**0**	**2,048**	**2,386**	**269,675**	**0**	**69,706**	**42,766**	**0**	***386,581***	**1,991**	**2,320**	**121,068**	**0**	**31,294**	**19,200**	**0**	***175,871***	**5.9**

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Building Use	Area per unit (m^2)	Number of units	Total area represented by model (m^2)	VALIDATION CHECK		REGULATED ENERGY CONSUMPTION BY END USE (kWh/m^2 p.a.) 'BE CLEAN' BER - SOURCE: BRUKL OUTPUT									REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m^2 p.a.) 'BE CLEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE								REGULATED CO2 EMISSIONS PER UNIT									
				Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water			Total Electricity generated by CHP (-) if applicable	Lighting	Auxiliary	Cooling	Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable			2012 CO2 emissions (kgCO2 p.a.)	Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable				SAP 10 CO2 emissions (kgCO2 p.a.)	BRUKL BER SAP10 (kgCO2 / m2)
										N/A	N/A					############	############	############	############				############	############	############	############					
Commercial	*1935*	*1*	*2474.4*	**8.8**	**8.8**	*11.1*	*Natural Gas*	*0.46*	*Natural Gas*				*7.72*	*2.23*	*2.29*	**12**	**12**						**17,124**	**12**	**12**						**10,216**	**5.3**
Sum	**1,935**	**1**	**2,474**	**11.3**	**-**	**21,479**	**N/A**	**890**	**N/A**			**0**	**14,938**	**4,315**	**4,431**	**12**	**12**	**0**	**0**				***21,897***	**12**	**12**	**0**	**0**				***13,064***	**6.8**

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m^2)	Calculated BER 2012 (kgCO2 / m2)	-	REGULATED ENERGY CONSUMPTION									REGULATED CO2 EMISSIONS		REGULATED CO2 EMISSIONS PER UNIT	
				Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space and Domestic Hot Water from CHP (kWh p.a.)	N/A	Electricity generated by CHP (kWh p.a.) if applicable	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)	2012 CO2 emissions (kgCO2 p.a.)	SAP 10 CO2 emissions (kgCO2 p.a.)	Calculated BER SAP10 (kgCO2 / m2)
Sum	**32,225**	**12.7**	**-**	**30,958**	**N/A**	**11,936**	**N/A**	**519,605**	**N/A**	**0**	**149,246**	**86,717**	**4,431**	***408,478***	***188,935***	**5.9**

The applicant should complete all the light blue cells including information on the 'be clean' energy consumption figures and the 'be clean' DER.

SAP 2012 CO2 PERFORMANCE

SAP10 CO2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK		REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE CLEAN' SAP DER WORKSHEET									REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)								REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)								
				Calculated DER 2012 (kgCO2 / m2)	DER Worksheet DER 2012 (kgCO2 / m2)	Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP if applicable	Fuel type CHP if applicable	Total Electricity generated by CHP (-) if applicable	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
					DER Sheet (Row 384)	DER Sheet [Row 307b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) ÷ (Row 362 x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) × (Row 361 ÷ 362)]	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315																	
1B2P - Ground Flo	51.12	71	869.04	14.6	14.6	18.60502793	Natural Gas	22.34201117	Natural Gas	1036.603543	Grid Electricity		246.61	139.9376		4	5	538		128	73		747	4	5	242		57	33		340	6.7
1B2P - Mid Floor	50.88	566	6665.28	13.6	13.6	14.66335196	Natural Gas	22.3027933	Natural Gas	935.8243714	Grid Electricity		247.99	135.8947		3	5	486		129	71		693	3	5	218		58	32		315	6.2
1B2P - Top Floor B	50.32	71	855.44	14.2	14.2	16.34122905	Natural Gas	22.2110145	Natural Gas	975.9787714	Grid Electricity		244.38	136.1843		4	5	507		127	71		712	3	5	227		57	32		324	6.4
2B3P - Top Floor B	64.62	178	3424.86	16.2	16.2	34.91698324	Natural Gas	24.48379888	Natural Gas	1503.773229	Grid Electricity		290.39	200.9837		8	5	780		151	104		1,048	7	5	350		68	47		477	7.4
2B4P - Mid Floor	73.74	356	7816.44	12.1	12.1	21.03877095	Natural Gas	25.73094972	Natural Gas	1184.008886	Grid Electricity		325.11	190.8589		5	6	615		169	99		892	4	5	276		76	44		406	5.5
2B4P - Mid Floor B	74	356	7844	11.9	11.9	19.35486034	Natural Gas	25.76312849	Natural Gas	1142.194114	Grid Electricity		324.98	209.6606		4	6	593		169	109		880	4	5	266		76	49		400	5.4
3B4P - Top Floor	72.42	41	289.68	13.4	13.4	27.1498324	Natural Gas	25.56446927	Natural Gas	1334.5002	Grid Electricity		320.59	193.5093		6	6	693		166	100		971	6	5	311		75	45		442	6.1
3B5P - Ground Flo	104.07	41	416.28	12.6	12.6	41.70871508	Natural Gas	28.17843575	Natural Gas	1769.243143	Grid Electricity		425.01	300.609		9	6	918		221	156		1,310	9	6	412		99	70		596	5.7
3B6P - Top Floor	94.73	19	663.11	12.9	12.9	37.58782123	Natural Gas	27.68391061	Natural Gas	1652.400514	Grid Electricity		408.17	275.1082		8	6	858		212	143		1,226	8	6	385		95	64		558	5.9
4P8P - Duplex	129.44	19	906.08	10.9	10.9	41.91553073	Natural Gas	28.84134078	Natural Gas	1791.260743	Grid Electricity		476.33	413.7074		9	6	930		247	215		1,407	9	6	417		111	96		640	4.9
Sum	111,593	1,718	29,750	3.5	-	35,710	N/A	41,754	N/A	1,961,053	N/A	0	505,719	308,227	0	7,713	9,019	1,017,786	0	262,468	159,970	0	*386,581*	7,499	8,768	456,925	0	117,833	71,817	0	*175,871*	1.6

NON-DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS

Building Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK		REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE CLEAN' BER - SOURCE: BRUKL OUTPUT									REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE CLEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE								REGULATED CO2 EMISSIONS PER UNIT							
				Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water			Total Electricity generated by CHP (-) if applicable	Lighting	Auxiliary	Cooling	Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable				2012 CO2 emissions (kgCO2 p.a.)	Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable				SAP 10 CO2 emissions (kgCO2 p.a.)	BRUKL BER SAP10 (kgCO2 / m2)
Commercial	1000	1	2474.4	8.8	8.8	11.1	Natural Gas	0.46	Natural Gas	N/A	N/A		7.72	2.23	2.29	12	12						8,850	12	12						5,280	5.3
Sum	1,000	1	2,474	21.9	-	11,100	N/A	460	N/A			0	7,720	2,230	2,290	12	12	0	0				*21,897*	12	12	0	0				*13,064*	13.1

SITE-WIDE ENERGY CONSUMPTION AND CO2 ANALYSIS

Use	Total Area (m²)	Calculated BER 2012 (kgCO2 / m2)	-	REGULATED ENERGY CONSUMPTION										REGULATED CO2 EMISSIONS		REGULATED CO2 EMISSIONS PER UNIT	
				Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space and Domestic Hot Water from CHP (kWh p.a.)	N/A	Electricity generated by CHP (kWh p.a.) if applicable	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)		2012 CO2 emissions (kgCO2 p.a.)	SAP 10 CO2 emissions (kgCO2 p.a.)	Calculated BER SAP10 (kgCO2 / m2)
Sum	32,225	12.7	-	46,810		42,214		1,961,053		0	513,439	310,457	2,290		*408,478*	*188,935*	5.9

Appendix K DER Worksheets – *Be Clean*

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	1B2P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.12	(1a) x	2.50	(2a) =	127.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.12	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.80	(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		0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	1	(19)
Shelter factor	1 - [0.075 x (19)] = 0.93	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.14	(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	0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.30	0.30	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(24a)

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

	0.30	0.30	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(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	
Window			8.18	x	1.24	=	10.11			(27)
Door			1.80	x	0.60	=	1.08			(26)
Ground floor			51.12	x	0.10	=	5.11			(28a)
External wall			18.25	x	0.17	=	3.10			(29a)
Party wall			17.80	x	0.00	=	0.00			(32)
External wall			25.45	x	0.15	=	3.82			(29a)
External wall			2.70	x	0.20	=	0.54			(29a)
Total area of external elements ∑A, m²			107.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.76 (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		8.51 (36)
Total fabric heat loss	(33) + (36) =	32.27 (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)	12.60	12.45	12.30	11.57	11.43	10.69	10.69	10.55	10.99	11.43	11.72	12.01	(38)
Heat transfer coefficient, W/K (37)m + (38)m	44.86	44.72	44.57	43.84	43.69	42.96	42.96	42.82	43.26	43.69	43.99	44.28	

Average = ∑(39)1...12/12 = 43.80 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.88	0.87	0.87	0.86	0.85	0.84	0.84	0.84	0.85	0.85	0.86	0.87	

Average = ∑(40)1...12/12 = 0.86 (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	75.12 (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)	82.64	79.63	76.63	73.62	70.62	67.61	67.61	70.62	73.62	76.63	79.63	82.64	

∑(44)1...12 = 901.49 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	122.55	107.18	110.60	96.42	92.52	79.84	73.98	84.90	85.91	100.12	109.29	118.68	

∑(45)1...12 = 1181.99 (45)

Distribution loss 0.15 x (45)m	18.38	16.08	16.59	14.46	13.88	11.98	11.10	12.73	12.89	15.02	16.39	17.80	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00 (47)
Water storage loss:	
b) Manufacturer's declared loss factor is not known	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)
Enter (50) or (54) in (55)	0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

149.85	131.84	137.90	122.85	119.83	106.26	101.29	112.20	112.33	127.42	135.71	145.98	(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

149.85	131.84	137.90	122.85	119.83	106.26	101.29	112.20	112.33	127.42	135.71	145.98	

∑(64)1...12 = 1503.47 (64)

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

62.59	55.37	58.62	53.20	52.61	47.68	46.44	50.07	49.70	55.13	57.48	61.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.96	12.40	10.09	7.64	5.71	4.82	5.21	6.77	9.08	11.54	13.46	14.35	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	150.14	151.70	147.77	139.42	128.87	118.95	112.32	110.77	114.69	123.05	133.60	143.52	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	(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)	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	(71)
Water heating gains (Table 5)	84.13	82.39	78.79	73.89	70.71	66.23	62.42	67.30	69.03	74.10	79.83	82.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	297.08	295.34	285.49	269.79	254.13	238.84	228.80	233.68	241.66	257.54	275.74	289.11	(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	8.18	x	19.64	x 0.9 x	0.45	x	0.70	=	35.07	(80)

Solar gains in watts ∑(74)m...(82)m

35.07	68.61	112.98	164.78	201.94	206.73	196.81	169.06	131.40	81.41	43.73	28.84	(83)

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

332.15	363.95	398.48	434.57	456.07	445.57	425.61	402.74	373.06	338.94	319.47	317.96	(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)													
	1.00	0.99	0.98	0.93	0.81	0.61	0.44	0.49	0.75	0.96	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.19	20.31	20.51	20.76	20.93	20.99	21.00	21.00	20.97	20.75	20.43	20.17	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.19	20.19	20.19	20.20	20.21	20.22	20.22	20.22	20.21	20.21	20.20	20.20	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.98	0.91	0.76	0.54	0.36	0.41	0.68	0.94	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.10	19.27	19.56	19.92	20.14	20.21	20.22	20.22	20.19	19.92	19.46	19.09	(90)

Living area fraction — Living area ÷ (4) = 0.47 (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													
	19.62	19.76	20.01	20.32	20.51	20.58	20.59	20.59	20.55	20.31	19.92	19.60	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.62	19.76	20.01	20.32	20.51	20.58	20.59	20.59	20.55	20.31	19.92	19.60	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.99	0.99	0.97	0.92	0.78	0.57	0.40	0.44	0.72	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	330.35	360.17	388.00	398.81	356.69	253.79	170.95	178.73	267.01	319.02	315.72	316.61	(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]													
	687.15	664.50	602.02	500.53	384.96	256.86	171.22	179.23	279.17	424.16	563.78	681.78	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	265.46	204.51	159.24	73.24	21.03	0.00	0.00	0.00	0.00	78.23	178.60	271.69	

∑(98)1...5, 10...12 = 1251.99 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 24.49 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1251.99		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	16.65	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1648.50	(307b)

Water heating

Annual water heating requirement	1503.47		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	20.00	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1979.62	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	36.65	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	103.29		(330a)
Total electricity for the above, kWh/year		103.29	(331)
Electricity for lighting (Appendix L)		246.61	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4014.67	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	16.65	x	4.24	x 0.01 =	0.71	(340a)
Space heating from heat pump	1648.50	x	4.24	x 0.01 =	69.90	(340b)
Water heating from boilers	20.00	x	4.24	x 0.01 =	0.85	(342a)
Water heating from heat pump	1979.62	x	4.24	x 0.01 =	83.94	(342b)
Pumps and fans	103.29	x	13.19	x 0.01 =	13.62	(349)
Electricity for lighting	246.61	x	13.19	x 0.01 =	32.53	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		321.54	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.40	(357)
SAP value	80.40	
SAP rating (section 13)	80	(358)
SAP band	C	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	40.95	x	0.216	=	8.84	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1036.60	x	0.519	=	538.00	(368)
Electrical energy for community heat distribution	36.65	x	0.519	=	19.02	(372)
Total CO2 associated with community systems					565.86	(373)
Total CO2 associated with space and water heating					565.86	(376)
Pumps and fans	103.29	x	0.519	=	53.61	(378)
Electricity for lighting	246.61	x	0.519	=	127.99	(379)
Total CO_2, kg/year				(376)..(382) =	747.46	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	14.62	(384)
EI value					89.58	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	40.95	x	1.22	=	49.96	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1036.60	x	3.07	=	3182.37	(368)
Electrical energy for community heat distribution	36.65	x	3.07	=	112.51	(372)
Total primary energy associated with community systems					3344.84	(373)
Total primary energy associated with space and water heating					3344.84	(376)
Pumps and fans	103.29	x	3.07	=	317.11	(378)
Electricity for lighting	246.61	x	3.07	=	757.11	(379)
Primary energy kWh/year					4419.06	(383)
Dwelling primary energy rate kWh/m2/year					86.44	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	1B2P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.88	(1a) x	2.50	(2a) =	127.20	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.88	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.20	(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		0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.12	(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	0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(24a)

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

	0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(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	
Window			7.76	x	1.24	=	9.59			(27)
Door			1.80	x	0.70	=	1.26			(26)
External wall			28.52	x	0.17	=	4.85			(29a)
Party wall			11.68	x	0.00	=	0.00			(32)
External wall			22.93	x	0.20	=	4.59			(29a)
Total area of external elements ∑A, m²			61.01							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	20.28 (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		7.20 (36)
Total fabric heat loss	(33) + (36) =	27.48 (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	
11.33	11.21	11.09	10.48	10.36	9.75	9.75	9.62	9.99	10.36	10.60	10.84	(38)

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

38.81	38.69	38.57	37.96	37.84	37.23	37.23	37.11	37.47	37.84	38.08	38.33	

Average = ∑(39)1...12/12 = 37.93 (39)

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

0.76	0.76	0.76	0.75	0.74	0.73	0.73	0.73	0.74	0.74	0.75	0.75	

Average = ∑(40)1...12/12 = 0.75 (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		74.96 (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	
82.45	79.45	76.45	73.46	70.46	67.46	67.46	70.46	73.46	76.45	79.45	82.45	

∑(44)1...12 = 899.47 (44)

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

122.27	106.94	110.35	96.21	92.31	79.66	73.82	84.71	85.72	99.90	109.04	118.41	

∑(45)1...12 = 1179.35 (45)

Distribution loss 0.15 x (45)m

18.34	16.04	16.55	14.43	13.85	11.95	11.07	12.71	12.86	14.98	16.36	17.76	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		3.00 (47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02 (51)
Volume factor from Table 2a		3.42 (52)
Temperature factor from Table 2b		0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)		0.13 (54)
Enter (50) or (54) in (55)		0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

149.58	131.60	137.66	122.63	119.62	106.08	101.12	112.01	112.14	127.20	135.47	145.72	(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

149.58	131.60	137.66	122.63	119.62	106.08	101.12	112.01	112.14	127.20	135.47	145.72	

∑(64)1...12 = 1500.82 (64)

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

62.50	55.29	58.54	53.13	52.54	47.63	46.39	50.01	49.64	55.06	57.40	61.22	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.04	12.47	10.14	7.68	5.74	4.85	5.24	6.81	9.14	11.60	13.54	14.43	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	149.52	151.07	147.16	138.84	128.33	118.46	111.86	110.31	114.22	122.54	133.05	142.92	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	(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)	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	(71)
Water heating gains (Table 5)	84.00	82.27	78.68	73.79	70.61	66.15	62.35	67.21	68.94	74.00	79.72	82.28	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	296.31	294.56	284.72	269.05	253.43	238.19	228.18	233.07	241.04	256.88	275.04	288.37	(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	4.56	x	10.63	x 0.9 x	0.45	x	0.70	=	10.58	(74)
East	0.77	x	3.20	x	19.64	x 0.9 x	0.45	x	0.70	=	13.72	(76)

Solar gains in watts ∑(74)m...(82)m

24.30	47.07	78.57	119.67	153.37	160.49	151.33	125.11	92.73	55.92	30.16	20.11	(83)

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

320.61	341.62	363.29	388.72	406.80	398.68	379.51	358.18	333.77	312.81	305.21	308.48	(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)

	1.00	0.99	0.98	0.94	0.81	0.59	0.43	0.48	0.74	0.95	0.99	1.00	(86)

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

	20.35	20.44	20.60	20.81	20.95	21.00	21.00	21.00	20.98	20.81	20.55	20.33	(87)

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

	20.29	20.29	20.29	20.30	20.30	20.31	20.31	20.32	20.31	20.30	20.30	20.29	(88)

Utilisation factor for gains for rest of dwelling n2,m

	1.00	0.99	0.98	0.92	0.76	0.53	0.36	0.41	0.68	0.94	0.99	1.00	(89)

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

	19.41	19.54	19.78	20.08	20.26	20.31	20.31	20.31	20.29	20.09	19.71	19.39	(90)

Living area fraction — Living area ÷ (4) = 0.45 (91)

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

	19.84	19.95	20.15	20.41	20.57	20.62	20.63	20.63	20.61	20.42	20.09	19.82	(92)

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

	19.84	19.95	20.15	20.41	20.57	20.62	20.63	20.63	20.61	20.42	20.09	19.82	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.98	0.92	0.78	0.56	0.39	0.44	0.71	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	318.87	338.35	354.81	358.81	317.30	222.73	149.75	156.61	236.58	293.94	301.50	307.17	(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]	603.01	582.26	526.48	437.04	335.76	224.18	149.85	156.82	243.77	371.40	494.80	598.63	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	211.40	163.90	127.72	56.33	13.73	0.00	0.00	0.00	0.00	57.63	139.17	216.85	

∑(98)1...5, 10...12 = 986.74 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.39 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	986.74		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	13.12	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1299.24	(307b)

Water heating

Annual water heating requirement	1500.82		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	19.96	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1976.13	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	33.08	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	102.81		(330a)
Total electricity for the above, kWh/year		102.81	(331)
Electricity for lighting (Appendix L)		247.99	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3659.26	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	13.12	x	4.24	x 0.01 =	0.56	(340a)
Space heating from heat pump	1299.24	x	4.24	x 0.01 =	55.09	(340b)
Water heating from boilers	19.96	x	4.24	x 0.01 =	0.85	(342a)
Water heating from heat pump	1976.13	x	4.24	x 0.01 =	83.79	(342b)
Pumps and fans	102.81	x	13.19	x 0.01 =	13.56	(349)
Electricity for lighting	247.99	x	13.19	x 0.01 =	32.71	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		306.55	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.34	(357)
SAP value	81.27	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	36.97	x	0.216	=	7.98	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	935.82	x	0.519	=	485.69	(368)
Electrical energy for community heat distribution	33.08	x	0.519	=	17.17	(372)
Total CO2 associated with community systems					510.85	(373)
Total CO2 associated with space and water heating					510.85	(376)
Pumps and fans	102.81	x	0.519	=	53.36	(378)
Electricity for lighting	247.99	x	0.519	=	128.71	(379)
Total CO_2, kg/year				(376)..(382) =	692.91	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	13.62	(384)
EI value					90.32	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	36.97	x	1.22	=	45.10	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	935.82	x	3.07	=	2872.97	(368)
Electrical energy for community heat distribution	33.08	x	3.07	=	101.57	(372)
Total primary energy associated with community systems					3019.64	(373)
Total primary energy associated with space and water heating					3019.64	(376)
Pumps and fans	102.81	x	3.07	=	315.62	(378)
Electricity for lighting	247.99	x	3.07	=	761.32	(379)
Primary energy kWh/year					4096.59	(383)
Dwelling primary energy rate kWh/m2/year					80.51	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	1B2P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.32	(1a) x	2.50	(2a) =	125.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.32	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.80	(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		0	x 10 = 0	(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) =	0	÷ (5) = 0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(24a)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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	
Window			7.86	x	1.24	=	9.71			(27)
Door			1.80	x	0.60	=	1.08			(26)
External wall			14.32	x	0.17	=	2.43			(29a)
Party wall			34.43	x	0.00	=	0.00			(32)
External wall			16.50	x	0.20	=	3.30			(29a)
Roof			50.32	x	0.13	=	6.54			(30)
Total area of external elements ∑A, m²			90.80							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.07 (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		6.77 (36)
Total fabric heat loss	(33) + (36) =	29.84 (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	
11.80	11.67	11.54	10.88	10.74	10.08	10.08	9.95	10.35	10.74	11.01	11.27	(38)

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

41.64	41.51	41.38	40.72	40.58	39.92	39.92	39.79	40.19	40.58	40.85	41.11	

Average = ∑(39)1...12/12 = 40.68 (39)

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

0.83	0.82	0.82	0.81	0.81	0.79	0.79	0.79	0.80	0.81	0.81	0.82	

Average = ∑(40)1...12/12 = 0.81 (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		1.70 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.56 (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	
82.02	79.04	76.06	73.07	70.09	67.11	67.11	70.09	73.07	76.06	79.04	82.02	

∑(44)1...12 = 894.76 (44)

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

121.63	106.38	109.78	95.71	91.83	79.24	73.43	84.26	85.27	99.37	108.47	117.80	

∑(45)1...12 = 1173.18 (45)

Distribution loss 0.15 x (45)m

18.25	15.96	16.47	14.36	13.77	11.89	11.01	12.64	12.79	14.91	16.27	17.67	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00 (47)
Water storage loss:	
b) Manufacturer's declared loss factor is not known	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)
Enter (50) or (54) in (55)	0.13 (55)
Water storage loss calculated for each month (55) x (41)m	

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

148.94	131.04	137.08	122.13	119.14	105.67	100.73	111.57	111.69	126.68	134.90	145.10	(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

148.94	131.04	137.08	122.13	119.14	105.67	100.73	111.57	111.69	126.68	134.90	145.10	

∑(64)1...12 = 1494.66 (64)

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

62.29	55.10	58.34	52.96	52.38	47.49	46.26	49.86	49.49	54.88	57.21	61.01	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.84	12.29	10.00	7.57	5.66	4.78	5.16	6.71	9.00	11.43	13.34	14.22	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	148.07	149.60	145.73	137.49	127.08	117.30	110.77	109.23	113.11	121.35	131.75	141.53	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	(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)	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	(71)
Water heating gains (Table 5)	83.72	82.00	78.42	73.56	70.40	65.95	62.18	67.02	68.74	73.77	79.45	82.00	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

294.11	292.38	282.64	267.10	251.63	236.53	226.60	231.45	239.34	255.04	273.04	286.25	(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	7.86	x	19.64	x 0.9 x	0.45	x	0.70	=	33.70	(80)

Solar gains in watts ∑(74)m...(82)m

33.70	65.92	108.56	158.33	194.04	198.64	189.11	162.44	126.26	78.22	42.02	27.71	(83)

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

327.81	358.30	391.20	425.44	445.67	435.16	415.71	393.90	365.60	333.26	315.06	313.96	(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)

	1.00	0.99	0.98	0.92	0.79	0.58	0.42	0.46	0.73	0.95	0.99	1.00	(86)

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

	20.27	20.38	20.57	20.80	20.95	20.99	21.00	21.00	20.98	20.79	20.49	20.25	(87)

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

	20.23	20.23	20.23	20.25	20.25	20.26	20.26	20.26	20.25	20.25	20.24	20.24	(88)

Utilisation factor for gains for rest of dwelling n2,m

	1.00	0.99	0.97	0.90	0.74	0.52	0.35	0.39	0.66	0.93	0.99	1.00	(89)

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

	19.25	19.41	19.69	20.02	20.20	20.26	20.26	20.26	20.24	20.01	19.59	19.23	(90)

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

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

	19.81	19.94	20.17	20.45	20.61	20.66	20.66	20.66	20.64	20.43	20.08	19.79	(92)

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

	19.81	19.94	20.17	20.45	20.61	20.66	20.66	20.66	20.64	20.43	20.08	19.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.91	0.76	0.55	0.39	0.43	0.70	0.93	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	325.95	354.36	380.06	386.99	340.74	239.90	162.03	169.34	254.35	311.59	311.08	312.58	(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]	645.68	624.31	565.55	470.12	361.50	241.86	162.19	169.64	262.84	399.12	530.20	640.78	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	237.88	181.41	138.01	59.85	15.45	0.00	0.00	0.00	0.00	65.12	157.77	244.18	

∑(98)1...5, 10...12 = 1099.65 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 21.85 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1099.65		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	14.63	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1447.92	(307b)

Water heating

Annual water heating requirement	1494.66		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	19.88	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1968.01	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	34.50	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	101.68		(330a)
Total electricity for the above, kWh/year		101.68	(331)
Electricity for lighting (Appendix L)		244.38	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3796.49	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	14.63	x	4.24	x 0.01 =	0.62	(340a)
Space heating from heat pump	1447.92	x	4.24	x 0.01 =	61.39	(340b)
Water heating from boilers	19.88	x	4.24	x 0.01 =	0.84	(342a)
Water heating from heat pump	1968.01	x	4.24	x 0.01 =	83.44	(342b)
Pumps and fans	101.68	x	13.19	x 0.01 =	13.41	(349)
Electricity for lighting	244.38	x	13.19	x 0.01 =	32.23	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	311.94	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.37	(357)
SAP value	80.83	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	38.55	x	0.216	=	8.33	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	975.98	x	0.519	=	506.53	(368)
Electrical energy for community heat distribution	34.50	x	0.519	=	17.91	(372)
Total CO2 associated with community systems					532.77	(373)
Total CO2 associated with space and water heating					532.77	(376)
Pumps and fans	101.68	x	0.519	=	52.77	(378)
Electricity for lighting	244.38	x	0.519	=	126.83	(379)
Total CO_2, kg/year				(376)..(382) =	712.37	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	14.16	(384)
EI value					89.99	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	38.55	x	1.22	=	47.03	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	975.98	x	3.07	=	2996.26	(368)
Electrical energy for community heat distribution	34.50	x	3.07	=	105.93	(372)
Total primary energy associated with community systems					3149.22	(373)
Total primary energy associated with space and water heating					3149.22	(376)
Pumps and fans	101.68	x	3.07	=	312.15	(378)
Electricity for lighting	244.38	x	3.07	=	750.24	(379)
Primary energy kWh/year					4211.61	(383)
Dwelling primary energy rate kWh/m2/year					83.70	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	2B3P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		64.62	(1a) x	2.50	(2a) =	161.55	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	64.62	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	161.55	(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		0	x 10 = 0	(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) =	0	÷ (5) = 0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	74.80	(23c)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(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	
Window			15.04	x	1.24	=	18.59			(27)
Door			1.80	x	0.60	=	1.08			(26)
External wall			31.51	x	0.17	=	5.36			(29a)
Party wall			14.88	x	0.00	=	0.00			(32)
External wall			22.05	x	0.20	=	4.41			(29a)
Roof			64.62	x	0.13	=	8.40			(30)
Total area of external elements ∑A, m²			135.02							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	37.83 (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		15.57 (36)
Total fabric heat loss	(33) + (36) =	53.41 (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	
15.38	15.21	15.04	14.19	14.02	13.17	13.17	13.00	13.51	14.02	14.36	14.70	(38)

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

68.79	68.62	68.45	67.60	67.43	66.58	66.58	66.41	66.92	67.43	67.77	68.11	

Average = ∑(39)1...12/12 = 67.56 (39)

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

1.06	1.06	1.06	1.05	1.04	1.03	1.03	1.03	1.04	1.04	1.05	1.05	

Average = ∑(40)1...12/12 = 1.05 (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		2.11 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		84.28 (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	
92.71	89.34	85.97	82.60	79.23	75.86	75.86	79.23	82.60	85.97	89.34	92.71	

∑(44)1...12 = 1011.41 (44)

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

137.49	120.25	124.09	108.18	103.80	89.57	83.00	95.25	96.39	112.33	122.61	133.15	

∑(45)1...12 = 1326.12 (45)

Distribution loss 0.15 x (45)m

20.62	18.04	18.61	16.23	15.57	13.44	12.45	14.29	14.46	16.85	18.39	19.97	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		3.00 (47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02 (51)
Volume factor from Table 2a		3.42 (52)
Temperature factor from Table 2b		0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)		0.13 (54)
Enter (50) or (54) in (55)		0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

164.79	144.91	151.39	134.60	131.11	116.00	110.31	122.55	122.81	139.63	149.04	160.46	(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

164.79	144.91	151.39	134.60	131.11	116.00	110.31	122.55	122.81	139.63	149.04	160.46	

∑(64)1...12 = 1647.59 (64)

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

67.56	59.71	63.10	57.11	56.36	50.92	49.44	53.51	53.19	59.19	61.91	66.12	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	16.44	14.60	11.88	8.99	6.72	5.67	6.13	7.97	10.70	13.58	15.85	16.90	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	184.43	186.34	181.52	171.25	158.29	146.11	137.98	136.06	140.88	151.15	164.11	176.29	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	(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)	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	(71)
Water heating gains (Table 5)	90.80	88.86	84.81	79.32	75.75	70.72	66.45	71.93	73.87	79.56	85.98	88.87	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	346.31	344.44	332.84	314.20	295.40	277.14	265.19	270.59	280.08	298.93	320.58	336.69	(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	8.20	x	10.63	x 0.9 x	0.45	x	0.70	=	19.03	(74)
East	0.77	x	6.84	x	19.64	x 0.9 x	0.45	x	0.70	=	29.33	(76)

Solar gains in watts ∑(74)m...(82)m

48.36	93.74	156.29	237.07	302.61	316.04	298.24	247.42	184.19	111.37	60.05	39.98	(83)

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

394.67	438.18	489.13	551.27	598.00	593.18	563.44	518.01	464.28	410.30	380.63	376.67	(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)													
	1.00	1.00	0.99	0.96	0.86	0.68	0.51	0.58	0.84	0.98	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	19.89	20.01	20.25	20.57	20.84	20.97	20.99	20.99	20.90	20.55	20.17	19.86	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.03	20.03	20.03	20.05	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.04	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.98	0.94	0.82	0.60	0.41	0.47	0.77	0.97	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	18.54	18.73	19.07	19.54	19.89	20.04	20.06	20.06	19.97	19.52	18.96	18.52	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

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

19.10	19.26	19.56	19.97	20.28	20.42	20.45	20.44	20.36	19.95	19.46	19.08	(92)

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

19.10	19.26	19.56	19.97	20.28	20.42	20.45	20.44	20.36	19.95	19.46	19.08	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	1.00	0.99	0.98	0.94	0.83	0.63	0.45	0.51	0.80	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	393.15	435.00	480.26	519.08	496.62	373.90	254.27	265.09	370.74	395.52	377.71	375.53	(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]													
	1018.15	985.60	894.04	748.23	578.72	387.77	256.12	268.62	418.59	630.70	837.84	1013.28	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	465.01	370.00	307.86	164.98	61.08	0.00	0.00	0.00	0.00	174.97	331.30	474.48	

∑(98)1...5, 10...12 = 2349.68 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 36.36 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	2349.68		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	31.25	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	3093.82	(307b)

Water heating

Annual water heating requirement	1647.59		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	21.91	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2169.39	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	53.16	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	147.82		(330a)
Total electricity for the above, kWh/year		147.82	(331)
Electricity for lighting (Appendix L)		290.37	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5754.56	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	31.25	x	4.24	x 0.01 =	1.33	(340a)
Space heating from heat pump	3093.82	x	4.24	x 0.01 =	131.18	(340b)
Water heating from boilers	21.91	x	4.24	x 0.01 =	0.93	(342a)
Water heating from heat pump	2169.39	x	4.24	x 0.01 =	91.98	(342b)
Pumps and fans	147.82	x	13.19	x 0.01 =	19.50	(349)
Electricity for lighting	290.37	x	13.19	x 0.01 =	38.30	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		403.21	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.54	(357)
SAP value	78.45	
SAP rating (section 13)	78	(358)
SAP band	C	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	59.40	x	0.216	=	12.83	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1503.77	x	0.519	=	780.46	(368)
Electrical energy for community heat distribution	53.16	x	0.519	=	27.59	(372)
Total CO2 associated with community systems					820.88	(373)
Total CO2 associated with space and water heating					820.88	(376)
Pumps and fans	147.82	x	0.519	=	76.72	(378)
Electricity for lighting	290.37	x	0.519	=	150.70	(379)
Total CO_2, kg/year				(376)..(382) =	1048.30	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	16.22	(384)
EI value					87.19	
EI rating (section 14)					87	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	59.40	x	1.22	=	72.47	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1503.77	x	3.07	=	4616.58	(368)
Electrical energy for community heat distribution	53.16	x	3.07	=	163.21	(372)
Total primary energy associated with community systems					4852.27	(373)
Total primary energy associated with space and water heating					4852.27	(376)
Pumps and fans	147.82	x	3.07	=	453.80	(378)
Electricity for lighting	290.37	x	3.07	=	891.45	(379)
Primary energy kWh/year					6197.51	(383)
Dwelling primary energy rate kWh/m2/year					95.91	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	2B4P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		73.74	(1a) x	2.50	(2a) =	184.35	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.74	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	184.35	(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		0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(24a)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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	
Window			15.42	x	1.24	=	19.06			(27)
Door			1.80	x	0.70	=	1.26			(26)
External wall			29.58	x	0.17	=	5.03			(29a)
Party wall			15.83	x	0.00	=	0.00			(32)
External wall			29.63	x	0.20	=	5.93			(29a)
Total area of external elements ∑A, m²			76.43							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	31.27 (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		9.45 (36)
Total fabric heat loss	(33) + (36) =	40.72 (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	
17.30	17.10	16.91	15.94	15.74	14.78	14.78	14.58	15.16	15.74	16.13	16.52	(38)

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

58.02	57.82	57.63	56.66	56.47	55.50	55.50	55.30	55.88	56.47	56.85	57.24	

Average = ∑(39)1...12/12 = 56.61 (39)

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

0.79	0.78	0.78	0.77	0.77	0.75	0.75	0.75	0.76	0.77	0.77	0.78	

Average = ∑(40)1...12/12 = 0.77 (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		2.33 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		89.62 (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	
98.58	95.00	91.41	87.83	84.24	80.66	80.66	84.24	87.83	91.41	95.00	98.58	

∑(44)1...12 = 1075.42 (44)

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

146.19	127.86	131.94	115.03	110.37	95.24	88.26	101.28	102.49	119.44	130.37	141.58	

∑(45)1...12 = 1410.04 (45)

Distribution loss 0.15 x (45)m

21.93	19.18	19.79	17.25	16.56	14.29	13.24	15.19	15.37	17.92	19.56	21.24	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		3.00 (47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02 (51)
Volume factor from Table 2a		3.42 (52)
Temperature factor from Table 2b		0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)		0.13 (54)
Enter (50) or (54) in (55)		0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

173.49	152.52	159.24	141.45	137.68	121.67	115.56	128.58	128.91	146.74	156.80	168.88	(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

173.49	152.52	159.24	141.45	137.68	121.67	115.56	128.58	128.91	146.74	156.80	168.88	

∑(64)1...12 = 1731.52 (64)

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

70.45	62.24	65.71	59.39	58.54	52.81	51.19	55.52	55.21	61.56	64.49	68.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.41	16.35	13.30	10.07	7.53	6.35	6.86	8.92	11.98	15.21	17.75	18.92	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	205.86	208.00	202.62	191.16	176.69	163.09	154.01	151.87	157.26	168.72	183.18	196.78	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	(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)	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	(71)
Water heating gains (Table 5)	94.69	92.62	88.32	82.48	78.69	73.34	68.80	74.62	76.69	82.74	89.57	92.63	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	376.97	374.97	362.24	341.70	320.90	300.79	287.68	293.42	303.92	324.66	348.50	366.33	(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	10.90	x	19.64	x 0.9 x	0.45	x	0.70	=	46.73	(76)
South	0.77	x	2.22	x	46.75	x 0.9 x	0.45	x	0.70	=	22.66	(78)
West	0.77	x	2.30	x	19.64	x 0.9 x	0.45	x	0.70	=	9.86	(80)

Solar gains in watts ∑(74)m...(82)m

79.25	147.81	229.59	319.33	381.54	387.17	369.94	323.64	261.42	171.39	97.42	66.12	(83)

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

456.22	522.79	591.83	661.03	702.45	687.96	657.61	617.06	565.34	496.05	445.92	432.45	(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)													
	1.00	0.99	0.97	0.89	0.72	0.51	0.37	0.41	0.67	0.94	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.30	20.44	20.64	20.87	20.97	21.00	21.00	21.00	20.99	20.83	20.52	20.28	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.26	20.27	20.27	20.28	20.28	20.29	20.29	20.30	20.29	20.28	20.28	20.27	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.96	0.86	0.67	0.46	0.31	0.35	0.60	0.91	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.32	19.52	19.82	20.13	20.26	20.29	20.29	20.30	20.28	20.10	19.66	19.30	(90)

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

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
	19.72	19.90	20.16	20.43	20.55	20.58	20.58	20.58	20.57	20.40	20.01	19.69	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.72	19.90	20.16	20.43	20.55	20.58	20.58	20.58	20.57	20.40	20.01	19.69	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	1.00	0.99	0.96	0.87	0.69	0.48	0.34	0.37	0.63	0.92	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	454.04	516.36	569.05	575.27	485.76	330.94	220.90	231.19	355.95	455.33	440.49	430.96	(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]													
	894.62	867.13	787.03	653.42	499.76	331.87	220.96	231.32	361.53	553.11	734.12	886.92	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	327.79	235.72	162.18	56.27	10.42	0.00	0.00	0.00	0.00	72.75	211.41	339.24	

∑(98)1...5, 10...12 = 1415.77 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.20 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1415.77		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	18.83	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1864.14	(307b)

Water heating

Annual water heating requirement	1731.52		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	23.03	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2279.89	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	41.86	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	149.00		(330a)
Total electricity for the above, kWh/year		149.00	(331)
Electricity for lighting (Appendix L)		325.11	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4660.00	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	18.83	x	4.24	x 0.01 =	0.80	(340a)
Space heating from heat pump	1864.14	x	4.24	x 0.01 =	79.04	(340b)
Water heating from boilers	23.03	x	4.24	x 0.01 =	0.98	(342a)
Water heating from heat pump	2279.89	x	4.24	x 0.01 =	96.67	(342b)
Pumps and fans	149.00	x	13.19	x 0.01 =	19.65	(349)
Electricity for lighting	325.11	x	13.19	x 0.01 =	42.88	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		360.02	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.27	(357)
SAP value	82.24	
SAP rating (section 13)	82	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	46.77	x	0.216	=	10.10	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1184.01	x	0.519	=	614.50	(368)
Electrical energy for community heat distribution	41.86	x	0.519	=	21.72	(372)
Total CO2 associated with community systems					646.33	(373)
Total CO2 associated with space and water heating					646.33	(376)
Pumps and fans	149.00	x	0.519	=	77.33	(378)
Electricity for lighting	325.11	x	0.519	=	168.73	(379)
Total CO_2, kg/year				(376)..(382) =	892.39	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.10	(384)
EI value					89.93	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	46.77	x	1.22	=	57.06	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1184.01	x	3.07	=	3634.91	(368)
Electrical energy for community heat distribution	41.86	x	3.07	=	128.51	(372)
Total primary energy associated with community systems					3820.48	(373)
Total primary energy associated with space and water heating					3820.48	(376)
Pumps and fans	149.00	x	3.07	=	457.43	(378)
Electricity for lighting	325.11	x	3.07	=	998.08	(379)
Primary energy kWh/year					5275.98	(383)
Dwelling primary energy rate kWh/m2/year					71.55	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	2B3P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		74.00	(1a) x	2.50	(2a) =	185.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	74.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	185.00	(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		0	x 10 =	0 (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) =	0	÷ (5) =	0.00 (8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (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) =	0.13 (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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		74.80 (23c)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(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	
Window			17.96	x	1.24	=	22.19			(27)
Door			1.80	x	0.70	=	1.26			(26)
External wall			30.44	x	0.17	=	5.17			(29a)
Party wall			32.15	x	0.00	=	0.00			(32)
External wall			2.65	x	0.20	=	0.53			(29a)
Total area of external elements ∑A, m²			52.85							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.16 (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		7.34 (36)
Total fabric heat loss	(33) + (36) =	36.49 (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	
17.62	17.42	17.23	16.25	16.06	15.09	15.09	14.89	15.48	16.06	16.45	16.84	(38)

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

54.11	53.92	53.72	52.75	52.55	51.58	51.58	51.39	51.97	52.55	52.94	53.33	

Average = ∑(39)1...12/12 = 52.70 (39)

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

0.73	0.73	0.73	0.71	0.71	0.70	0.70	0.69	0.70	0.71	0.72	0.72	

Average = ∑(40)1...12/12 = 0.71 (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		2.34 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		89.76 (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	
98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73	

∑(44)1...12 = 1077.07 (44)

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

146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.80	

∑(45)1...12 = 1412.21 (45)

Distribution loss 0.15 x (45)m

21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.40	17.94	19.59	21.27	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		3.00 (47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02 (51)
Volume factor from Table 2a		3.42 (52)
Temperature factor from Table 2b		0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)		0.13 (54)
Enter (50) or (54) in (55)		0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04 (57)

Primary circuit loss for each month from Table 3

	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (59)

Combi loss 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

	173.72	152.72	159.45	141.63	137.85	121.81	115.70	128.74	129.07	146.92	157.00	169.10 (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

	173.72	152.72	159.45	141.63	137.85	121.81	115.70	128.74	129.07	146.92	157.00	169.10

∑(64)1...12 = 1733.69 (64)

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

	70.53	62.31	65.78	59.44	58.60	52.86	51.23	55.57	55.27	61.62	64.55	68.99 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.40	16.35	13.29	10.06	7.52	6.35	6.86	8.92	11.97	15.20	17.74	18.92	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	206.45	208.59	203.19	191.70	177.19	163.56	154.45	152.30	157.70	169.20	183.70	197.34	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	(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)	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
Water heating gains (Table 5)	94.79	92.72	88.41	82.56	78.76	73.41	68.86	74.69	76.76	82.82	89.66	92.73	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	377.73	375.74	362.99	342.41	321.56	301.41	288.26	294.00	304.52	325.31	349.19	367.07	(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	
North	0.77	x	6.10	x	10.63	x 0.9 x	0.45	x	0.70	=	14.16	(74)
NorthEast	0.77	x	3.20	x	11.28	x 0.9 x	0.45	x	0.70	=	7.88	(75)
West	0.77	x	8.66	x	19.64	x 0.9 x	0.45	x	0.70	=	37.13	(80)

Solar gains in watts ∑(74)m...(82)m

	59.17	115.73	194.50	295.78	377.09	393.39	371.44	308.60	229.62	138.00	73.68	48.77 (83)

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

	436.90	491.48	557.49	638.19	698.66	694.80	659.70	602.61	534.14	463.31	422.87	415.84 (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)													
	1.00	0.99	0.97	0.88	0.68	0.47	0.34	0.39	0.66	0.94	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.36	20.48	20.68	20.90	20.99	21.00	21.00	21.00	20.99	20.85	20.56	20.34	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.31	20.32	20.32	20.33	20.33	20.34	20.34	20.35	20.34	20.33	20.33	20.32	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.97	0.86	0.64	0.43	0.29	0.34	0.60	0.92	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.45	19.62	19.91	20.21	20.32	20.34	20.34	20.35	20.33	20.16	19.76	19.43	(90)

Living area fraction — Living area ÷ (4) = 0.48 (91)

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

19.89	20.04	20.28	20.54	20.64	20.66	20.66	20.66	20.65	20.49	20.15	19.87	(92)

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

19.89	20.04	20.28	20.54	20.64	20.66	20.66	20.66	20.65	20.49	20.15	19.87	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	1.00	0.99	0.97	0.86	0.66	0.45	0.32	0.36	0.63	0.93	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	435.20	486.72	538.75	551.86	461.84	312.23	209.46	218.96	336.37	429.41	418.62	414.67	(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]													
	843.43	816.12	740.27	614.24	469.92	312.61	209.48	219.02	340.50	519.94	690.86	835.56	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	303.72	221.36	149.93	44.92	6.01	0.00	0.00	0.00	0.00	67.35	196.02	313.15	

∑(98)1...5, 10...12 = 1302.45 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 17.60 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1302.45		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	17.32	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1714.94	(307b)

Water heating

Annual water heating requirement	1733.69		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	23.06	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2282.75	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	40.38	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	169.28		(330a)
Total electricity for the above, kWh/year		169.28	(331)
Electricity for lighting (Appendix L)		325.04	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4532.37	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	17.32	x	4.24	x 0.01 =	0.73	(340a)
Space heating from heat pump	1714.94	x	4.24	x 0.01 =	72.71	(340b)
Water heating from boilers	23.06	x	4.24	x 0.01 =	0.98	(342a)
Water heating from heat pump	2282.75	x	4.24	x 0.01 =	96.79	(342b)
Pumps and fans	169.28	x	13.19	x 0.01 =	22.33	(349)
Electricity for lighting	325.04	x	13.19	x 0.01 =	42.87	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		356.41	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.26	(357)
SAP value	82.45	
SAP rating (section 13)	82	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	45.12	x	0.216	=	9.75	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1142.19	x	0.519	=	592.80	(368)
Electrical energy for community heat distribution	40.38	x	0.519	=	20.96	(372)
Total CO2 associated with community systems					623.50	(373)
Total CO2 associated with space and water heating					623.50	(376)
Pumps and fans	169.28	x	0.519	=	87.85	(378)
Electricity for lighting	325.04	x	0.519	=	168.69	(379)
Total CO_2, kg/year				(376)..(382) =	880.05	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.89	(384)
EI value					90.09	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	45.12	x	1.22	=	55.04	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1142.19	x	3.07	=	3506.54	(368)
Electrical energy for community heat distribution	40.38	x	3.07	=	123.97	(372)
Total primary energy associated with community systems					3685.55	(373)
Total primary energy associated with space and water heating					3685.55	(376)
Pumps and fans	169.28	x	3.07	=	519.67	(378)
Electricity for lighting	325.04	x	3.07	=	997.86	(379)
Primary energy kWh/year					5203.09	(383)
Dwelling primary energy rate kWh/m2/year					70.31	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	3B4P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.42	(1a) x	2.50	(2a) =	181.05	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.42	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	181.05	(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		0	x 10 = 0	(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) =	0	÷ (5) = 0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(24a)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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	
Window			15.02	x	1.24	=	18.56			(27)
Door			1.80	x	0.70	=	1.26			(26)
External wall			30.08	x	0.17	=	5.11			(29a)
Party wall			32.93	x	0.00	=	0.00			(32)
External wall			10.38	x	0.20	=	2.08			(29a)
Roof			72.42	x	0.13	=	9.41			(30)
Total area of external elements ∑A, m²			129.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	36.43 (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		12.44 (36)
Total fabric heat loss	(33) + (36) =	48.87 (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	
16.99	16.80	16.61	15.65	15.46	14.51	14.51	14.32	14.89	15.46	15.84	16.22	(38)

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

65.85	65.66	65.47	64.52	64.33	63.38	63.38	63.19	63.76	64.33	64.71	65.09	

Average = ∑(39)1...12/12 = 64.47 (39)

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

0.91	0.91	0.90	0.89	0.89	0.88	0.88	0.87	0.88	0.89	0.89	0.90	

Average = ∑(40)1...12/12 = 0.89 (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	2.30	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.91	(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	
97.80	94.24	90.68	87.13	83.57	80.02	80.02	83.57	87.13	90.68	94.24	97.80	

∑(44)1...12 = 1066.87 (44)

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

145.03	126.84	130.89	114.11	109.50	94.49	87.56	100.47	101.67	118.49	129.34	140.45	

∑(45)1...12 = 1398.84 (45)

Distribution loss 0.15 x (45)m

21.75	19.03	19.63	17.12	16.42	14.17	13.13	15.07	15.25	17.77	19.40	21.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	3.42	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13	(54)
Enter (50) or (54) in (55)	0.13	(55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

172.33	151.51	158.20	140.54	136.80	120.91	114.86	127.77	128.09	145.79	155.76	167.76	(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

172.33	151.51	158.20	140.54	136.80	120.91	114.86	127.77	128.09	145.79	155.76	167.76	

∑(64)1...12 = 1720.32 (64)

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

70.07	61.90	65.36	59.08	58.25	52.55	50.96	55.25	54.94	61.24	64.14	68.54	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.15	16.12	13.11	9.93	7.42	6.26	6.77	8.80	11.81	15.00	17.50	18.66	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	202.88	204.98	199.68	188.38	174.13	160.73	151.78	149.67	154.98	166.27	180.53	193.93	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	(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)	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	(71)
Water heating gains (Table 5)	94.17	92.12	87.86	82.06	78.29	72.99	68.49	74.26	76.31	82.31	89.09	92.13	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	372.76	370.78	358.20	337.92	317.39	297.54	284.59	290.28	300.65	321.13	344.67	362.26	(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	10.54	x	19.64	x 0.9 x	0.45	x	0.70	=	45.19	(80)
South	0.77	x	4.48	x	46.75	x 0.9 x	0.45	x	0.70	=	45.72	(78)

Solar gains in watts ∑(74)m...(82)m

90.91	163.28	240.97	320.13	372.55	374.48	359.22	320.42	268.96	185.66	110.54	76.67	(83)

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

463.67	534.06	599.16	658.05	689.94	672.02	643.81	610.70	569.61	506.79	455.21	438.93	(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)													
	1.00	0.99	0.98	0.92	0.79	0.59	0.43	0.47	0.73	0.95	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.14	20.28	20.51	20.76	20.93	20.99	21.00	21.00	20.97	20.74	20.39	20.11	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.16	20.16	20.16	20.18	20.18	20.19	20.19	20.19	20.18	20.18	20.17	20.17	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.97	0.90	0.74	0.52	0.35	0.39	0.66	0.93	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.00	19.22	19.54	19.91	20.11	20.18	20.19	20.19	20.16	19.89	19.39	18.97	(90)

Living area fraction — Living area ÷ (4) = 0.38 (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													
	19.43	19.62	19.90	20.23	20.42	20.49	20.49	20.49	20.46	20.21	19.76	19.40	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.43	19.62	19.90	20.23	20.42	20.49	20.49	20.49	20.46	20.21	19.76	19.40	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.99	0.99	0.97	0.90	0.76	0.55	0.38	0.42	0.69	0.93	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	461.31	527.58	579.47	593.51	523.53	368.87	246.32	257.97	390.45	471.88	449.78	437.28	(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]													
	996.17	966.53	877.50	730.87	560.91	373.02	246.69	258.64	405.71	618.19	819.39	989.23	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	397.94	294.98	221.73	98.90	27.82	0.00	0.00	0.00	0.00	108.86	266.12	410.65	

∑(98)1...5, 10...12 = 1827.00 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 25.23 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1827.00		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	24.30	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	2405.61	(307b)

Water heating

Annual water heating requirement	1720.32		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	22.88	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2265.14	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	47.18	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	146.33		(330a)
Total electricity for the above, kWh/year		146.33	(331)
Electricity for lighting (Appendix L)		320.59	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5184.85	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	24.30	x	4.24	x 0.01 =	1.03	(340a)
Space heating from heat pump	2405.61	x	4.24	x 0.01 =	102.00	(340b)
Water heating from boilers	22.88	x	4.24	x 0.01 =	0.97	(342a)
Water heating from heat pump	2265.14	x	4.24	x 0.01 =	96.04	(342b)
Pumps and fans	146.33	x	13.19	x 0.01 =	19.30	(349)
Electricity for lighting	320.59	x	13.19	x 0.01 =	42.29	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		381.63	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.37	(357)
SAP value	80.96	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	52.71	x	0.216	=	11.39	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1334.50	x	0.519	=	692.61	(368)
Electrical energy for community heat distribution	47.18	x	0.519	=	24.49	(372)
Total CO2 associated with community systems					728.48	(373)
Total CO2 associated with space and water heating					728.48	(376)
Pumps and fans	146.33	x	0.519	=	75.95	(378)
Electricity for lighting	320.59	x	0.519	=	166.39	(379)
Total CO_2, kg/year				(376)..(382) =	970.81	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	13.41	(384)
EI value					88.92	
EI rating (section 14)					89	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	52.71	x	1.22	=	64.31	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1334.50	x	3.07	=	4096.91	(368)
Electrical energy for community heat distribution	47.18	x	3.07	=	144.84	(372)
Total primary energy associated with community systems					4306.07	(373)
Total primary energy associated with space and water heating					4306.07	(376)
Pumps and fans	146.33	x	3.07	=	449.24	(378)
Electricity for lighting	320.59	x	3.07	=	984.22	(379)
Primary energy kWh/year					5739.53	(383)
Dwelling primary energy rate kWh/m2/year					79.25	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	3B5P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		104.07	(1a) x	2.50	(2a) =	260.18	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	104.07	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	260.18	(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		0	x 10 = 0	(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) =	0	÷ (5) = 0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	74.80	(23c)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(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	
Window			18.08	x	1.24	=	22.34			(27)
Door			1.80	x	1.30	=	2.34			(26)
Ground floor			104.07	x	0.10	=	10.41			(28a)
External wall			38.90	x	0.17	=	6.61			(29a)
Party wall			24.13	x	0.00	=	0.00			(32)
External wall			26.50	x	0.20	=	5.30			(29a)
Total area of external elements ∑A, m²			189.35							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	47.00 (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		13.64 (36)
Total fabric heat loss	(33) + (36) =	60.64 (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)													
	24.78	24.50	24.23	22.86	22.59	21.22	21.22	20.94	21.76	22.59	23.13	23.68	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	85.42	85.14	84.87	83.50	83.23	81.86	81.86	81.58	82.41	83.23	83.77	84.32	
Average = ∑(39)1...12/12 =												83.43	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	0.82	0.82	0.82	0.80	0.80	0.79	0.79	0.78	0.79	0.80	0.80	0.81	
Average = ∑(40)1...12/12 =												0.80	(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	2.77 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	100.09 (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)													
	110.09	106.09	102.09	98.08	94.08	90.08	90.08	94.08	98.08	102.09	106.09	110.09	
∑(44)1...12 =												1201.03	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	163.27	142.79	147.35	128.46	123.26	106.37	98.57	113.11	114.46	133.39	145.60	158.12	
∑(45)1...12 =												1574.74	(45)
Distribution loss 0.15 x (45)m													
	24.49	21.42	22.10	19.27	18.49	15.96	14.78	16.97	17.17	20.01	21.84	23.72	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00 (47)
Water storage loss:	
b) Manufacturer's declared loss factor is not known	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)
Enter (50) or (54) in (55)	0.13 (55)
Water storage loss calculated for each month (55) x (41)m	

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

190.57	167.46	174.65	154.89	150.57	132.79	125.87	140.41	140.88	160.69	172.03	185.42	(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

190.57	167.46	174.65	154.89	150.57	132.79	125.87	140.41	140.88	160.69	172.03	185.42	

∑(64)1...12 = 1896.22 (64)

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

76.13	67.21	70.84	63.85	62.83	56.51	54.62	59.45	59.19	66.19	69.55	74.42	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.07	21.38	17.38	13.16	9.84	8.31	8.97	11.66	15.66	19.88	23.20	24.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.74	265.47	258.60	243.97	225.51	208.16	196.56	193.84	200.71	215.33	233.80	251.15	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	(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)	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	(71)
Water heating gains (Table 5)	102.32	100.01	95.21	88.68	84.45	78.48	73.41	79.91	82.22	88.97	96.60	100.02	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	453.75	451.47	435.81	410.43	384.41	359.55	343.56	350.02	363.19	388.80	418.21	440.52	(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	6.86	x	10.63	x 0.9 x	0.45	x	0.70	=	15.92	(74)
NorthEast	0.77	x	2.18	x	11.28	x 0.9 x	0.45	x	0.70	=	5.37	(75)
East	0.77	x	6.78	x	19.64	x 0.9 x	0.45	x	0.70	=	29.07	(76)
SouthEast	0.77	x	2.26	x	36.79	x 0.9 x	0.45	x	0.70	=	18.15	(77)

Solar gains in watts ∑(74)m...(82)m

68.51	129.14	207.35	304.39	381.45	395.76	374.51	314.91	240.89	151.23	84.39	57.10	(83)

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

522.26	580.61	643.16	714.82	765.86	755.31	718.06	664.93	604.08	540.02	502.60	497.62	(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)	1.00	1.00	0.99	0.97	0.88	0.68	0.50	0.56	0.84	0.98	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.13	20.24	20.43	20.69	20.90	20.99	21.00	21.00	20.94	20.68	20.36	20.12	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.24	20.24	20.24	20.25	20.25	20.26	20.26	20.27	20.26	20.25	20.25	20.24	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	0.99	0.96	0.84	0.61	0.42	0.47	0.79	0.98	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	19.06	19.22	19.50	19.88	20.15	20.26	20.26	20.27	20.21	19.86	19.40	19.04	(90)

Living area fraction | Living area ÷ (4) = | 0.32 | (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.40	19.54	19.80	20.14	20.39	20.49	20.50	20.50	20.45	20.12	19.71	19.38	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.40	19.54	19.80	20.14	20.39	20.49	20.50	20.50	20.45	20.12	19.71	19.38	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	0.99	0.96	0.85	0.63	0.44	0.50	0.80	0.98	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	521.49	578.70	636.59	684.18	647.54	473.96	318.52	333.02	484.39	526.64	500.84	497.08	(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]	1289.74	1246.75	1128.37	938.66	723.49	482.13	319.18	334.48	523.04	792.69	1056.33	1280.28	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	571.57	448.93	365.88	183.23	56.51	0.00	0.00	0.00	0.00	197.94	399.95	582.70	

∑(98)1...5, 10...12 = | 2806.71 | (98)

Space heating requirement kWh/m²/year | (98) ÷ (4) | 26.97 | (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement | 2806.71 | (98)

Space heat from boilers | (98) x (304a) x (305) x (306) = | 37.33 | (307a)

Space heat from heat pump	(98) x (304b) x (305) x (306) =	3695.60	(307b)

Water heating

Annual water heating requirement	1896.22		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	25.22	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2496.75	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	62.55	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	238.06		(330a)
Total electricity for the above, kWh/year		238.06	(331)
Electricity for lighting (Appendix L)		425.01	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	6917.97	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	37.33	x	4.24	x 0.01 =	1.58	(340a)
Space heating from heat pump	3695.60	x	4.24	x 0.01 =	156.69	(340b)
Water heating from boilers	25.22	x	4.24	x 0.01 =	1.07	(342a)
Water heating from heat pump	2496.75	x	4.24	x 0.01 =	105.86	(342b)
Pumps and fans	238.06	x	13.19	x 0.01 =	31.40	(349)
Electricity for lighting	425.01	x	13.19	x 0.01 =	56.06	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		472.67	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.33	(357)
SAP value	81.42	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	69.89	x	0.216	=	15.10	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1769.24	x	0.519	=	918.24	(368)
Electrical energy for community heat distribution	62.55	x	0.519	=	32.46	(372)
Total CO2 associated with community systems					965.80	(373)
Total CO2 associated with space and water heating					965.80	(376)
Pumps and fans	238.06	x	0.519	=	123.55	(378)
Electricity for lighting	425.01	x	0.519	=	220.58	(379)
Total CO_2, kg/year				(376)..(382) =	1309.93	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.59	(384)
EI value					88.22	

EI rating (section 14)	88	(385)
EI band	B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	69.89	x	1.22	=	85.26	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1769.24	x	3.07	=	5431.57	(368)
Electrical energy for community heat distribution	62.55	x	3.07	=	192.03	(372)
Total primary energy associated with community systems					5708.86	(373)
Total primary energy associated with space and water heating					5708.86	(376)
Pumps and fans	238.06	x	3.07	=	730.84	(378)
Electricity for lighting	425.01	x	3.07	=	1304.79	(379)
Primary energy kWh/year					7744.49	(383)
Dwelling primary energy rate kWh/m2/year					74.42	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	3B6P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		94.73	(1a) x	2.50	(2a) =	236.83	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	94.73	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	236.83	(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		0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	74.80	(23c)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(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	
Window			14.86	x	1.24	=	18.36			(27)
Door			1.80	x	0.60	=	1.08			(26)
External wall			36.28	x	0.17	=	6.17			(29a)
Party wall			15.15	x	0.00	=	0.00			(32)
External wall			34.68	x	0.20	=	6.94			(29a)
Roof			94.73	x	0.13	=	12.31			(30)
Total area of external elements ∑A, m²			182.35							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	44.86 (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		14.02 (36)
Total fabric heat loss	(33) + (36) =	58.88 (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	
22.55	22.30	22.05	20.81	20.56	19.31	19.31	19.06	19.81	20.56	21.06	21.56	(38)

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

81.44	81.19	80.94	79.69	79.44	78.20	78.20	77.95	78.70	79.44	79.94	80.44	

Average = ∑(39)1...12/12 = 79.63 (39)

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

0.86	0.86	0.85	0.84	0.84	0.83	0.83	0.82	0.83	0.84	0.84	0.85	

Average = ∑(40)1...12/12 = 0.84 (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	2.69	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	97.97	(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	
107.77	103.85	99.93	96.01	92.09	88.17	88.17	92.09	96.01	99.93	103.85	107.77	

∑(44)1...12 = 1175.65 (44)

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

159.82	139.78	144.24	125.75	120.66	104.12	96.48	110.72	112.04	130.57	142.53	154.77	

∑(45)1...12 = 1541.46 (45)

Distribution loss 0.15 x (45)m

23.97	20.97	21.64	18.86	18.10	15.62	14.47	16.61	16.81	19.59	21.38	23.22	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	3.42	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13	(54)
Enter (50) or (54) in (55)	0.13	(55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

187.12	164.44	171.54	152.17	147.96	130.54	123.79	138.02	138.46	157.87	168.95	182.08	(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

187.12	164.44	171.54	152.17	147.96	130.54	123.79	138.02	138.46	157.87	168.95	182.08	

∑(64)1...12 = 1862.94 (64)

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

74.98	66.20	69.80	62.95	61.96	55.76	53.92	58.66	58.39	65.26	68.53	73.31	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.11	20.53	16.69	12.64	9.45	7.98	8.62	11.20	15.04	19.09	22.28	23.75	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.52	250.08	243.61	229.83	212.44	196.09	185.17	182.60	189.08	202.85	220.25	236.59	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	(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)	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	(71)
Water heating gains (Table 5)	100.78	98.52	93.82	87.43	83.28	77.44	72.48	78.84	81.10	87.71	95.18	98.53	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	434.69	432.41	417.40	393.18	368.45	344.79	329.54	335.92	348.49	372.93	400.98	422.15	(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	10.44	x	19.64	x 0.9 x	0.45	x	0.70	=	44.76	(76)
South	0.77	x	4.42	x	46.75	x 0.9 x	0.45	x	0.70	=	45.11	(78)

Solar gains in watts ∑(74)m...(82)m

89.87	161.44	238.31	316.67	368.57	370.50	355.40	316.98	266.02	183.58	109.28	75.79	(83)

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

524.56	593.85	655.71	709.85	737.02	715.29	684.95	652.90	614.50	556.51	510.27	497.94	(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)													
	1.00	1.00	0.99	0.96	0.87	0.68	0.50	0.54	0.81	0.97	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.12	20.25	20.45	20.70	20.90	20.98	21.00	21.00	20.95	20.70	20.37	20.10	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.20	20.20	20.21	20.22	20.22	20.23	20.23	20.23	20.23	20.22	20.22	20.21	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	1.00	0.99	0.95	0.83	0.61	0.41	0.46	0.74	0.96	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.02	19.20	19.50	19.86	20.12	20.22	20.23	20.23	20.19	19.87	19.38	19.00	(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

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

19.38	19.55	19.81	20.14	20.37	20.47	20.48	20.48	20.44	20.14	19.71	19.36	(92)

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

19.38	19.55	19.81	20.14	20.37	20.47	20.48	20.48	20.44	20.14	19.71	19.36	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	1.00	0.99	0.98	0.94	0.84	0.63	0.44	0.49	0.76	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	523.24	590.34	644.84	670.52	616.23	450.06	302.87	316.93	468.83	534.66	507.20	497.03	(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]													
	1228.32	1189.33	1077.28	895.73	689.03	459.16	303.66	318.33	498.88	758.06	1007.88	1219.55	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	524.58	402.52	321.74	162.15	54.16	0.00	0.00	0.00	0.00	166.21	360.49	537.56	

∑(98)1...5, 10...12 = 2529.40 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 26.70 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	2529.40		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	33.64	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	3330.46	(307b)

Water heating

Annual water heating requirement	1862.94		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	24.78	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2452.94	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	58.42	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	216.69		(330a)
Total electricity for the above, kWh/year		216.69	(331)
Electricity for lighting (Appendix L)		408.17	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	6466.68	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	33.64	x	4.24	x 0.01 =	1.43	(340a)
Space heating from heat pump	3330.46	x	4.24	x 0.01 =	141.21	(340b)
Water heating from boilers	24.78	x	4.24	x 0.01 =	1.05	(342a)
Water heating from heat pump	2452.94	x	4.24	x 0.01 =	104.00	(342b)
Pumps and fans	216.69	x	13.19	x 0.01 =	28.58	(349)
Electricity for lighting	408.17	x	13.19	x 0.01 =	53.84	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		450.11	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.35	(357)
SAP value	81.13	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	65.27	x	0.216	=	14.10	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1652.40	x	0.519	=	857.60	(368)
Electrical energy for community heat distribution	58.42	x	0.519	=	30.32	(372)
Total CO2 associated with community systems					902.01	(373)
Total CO2 associated with space and water heating					902.01	(376)
Pumps and fans	216.69	x	0.519	=	112.46	(378)
Electricity for lighting	408.17	x	0.519	=	211.84	(379)
Total CO_2, kg/year				(376)..(382) =	1226.32	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.95	(384)
EI value					88.24	
EI rating (section 14)					88	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	65.27	x	1.22	=	79.63	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1652.40	x	3.07	=	5072.87	(368)
Electrical energy for community heat distribution	58.42	x	3.07	=	179.34	(372)
Total primary energy associated with community systems					5331.84	(373)
Total primary energy associated with space and water heating					5331.84	(376)
Pumps and fans	216.69	x	3.07	=	665.25	(378)
Electricity for lighting	408.17	x	3.07	=	1253.08	(379)
Primary energy kWh/year					7250.18	(383)
Dwelling primary energy rate kWh/m2/year					76.54	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	23/10/2020
Address	4B8P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		72.24	(1a)	x	2.50	(2a)	=	180.60	(3a)
+1		57.20	(1b)	x	2.50	(2b)	=	143.00	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	129.44	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	323.60	(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	0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	73.10	(23c)

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

	0.30	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(24a)

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

0.30	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28 (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	
Window			23.72	x	1.24	=	29.31			(27)
Door			1.80	x	1.30	=	2.34			(26)
Ground floor			72.24	x	0.10	=	7.22			(28a)
External wall			64.31	x	0.17	=	10.93			(29a)
Party wall			79.95	x	0.00	=	0.00			(32)
Roof			15.04	x	0.13	=	1.96			(30)
Roof			2.58	x	0.16	=	0.41			(30)
Total area of external elements ∑A, m²			179.69							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	52.18 (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		14.96 (36)
Total fabric heat loss	(33) + (36) =	67.14 (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)													
	31.72	31.38	31.04	29.34	29.00	27.30	27.30	26.96	27.98	29.00	29.68	30.36	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	98.86	98.52	98.18	96.48	96.14	94.43	94.43	94.09	95.11	96.14	96.82	97.50	
Average = ∑(39)1...12/12 =												96.39	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	0.76	0.76	0.76	0.75	0.74	0.73	0.73	0.73	0.73	0.74	0.75	0.75	
Average = ∑(40)1...12/12 =												0.74	(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	2.89 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	102.92 (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)													
	113.21	109.10	104.98	100.86	96.75	92.63	92.63	96.75	100.86	104.98	109.10	113.21	
∑(44)1...12 =												1235.05	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	167.89	146.84	151.53	132.10	126.76	109.38	101.36	116.31	117.70	137.17	149.73	162.59	
∑(45)1...12 =												1619.35	(45)
Distribution loss 0.15 x (45)m													
	25.18	22.03	22.73	19.82	19.01	16.41	15.20	17.45	17.65	20.57	22.46	24.39	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00 (47)
Water storage loss:	
b) Manufacturer's declared loss factor is not known	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)

Enter (50) or (54) in (55) | 0.13 | (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04 (56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04 (57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (59)

Combi loss 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

195.20	171.50	178.83	158.53	154.06	135.80	128.66	143.61	144.12	164.47	176.15	189.90 (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

195.20	171.50	178.83	158.53	154.06	135.80	128.66	143.61	144.12	164.47	176.15	189.90

∑(64)1...12 = 1940.83 (64)

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

77.67	68.55	72.22	65.06	63.99	57.51	55.54	60.52	60.27	67.45	70.92	75.91 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.97	23.96	19.48	14.75	11.03	9.31	10.06	13.07	17.55	22.28	26.00	27.72	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.04	300.13	292.36	275.82	254.95	235.33	222.22	219.14	226.91	243.45	264.32	283.94	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	(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)	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	(71)
Water heating gains (Table 5)	104.39	102.01	97.08	90.36	86.01	79.87	74.66	81.34	83.71	90.66	98.50	102.02	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	494.81	492.50	475.32	447.34	418.38	390.91	373.34	379.96	394.57	422.79	455.23	480.09	(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	
South	0.77	x	9.04	x	46.75	x 0.9 x	0.50	x	0.70	=	102.51	(78)
East	0.77	x	10.68	x	19.64	x 0.9 x	0.45	x	0.70	=	45.79	(76)
SouthEast	0.77	x	4.00	x	36.79	x 0.9 x	0.50	x	0.70	=	35.70	(77)

Solar gains in watts ∑(74)m...(82)m

184.00	318.27	444.57	559.93	631.00	626.93	604.31	552.00	485.05	354.57	221.36	156.78 (83)

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

678.81	810.77	919.89	1007.27	1049.38	1017.84	977.65	931.96	879.62	777.36	676.59	636.87 (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)	1.00	1.00	0.98	0.93	0.80	0.59	0.42	0.46	0.72	0.96	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.24	20.39	20.59	20.82	20.96	21.00	21.00	21.00	20.98	20.80	20.47	20.22	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.28	20.29	20.29	20.30	20.30	20.31	20.31	20.32	20.31	20.30	20.30	20.29	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.98	0.91	0.75	0.53	0.36	0.40	0.66	0.94	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	19.25	19.48	19.77	20.09	20.26	20.31	20.31	20.32	20.30	20.07	19.61	19.23	(90)

Living area fraction | Living area ÷ (4) = | 0.30 | (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.55	19.75	20.02	20.31	20.47	20.52	20.52	20.52	20.50	20.29	19.87	19.52	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.55	19.75	20.02	20.31	20.47	20.52	20.52	20.52	20.50	20.29	19.87	19.52	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.98	0.91	0.76	0.55	0.38	0.42	0.68	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	677.47	805.20	897.89	920.24	802.43	555.80	370.14	387.58	595.71	732.56	672.54	636.04	(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]	1507.74	1463.21	1327.29	1101.17	843.21	558.90	370.32	387.94	609.16	931.85	1236.13	1494.12	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	617.72	442.19	319.47	130.26	30.34	0.00	0.00	0.00	0.00	148.28	405.78	638.41	

∑(98)1...5, 10...12 = | 2732.45 | (98)

Space heating requirement kWh/m²/year | (98) ÷ (4) | 21.11 | (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement | 2732.45 | (98)

Space heat from boilers | (98) x (304a) x (305) x (306) = | 36.34 | (307a)

Space heat from heat pump	(98) x (304b) x (305) x (306) =	3597.81	(307b)

Water heating

Annual water heating requirement	1940.83		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	25.81	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2555.49	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	62.15	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	350.38		(330a)
Total electricity for the above, kWh/year		350.38	(331)
Electricity for lighting (Appendix L)		476.33	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	7042.17	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	36.34	x	4.24	x 0.01 =	1.54	(340a)
Space heating from heat pump	3597.81	x	4.24	x 0.01 =	152.55	(340b)
Water heating from boilers	25.81	x	4.24	x 0.01 =	1.09	(342a)
Water heating from heat pump	2555.49	x	4.24	x 0.01 =	108.35	(342b)
Pumps and fans	350.38	x	13.19	x 0.01 =	46.21	(349)
Electricity for lighting	476.33	x	13.19	x 0.01 =	62.83	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		492.58	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.19	(357)
SAP value	83.46	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

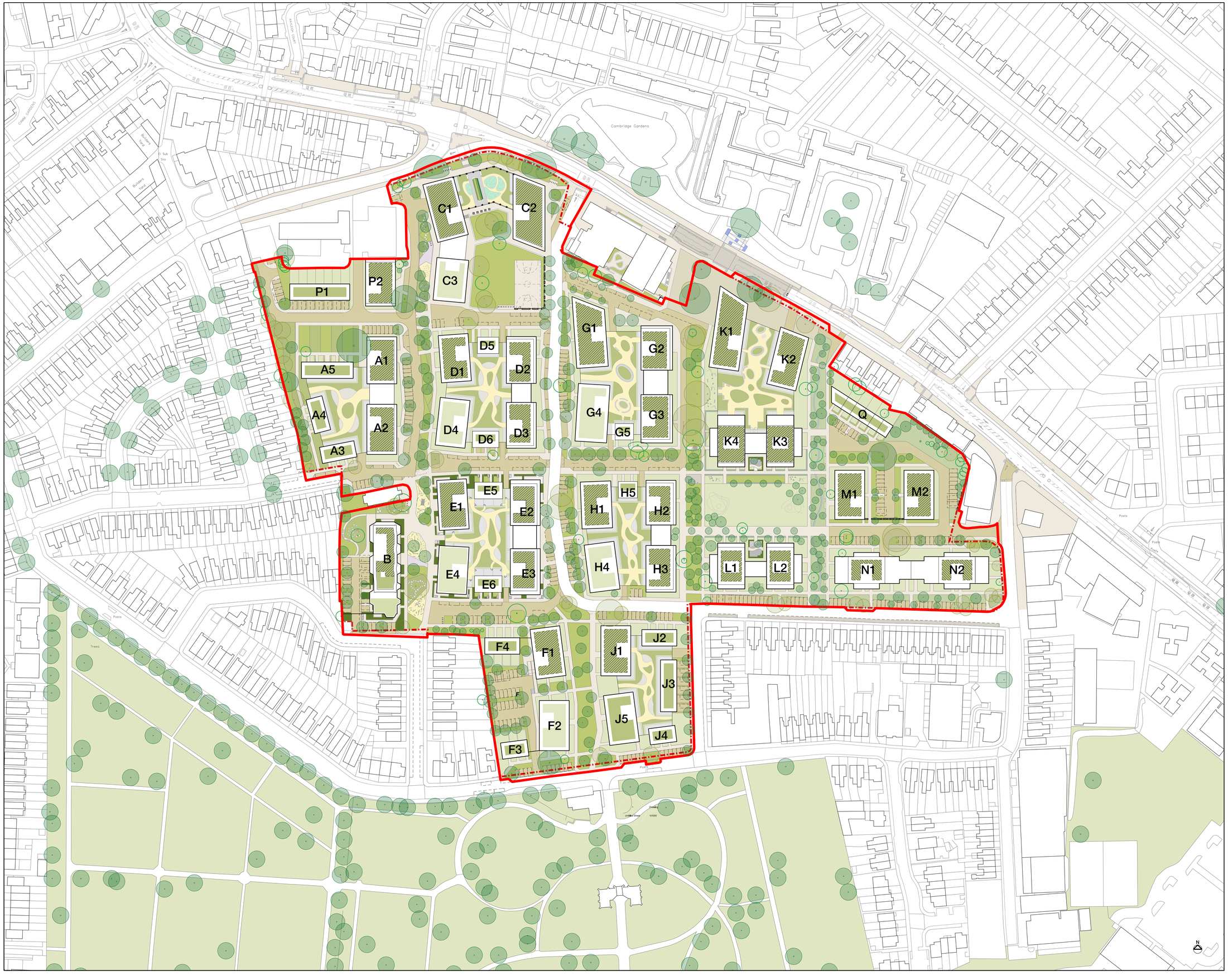
	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	69.45	x	0.216	=	15.00	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1758.09	x	0.519	=	912.45	(368)
Electrical energy for community heat distribution	62.15	x	0.519	=	32.26	(372)
Total CO2 associated with community systems					959.71	(373)
Total CO2 associated with space and water heating					959.71	(376)
Pumps and fans	350.38	x	0.519	=	181.85	(378)
Electricity for lighting	476.33	x	0.519	=	247.22	(379)
Total CO_2, kg/year				(376)..(382) =	1388.77	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.73	(384)
EI value					89.33	

EI rating (section 14)	89	(385)
EI band	B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	69.45	x	1.22	=	84.72	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1758.09	x	3.07	=	5397.32	(368)
Electrical energy for community heat distribution	62.15	x	3.07	=	190.81	(372)
Total primary energy associated with community systems					5672.86	(373)
Total primary energy associated with space and water heating					5672.86	(376)
Pumps and fans	350.38	x	3.07	=	1075.66	(378)
Electricity for lighting	476.33	x	3.07	=	1462.34	(379)
Primary energy kWh/year					8210.87	(383)
Dwelling primary energy rate kWh/m2/year					63.43	(384)

Appendix L Indicative PV Locations



General Notes

DO NOT SCALE. All dimensions must be checked on site, errors are to be reported.

Contractors must ensure that cross referenced drawings and specifications noted on these drawings are checked on a regular basis to ensure that the latest revisions are used.

Key Plan

Client
Countryside
Aurora House
71 – 75 Uxbridge Road
London W5 5SL

Architect
Patel Taylor
48 Rawstorne Street
London
EC1V 7ND

Site Boundary

- Title boundary
- Planning boundary
- Phase 1 boundary

PV panels

Scale 1:1000 @ A1

0 10m 25m 50m 75m

Issue Record		By	Chk	Date
P01	For information	EP	NE	21.10.2020

Title
Proposed masterplan
Roof plan

Project
Cambridge Road

Scale
1:1000 @ A1 1:2000 @ A3

Status
For information

Drawing Number **Revision**
503-PTA-MP-RF-DR-A-1244 **P01**

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Patel Taylor

Appendix M BREEAM ENE 04 review

Feasibility Study Table

Technology	Sufficient Energy Generated?	Payback	Land Use Issues	Local Planning Requirements	Noise	Ability for exporting heat or electricity	Carbon Payback	Available Grants	Feasible	Reason not Feasible or Selected
Combined Heat & Power (CHP)	No	Medium	Air quality in residential area	Encouraged for large scale developments	In Plant Room	Plant would be sized for development so no heat export. Electricity generation would be used onsite.	Yes	Tax Relief - ECA, RHI	No	Not selected because it is not policy compliant technology.
Biomass	Yes	None	Air quality in residential area	Encouraged for large scale developments	In Plant Room	Plant would be sized for development so no heat export.	Yes	RHI; Bio-energy Capital Grants Scheme	No	Not selected due to air quality concerns
Solar Thermal	Yes	Long period	Sufficient roof space required	Encouraged	None	Insufficent heat generated for export	~2 years	RHI	Yes	Not selected because PV has been preferred.
Solar Photovoltaic (PV)	Yes	Circa 20 years	Sufficient roof space required	Encouraged	None	Generated electricity expected to be used onsite.	2-5 years	FiT longer available since March 2019.	Yes	Selected and 265 kWp specified for the development
Air Source Heat Pumps (ASHPs)	Yes	Long term	Visual intrusion of external units	Encouraged	Depends on location, can be high	Plant would be sized for development so no heat export.	No	RHI only until 2022	Yes	Not selected as offsite heat utilised as a priority.
Ground Source Heat Pumps (GSHPs)	Yes	Long term	Requires large area for coils or borehole	Encouraged	Depends on location, can be medium	Plant would be sized for development so no heat export.	No	RHI only until 2022	No	Not selected due to complexity and high cost associated with the ground excavation work.
Water Source Heat Pumps (WSHPs)	Yes	Long term	Requires large area for coils or abstration rates (suitable water resource)	Encouraged	Depends on location, can be medium	Plant would be sized for development so no heat export.	No	RHI only until 2022	No	Not selected as no water running through development.
Wind Power	No	Long term	Urban Area - low and turbulent wind; Visual impact	Encouraged for large scale developments	Yes	Insufficient energy produced for export	~1 year	N/A	No	Not selected due to insufficient wind speeds in area
Hydro Power	No	Medium	Requires suitable water resource; Visual impact	None	Low	Insufficient energy produced for export	~1 year	N/A	No	Not selected due to no nearby sources
Energy storage - Battery	No	None	Requries space and sufficient ventilation	None	Low	Insufficient energy produced for export	Depends on source	No	No	Not selected due to lack of payback.

RHI - Renewable Heat Incentive
FiT - Feed in Tariff

Appendix N CO_2 Emissions Summary – *Be Green*

The applicant should complete all the light blue cells including information on the 'be green' energy consumption figures and the 'be green' DER.

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m^2)	Number of units	Total area represented by model (m^2)	VALIDATION CHECK: Calculated DER 2012 (kgCO2 / m2)	VALIDATION CHECK: DER Worksheet DER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE GREEN' SAP DER WORKSHEET: Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space Heating (Heat source 2) if applicable	Fuel type Space Heating	Domestic Hot Water (Heat source 2) if applicable	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP if applicable	Fuel type CHP if applicable	Total Electricity generated by CHP (-) if applicable	Electricity generated by renewable (-) if applicable	Lighting	Auxiliary	Cooling
				DER Sheet (Row 384)		DER Sheet (Row 307b + (Row 367b x 0.01)]	Select fuel type	DER Sheet (Row 310b + (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 307c + (Row 367c x 0.01)]	Select fuel type	DER Sheet [(Row 310c + (Row 367c x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) + (Row 362 x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) × (Row 361 + 362)]	DER Sheet Row 380	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
1B2P - Ground Flo	51.12	17	869.04	13.7	13.7	18.60502793	Natural Gas	22.34201117	Natural Gas	470.9895714	Grid Electricity	565.6039714	Grid Electricity		Grid Electricity		-91.26	246.61	139.9376	
1B2P - Mid Floor	50.88	131	6665.28	12.7	12.7	14.66335196	Natural Gas	22.3027933	Natural Gas	371.2132286	Grid Electricity	564.6111429	Grid Electricity		Grid Electricity		-91.26	247.99	135.8947	
1B2P - Top Floor B	50.32	17	855.44	13.2	13.2	16.34122905	Natural Gas	22.21106145	Natural Gas	413.6898857	Grid Electricity	562.2888857	Grid Electricity		Grid Electricity		-91.26	244.38	136.1843	
2B3P - Top Floor B	64.62	53	3424.86	15.5	15.5	34.91698324	Natural Gas	24.48379888	Natural Gas	883.9483714	Grid Electricity	619.8248571	Grid Electricity		Grid Electricity		-91.26	290.37	200.9837	
2B4P - Mid Floor	73.74	106	7816.44	11.5	11.5	21.03877095	Natural Gas	25.73094972	Natural Gas	532.6115143	Grid Electricity	651.3973714	Grid Electricity		Grid Electricity		-91.26	325.11	190.8589	
2B4P - Mid Floor B	74	106	7844	11.3	11.3	19.35486034	Natural Gas	25.76312849	Natural Gas	489.9821143	Grid Electricity	652.212	Grid Electricity		Grid Electricity		-91.26	325.04	209.6606	
3B4P - Top Floor	72.42	4	289.68	12.8	12.8	27.1498324	Natural Gas	25.56446927	Natural Gas	687.3174	Grid Electricity	647.1828	Grid Electricity		Grid Electricity		-91.26	320.59	193.5093	
3B5P - Ground Flo	104.07	4	416.28	12.1	12.1	41.70871508	Natural Gas	28.17843575	Natural Gas	1055.885914	Grid Electricity	713.3572286	Grid Electricity		Grid Electricity		-91.26	425.01	300.609	
3B6P - Top Floor	94.73	7	663.11	12.4	12.4	37.58782123	Natural Gas	27.68391061	Natural Gas	951.5625429	Grid Electricity	700.8379714	Grid Electricity		Grid Electricity		-91.26	408.17	275.1082	
4P3P - Duplex	129.44	7	906.08	10.5	10.5	41.91553073	Natural Gas	28.84134078	Natural Gas	1061.1216	Grid Electricity	730.1391429	Grid Electricity		Grid Electricity		-91.26	476.33	413.7074	
Sum	29,750	452	29,750	12.3	-	9,479	N/A	11,046	N/A	0	N/A	279,631	N/A	0	N/A	0	-41,250	134,313	82,402	0

REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.): Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Electricity generated by renewable if applicable	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)
248	298	0		-47	128	73		700
196	298	0		-47	129	71		646
218	297	0		-47	127	71		665
466	327	0		-47	151	104		1,001
281	344	0		-47	169	99		845
258	344	0		-47	169	109		833
363	341	0		-47	166	100		923
557	376	0		-47	221	156		1,263
502	370	0		-47	212	143		1,179
560	385	0		-47	247	215		1,360
126,594	147,514	0	0	-21,409	69,708	42,766	0	*365,175*

REGULATED CO2 EMISSIONS PER UNIT: Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Electricity generated by renewable if applicable	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
114	136	0		-21	57	33		319	6.2
90	136	0		-21	58	32		294	5.8
100	136	0		-21	57	32		303	6.0
213	150	0		-21	68	47		456	7.1
129	157	0		-21	76	44		385	5.2
118	157	0		-21	76	49		379	5.1
166	156	0		-21	75	45		421	5.8
255	172	0		-21	99	70		575	5.5
230	169	0		-21	95	64		537	5.7
256	176	0		-21	111	96		618	4.8
57,905	67,474	0	0	-9,611	31,295	19,200	0	*166,262*	5.6

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Area per unit (m^2)	Number of units	Total area represented by model (m^2)	VALIDATION CHECK: Calculated BER 2012 (kgCO2 / m2)	VALIDATION CHECK: BRUKL BER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m^2 p.a.) 'BE GREEN' BER - SOURCE: BRUKL OUTPUT: Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water							Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Lighting	Auxiliary	Cooling
Commercial	1935	1	2474.4	7.7	7.7	2.24	Grid Electricity	0.4	Grid Electricity	N/A	N/A	N/A	N/A	N/A	N/A			7.72	2.23	2.29
Sum	1,935	1	2,474	9.9	-	4,334	N/A	774	N/A							0	0	14,938	4,315	4,431

REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m^2 p.a.) 'BE GREEN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	2012 CO2 emissions (kgCO2 p.a.)
	15							14,943
0	15	0	0	0	0	0	0	*19,109*

REGULATED CO2 EMISSIONS PER UNIT: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	SAP10 CO2 emissions	BRUKL BER SAP10 (kgCO2 / m2)
	15							6,709	3.5
0	15	0	0	0	0	0	0	*8,579*	4.4

SITE-WIDE ENERGY CONSUMPTION AND CO 2 ANALYSIS

Use	Total Area (m^2)	Calculated BER 2012 (kgCO2 / m2)	-	REGULATED CO2 EMISSIONS: Space Heating (kWh p.a.)		Domestic Hot Water (kWh p.a.)		Space Heating (kWh p.a.)		Domestic Hot Water (kWh p.a.)		Space and Domestic Hot Water from CHP (kWh p.a.)		Electricity generated by CHP (kWh p.a.) if applicable	Electricity generated by renewable (kWh p.a.) if applicable	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	32,225	0.0	-	13,814	N/A	11,820	N/A	0	N/A	279,631	N/A	0	N/A	0	-41,250	149,251	86,717	4,431

REGULATED CO2 EMISSIONS: Space Heating CO2 emissions	Domestic Hot Water CO2 emissions	Space Heating and DHW from CHP CO2 emissions if applicable	Electricity generated by CHP CO2 savings if applicable	Electricity generated by renewable CO2 savings if applicable	Lighting CO2 emissions	Auxiliary CO2 emissions	Cooling CO2 emissions	2012 CO2 emissions
126,594	147,529	0	0	-21,409	69,708	42,766	0	*384,284*

REGULATED CO2 EMISSIONS PER UNIT: Space Heating CO2 emissions	Domestic Hot Water CO2 emissions	Space Heating and DHW from CHP CO2 emissions if applicable	Electricity generated by CHP CO2 savings if applicable	Electricity generated by renewable CO2 savings if applicable	Lighting CO2 emissions	Auxiliary CO2 emissions	Cooling CO2 emissions	SAP10 CO2 emissions	Calculated BER SAP10 (kgCO2 / m2)
57,905	67,488	0	0	-9,611	31,295	19,200	0	*174,840*	5.4

The applicant should complete all the light blue cells including information on the 'be green' energy consumption figures and the 'be green' DER.

SAP 2012 CO2 PERFORMANCE

SAP10 CO2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

VALIDATION CHECK

REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE GREEN' SAP DER WORKSHEET

REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)

REGULATED CO2 EMISSIONS PER UNIT

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m^2)	Number of units	Total area represented by model (m^2)	Calculated DER 2012 (kgCO2 / m2)	DER Worksheet DER 2012 (kgCO2 / m2)	Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space Heating (Heat source 2) if applicable	Fuel type Space Heating	Domestic Hot Water (Heat source 2) if applicable	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP if applicable	Fuel type CHP if applicable	Total Electricity generated by CHP (-) if applicable	Electricity generated by renewable (-) if applicable	Lighting	Auxiliary	Cooling
					DER Sheet (Row 384)	DER Sheet [Row 307b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 307c ÷ (Row 367c x 0.01)]	Select fuel type	DER Sheet [Row 310c ÷ (Row 367c x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) ÷ (Row 362 x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) × (Row 361 + 362)]	DER Sheet Row 380	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
1B2P - Ground Flo	51.12	71	869.04	13.7	13.7	18.60502793	Natural Gas	22.34201117	Natural Gas	470.9895714	Grid Electricity	565.6039714	Grid Electricity		Grid Electricity		-91.26	246.61	139.9376	
1B2P - Mid Floor	50.88	566	6665.28	12.7	12.7	14.66335196	Natural Gas	22.3027933	Natural Gas	371.2132286	Grid Electricity	564.6111429	Grid Electricity		Grid Electricity		-91.26	247.99	135.8947	
1B2P - Top Floor B	50.32	71	855.44	13.2	13.2	16.34122905	Natural Gas	22.21106145	Natural Gas	413.6898857	Grid Electricity	562.2888857	Grid Electricity		Grid Electricity		-91.26	244.38	136.1843	
2B3P - Top Floor B	64.62	178	3424.86	15.5	15.5	34.91698324	Natural Gas	24.48379888	Natural Gas	883.9483714	Grid Electricity	619.8248571	Grid Electricity		Grid Electricity		-91.26	290.37	200.9837	
2B4P - Mid Floor	73.74	356	7816.44	11.5	11.5	21.03877095	Natural Gas	25.73094972	Natural Gas	532.6115143	Grid Electricity	651.3973714	Grid Electricity		Grid Electricity		-91.26	325.11	190.8589	
2B4P - Mid Floor B	74	356	7844	11.3	11.3	19.35486034	Natural Gas	25.76312849	Natural Gas	489.9821143	Grid Electricity	652.212	Grid Electricity		Grid Electricity		-91.26	325.04	209.6606	
3B4P - Top Floor	72.42	41	289.68	12.8	12.8	27.1498324	Natural Gas	25.56446927	Natural Gas	687.3174	Grid Electricity	647.1828	Grid Electricity		Grid Electricity		-91.26	320.59	193.5093	
3B5P - Ground Flo	104.07	41	416.28	12.1	12.1	41.70871508	Natural Gas	28.17843575	Natural Gas	1055.885914	Grid Electricity	713.3572286	Grid Electricity		Grid Electricity		-91.26	425.01	300.609	
3B6P - Top Floor	94.73	19	663.11	12.4	12.4	37.58782123	Natural Gas	27.68391061	Natural Gas	951.5625429	Grid Electricity	700.8379714	Grid Electricity		Grid Electricity		-91.26	408.17	275.1082	
4P8P - Duplex	129.44	19	906.08	10.5	10.5	41.91553073	Natural Gas	28.84134078	Natural Gas	1061.1216	Grid Electricity	730.1391429	Grid Electricity		Grid Electricity		-91.26	476.33	413.7074	
Sum	111,593	1,718	29,750	3.3	-	35,710	N/A	41,754	N/A	0	N/A	1,057,035	N/A	0	N/A	0	-156,785	505,737	308,227	0

Unit identifier (e.g. plot number, dwelling type etc.)	Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Electricity generated by renewable if applicable	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)
1B2P - Ground Flo	248	298	0		-47	128	73		700
1B2P - Mid Floor	196	298	0		-47	129	71		646
1B2P - Top Floor B	218	297	0		-47	127	71		665
2B3P - Top Floor B	466	327	0		-47	151	104		1,001
2B4P - Mid Floor	281	344	0		-47	169	99		845
2B4P - Mid Floor B	258	344	0		-47	169	109		833
3B4P - Top Floor	363	341	0		-47	166	100		923
3B5P - Ground Flo	557	376	0		-47	221	156		1,263
3B6P - Top Floor	502	370	0		-47	212	143		1,179
4P8P - Duplex	560	385	0		-47	247	215		1,360
Sum	476,899	557,620	0	0	-81,371	262,477	159,970	0	*365,175*

Unit identifier (e.g. plot number, dwelling type etc.)	Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Electricity generated by renewable if applicable	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
1B2P - Ground Flo	114	136	0		-21	57	33		319	6.2
1B2P - Mid Floor	90	136	0		-21	58	32		294	5.8
1B2P - Top Floor B	100	136	0		-21	57	32		303	6.0
2B3P - Top Floor B	213	150	0		-21	68	47		456	7.1
2B4P - Mid Floor	129	157	0		-21	76	44		385	5.2
2B4P - Mid Floor B	118	157	0		-21	76	49		379	5.1
3B4P - Top Floor	166	156	0		-21	75	45		421	5.8
3B5P - Ground Flo	255	172	0		-21	99	70		575	5.5
3B6P - Top Floor	230	169	0		-21	95	64		537	5.7
4P8P - Duplex	256	176	0		-21	111	96		618	4.8
Sum	218,135	255,057	0	0	-36,531	117,837	71,817	0	*166,262*	1.5

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

VALIDATION CHECK

REGULATED ENERGY CONSUMPTION BY END USE (kWh/m^2 p.a.) 'BE GREEN' BER - SOURCE: BRUKL OUTPUT

REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m^2 p.a.) 'BE GREEN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE

REGULATED CO2 EMISSIONS PER UNIT

Use	Area per unit (m^2)	Number of units	Total area represented by model (m^2)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water							Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Lighting	Auxiliary	Cooling
Commercial	1000	1	2474.4	7.7	7.7	2.24	Grid Electricity	0.4	Grid Electricity	N/A	N/A	N/A	N/A	N/A	N/A			7.72	2.23	2.29
Sum	1,000	1	2,474	19.1	-	2,240	N/A	400	N/A							0	0	7,720	2,230	2,290

Use	Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	2012 CO2 emissions (kgCO2 p.a.)
Commercial		15							7,723
Sum	0	15	0	0	0	0	0	0	*19,109*

Use	Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	SAP10 CO2 emissions	BRUKL BER SAP10 (kgCO2 / m2)
Commercial		15							3,467	3.5
Sum	0	15	0	0	0	0	0	0	*8,579*	8.6

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

REGULATED CO2 EMISSIONS

REGULATED CO2 EMISSIONS

REGULATED CO2 EMISSIONS PER UNIT

Use	Total Area (m^2)	Calculated BER 2012 (kgCO2 / m2)	-	Space Heating (kWh p.a.)		Domestic Hot Water (kWh p.a.)		Space Heating (kWh p.a.)		Domestic Hot Water (kWh p.a.)		Space and Domestic Hot Water from CHP (kWh p.a.)		Electricity generated by CHP (kWh p.a.) if applicable	Electricity generated by renewable (kWh p.a.) if applicable	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	32,225	0.0	-	37,950	N/A	42,154	N/A	0	N/A	1,057,035	N/A	0	N/A	0	-156,785	513,457	310,457	2,290

Use	Space Heating CO2 emissions	Domestic Hot Water CO2 emissions	Space Heating and DHW from CHP CO2 emissions if applicable	Electricity generated by CHP CO2 savings if applicable	Electricity generated by renewable CO2 savings if applicable	Lighting CO2 emissions	Auxiliary CO2 emissions	Cooling CO2 emissions	2012 CO2 emissions
Sum	476,899	557,635	0	0	-81,371	262,477	159,970	0	*384,284*

Use	Space Heating CO2 emissions	Domestic Hot Water CO2 emissions	Space Heating and DHW from CHP CO2 emissions if applicable	Electricity generated by CHP CO2 savings if applicable	Electricity generated by renewable CO2 savings if applicable	Lighting CO2 emissions	Auxiliary CO2 emissions	Cooling CO2 emissions	SAP10 CO2 emissions	Calculated BER SAP10 (kgCO2 / m2)
Sum	218,135	255,072	0	0	-36,531	117,837	71,817	0	*174,840*	5.4

Appendix O DER Worksheets – *Be Green*

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	1B2P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.12	(1a) x	2.50	(2a) =	127.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.12	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.80	(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		0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	1	(19)
Shelter factor	1 - [0.075 x (19)] = 0.93	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.14	(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	0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.30	0.30	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(24a)

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

	0.30	0.30	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(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	
Window			8.18	x	1.24	=	10.11			(27)
Door			1.80	x	0.60	=	1.08			(26)
Ground floor			51.12	x	0.10	=	5.11			(28a)
External wall			18.25	x	0.17	=	3.10			(29a)
Party wall			17.80	x	0.00	=	0.00			(32)
External wall			25.45	x	0.15	=	3.82			(29a)
External wall			2.70	x	0.20	=	0.54			(29a)
Total area of external elements ∑A, m²			107.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.76 (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		8.51 (36)
Total fabric heat loss	(33) + (36) =	32.27 (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)	12.60	12.45	12.30	11.57	11.43	10.69	10.69	10.55	10.99	11.43	11.72	12.01	(38)
Heat transfer coefficient, W/K (37)m + (38)m	44.86	44.72	44.57	43.84	43.69	42.96	42.96	42.82	43.26	43.69	43.99	44.28	

Average = ∑(39)1...12/12 = 43.80 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.88	0.87	0.87	0.86	0.85	0.84	0.84	0.84	0.85	0.85	0.86	0.87	

Average = ∑(40)1...12/12 = 0.86 (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	1.72 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	75.12 (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)	82.64	79.63	76.63	73.62	70.62	67.61	67.61	70.62	73.62	76.63	79.63	82.64	

∑(44)1...12 = 901.49 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	122.55	107.18	110.60	96.42	92.52	79.84	73.98	84.90	85.91	100.12	109.29	118.68	

∑(45)1...12 = 1181.99 (45)

Distribution loss 0.15 x (45)m	18.38	16.08	16.59	14.46	13.88	11.98	11.10	12.73	12.89	15.02	16.39	17.80	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00 (47)
Water storage loss:	
b) Manufacturer's declared loss factor is not known	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)
Enter (50) or (54) in (55)	0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

149.85	131.84	137.90	122.85	119.83	106.26	101.29	112.20	112.33	127.42	135.71	145.98	(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

149.85	131.84	137.90	122.85	119.83	106.26	101.29	112.20	112.33	127.42	135.71	145.98	

∑(64)1...12 = 1503.47 (64)

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

62.59	55.37	58.62	53.20	52.61	47.68	46.44	50.07	49.70	55.13	57.48	61.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.96	12.40	10.09	7.64	5.71	4.82	5.21	6.77	9.08	11.54	13.46	14.35	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	150.14	151.70	147.77	139.42	128.87	118.95	112.32	110.77	114.69	123.05	133.60	143.52	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	(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)	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	(71)
Water heating gains (Table 5)	84.13	82.39	78.79	73.89	70.71	66.23	62.42	67.30	69.03	74.10	79.83	82.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	297.08	295.34	285.49	269.79	254.13	238.84	228.80	233.68	241.66	257.54	275.74	289.11	(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	8.18	x	19.64	x 0.9 x	0.45	x	0.70	=	35.07	(80)

Solar gains in watts ∑(74)m...(82)m

35.07	68.61	112.98	164.78	201.94	206.73	196.81	169.06	131.40	81.41	43.73	28.84	(83)

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

332.15	363.95	398.48	434.57	456.07	445.57	425.61	402.74	373.06	338.94	319.47	317.96	(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)													
	1.00	0.99	0.98	0.93	0.81	0.61	0.44	0.49	0.75	0.96	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.19	20.31	20.51	20.76	20.93	20.99	21.00	21.00	20.97	20.75	20.43	20.17	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.19	20.19	20.19	20.20	20.21	20.22	20.22	20.22	20.21	20.21	20.20	20.20	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.98	0.91	0.76	0.54	0.36	0.41	0.68	0.94	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.10	19.27	19.56	19.92	20.14	20.21	20.22	20.22	20.19	19.92	19.46	19.09	(90)

Living area fraction — Living area ÷ (4) = 0.47 (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													
	19.62	19.76	20.01	20.32	20.51	20.58	20.59	20.59	20.55	20.31	19.92	19.60	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.62	19.76	20.01	20.32	20.51	20.58	20.59	20.59	20.55	20.31	19.92	19.60	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.99	0.99	0.97	0.92	0.78	0.57	0.40	0.44	0.72	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	330.35	360.17	388.00	398.81	356.69	253.79	170.95	178.73	267.01	319.02	315.72	316.61	(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]													
	687.15	664.50	602.02	500.53	384.96	256.86	171.22	179.23	279.17	424.16	563.78	681.78	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	265.46	204.51	159.24	73.24	21.03	0.00	0.00	0.00	0.00	78.23	178.60	271.69	

∑(98)1...5, 10...12 = 1251.99 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 24.49 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1251.99		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	16.65	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1648.50	(307b)

Water heating

Annual water heating requirement	1503.47		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	20.00	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1979.62	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	36.65	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	103.29		(330a)
Total electricity for the above, kWh/year		103.29	(331)
Electricity for lighting (Appendix L)		246.61	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3923.41	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	16.65	x	4.24	x 0.01 =	0.71	(340a)
Space heating from heat pump	1648.50	x	4.24	x 0.01 =	69.90	(340b)
Water heating from boilers	20.00	x	4.24	x 0.01 =	0.85	(342a)
Water heating from heat pump	1979.62	x	4.24	x 0.01 =	83.94	(342b)
Pumps and fans	103.29	x	13.19	x 0.01 =	13.62	(349)
Electricity for lighting	246.61	x	13.19	x 0.01 =	32.53	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		321.54	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.40	(357)
SAP value	80.40	
SAP rating (section 13)	80	(358)
SAP band	C	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	40.95	x	0.216	=	8.84	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1036.60	x	0.519	=	538.00	(368)
Electrical energy for community heat distribution	36.65	x	0.519	=	19.02	(372)
Total CO2 associated with community systems					565.86	(373)
Total CO2 associated with space and water heating					565.86	(376)
Pumps and fans	103.29	x	0.519	=	53.61	(378)
Electricity for lighting	246.61	x	0.519	=	127.99	(379)
Energy saving/generation technologies						

pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	700.10	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	13.70	(384)
EI value					90.24	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	40.95	x	1.22	=	49.96	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1036.60	x	3.07	=	3182.37	(368)
Electrical energy for community heat distribution	36.65	x	3.07	=	112.51	(372)
Total primary energy associated with community systems					3344.84	(373)
Total primary energy associated with space and water heating					3344.84	(376)
Pumps and fans	103.29	x	3.07	=	317.11	(378)
Electricity for lighting	246.61	x	3.07	=	757.11	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					4138.89	(383)
Dwelling primary energy rate kWh/m2/year					80.96	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	1B2P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.88	(1a) x	2.50	(2a) =	127.20	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.88	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.20	(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		0	x 10 =	0 (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) =	0	÷ (5) =	0.00 (8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (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) =	0.12 (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	0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		75.65 (23c)

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

0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(24a)

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

0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(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	
Window			7.76	x	1.24	=	9.59			(27)
Door			1.80	x	0.70	=	1.26			(26)
External wall			28.52	x	0.17	=	4.85			(29a)
Party wall			11.68	x	0.00	=	0.00			(32)
External wall			22.93	x	0.20	=	4.59			(29a)
Total area of external elements ∑A, m²			61.01							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	20.28 (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		7.20 (36)
Total fabric heat loss	(33) + (36) =	27.48 (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	
11.33	11.21	11.09	10.48	10.36	9.75	9.75	9.62	9.99	10.36	10.60	10.84	(38)

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

38.81	38.69	38.57	37.96	37.84	37.23	37.23	37.11	37.47	37.84	38.08	38.33	

Average = ∑(39)1...12/12 = 37.93 (39)

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

0.76	0.76	0.76	0.75	0.74	0.73	0.73	0.73	0.74	0.74	0.75	0.75	

Average = ∑(40)1...12/12 = 0.75 (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		74.96 (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	
82.45	79.45	76.45	73.46	70.46	67.46	67.46	70.46	73.46	76.45	79.45	82.45	

∑(44)1...12 = 899.47 (44)

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

122.27	106.94	110.35	96.21	92.31	79.66	73.82	84.71	85.72	99.90	109.04	118.41	

∑(45)1...12 = 1179.35 (45)

Distribution loss 0.15 x (45)m

18.34	16.04	16.55	14.43	13.85	11.95	11.07	12.71	12.86	14.98	16.36	17.76	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		3.00 (47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02 (51)
Volume factor from Table 2a		3.42 (52)
Temperature factor from Table 2b		0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)		0.13 (54)
Enter (50) or (54) in (55)		0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04 (57)

Primary circuit loss for each month from Table 3

	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (59)

Combi loss 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

	149.58	131.60	137.66	122.63	119.62	106.08	101.12	112.01	112.14	127.20	135.47	145.72 (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

	149.58	131.60	137.66	122.63	119.62	106.08	101.12	112.01	112.14	127.20	135.47	145.72

∑(64)1...12 = 1500.82 (64)

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

	62.50	55.29	58.54	53.13	52.54	47.63	46.39	50.01	49.64	55.06	57.40	61.22 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.04	12.47	10.14	7.68	5.74	4.85	5.24	6.81	9.14	11.60	13.54	14.43	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	149.52	151.07	147.16	138.84	128.33	118.46	111.86	110.31	114.22	122.54	133.05	142.92	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	(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)	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	(71)
Water heating gains (Table 5)	84.00	82.27	78.68	73.79	70.61	66.15	62.35	67.21	68.94	74.00	79.72	82.28	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	296.31	294.56	284.72	269.05	253.43	238.19	228.18	233.07	241.04	256.88	275.04	288.37	(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	4.56	x	10.63	x 0.9 x	0.45	x	0.70	=	10.58	(74)
East	0.77	x	3.20	x	19.64	x 0.9 x	0.45	x	0.70	=	13.72	(76)

Solar gains in watts ∑(74)m...(82)m

	24.30	47.07	78.57	119.67	153.37	160.49	151.33	125.11	92.73	55.92	30.16	20.11 (83)

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

	320.61	341.62	363.29	388.72	406.80	398.68	379.51	358.18	333.77	312.81	305.21	308.48 (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)

1.00	0.99	0.98	0.94	0.81	0.59	0.43	0.48	0.74	0.95	0.99	1.00

(86)

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

20.35	20.44	20.60	20.81	20.95	21.00	21.00	21.00	20.98	20.81	20.55	20.33

(87)

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

20.29	20.29	20.29	20.30	20.30	20.31	20.31	20.32	20.31	20.30	20.30	20.29

(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.92	0.76	0.53	0.36	0.41	0.68	0.94	0.99	1.00

(89)

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

19.41	19.54	19.78	20.08	20.26	20.31	20.31	20.31	20.29	20.09	19.71	19.39

(90)

Living area fraction — Living area ÷ (4) = 0.45 (91)

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

19.84	19.95	20.15	20.41	20.57	20.62	20.63	20.63	20.61	20.42	20.09	19.82

(92)

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

19.84	19.95	20.15	20.41	20.57	20.62	20.63	20.63	20.61	20.42	20.09	19.82

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.98	0.92	0.78	0.56	0.39	0.44	0.71	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	318.87	338.35	354.81	358.81	317.30	222.73	149.75	156.61	236.58	293.94	301.50	307.17	(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]	603.01	582.26	526.48	437.04	335.76	224.18	149.85	156.82	243.77	371.40	494.80	598.63	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	211.40	163.90	127.72	56.33	13.73	0.00	0.00	0.00	0.00	57.63	139.17	216.85	

∑(98)1...5, 10...12 = 986.74 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.39 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	986.74		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	13.12	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1299.24	(307b)

Water heating

Annual water heating requirement	1500.82		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	19.96	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1976.13	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	33.08	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	102.81		(330a)
Total electricity for the above, kWh/year		102.81	(331)
Electricity for lighting (Appendix L)		247.99	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3568.00	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	13.12	x	4.24	x 0.01 =	0.56	(340a)
Space heating from heat pump	1299.24	x	4.24	x 0.01 =	55.09	(340b)
Water heating from boilers	19.96	x	4.24	x 0.01 =	0.85	(342a)
Water heating from heat pump	1976.13	x	4.24	x 0.01 =	83.79	(342b)
Pumps and fans	102.81	x	13.19	x 0.01 =	13.56	(349)
Electricity for lighting	247.99	x	13.19	x 0.01 =	32.71	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		306.55	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.34	(357)
SAP value	81.27	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	36.97	x	0.216	=	7.98	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	935.82	x	0.519	=	485.69	(368)
Electrical energy for community heat distribution	33.08	x	0.519	=	17.17	(372)
Total CO2 associated with community systems					510.85	(373)
Total CO2 associated with space and water heating					510.85	(376)
Pumps and fans	102.81	x	0.519	=	53.36	(378)
Electricity for lighting	247.99	x	0.519	=	128.71	(379)
Energy saving/generation technologies						
pv savings	-91.26	x	0.519	=	-47.36	(380)

Total CO_2, kg/year	(376)..(382) =	645.55	(383)
Dwelling CO_2 emission rate	(383) ÷ (4) =	12.69	(384)
EI value		90.98	
EI rating (section 14)		91	(385)
EI band		B	

13b. Primary energy - community heating scheme

		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)							
Efficiency of boilers		89.50					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	36.97	x	1.22	=	45.10	(367)
Efficiency of heat pump		350.00					(367b)
Primary energy from heat pump	[(307b)+(310b)] x 100 ÷ (367b) =	935.82	x	3.07	=	2872.97	(368)
Electrical energy for community heat distribution		33.08	x	3.07	=	101.57	(372)
Total primary energy associated with community systems						3019.64	(373)
Total primary energy associated with space and water heating						3019.64	(376)
Pumps and fans		102.81	x	3.07	=	315.62	(378)
Electricity for lighting		247.99	x	3.07	=	761.32	(379)
Energy saving/generation technologies							
Electricity generated - PVs		-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year						3816.42	(383)
Dwelling primary energy rate kWh/m2/year						75.01	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	1B2P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.32	(1a) x	2.50	(2a) =	125.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.32	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.80	(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		0	x 10 = 0	(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) =	0	÷ (5) = 0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(24a)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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	
Window			7.86	x	1.24	=	9.71			(27)
Door			1.80	x	0.60	=	1.08			(26)
External wall			14.32	x	0.17	=	2.43			(29a)
Party wall			34.43	x	0.00	=	0.00			(32)
External wall			16.50	x	0.20	=	3.30			(29a)
Roof			50.32	x	0.13	=	6.54			(30)
Total area of external elements ∑A, m²			90.80							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.07 (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		6.77 (36)
Total fabric heat loss	(33) + (36) =	29.84 (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	
11.80	11.67	11.54	10.88	10.74	10.08	10.08	9.95	10.35	10.74	11.01	11.27	(38)

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

41.64	41.51	41.38	40.72	40.58	39.92	39.92	39.79	40.19	40.58	40.85	41.11	

Average = ∑(39)1...12/12 = 40.68 (39)

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

0.83	0.82	0.82	0.81	0.81	0.79	0.79	0.79	0.80	0.81	0.81	0.82	

Average = ∑(40)1...12/12 = 0.81 (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	1.70	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	74.56	(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	
82.02	79.04	76.06	73.07	70.09	67.11	67.11	70.09	73.07	76.06	79.04	82.02	

∑(44)1...12 = 894.76 (44)

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

121.63	106.38	109.78	95.71	91.83	79.24	73.43	84.26	85.27	99.37	108.47	117.80	

∑(45)1...12 = 1173.18 (45)

Distribution loss 0.15 x (45)m

18.25	15.96	16.47	14.36	13.77	11.89	11.01	12.64	12.79	14.91	16.27	17.67	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	3.42	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13	(54)
Enter (50) or (54) in (55)	0.13	(55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

148.94	131.04	137.08	122.13	119.14	105.67	100.73	111.57	111.69	126.68	134.90	145.10	(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

148.94	131.04	137.08	122.13	119.14	105.67	100.73	111.57	111.69	126.68	134.90	145.10	

∑(64)1...12 = 1494.66 (64)

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

62.29	55.10	58.34	52.96	52.38	47.49	46.26	49.86	49.49	54.88	57.21	61.01	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.84	12.29	10.00	7.57	5.66	4.78	5.16	6.71	9.00	11.43	13.34	14.22	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	148.07	149.60	145.73	137.49	127.08	117.30	110.77	109.23	113.11	121.35	131.75	141.53	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	(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)	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	(71)
Water heating gains (Table 5)	83.72	82.00	78.42	73.56	70.40	65.95	62.18	67.02	68.74	73.77	79.45	82.00	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	294.11	292.38	282.64	267.10	251.63	236.53	226.60	231.45	239.34	255.04	273.04	286.25	(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	7.86	x	19.64	x 0.9 x	0.45	x	0.70	=	33.70	(80)

Solar gains in watts ∑(74)m...(82)m

33.70	65.92	108.56	158.33	194.04	198.64	189.11	162.44	126.26	78.22	42.02	27.71	(83)

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

327.81	358.30	391.20	425.44	445.67	435.16	415.71	393.90	365.60	333.26	315.06	313.96	(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)

	1.00	0.99	0.98	0.92	0.79	0.58	0.42	0.46	0.73	0.95	0.99	1.00	(86)

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

	20.27	20.38	20.57	20.80	20.95	20.99	21.00	21.00	20.98	20.79	20.49	20.25	(87)

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

	20.23	20.23	20.23	20.25	20.25	20.26	20.26	20.26	20.25	20.25	20.24	20.24	(88)

Utilisation factor for gains for rest of dwelling n2,m

	1.00	0.99	0.97	0.90	0.74	0.52	0.35	0.39	0.66	0.93	0.99	1.00	(89)

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

	19.25	19.41	19.69	20.02	20.20	20.26	20.26	20.26	20.24	20.01	19.59	19.23	(90)

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

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

	19.81	19.94	20.17	20.45	20.61	20.66	20.66	20.66	20.64	20.43	20.08	19.79	(92)

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

	19.81	19.94	20.17	20.45	20.61	20.66	20.66	20.66	20.64	20.43	20.08	19.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.91	0.76	0.55	0.39	0.43	0.70	0.93	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	325.95	354.36	380.06	386.99	340.74	239.90	162.03	169.34	254.35	311.59	311.08	312.58	(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]	645.68	624.31	565.55	470.12	361.50	241.86	162.19	169.64	262.84	399.12	530.20	640.78	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	237.88	181.41	138.01	59.85	15.45	0.00	0.00	0.00	0.00	65.12	157.77	244.18	

∑(98)1...5, 10...12 = 1099.65 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 21.85 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1099.65		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	14.63	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1447.92	(307b)

Water heating

Annual water heating requirement	1494.66		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	19.88	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1968.01	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	34.50	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	101.68		(330a)
Total electricity for the above, kWh/year		101.68	(331)
Electricity for lighting (Appendix L)		244.38	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3705.23	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	14.63	x	4.24	x 0.01 =	0.62	(340a)
Space heating from heat pump	1447.92	x	4.24	x 0.01 =	61.39	(340b)
Water heating from boilers	19.88	x	4.24	x 0.01 =	0.84	(342a)
Water heating from heat pump	1968.01	x	4.24	x 0.01 =	83.44	(342b)
Pumps and fans	101.68	x	13.19	x 0.01 =	13.41	(349)
Electricity for lighting	244.38	x	13.19	x 0.01 =	32.23	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		311.94	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.37	(357)
SAP value	80.83	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	38.55	x	0.216	=	8.33	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	975.98	x	0.519	=	506.53	(368)
Electrical energy for community heat distribution	34.50	x	0.519	=	17.91	(372)
Total CO2 associated with community systems					532.77	(373)
Total CO2 associated with space and water heating					532.77	(376)
Pumps and fans	101.68	x	0.519	=	52.77	(378)
Electricity for lighting	244.38	x	0.519	=	126.83	(379)
Energy saving/generation technologies						
pv savings	-91.26	x	0.519	=	-47.36	(380)

Total CO_2, kg/year	(376)..(382) =	665.01	(383)
Dwelling CO_2 emission rate	(383) ÷ (4) =	13.22	(384)
EI value		90.65	
EI rating (section 14)		91	(385)
EI band		B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	38.55	x	1.22	=	47.03	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	975.98	x	3.07	=	2996.26	(368)
Electrical energy for community heat distribution	34.50	x	3.07	=	105.93	(372)
Total primary energy associated with community systems					3149.22	(373)
Total primary energy associated with space and water heating					3149.22	(376)
Pumps and fans	101.68	x	3.07	=	312.15	(378)
Electricity for lighting	244.38	x	3.07	=	750.24	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					3931.45	(383)
Dwelling primary energy rate kWh/m2/year					78.13	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	2B3P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		64.62	(1a) x	2.50	(2a) =	161.55	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	64.62	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	161.55	(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		0	x 10 = 0	(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) =	0	÷ (5) = 0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	74.80	(23c)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(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	
Window			15.04	x	1.24	=	18.59			(27)
Door			1.80	x	0.60	=	1.08			(26)
External wall			31.51	x	0.17	=	5.36			(29a)
Party wall			14.88	x	0.00	=	0.00			(32)
External wall			22.05	x	0.20	=	4.41			(29a)
Roof			64.62	x	0.13	=	8.40			(30)
Total area of external elements ∑A, m²			135.02							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	37.83 (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		15.57 (36)
Total fabric heat loss	(33) + (36) =	53.41 (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	
15.38	15.21	15.04	14.19	14.02	13.17	13.17	13.00	13.51	14.02	14.36	14.70	(38)

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

68.79	68.62	68.45	67.60	67.43	66.58	66.58	66.41	66.92	67.43	67.77	68.11	

Average = ∑(39)1...12/12 = 67.56 (39)

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

1.06	1.06	1.06	1.05	1.04	1.03	1.03	1.03	1.04	1.04	1.05	1.05	

Average = ∑(40)1...12/12 = 1.05 (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		2.11 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		84.28 (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	
92.71	89.34	85.97	82.60	79.23	75.86	75.86	79.23	82.60	85.97	89.34	92.71	

∑(44)1...12 = 1011.41 (44)

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

137.49	120.25	124.09	108.18	103.80	89.57	83.00	95.25	96.39	112.33	122.61	133.15	

∑(45)1...12 = 1326.12 (45)

Distribution loss 0.15 x (45)m

20.62	18.04	18.61	16.23	15.57	13.44	12.45	14.29	14.46	16.85	18.39	19.97	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		3.00 (47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02 (51)
Volume factor from Table 2a		3.42 (52)
Temperature factor from Table 2b		0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)		0.13 (54)
Enter (50) or (54) in (55)		0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

164.79	144.91	151.39	134.60	131.11	116.00	110.31	122.55	122.81	139.63	149.04	160.46	(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

164.79	144.91	151.39	134.60	131.11	116.00	110.31	122.55	122.81	139.63	149.04	160.46	

∑(64)1...12 = 1647.59 (64)

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

67.56	59.71	63.10	57.11	56.36	50.92	49.44	53.51	53.19	59.19	61.91	66.12	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	16.44	14.60	11.88	8.99	6.72	5.67	6.13	7.97	10.70	13.58	15.85	16.90	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	184.43	186.34	181.52	171.25	158.29	146.11	137.98	136.06	140.88	151.15	164.11	176.29	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	(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)	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	(71)
Water heating gains (Table 5)	90.80	88.86	84.81	79.32	75.75	70.72	66.45	71.93	73.87	79.56	85.98	88.87	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	346.31	344.44	332.84	314.20	295.40	277.14	265.19	270.59	280.08	298.93	320.58	336.69	(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	8.20	x	10.63	x 0.9 x	0.45	x	0.70	=	19.03	(74)
East	0.77	x	6.84	x	19.64	x 0.9 x	0.45	x	0.70	=	29.33	(76)

Solar gains in watts ∑(74)m...(82)m

48.36	93.74	156.29	237.07	302.61	316.04	298.24	247.42	184.19	111.37	60.05	39.98	(83)

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

394.67	438.18	489.13	551.27	598.00	593.18	563.44	518.01	464.28	410.30	380.63	376.67	(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)													
	1.00	1.00	0.99	0.96	0.86	0.68	0.51	0.58	0.84	0.98	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	19.89	20.01	20.25	20.57	20.84	20.97	20.99	20.99	20.90	20.55	20.17	19.86	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.03	20.03	20.03	20.05	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.04	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.98	0.94	0.82	0.60	0.41	0.47	0.77	0.97	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	18.54	18.73	19.07	19.54	19.89	20.04	20.06	20.06	19.97	19.52	18.96	18.52	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

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

19.10	19.26	19.56	19.97	20.28	20.42	20.45	20.44	20.36	19.95	19.46	19.08	(92)

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

19.10	19.26	19.56	19.97	20.28	20.42	20.45	20.44	20.36	19.95	19.46	19.08	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	1.00	0.99	0.98	0.94	0.83	0.63	0.45	0.51	0.80	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	393.15	435.00	480.26	519.08	496.62	373.90	254.27	265.09	370.74	395.52	377.71	375.53	(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]													
	1018.15	985.60	894.04	748.23	578.72	387.77	256.12	268.62	418.59	630.70	837.84	1013.28	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	465.01	370.00	307.86	164.98	61.08	0.00	0.00	0.00	0.00	174.97	331.30	474.48	

∑(98)1...5, 10...12 = 2349.68 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 36.36 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	2349.68		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	31.25	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	3093.82	(307b)

Water heating

Annual water heating requirement	1647.59		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	21.91	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2169.39	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	53.16	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	147.82		(330a)
Total electricity for the above, kWh/year		147.82	(331)
Electricity for lighting (Appendix L)		290.37	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5663.30	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	31.25	x	4.24	x 0.01 =	1.33	(340a)
Space heating from heat pump	3093.82	x	4.24	x 0.01 =	131.18	(340b)
Water heating from boilers	21.91	x	4.24	x 0.01 =	0.93	(342a)
Water heating from heat pump	2169.39	x	4.24	x 0.01 =	91.98	(342b)
Pumps and fans	147.82	x	13.19	x 0.01 =	19.50	(349)
Electricity for lighting	290.37	x	13.19	x 0.01 =	38.30	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		403.21	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.54	(357)
SAP value	78.45	
SAP rating (section 13)	78	(358)
SAP band	C	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	59.40	x	0.216	=	12.83	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1503.77	x	0.519	=	780.46	(368)
Electrical energy for community heat distribution	53.16	x	0.519	=	27.59	(372)
Total CO2 associated with community systems					820.88	(373)
Total CO2 associated with space and water heating					820.88	(376)
Pumps and fans	147.82	x	0.519	=	76.72	(378)
Electricity for lighting	290.37	x	0.519	=	150.70	(379)
Energy saving/generation technologies						

pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	1000.94	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	15.49	(384)
EI value					87.76	
EI rating (section 14)					88	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	59.40	x	1.22	=	72.47	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1503.77	x	3.07	=	4616.58	(368)
Electrical energy for community heat distribution	53.16	x	3.07	=	163.21	(372)
Total primary energy associated with community systems					4852.27	(373)
Total primary energy associated with space and water heating					4852.27	(376)
Pumps and fans	147.82	x	3.07	=	453.80	(378)
Electricity for lighting	290.37	x	3.07	=	891.45	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					5917.35	(383)
Dwelling primary energy rate kWh/m2/year					91.57	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	2B4P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		73.74	(1a) x	2.50	(2a) =	184.35	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.74	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	184.35	(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		0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(24a)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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	
Window			15.42	x	1.24	=	19.06			(27)
Door			1.80	x	0.70	=	1.26			(26)
External wall			29.58	x	0.17	=	5.03			(29a)
Party wall			15.83	x	0.00	=	0.00			(32)
External wall			29.63	x	0.20	=	5.93			(29a)
Total area of external elements ∑A, m²			76.43							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	31.27 (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		9.45 (36)
Total fabric heat loss	(33) + (36) =	40.72 (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	
17.30	17.10	16.91	15.94	15.74	14.78	14.78	14.58	15.16	15.74	16.13	16.52	(38)

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

58.02	57.82	57.63	56.66	56.47	55.50	55.50	55.30	55.88	56.47	56.85	57.24	

Average = ∑(39)1...12/12 = 56.61 (39)

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

0.79	0.78	0.78	0.77	0.77	0.75	0.75	0.75	0.76	0.77	0.77	0.78	

Average = ∑(40)1...12/12 = 0.77 (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		2.33 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		89.62 (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	
98.58	95.00	91.41	87.83	84.24	80.66	80.66	84.24	87.83	91.41	95.00	98.58	

∑(44)1...12 = 1075.42 (44)

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

146.19	127.86	131.94	115.03	110.37	95.24	88.26	101.28	102.49	119.44	130.37	141.58	

∑(45)1...12 = 1410.04 (45)

Distribution loss 0.15 x (45)m

21.93	19.18	19.79	17.25	16.56	14.29	13.24	15.19	15.37	17.92	19.56	21.24	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		3.00 (47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02 (51)
Volume factor from Table 2a		3.42 (52)
Temperature factor from Table 2b		0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)		0.13 (54)
Enter (50) or (54) in (55)		0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

173.49	152.52	159.24	141.45	137.68	121.67	115.56	128.58	128.91	146.74	156.80	168.88	(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

173.49	152.52	159.24	141.45	137.68	121.67	115.56	128.58	128.91	146.74	156.80	168.88	

∑(64)1...12 = 1731.52 (64)

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

70.45	62.24	65.71	59.39	58.54	52.81	51.19	55.52	55.21	61.56	64.49	68.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.41	16.35	13.30	10.07	7.53	6.35	6.86	8.92	11.98	15.21	17.75	18.92	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	205.86	208.00	202.62	191.16	176.69	163.09	154.01	151.87	157.26	168.72	183.18	196.78	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	(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)	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	(71)
Water heating gains (Table 5)	94.69	92.62	88.32	82.48	78.69	73.34	68.80	74.62	76.69	82.74	89.57	92.63	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	376.97	374.97	362.24	341.70	320.90	300.79	287.68	293.42	303.92	324.66	348.50	366.33	(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	10.90	x	19.64	x 0.9 x	0.45	x	0.70	=	46.73	(76)
South	0.77	x	2.22	x	46.75	x 0.9 x	0.45	x	0.70	=	22.66	(78)
West	0.77	x	2.30	x	19.64	x 0.9 x	0.45	x	0.70	=	9.86	(80)

Solar gains in watts ∑(74)m...(82)m

79.25	147.81	229.59	319.33	381.54	387.17	369.94	323.64	261.42	171.39	97.42	66.12	(83)

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

456.22	522.79	591.83	661.03	702.45	687.96	657.61	617.06	565.34	496.05	445.92	432.45	(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)													
	1.00	0.99	0.97	0.89	0.72	0.51	0.37	0.41	0.67	0.94	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.30	20.44	20.64	20.87	20.97	21.00	21.00	21.00	20.99	20.83	20.52	20.28	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.26	20.27	20.27	20.28	20.28	20.29	20.29	20.30	20.29	20.28	20.28	20.27	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.96	0.86	0.67	0.46	0.31	0.35	0.60	0.91	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.32	19.52	19.82	20.13	20.26	20.29	20.29	20.30	20.28	20.10	19.66	19.30	(90)

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

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
	19.72	19.90	20.16	20.43	20.55	20.58	20.58	20.58	20.57	20.40	20.01	19.69	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.72	19.90	20.16	20.43	20.55	20.58	20.58	20.58	20.57	20.40	20.01	19.69	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	1.00	0.99	0.96	0.87	0.69	0.48	0.34	0.37	0.63	0.92	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	454.04	516.36	569.05	575.27	485.76	330.94	220.90	231.19	355.95	455.33	440.49	430.96	(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]													
	894.62	867.13	787.03	653.42	499.76	331.87	220.96	231.32	361.53	553.11	734.12	886.92	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	327.79	235.72	162.18	56.27	10.42	0.00	0.00	0.00	0.00	72.75	211.41	339.24	

∑(98)1...5, 10...12 = 1415.77 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.20 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1415.77		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	18.83	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1864.14	(307b)

Water heating

Annual water heating requirement	1731.52		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	23.03	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2279.89	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	41.86	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	149.00		(330a)
Total electricity for the above, kWh/year		149.00	(331)
Electricity for lighting (Appendix L)		325.11	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4568.74	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	18.83	x	4.24	x 0.01 =	0.80	(340a)
Space heating from heat pump	1864.14	x	4.24	x 0.01 =	79.04	(340b)
Water heating from boilers	23.03	x	4.24	x 0.01 =	0.98	(342a)
Water heating from heat pump	2279.89	x	4.24	x 0.01 =	96.67	(342b)
Pumps and fans	149.00	x	13.19	x 0.01 =	19.65	(349)
Electricity for lighting	325.11	x	13.19	x 0.01 =	42.88	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		360.02	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.27	(357)
SAP value	82.24	
SAP rating (section 13)	82	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	46.77	x	0.216	=	10.10	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1184.01	x	0.519	=	614.50	(368)
Electrical energy for community heat distribution	41.86	x	0.519	=	21.72	(372)
Total CO2 associated with community systems					646.33	(373)
Total CO2 associated with space and water heating					646.33	(376)
Pumps and fans	149.00	x	0.519	=	77.33	(378)
Electricity for lighting	325.11	x	0.519	=	168.73	(379)
Energy saving/generation technologies						

pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	845.03	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.46	(384)
EI value					90.46	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	46.77	x	1.22	=	57.06	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1184.01	x	3.07	=	3634.91	(368)
Electrical energy for community heat distribution	41.86	x	3.07	=	128.51	(372)
Total primary energy associated with community systems					3820.48	(373)
Total primary energy associated with space and water heating					3820.48	(376)
Pumps and fans	149.00	x	3.07	=	457.43	(378)
Electricity for lighting	325.11	x	3.07	=	998.08	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					4995.82	(383)
Dwelling primary energy rate kWh/m2/year					67.75	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	2B3P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		74.00	(1a) x	2.50	(2a) =	185.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	74.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	185.00	(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		0	x 10 =	0 (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) =	0	÷ (5) =	0.00 (8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (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) =	0.13 (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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		74.80 (23c)

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

0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(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	
Window			17.96	x	1.24	=	22.19			(27)
Door			1.80	x	0.70	=	1.26			(26)
External wall			30.44	x	0.17	=	5.17			(29a)
Party wall			32.15	x	0.00	=	0.00			(32)
External wall			2.65	x	0.20	=	0.53			(29a)
Total area of external elements ∑A, m²			52.85							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.16 (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		7.34 (36)
Total fabric heat loss	(33) + (36) =	36.49 (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	
17.62	17.42	17.23	16.25	16.06	15.09	15.09	14.89	15.48	16.06	16.45	16.84	(38)

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

54.11	53.92	53.72	52.75	52.55	51.58	51.58	51.39	51.97	52.55	52.94	53.33	

Average = ∑(39)1...12/12 = 52.70 (39)

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

0.73	0.73	0.73	0.71	0.71	0.70	0.70	0.69	0.70	0.71	0.72	0.72	

Average = ∑(40)1...12/12 = 0.71 (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		2.34 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		89.76 (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	
98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73	

∑(44)1...12 = 1077.07 (44)

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

146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.80	

∑(45)1...12 = 1412.21 (45)

Distribution loss 0.15 x (45)m

21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.40	17.94	19.59	21.27	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		3.00 (47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02 (51)
Volume factor from Table 2a		3.42 (52)
Temperature factor from Table 2b		0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)		0.13 (54)
Enter (50) or (54) in (55)		0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

173.72	152.72	159.45	141.63	137.85	121.81	115.70	128.74	129.07	146.92	157.00	169.10	(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

173.72	152.72	159.45	141.63	137.85	121.81	115.70	128.74	129.07	146.92	157.00	169.10	

∑(64)1...12 = 1733.69 (64)

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

70.53	62.31	65.78	59.44	58.60	52.86	51.23	55.57	55.27	61.62	64.55	68.99	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.40	16.35	13.29	10.06	7.52	6.35	6.86	8.92	11.97	15.20	17.74	18.92	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	206.45	208.59	203.19	191.70	177.19	163.56	154.45	152.30	157.70	169.20	183.70	197.34	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	(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)	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
Water heating gains (Table 5)	94.79	92.72	88.41	82.56	78.76	73.41	68.86	74.69	76.76	82.82	89.66	92.73	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	377.73	375.74	362.99	342.41	321.56	301.41	288.26	294.00	304.52	325.31	349.19	367.07	(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	
North	0.77	x	6.10	x	10.63	x 0.9 x	0.45	x	0.70	=	14.16	(74)
NorthEast	0.77	x	3.20	x	11.28	x 0.9 x	0.45	x	0.70	=	7.88	(75)
West	0.77	x	8.66	x	19.64	x 0.9 x	0.45	x	0.70	=	37.13	(80)

Solar gains in watts ∑(74)m...(82)m

59.17	115.73	194.50	295.78	377.09	393.39	371.44	308.60	229.62	138.00	73.68	48.77	(83)

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

436.90	491.48	557.49	638.19	698.66	694.80	659.70	602.61	534.14	463.31	422.87	415.84	(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)													
	1.00	0.99	0.97	0.88	0.68	0.47	0.34	0.39	0.66	0.94	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.36	20.48	20.68	20.90	20.99	21.00	21.00	21.00	20.99	20.85	20.56	20.34	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.31	20.32	20.32	20.33	20.33	20.34	20.34	20.35	20.34	20.33	20.33	20.32	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.97	0.86	0.64	0.43	0.29	0.34	0.60	0.92	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.45	19.62	19.91	20.21	20.32	20.34	20.34	20.35	20.33	20.16	19.76	19.43	(90)

Living area fraction — Living area ÷ (4) = 0.48 (91)

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

19.89	20.04	20.28	20.54	20.64	20.66	20.66	20.66	20.65	20.49	20.15	19.87	(92)

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

19.89	20.04	20.28	20.54	20.64	20.66	20.66	20.66	20.65	20.49	20.15	19.87	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	1.00	0.99	0.97	0.86	0.66	0.45	0.32	0.36	0.63	0.93	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	435.20	486.72	538.75	551.86	461.84	312.23	209.46	218.96	336.37	429.41	418.62	414.67	(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]													
	843.43	816.12	740.27	614.24	469.92	312.61	209.48	219.02	340.50	519.94	690.86	835.56	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	303.72	221.36	149.93	44.92	6.01	0.00	0.00	0.00	0.00	67.35	196.02	313.15	

∑(98)1...5, 10...12 = 1302.45 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 17.60 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1302.45		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	17.32	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1714.94	(307b)

Water heating

Annual water heating requirement	1733.69		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	23.06	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2282.75	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	40.38	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	169.28		(330a)
Total electricity for the above, kWh/year		169.28	(331)
Electricity for lighting (Appendix L)		325.04	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4441.11	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	17.32	x	4.24	x 0.01 =	0.73	(340a)
Space heating from heat pump	1714.94	x	4.24	x 0.01 =	72.71	(340b)
Water heating from boilers	23.06	x	4.24	x 0.01 =	0.98	(342a)
Water heating from heat pump	2282.75	x	4.24	x 0.01 =	96.79	(342b)
Pumps and fans	169.28	x	13.19	x 0.01 =	22.33	(349)
Electricity for lighting	325.04	x	13.19	x 0.01 =	42.87	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		356.41	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.26	(357)
SAP value	82.45	
SAP rating (section 13)	82	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	45.12	x	0.216	=	9.75	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1142.19	x	0.519	=	592.80	(368)
Electrical energy for community heat distribution	40.38	x	0.519	=	20.96	(372)
Total CO2 associated with community systems					623.50	(373)
Total CO2 associated with space and water heating					623.50	(376)
Pumps and fans	169.28	x	0.519	=	87.85	(378)
Electricity for lighting	325.04	x	0.519	=	168.69	(379)
Energy saving/generation technologies						

pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	832.69	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.25	(384)
EI value					90.62	
EI rating (section 14)					91	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	45.12	x	1.22	=	55.04	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1142.19	x	3.07	=	3506.54	(368)
Electrical energy for community heat distribution	40.38	x	3.07	=	123.97	(372)
Total primary energy associated with community systems					3685.55	(373)
Total primary energy associated with space and water heating					3685.55	(376)
Pumps and fans	169.28	x	3.07	=	519.67	(378)
Electricity for lighting	325.04	x	3.07	=	997.86	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					4922.92	(383)
Dwelling primary energy rate kWh/m2/year					66.53	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	3B4P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.42	(1a) x	2.50	(2a) =	181.05	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.42	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	181.05	(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		0	x 10 = 0	(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) =	0	÷ (5) = 0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(24a)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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	
Window			15.02	x	1.24	=	18.56			(27)
Door			1.80	x	0.70	=	1.26			(26)
External wall			30.08	x	0.17	=	5.11			(29a)
Party wall			32.93	x	0.00	=	0.00			(32)
External wall			10.38	x	0.20	=	2.08			(29a)
Roof			72.42	x	0.13	=	9.41			(30)
Total area of external elements ∑A, m²			129.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	36.43 (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		12.44 (36)
Total fabric heat loss	(33) + (36) =	48.87 (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	
16.99	16.80	16.61	15.65	15.46	14.51	14.51	14.32	14.89	15.46	15.84	16.22	(38)

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

65.85	65.66	65.47	64.52	64.33	63.38	63.38	63.19	63.76	64.33	64.71	65.09	

Average = ∑(39)1...12/12 = 64.47 (39)

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

0.91	0.91	0.90	0.89	0.89	0.88	0.88	0.87	0.88	0.89	0.89	0.90	

Average = ∑(40)1...12/12 = 0.89 (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	2.30	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.91	(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	
97.80	94.24	90.68	87.13	83.57	80.02	80.02	83.57	87.13	90.68	94.24	97.80	

∑(44)1...12 = 1066.87 (44)

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

145.03	126.84	130.89	114.11	109.50	94.49	87.56	100.47	101.67	118.49	129.34	140.45	

∑(45)1...12 = 1398.84 (45)

Distribution loss 0.15 x (45)m

21.75	19.03	19.63	17.12	16.42	14.17	13.13	15.07	15.25	17.77	19.40	21.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	3.42	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13	(54)
Enter (50) or (54) in (55)	0.13	(55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

172.33	151.51	158.20	140.54	136.80	120.91	114.86	127.77	128.09	145.79	155.76	167.76	(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

172.33	151.51	158.20	140.54	136.80	120.91	114.86	127.77	128.09	145.79	155.76	167.76	

∑(64)1...12 = 1720.32 (64)

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

70.07	61.90	65.36	59.08	58.25	52.55	50.96	55.25	54.94	61.24	64.14	68.54	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.15	16.12	13.11	9.93	7.42	6.26	6.77	8.80	11.81	15.00	17.50	18.66	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	202.88	204.98	199.68	188.38	174.13	160.73	151.78	149.67	154.98	166.27	180.53	193.93	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	(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)	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	(71)
Water heating gains (Table 5)	94.17	92.12	87.86	82.06	78.29	72.99	68.49	74.26	76.31	82.31	89.09	92.13	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	372.76	370.78	358.20	337.92	317.39	297.54	284.59	290.28	300.65	321.13	344.67	362.26	(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	10.54	x	19.64	x 0.9 x	0.45	x	0.70	=	45.19	(80)
South	0.77	x	4.48	x	46.75	x 0.9 x	0.45	x	0.70	=	45.72	(78)

Solar gains in watts ∑(74)m...(82)m

90.91	163.28	240.97	320.13	372.55	374.48	359.22	320.42	268.96	185.66	110.54	76.67	(83)

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

463.67	534.06	599.16	658.05	689.94	672.02	643.81	610.70	569.61	506.79	455.21	438.93	(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)													
	1.00	0.99	0.98	0.92	0.79	0.59	0.43	0.47	0.73	0.95	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.14	20.28	20.51	20.76	20.93	20.99	21.00	21.00	20.97	20.74	20.39	20.11	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.16	20.16	20.16	20.18	20.18	20.19	20.19	20.19	20.18	20.18	20.17	20.17	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.97	0.90	0.74	0.52	0.35	0.39	0.66	0.93	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.00	19.22	19.54	19.91	20.11	20.18	20.19	20.19	20.16	19.89	19.39	18.97	(90)

Living area fraction — Living area ÷ (4) = 0.38 (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													
	19.43	19.62	19.90	20.23	20.42	20.49	20.49	20.49	20.46	20.21	19.76	19.40	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.43	19.62	19.90	20.23	20.42	20.49	20.49	20.49	20.46	20.21	19.76	19.40	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.99	0.99	0.97	0.90	0.76	0.55	0.38	0.42	0.69	0.93	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	461.31	527.58	579.47	593.51	523.53	368.87	246.32	257.97	390.45	471.88	449.78	437.28	(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]													
	996.17	966.53	877.50	730.87	560.91	373.02	246.69	258.64	405.71	618.19	819.39	989.23	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	397.94	294.98	221.73	98.90	27.82	0.00	0.00	0.00	0.00	108.86	266.12	410.65	

∑(98)1...5, 10...12 = 1827.00 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 25.23 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1827.00		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	24.30	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	2405.61	(307b)

Water heating

Annual water heating requirement	1720.32		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	22.88	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2265.14	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	47.18	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	146.33		(330a)
Total electricity for the above, kWh/year		146.33	(331)
Electricity for lighting (Appendix L)		320.59	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5093.59	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	24.30	x	4.24	x 0.01 =	1.03	(340a)
Space heating from heat pump	2405.61	x	4.24	x 0.01 =	102.00	(340b)
Water heating from boilers	22.88	x	4.24	x 0.01 =	0.97	(342a)
Water heating from heat pump	2265.14	x	4.24	x 0.01 =	96.04	(342b)
Pumps and fans	146.33	x	13.19	x 0.01 =	19.30	(349)
Electricity for lighting	320.59	x	13.19	x 0.01 =	42.29	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		381.63	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.37	(357)
SAP value	80.96	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	52.71	x	0.216	=	11.39	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1334.50	x	0.519	=	692.61	(368)
Electrical energy for community heat distribution	47.18	x	0.519	=	24.49	(372)
Total CO2 associated with community systems					728.48	(373)
Total CO2 associated with space and water heating					728.48	(376)
Pumps and fans	146.33	x	0.519	=	75.95	(378)
Electricity for lighting	320.59	x	0.519	=	166.39	(379)
Energy saving/generation technologies						

pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	923.45	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.75	(384)
EI value					89.46	
EI rating (section 14)					89	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	52.71	x	1.22	=	64.31	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1334.50	x	3.07	=	4096.91	(368)
Electrical energy for community heat distribution	47.18	x	3.07	=	144.84	(372)
Total primary energy associated with community systems					4306.07	(373)
Total primary energy associated with space and water heating					4306.07	(376)
Pumps and fans	146.33	x	3.07	=	449.24	(378)
Electricity for lighting	320.59	x	3.07	=	984.22	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					5459.36	(383)
Dwelling primary energy rate kWh/m2/year					75.38	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	3B5P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		104.07	(1a) x	2.50	(2a) =	260.18	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	104.07	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	260.18	(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		0	x 10 = 0	(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) =	0	÷ (5) = 0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	74.80	(23c)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(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	
Window			18.08	x	1.24	=	22.34			(27)
Door			1.80	x	1.30	=	2.34			(26)
Ground floor			104.07	x	0.10	=	10.41			(28a)
External wall			38.90	x	0.17	=	6.61			(29a)
Party wall			24.13	x	0.00	=	0.00			(32)
External wall			26.50	x	0.20	=	5.30			(29a)
Total area of external elements ∑A, m²			189.35							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	47.00 (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		13.64 (36)
Total fabric heat loss	(33) + (36) =	60.64 (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)													
	24.78	24.50	24.23	22.86	22.59	21.22	21.22	20.94	21.76	22.59	23.13	23.68	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	85.42	85.14	84.87	83.50	83.23	81.86	81.86	81.58	82.41	83.23	83.77	84.32	
Average = ∑(39)1...12/12 =												83.43	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	0.82	0.82	0.82	0.80	0.80	0.79	0.79	0.78	0.79	0.80	0.80	0.81	
Average = ∑(40)1...12/12 =												0.80	(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	2.77 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	100.09 (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)													
	110.09	106.09	102.09	98.08	94.08	90.08	90.08	94.08	98.08	102.09	106.09	110.09	
∑(44)1...12 =												1201.03	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	163.27	142.79	147.35	128.46	123.26	106.37	98.57	113.11	114.46	133.39	145.60	158.12	
∑(45)1...12 =												1574.74	(45)
Distribution loss 0.15 x (45)m													
	24.49	21.42	22.10	19.27	18.49	15.96	14.78	16.97	17.17	20.01	21.84	23.72	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00 (47)
Water storage loss:	
b) Manufacturer's declared loss factor is not known	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)
Enter (50) or (54) in (55)	0.13 (55)
Water storage loss calculated for each month (55) x (41)m	

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

190.57	167.46	174.65	154.89	150.57	132.79	125.87	140.41	140.88	160.69	172.03	185.42	(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

190.57	167.46	174.65	154.89	150.57	132.79	125.87	140.41	140.88	160.69	172.03	185.42	

∑(64)1...12 = 1896.22 (64)

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

76.13	67.21	70.84	63.85	62.83	56.51	54.62	59.45	59.19	66.19	69.55	74.42	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.07	21.38	17.38	13.16	9.84	8.31	8.97	11.66	15.66	19.88	23.20	24.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.74	265.47	258.60	243.97	225.51	208.16	196.56	193.84	200.71	215.33	233.80	251.15	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	(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)	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	(71)
Water heating gains (Table 5)	102.32	100.01	95.21	88.68	84.45	78.48	73.41	79.91	82.22	88.97	96.60	100.02	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	453.75	451.47	435.81	410.43	384.41	359.55	343.56	350.02	363.19	388.80	418.21	440.52	(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	6.86	x	10.63	x 0.9 x	0.45	x	0.70	=	15.92	(74)
NorthEast	0.77	x	2.18	x	11.28	x 0.9 x	0.45	x	0.70	=	5.37	(75)
East	0.77	x	6.78	x	19.64	x 0.9 x	0.45	x	0.70	=	29.07	(76)
SouthEast	0.77	x	2.26	x	36.79	x 0.9 x	0.45	x	0.70	=	18.15	(77)

Solar gains in watts ∑(74)m...(82)m

68.51	129.14	207.35	304.39	381.45	395.76	374.51	314.91	240.89	151.23	84.39	57.10	(83)

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

522.26	580.61	643.16	714.82	765.86	755.31	718.06	664.93	604.08	540.02	502.60	497.62	(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)	1.00	1.00	0.99	0.97	0.88	0.68	0.50	0.56	0.84	0.98	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.13	20.24	20.43	20.69	20.90	20.99	21.00	21.00	20.94	20.68	20.36	20.12	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.24	20.24	20.24	20.25	20.25	20.26	20.26	20.27	20.26	20.25	20.25	20.24	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	0.99	0.96	0.84	0.61	0.42	0.47	0.79	0.98	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	19.06	19.22	19.50	19.88	20.15	20.26	20.26	20.27	20.21	19.86	19.40	19.04	(90)

Living area fraction | Living area ÷ (4) = | 0.32 | (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.40	19.54	19.80	20.14	20.39	20.49	20.50	20.50	20.45	20.12	19.71	19.38	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.40	19.54	19.80	20.14	20.39	20.49	20.50	20.50	20.45	20.12	19.71	19.38	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	0.99	0.96	0.85	0.63	0.44	0.50	0.80	0.98	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	521.49	578.70	636.59	684.18	647.54	473.96	318.52	333.02	484.39	526.64	500.84	497.08	(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]	1289.74	1246.75	1128.37	938.66	723.49	482.13	319.18	334.48	523.04	792.69	1056.33	1280.28	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	571.57	448.93	365.88	183.23	56.51	0.00	0.00	0.00	0.00	197.94	399.95	582.70	

∑(98)1...5, 10...12 = | 2806.71 | (98)

Space heating requirement kWh/m²/year | (98) ÷ (4) | 26.97 | (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement | 2806.71 | (98)

Space heat from boilers | (98) x (304a) x (305) x (306) = | 37.33 | (307a)

Space heat from heat pump	(98) x (304b) x (305) x (306) =	3695.60	(307b)

Water heating

Annual water heating requirement	1896.22		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	25.22	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2496.75	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	62.55	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	238.06		(330a)
Total electricity for the above, kWh/year		238.06	(331)
Electricity for lighting (Appendix L)		425.01	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	6826.71	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	37.33	x	4.24	x 0.01 =	1.58	(340a)
Space heating from heat pump	3695.60	x	4.24	x 0.01 =	156.69	(340b)
Water heating from boilers	25.22	x	4.24	x 0.01 =	1.07	(342a)
Water heating from heat pump	2496.75	x	4.24	x 0.01 =	105.86	(342b)
Pumps and fans	238.06	x	13.19	x 0.01 =	31.40	(349)
Electricity for lighting	425.01	x	13.19	x 0.01 =	56.06	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		472.67	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.33	(357)
SAP value	81.42	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	69.89	x	0.216	=	15.10	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1769.24	x	0.519	=	918.24	(368)
Electrical energy for community heat distribution	62.55	x	0.519	=	32.46	(372)
Total CO2 associated with community systems					965.80	(373)
Total CO2 associated with space and water heating					965.80	(376)
Pumps and fans	238.06	x	0.519	=	123.55	(378)

Electricity for lighting	425.01	x	0.519	=	220.58	(379)
Energy saving/generation technologies						
pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	1262.57	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.13	(384)
EI value					88.65	
EI rating (section 14)					89	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	69.89	x	1.22	=	85.26	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1769.24	x	3.07	=	5431.57	(368)
Electrical energy for community heat distribution	62.55	x	3.07	=	192.03	(372)
Total primary energy associated with community systems					5708.86	(373)
Total primary energy associated with space and water heating					5708.86	(376)
Pumps and fans	238.06	x	3.07	=	730.84	(378)
Electricity for lighting	425.01	x	3.07	=	1304.79	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					7464.33	(383)
Dwelling primary energy rate kWh/m2/year					71.72	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	3B6P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)		Volume (m³)	
Lowest occupied		94.73	(1a)	x	2.50	(2a) =	236.83	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	94.73	(4)					
Dwelling volume						(3a) + (3b) + (3c) + (3d)...(3n) =	236.83	(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	0	x 10 =	0	(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) = 0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (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) =	0.13 (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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	74.80	(23c)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(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	
Window			14.86	x	1.24	=	18.36			(27)
Door			1.80	x	0.60	=	1.08			(26)
External wall			36.28	x	0.17	=	6.17			(29a)
Party wall			15.15	x	0.00	=	0.00			(32)
External wall			34.68	x	0.20	=	6.94			(29a)
Roof			94.73	x	0.13	=	12.31			(30)
Total area of external elements ∑A, m²			182.35							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	44.86 (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		14.02 (36)
Total fabric heat loss	(33) + (36) =	58.88 (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	
22.55	22.30	22.05	20.81	20.56	19.31	19.31	19.06	19.81	20.56	21.06	21.56	(38)

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

81.44	81.19	80.94	79.69	79.44	78.20	78.20	77.95	78.70	79.44	79.94	80.44	

Average = ∑(39)1...12/12 = 79.63 (39)

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

0.86	0.86	0.85	0.84	0.84	0.83	0.83	0.82	0.83	0.84	0.84	0.85	

Average = ∑(40)1...12/12 = 0.84 (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: 2.69 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36: 97.97 (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	
107.77	103.85	99.93	96.01	92.09	88.17	88.17	92.09	96.01	99.93	103.85	107.77	

∑(44)1...12 = 1175.65 (44)

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

159.82	139.78	144.24	125.75	120.66	104.12	96.48	110.72	112.04	130.57	142.53	154.77	

∑(45)1...12 = 1541.46 (45)

Distribution loss 0.15 x (45)m

23.97	20.97	21.64	18.86	18.10	15.62	14.47	16.61	16.81	19.59	21.38	23.22	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel: 3.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)

Enter (50) or (54) in (55): 0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

187.12	164.44	171.54	152.17	147.96	130.54	123.79	138.02	138.46	157.87	168.95	182.08	(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

187.12	164.44	171.54	152.17	147.96	130.54	123.79	138.02	138.46	157.87	168.95	182.08	

∑(64)1...12 = 1862.94 (64)

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

74.98	66.20	69.80	62.95	61.96	55.76	53.92	58.66	58.39	65.26	68.53	73.31	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.11	20.53	16.69	12.64	9.45	7.98	8.62	11.20	15.04	19.09	22.28	23.75	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.52	250.08	243.61	229.83	212.44	196.09	185.17	182.60	189.08	202.85	220.25	236.59	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	(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)	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	(71)
Water heating gains (Table 5)	100.78	98.52	93.82	87.43	83.28	77.44	72.48	78.84	81.10	87.71	95.18	98.53	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

434.69	432.41	417.40	393.18	368.45	344.79	329.54	335.92	348.49	372.93	400.98	422.15	(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	10.44	x	19.64	x 0.9 x	0.45	x	0.70	=	44.76	(76)
South	0.77	x	4.42	x	46.75	x 0.9 x	0.45	x	0.70	=	45.11	(78)

Solar gains in watts ∑(74)m...(82)m

89.87	161.44	238.31	316.67	368.57	370.50	355.40	316.98	266.02	183.58	109.28	75.79	(83)

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

524.56	593.85	655.71	709.85	737.02	715.29	684.95	652.90	614.50	556.51	510.27	497.94	(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)													
	1.00	1.00	0.99	0.96	0.87	0.68	0.50	0.54	0.81	0.97	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.12	20.25	20.45	20.70	20.90	20.98	21.00	21.00	20.95	20.70	20.37	20.10	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.20	20.20	20.21	20.22	20.22	20.23	20.23	20.23	20.23	20.22	20.22	20.21	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	1.00	0.99	0.95	0.83	0.61	0.41	0.46	0.74	0.96	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.02	19.20	19.50	19.86	20.12	20.22	20.23	20.23	20.19	19.87	19.38	19.00	(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

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

19.38	19.55	19.81	20.14	20.37	20.47	20.48	20.48	20.44	20.14	19.71	19.36	(92)

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

19.38	19.55	19.81	20.14	20.37	20.47	20.48	20.48	20.44	20.14	19.71	19.36	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	1.00	0.99	0.98	0.94	0.84	0.63	0.44	0.49	0.76	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	523.24	590.34	644.84	670.52	616.23	450.06	302.87	316.93	468.83	534.66	507.20	497.03	(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]													
	1228.32	1189.33	1077.28	895.73	689.03	459.16	303.66	318.33	498.88	758.06	1007.88	1219.55	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	524.58	402.52	321.74	162.15	54.16	0.00	0.00	0.00	0.00	166.21	360.49	537.56	

∑(98)1...5, 10...12 = 2529.40 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 26.70 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	2529.40		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	33.64	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	3330.46	(307b)

Water heating

Annual water heating requirement	1862.94		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	24.78	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2452.94	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	58.42	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	216.69		(330a)
Total electricity for the above, kWh/year		216.69	(331)
Electricity for lighting (Appendix L)		408.17	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	6375.42	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	33.64	x	4.24	x 0.01 =	1.43	(340a)
Space heating from heat pump	3330.46	x	4.24	x 0.01 =	141.21	(340b)
Water heating from boilers	24.78	x	4.24	x 0.01 =	1.05	(342a)
Water heating from heat pump	2452.94	x	4.24	x 0.01 =	104.00	(342b)
Pumps and fans	216.69	x	13.19	x 0.01 =	28.58	(349)
Electricity for lighting	408.17	x	13.19	x 0.01 =	53.84	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		450.11	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.35	(357)
SAP value	81.13	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	65.27	x	0.216	=	14.10	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1652.40	x	0.519	=	857.60	(368)
Electrical energy for community heat distribution	58.42	x	0.519	=	30.32	(372)
Total CO2 associated with community systems					902.01	(373)
Total CO2 associated with space and water heating					902.01	(376)
Pumps and fans	216.69	x	0.519	=	112.46	(378)
Electricity for lighting	408.17	x	0.519	=	211.84	(379)
Energy saving/generation technologies						

pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	1178.95	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	12.45	(384)
EI value					88.69	
EI rating (section 14)					89	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	65.27	x	1.22	=	79.63	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1652.40	x	3.07	=	5072.87	(368)
Electrical energy for community heat distribution	58.42	x	3.07	=	179.34	(372)
Total primary energy associated with community systems					5331.84	(373)
Total primary energy associated with space and water heating					5331.84	(376)
Pumps and fans	216.69	x	3.07	=	665.25	(378)
Electricity for lighting	408.17	x	3.07	=	1253.08	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					6970.01	(383)
Dwelling primary energy rate kWh/m2/year					73.58	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	23/10/2020
Address	4B8P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		72.24	(1a)	x	2.50	(2a)	=	180.60	(3a)
+1		57.20	(1b)	x	2.50	(2b)	=	143.00	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	129.44	(4)						
Dwelling volume						(3a) + (3b) + (3c) + (3d)...(3n) =		323.60	(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	0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	73.10	(23c)

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

	0.30	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(24a)

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

0.30	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28 (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	
Window			23.72	x	1.24	=	29.31			(27)
Door			1.80	x	1.30	=	2.34			(26)
Ground floor			72.24	x	0.10	=	7.22			(28a)
External wall			64.31	x	0.17	=	10.93			(29a)
Party wall			79.95	x	0.00	=	0.00			(32)
Roof			15.04	x	0.13	=	1.96			(30)
Roof			2.58	x	0.16	=	0.41			(30)
Total area of external elements ∑A, m²			179.69							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	52.18 (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		14.96 (36)
Total fabric heat loss	(33) + (36) =	67.14 (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)													
	31.72	31.38	31.04	29.34	29.00	27.30	27.30	26.96	27.98	29.00	29.68	30.36	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	98.86	98.52	98.18	96.48	96.14	94.43	94.43	94.09	95.11	96.14	96.82	97.50	
Average = ∑(39)1...12/12 =												96.39	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	0.76	0.76	0.76	0.75	0.74	0.73	0.73	0.73	0.73	0.74	0.75	0.75	
Average = ∑(40)1...12/12 =												0.74	(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	2.89 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	102.92 (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)													
	113.21	109.10	104.98	100.86	96.75	92.63	92.63	96.75	100.86	104.98	109.10	113.21	
∑(44)1...12 =												1235.05	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	167.89	146.84	151.53	132.10	126.76	109.38	101.36	116.31	117.70	137.17	149.73	162.59	
∑(45)1...12 =												1619.35	(45)
Distribution loss 0.15 x (45)m													
	25.18	22.03	22.73	19.82	19.01	16.41	15.20	17.45	17.65	20.57	22.46	24.39	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00 (47)
Water storage loss:	
b) Manufacturer's declared loss factor is not known	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)

Enter (50) or (54) in (55) | 0.13 | (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

195.20	171.50	178.83	158.53	154.06	135.80	128.66	143.61	144.12	164.47	176.15	189.90	(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

195.20	171.50	178.83	158.53	154.06	135.80	128.66	143.61	144.12	164.47	176.15	189.90	

∑(64)1...12 = 1940.83 (64)

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

77.67	68.55	72.22	65.06	63.99	57.51	55.54	60.52	60.27	67.45	70.92	75.91	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.97	23.96	19.48	14.75	11.03	9.31	10.06	13.07	17.55	22.28	26.00	27.72	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.04	300.13	292.36	275.82	254.95	235.33	222.22	219.14	226.91	243.45	264.32	283.94	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	(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)	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	(71)
Water heating gains (Table 5)	104.39	102.01	97.08	90.36	86.01	79.87	74.66	81.34	83.71	90.66	98.50	102.02	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	494.81	492.50	475.32	447.34	418.38	390.91	373.34	379.96	394.57	422.79	455.23	480.09	(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	
South	0.77	x	9.04	x	46.75	x 0.9 x	0.50	x	0.70	=	102.51	(78)
East	0.77	x	10.68	x	19.64	x 0.9 x	0.45	x	0.70	=	45.79	(76)
SouthEast	0.77	x	4.00	x	36.79	x 0.9 x	0.50	x	0.70	=	35.70	(77)

Solar gains in watts ∑(74)m...(82)m

184.00	318.27	444.57	559.93	631.00	626.93	604.31	552.00	485.05	354.57	221.36	156.78	(83)

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

678.81	810.77	919.89	1007.27	1049.38	1017.84	977.65	931.96	879.62	777.36	676.59	636.87	(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)	1.00	1.00	0.98	0.93	0.80	0.59	0.42	0.46	0.72	0.96	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.24	20.39	20.59	20.82	20.96	21.00	21.00	21.00	20.98	20.80	20.47	20.22	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.28	20.29	20.29	20.30	20.30	20.31	20.31	20.32	20.31	20.30	20.30	20.29	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.98	0.91	0.75	0.53	0.36	0.40	0.66	0.94	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	19.25	19.48	19.77	20.09	20.26	20.31	20.31	20.32	20.30	20.07	19.61	19.23	(90)

Living area fraction | Living area ÷ (4) = | 0.30 | (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.55	19.75	20.02	20.31	20.47	20.52	20.52	20.52	20.50	20.29	19.87	19.52	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.55	19.75	20.02	20.31	20.47	20.52	20.52	20.52	20.50	20.29	19.87	19.52	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.98	0.91	0.76	0.55	0.38	0.42	0.68	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	677.47	805.20	897.89	920.24	802.43	555.80	370.14	387.58	595.71	732.56	672.54	636.04	(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]	1507.74	1463.21	1327.29	1101.17	843.21	558.90	370.32	387.94	609.16	931.85	1236.13	1494.12	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	617.72	442.19	319.47	130.26	30.34	0.00	0.00	0.00	0.00	148.28	405.78	638.41	

∑(98)1...5, 10...12 = | 2732.45 | (98)

Space heating requirement kWh/m²/year | (98) ÷ (4) | 21.11 | (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.01	(303a)
Fraction of community heat from heat pump		0.99	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.01	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.99	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement | 2732.45 | (98)

Space heat from boilers | (98) x (304a) x (305) x (306) = | 36.34 | (307a)

Space heat from heat pump	(98) x (304b) x (305) x (306) =	3597.81	(307b)

Water heating

Annual water heating requirement	1940.83		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	25.81	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	2555.49	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	62.15	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	350.38		(330a)
Total electricity for the above, kWh/year		350.38	(331)
Electricity for lighting (Appendix L)		476.33	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	6950.91	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	36.34	x	4.24	x 0.01 =	1.54	(340a)
Space heating from heat pump	3597.81	x	4.24	x 0.01 =	152.55	(340b)
Water heating from boilers	25.81	x	4.24	x 0.01 =	1.09	(342a)
Water heating from heat pump	2555.49	x	4.24	x 0.01 =	108.35	(342b)
Pumps and fans	350.38	x	13.19	x 0.01 =	46.21	(349)
Electricity for lighting	476.33	x	13.19	x 0.01 =	62.83	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		492.58	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.19	(357)
SAP value	83.46	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	69.45	x	0.216	=	15.00	(367)
Efficiency of heat pump	350.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1758.09	x	0.519	=	912.45	(368)
Electrical energy for community heat distribution	62.15	x	0.519	=	32.26	(372)
Total CO2 associated with community systems					959.71	(373)
Total CO2 associated with space and water heating					959.71	(376)
Pumps and fans	350.38	x	0.519	=	181.85	(378)

Electricity for lighting	476.33	x	0.519	=	247.22	(379)
Energy saving/generation technologies						
pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	1341.40	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	10.36	(384)
EI value					89.70	
EI rating (section 14)					90	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	69.45	x	1.22	=	84.72	(367)
Efficiency of heat pump	350.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1758.09	x	3.07	=	5397.32	(368)
Electrical energy for community heat distribution	62.15	x	3.07	=	190.81	(372)
Total primary energy associated with community systems					5672.86	(373)
Total primary energy associated with space and water heating					5672.86	(376)
Pumps and fans	350.38	x	3.07	=	1075.66	(378)
Electricity for lighting	476.33	x	3.07	=	1462.34	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					7930.70	(383)
Dwelling primary energy rate kWh/m2/year					61.27	(384)

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Appendix P BRUKL – *Be Green*

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Cambridge Road Estate Commercial Units

As designed

Date: Wed Sep 30 17:48:37 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v6.1.7

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	11.3
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	11.3
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	7.7
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.3	"01 Ground Floor - Community Space_W_18"
Floor	0.25	0.15	0.15	"01 Ground Floor - Community Space_F_2"
Roof	0.25	0.13	0.13	"01 Ground Floor - Community Space_R_5"
Windows***, roof windows, and rooflights	2.2	1.3	1.3	"01 Ground Floor - Community Space_G_9"
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- ASHP

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.5	4.2	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

1- Project DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
01 Ground Floor - Community Space	-	-	-	1.4	-	-	-	-	-	0.85	0.5
01 Ground Floor - Retail	-	-	-	1.4	-	-	-	-	-	0.85	0.5
01 Ground Floor - Workspace	-	-	-	1.4	-	-	-	-	-	0.85	0.5
02 First Floor 1 - Community Space	-	-	-	1.4	-	-	-	-	-	0.85	0.5

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
01 Ground Floor - Community Space	-	110	-	6776
01 Ground Floor - Retail	-	110	75	1868
01 Ground Floor - Workspace	110	-	-	1254
02 First Floor 1 - Community Space	-	110	-	1768

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
01 Ground Floor - Community Space	NO (-70.3%)	NO
01 Ground Floor - Retail	NO (-55%)	NO
01 Ground Floor - Workspace	NO (-25.6%)	NO
02 First Floor 1 - Community Space	NO (-44.2%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	2474.4	2474.4
External area [m^2]	4832.7	4832.7
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	6
Average conductance [W/K]	1571.51	1575.04
Average U-value [W/m^2K]	0.33	0.33
Alpha value* [%]	10.65	28.18

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
9	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
9	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
83	**D1 Non-residential Institutions: Community/Day Centre**
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	2.24	3.74
Cooling	2.29	3.76
Auxiliary	2.23	1.43
Lighting	7.72	13.14
Hot water	0.4	0.46
Equipment*	10.12	10.12
TOTAL**	**14.88**	**22.53**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	71.95	81.42
Primary energy* [kWh/m^2]	45.69	66.57
Total emissions [kg/m^2]	7.7	11.3

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	33.9	38.1	2.2	2.3	2.2	4.19	4.62	4.5	6.5
	Notional	32.7	48.7	3.7	3.8	1.4	2.43	3.6	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.17	"01 Ground Floor - Community Space_W_8"
Floor	0.2	0.15	"01 Ground Floor - Community Space_F_2"
Roof	0.15	0.13	"01 Ground Floor - Community Space_R_5"
Windows, roof windows, and rooflights	1.5	1.3	"01 Ground Floor - Community Space_G_9"
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5

Appendix Q CO_2 Emissions Summary – *Be Green- Alternative energy strategy*

SAP 2012 PERFORMANCE

DOMESTIC

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	509	573
After energy demand reduction	460	573
After heat network / CHP	460	573
After renewable energy	483	573

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	49	10%
Savings from heat network / CHP	0	0%
Savings from renewable energy	-23	-4%
Cumulative on site savings	**27**	**5%**
Annual savings from off-set payment	483	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**14,486**	-
Cash in-lieu contribution (£)	**869,170**	

NON-DOMESTIC

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	29	10
After energy demand reduction	22	10
After heat network / CHP	22	10
After renewable energy	19	10

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	7	25%
Savings from heat network / CHP	0	0%
Savings from renewable energy	3	10%
Total Cumulative Savings	**10**	**34%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	**10**	-
Shortfall	0	5
Cash in-lieu contribution (£)	**327**	-

SITE-WIDE

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	539		
Be lean	482	56	10%
Be clean	482	0	0%
Be green	502	-20	-4%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**14,492**	-

Building use	Energy demand following energy efficiency measures (MWh/year)						
	Space Heating	Hot Water	Lighting	Auxilary	Cooling	Unregulated electricity	Unregulated gas
Domestic	3568	4168	640	369	0		
Non-domestic	33	1	23	7	7		

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	46.42	40.66	12%

	Area weighted average non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual		
Notional		

SAP10 PERFORMANCE

DOMESTIC

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	450	257
After energy demand reduction	390	257
After heat network / CHP	390	257
After renewable energy	293	257

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	60	13%
Savings from heat network / CHP	0	0%
Savings from renewable energy	96	21%
Cumulative on site savings	**156**	**35%**
Annual savings from off-set payment	293	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**8,799**	-
Cash in-lieu contribution (£)	**527,947**	

NON-DOMESTIC

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	16	5
After energy demand reduction	13	5
After heat network / CHP	13	5
After renewable energy	9	5

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	3	20%
Savings from heat network / CHP	0	0%
Savings from renewable energy	4	28%
Total Cumulative Savings	**8**	**47%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	6	-
Shortfall	-2	-60
Cash in-lieu contribution (£)	**-3,629**	-

SITE-WIDE

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	466		
Be lean	403	63	14%
Be clean	403	0	0%
Be green	302	101	22%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**8,739**	-

The applicant should complete all the light blue cells including information on the 'be green' energy consumption figures and the 'be green' DER.

SAP 2012 CO2 PERFORMANCE | SAP10 CO2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m^2)	Number of units	Total area represented by model (m^2)	VALIDATION CHECK: Calculated DER 2012 (kgCO2 / m2)	VALIDATION CHECK: DER Worksheet DER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE GREEN' SAP DER WORKSHEET: Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space Heating (Heat source 2) if applicable	Fuel type Space Heating	Domestic Hot Water (Heat source 2) if applicable	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP if applicable	Fuel type CHP if applicable	Total Electricity generated by CHP (-) if applicable	Electricity generated by renewable (-) if applicable	Lighting	Auxiliary	Cooling
					DER Sheet (Row 384)	DER Sheet [Row 307b + (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b + (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 307c + (Row 367c x 0.01)]	Select fuel type	DER Sheet [Row 310c + (Row 367c x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) + (Row 362 x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) x (Row 361 + 362)]	DER Sheet Row 380	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
1B2P - Ground Flo	*51.12*	*88*	*869.04*	**18.3**	**18.3**	*613.9659218*	*Natural Gas*	*737.2863687*	*Natural Gas*	*429.0963462*	*Grid Electricity*	*515.2841154*	*Grid Electricity*			*-91.26*	*246.61*	*139.9376*		
1B2P - Mid Floor	*50.88*	*697*	*6665.28*	**16.9**	**16.9**	*483.8906145*	*Natural Gas*	*735.9921788*	*Natural Gas*	*338.1876538*	*Grid Electricity*	*514.3796154*	*Grid Electricity*			*-91.26*	*247.99*	*135.8947*		
1B2P - Top Floor B	*50.32*	*88*	*855.44*	**17.6**	**17.6**	*539.2605587*	*Natural Gas*	*732.9650279*	*Natural Gas*	*376.8853077*	*Grid Electricity*	*512.2639615*	*Grid Electricity*			*-91.26*	*244.38*	*136.1843*		
2B3P - Top Floor B	*64.62*	*231*	*3424.86*	**20.8**	**20.8**	*1152.260447*	*Natural Gas*	*807.9653631*	*Natural Gas*	*805.3065*	*Grid Electricity*	*564.6811538*	*Grid Electricity*			*-91.26*	*290.37*	*200.9837*		
2B4P - Mid Floor	*73.74*	*462*	*7816.44*	**15.1**	**15.1**	*694.2794413*	*Natural Gas*	*849.1213408*	*Natural Gas*	*485.2268846*	*Grid Electricity*	*593.4447692*	*Grid Electricity*			*-91.26*	*325.11*	*190.8589*		
2B4P - Mid Floor B	*74*	*462*	*7844*	**14.8**	**14.8**	*638.7103911*	*Natural Gas*	*850.1832402*	*Natural Gas*	*446.3900769*	*Grid Electricity*	*594.1869231*	*Grid Electricity*			*-91.26*	*325.04*	*209.6606*		
3B4P - Top Floor	*72.42*	*45*	*289.68*	**16.9**	**16.9**	*895.9444693*	*Natural Gas*	*843.627486*	*Natural Gas*	*626.1691154*	*Grid Electricity*	*589.6051538*	*Grid Electricity*			*-91.26*	*320.59*	*193.5093*		
3B5P - Ground Flo	*104.07*	*45*	*416.28*	**16.0**	**16.0**	*1376.387598*	*Natural Gas*	*929.8883799*	*Natural Gas*	*961.9473462*	*Grid Electricity*	*649.8922692*	*Grid Electricity*			*-91.26*	*425.01*	*300.609*		
3B6P - Top Floor	*94.73*	*26*	*663.11*	**16.4**	**16.4**	*1240.398101*	*Natural Gas*	*913.5690503*	*Natural Gas*	*866.9052692*	*Grid Electricity*	*638.4868077*	*Grid Electricity*			*-91.26*	*408.17*	*275.1082*		
4P8P - Duplex	*129.44*	*26*	*906.08*	**13.4**	**13.4**	*1139.965922*	*Natural Gas*	*951.7642458*	*Natural Gas*	*936.4925*	*Grid Electricity*	*665.1811538*	*Grid Electricity*			*-91.26*	*476.33*	*412.5345*		
Sum	**141,344**	**2,170**	**29,750**	**3.4**	**-**	**1,490,114**	**N/A**	**1,742,394**	**N/A**	**0**	**N/A**	**1,217,747**	**N/A**	**0**	**N/A**	**0**	**-198,034**	**640,050**	**390,599**	**0**

Unit identifier	REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.): Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Electricity generated by renewable if applicable	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	REGULATED CO2 EMISSIONS PER UNIT: Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Electricity generated by renewable if applicable	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
1B2P - Ground Flo	**355**	**427**	**0**	**-47**	**128**	**73**			**935**	**229**	**275**	**0**	**-21**	**57**	**33**			**573**	**11.2**
1B2P - Mid Floor	**280**	**426**	**0**	**-47**	**129**	**71**			**858**	**180**	**274**	**0**	**-21**	**58**	**32**			**523**	**10.3**
1B2P - Top Floor B	**312**	**424**	**0**	**-47**	**127**	**71**			**886**	**201**	**273**	**0**	**-21**	**57**	**32**			**542**	**10.8**
2B3P - Top Floor B	**667**	**468**	**0**	**-47**	**151**	**104**			**1,342**	**430**	**301**	**0**	**-21**	**68**	**47**			**824**	**12.8**
2B4P - Mid Floor	**402**	**491**	**0**	**-47**	**169**	**99**			**1,114**	**259**	**317**	**0**	**-21**	**76**	**44**			**674**	**9.1**
2B4P - Mid Floor B	**370**	**492**	**0**	**-47**	**169**	**109**			**1,092**	**238**	**317**	**0**	**-21**	**76**	**49**			**658**	**8.9**
3B4P - Top Floor	**519**	**488**	**0**	**-47**	**166**	**100**			**1,226**	**334**	**315**	**0**	**-21**	**75**	**45**			**747**	**10.3**
3B5P - Ground Flo	**797**	**538**	**0**	**-47**	**221**	**156**			**1,664**	**513**	**347**	**0**	**-21**	**99**	**70**			**1,008**	**9.7**
3B6P - Top Floor	**718**	**529**	**0**	**-47**	**212**	**143**			**1,554**	**462**	**341**	**0**	**-21**	**95**	**64**			**941**	**9.9**
4P8P - Duplex	**775**	**551**	**0**	**-47**	**247**	**214**			**1,740**	**500**	**355**	**0**	**-21**	**111**	**96**			**1,040**	**8.0**
Sum	**862,366**	**1,008,368**	**0**	**0**	**-102,780**	**332,186**	**202,721**	**0**	***482,872***	**555,577**	**649,638**	**0**	**0**	**-46,142**	**149,132**	**91,009**	**0**	***293,304***	**2.1**

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Area per unit (m^2)	Number of units	Total area represented by model (m^2)	VALIDATION CHECK: Calculated BER 2012 (kgCO2 / m2)	VALIDATION CHECK: BRUKL BER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m^2 p.a.) 'BE GREEN' BER - SOURCE: BRUKL OUTPUT: Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water							Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Lighting	Auxiliary	Cooling
Commercial	*2935*	*1*	*2474.4*	**7.7**	**7.7**	*2.24*	*Grid Electricity*	*0.4*	*Grid Electricity*	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**			*7.72*	*2.23*	*2.29*
Sum	**2,935**	**1**	**2,474**	**6.5**	**-**	**6,574**	**N/A**	**1,174**	**N/A**							**0**	**0**	**22,658**	**6,545**	**6,721**

Use	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m^2 p.a.) 'BE GREEN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	2012 CO2 emissions (kgCO2 p.a.)	REGULATED CO2 EMISSIONS PER UNIT: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	SAP10 CO2 emissions	BRUKL BER SAP10 (kgCO2 / m2)
Commercial	##########	**15**	##########	##########	##########	##########	##########	##########	**22,666**	##########	**15**	##########	##########	##########	##########	##########	##########	**10,176**	**3.5**
Sum	**0**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	***19,109***	**0**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	***8,579***	**2.9**

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m^2)	Calculated BER 2012 (kgCO2 / m2)	-	REGULATED CO2 EMISSIONS: Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space and Domestic Hot Water from CHP (kWh p.a.)	N/A	Electricity generated by CHP (kWh p.a.) if applicable	Electricity generated by renewable (kWh p.a.) if applicable	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	**32,225**	**0.0**	**-**	**1,496,688**		**1,743,568**		**0**		**1,217,747**		**0**		**0**	**-198,034**	**662,708**	**397,144**	**6,721**

Use	REGULATED CO2 EMISSIONS: Space Heating CO2 emissions	Domestic Hot Water CO2 emissions	Space Heating and DHW from CHP CO2 emissions if applicable	Electricity generated by CHP CO2 savings if applicable	Electricity generated by renewable CO2 savings if applicable	Lighting CO2 emissions	Auxiliary CO2 emissions	Cooling CO2 emissions	2012 CO2 emissions	REGULATED CO2 EMISSIONS PER UNIT: Space Heating CO2 emissions	Domestic Hot Water CO2 emissions	Space Heating and DHW from CHP CO2 emissions if applicable	Electricity generated by CHP CO2 savings if applicable	Electricity generated by renewable CO2 savings if applicable	Lighting CO2 emissions	Auxiliary CO2 emissions	Cooling CO2 emissions	SAP10 CO2 emissions	Calculated BER SAP10 (kgCO2 / m2)
Sum	**862,366**	**1,008,383**	**0**	**0**	**-102,780**	**332,186**	**202,721**	**0**	***501,981***	**555,577**	**649,653**	**0**	**0**	**-46,142**	**149,132**	**91,009**	**0**	***301,883***	**9.4**

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	26/10/2020
Address	1B2P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		51.12	(1a) x	2.50	(2a) =	127.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	51.12	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.80	(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	0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	1	(19)
Shelter factor	1 - [0.075 x (19)] = 0.93	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.14	(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	0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.30	0.30	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(24a)

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

	0.30	0.30	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(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	
Window			8.18	x	1.24	=	10.11			(27)
Door			1.80	x	0.60	=	1.08			(26)
Ground floor			51.12	x	0.10	=	5.11			(28a)
External wall			18.25	x	0.17	=	3.10			(29a)
Party wall			17.80	x	0.00	=	0.00			(32)
External wall			25.45	x	0.15	=	3.82			(29a)
External wall			2.70	x	0.20	=	0.54			(29a)
Total area of external elements ∑A, m²			107.50							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.76 (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		8.51 (36)
Total fabric heat loss	(33) + (36) =	32.27 (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)	12.60	12.45	12.30	11.57	11.43	10.69	10.69	10.55	10.99	11.43	11.72	12.01	(38)
Heat transfer coefficient, W/K (37)m + (38)m	44.86	44.72	44.57	43.84	43.69	42.96	42.96	42.82	43.26	43.69	43.99	44.28	

Average = ∑(39)1...12/12 = 43.80 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.88	0.87	0.87	0.86	0.85	0.84	0.84	0.84	0.85	0.85	0.86	0.87	

Average = ∑(40)1...12/12 = 0.86 (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	1.72 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	75.12 (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)	82.64	79.63	76.63	73.62	70.62	67.61	67.61	70.62	73.62	76.63	79.63	82.64	

∑(44)1...12 = 901.49 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	122.55	107.18	110.60	96.42	92.52	79.84	73.98	84.90	85.91	100.12	109.29	118.68	

∑(45)1...12 = 1181.99 (45)

Distribution loss 0.15 x (45)m	18.38	16.08	16.59	14.46	13.88	11.98	11.10	12.73	12.89	15.02	16.39	17.80	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00 (47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)
Enter (50) or (54) in (55)	0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

149.85	131.84	137.90	122.85	119.83	106.26	101.29	112.20	112.33	127.42	135.71	145.98	(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

149.85	131.84	137.90	122.85	119.83	106.26	101.29	112.20	112.33	127.42	135.71	145.98	

∑(64)1...12 = 1503.47 (64)

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

62.59	55.37	58.62	53.20	52.61	47.68	46.44	50.07	49.70	55.13	57.48	61.30	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.96	12.40	10.09	7.64	5.71	4.82	5.21	6.77	9.08	11.54	13.46	14.35	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	150.14	151.70	147.77	139.42	128.87	118.95	112.32	110.77	114.69	123.05	133.60	143.52	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	(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)	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	(71)
Water heating gains (Table 5)	84.13	82.39	78.79	73.89	70.71	66.23	62.42	67.30	69.03	74.10	79.83	82.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	297.08	295.34	285.49	269.79	254.13	238.84	228.80	233.68	241.66	257.54	275.74	289.11	(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	8.18	x	19.64	x 0.9 x	0.45	x	0.70	=	35.07	(80)

Solar gains in watts ∑(74)m...(82)m

35.07	68.61	112.98	164.78	201.94	206.73	196.81	169.06	131.40	81.41	43.73	28.84	(83)

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

332.15	363.95	398.48	434.57	456.07	445.57	425.61	402.74	373.06	338.94	319.47	317.96	(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)													
	1.00	0.99	0.98	0.93	0.81	0.61	0.44	0.49	0.75	0.96	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.19	20.31	20.51	20.76	20.93	20.99	21.00	21.00	20.97	20.75	20.43	20.17	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.19	20.19	20.19	20.20	20.21	20.22	20.22	20.22	20.21	20.21	20.20	20.20	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.98	0.91	0.76	0.54	0.36	0.41	0.68	0.94	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.10	19.27	19.56	19.92	20.14	20.21	20.22	20.22	20.19	19.92	19.46	19.09	(90)

Living area fraction — Living area ÷ (4) = 0.47 (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													
	19.62	19.76	20.01	20.32	20.51	20.58	20.59	20.59	20.55	20.31	19.92	19.60	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.62	19.76	20.01	20.32	20.51	20.58	20.59	20.59	20.55	20.31	19.92	19.60	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.99	0.99	0.97	0.92	0.78	0.57	0.40	0.44	0.72	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	330.35	360.17	388.00	398.81	356.69	253.79	170.95	178.73	267.01	319.02	315.72	316.61	(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]													
	687.15	664.50	602.02	500.53	384.96	256.86	171.22	179.23	279.17	424.16	563.78	681.78	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	265.46	204.51	159.24	73.24	21.03	0.00	0.00	0.00	0.00	78.23	178.60	271.69	

∑(98)1...5, 10...12 = 1251.99 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 24.49 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.33	(303a)
Fraction of community heat from heat pump		0.67	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.33	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.67	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1251.99		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	549.50	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1115.65	(307b)

Water heating

Annual water heating requirement	1503.47		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	659.87	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1339.74	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	36.65	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	103.29		(330a)
Total electricity for the above, kWh/year		103.29	(331)
Electricity for lighting (Appendix L)		246.61	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3923.41	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	549.50	x	4.24	x 0.01 =	23.30	(340a)
Space heating from heat pump	1115.65	x	4.24	x 0.01 =	47.30	(340b)
Water heating from boilers	659.87	x	4.24	x 0.01 =	27.98	(342a)
Water heating from heat pump	1339.74	x	4.24	x 0.01 =	56.81	(342b)
Pumps and fans	103.29	x	13.19	x 0.01 =	13.62	(349)
Electricity for lighting	246.61	x	13.19	x 0.01 =	32.53	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		321.54	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.40	(357)
SAP value	80.40	
SAP rating (section 13)	80	(358)
SAP band	C	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1351.25	x	0.216	=	291.87	(367)
Efficiency of heat pump	260.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	944.38	x	0.519	=	490.13	(368)
Electrical energy for community heat distribution	36.65	x	0.519	=	19.02	(372)
Total CO2 associated with community systems					801.02	(373)
Total CO2 associated with space and water heating					801.02	(376)
Pumps and fans	103.29	x	0.519	=	53.61	(378)
Electricity for lighting	246.61	x	0.519	=	127.99	(379)
Energy saving/generation technologies						

pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	935.26	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	18.30	(384)
EI value					86.96	
EI rating (section 14)					87	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1351.25	x	1.22	=	1648.53	(367)
Efficiency of heat pump	260.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	944.38	x	3.07	=	2899.25	(368)
Electrical energy for community heat distribution	36.65	x	3.07	=	112.51	(372)
Total primary energy associated with community systems					4660.28	(373)
Total primary energy associated with space and water heating					4660.28	(376)
Pumps and fans	103.29	x	3.07	=	317.11	(378)
Electricity for lighting	246.61	x	3.07	=	757.11	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					5454.34	(383)
Dwelling primary energy rate kWh/m2/year					106.70	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	26/10/2020
Address	1B2P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.88	(1a) x	2.50	(2a) =	127.20	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.88	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	127.20	(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		0	x 10 =	0 (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) =	0	÷ (5) =	0.00 (8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.12	(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	0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(24a)

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

	0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(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	
Window			7.76	x	1.24	=	9.59			(27)
Door			1.80	x	0.70	=	1.26			(26)
External wall			28.52	x	0.17	=	4.85			(29a)
Party wall			11.68	x	0.00	=	0.00			(32)
External wall			22.93	x	0.20	=	4.59			(29a)
Total area of external elements ∑A, m²			61.01							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	20.28 (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		7.20 (36)
Total fabric heat loss	(33) + (36) =	27.48 (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	
11.33	11.21	11.09	10.48	10.36	9.75	9.75	9.62	9.99	10.36	10.60	10.84	(38)

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

38.81	38.69	38.57	37.96	37.84	37.23	37.23	37.11	37.47	37.84	38.08	38.33	

Average = ∑(39)1...12/12 = 37.93 (39)

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

0.76	0.76	0.76	0.75	0.74	0.73	0.73	0.73	0.74	0.74	0.75	0.75	

Average = ∑(40)1...12/12 = 0.75 (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	74.96 (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	
82.45	79.45	76.45	73.46	70.46	67.46	67.46	70.46	73.46	76.45	79.45	82.45	

∑(44)1...12 = 899.47 (44)

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

122.27	106.94	110.35	96.21	92.31	79.66	73.82	84.71	85.72	99.90	109.04	118.41	

∑(45)1...12 = 1179.35 (45)

Distribution loss 0.15 x (45)m

18.34	16.04	16.55	14.43	13.85	11.95	11.07	12.71	12.86	14.98	16.36	17.76	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00 (47)
Water storage loss:	
b) Manufacturer's declared loss factor is not known	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)
Enter (50) or (54) in (55)	0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

149.58	131.60	137.66	122.63	119.62	106.08	101.12	112.01	112.14	127.20	135.47	145.72	(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

149.58	131.60	137.66	122.63	119.62	106.08	101.12	112.01	112.14	127.20	135.47	145.72	

∑(64)1...12 = 1500.82 (64)

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

62.50	55.29	58.54	53.13	52.54	47.63	46.39	50.01	49.64	55.06	57.40	61.22	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.04	12.47	10.14	7.68	5.74	4.85	5.24	6.81	9.14	11.60	13.54	14.43	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	149.52	151.07	147.16	138.84	128.33	118.46	111.86	110.31	114.22	122.54	133.05	142.92	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	(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)	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	(71)
Water heating gains (Table 5)	84.00	82.27	78.68	73.79	70.61	66.15	62.35	67.21	68.94	74.00	79.72	82.28	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	296.31	294.56	284.72	269.05	253.43	238.19	228.18	233.07	241.04	256.88	275.04	288.37	(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	4.56	x	10.63	x 0.9 x	0.45	x	0.70	=	10.58	(74)
East	0.77	x	3.20	x	19.64	x 0.9 x	0.45	x	0.70	=	13.72	(76)

Solar gains in watts ∑(74)m...(82)m

24.30	47.07	78.57	119.67	153.37	160.49	151.33	125.11	92.73	55.92	30.16	20.11	(83)

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

320.61	341.62	363.29	388.72	406.80	398.68	379.51	358.18	333.77	312.81	305.21	308.48	(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)

	1.00	0.99	0.98	0.94	0.81	0.59	0.43	0.48	0.74	0.95	0.99	1.00	(86)

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

	20.35	20.44	20.60	20.81	20.95	21.00	21.00	21.00	20.98	20.81	20.55	20.33	(87)

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

	20.29	20.29	20.29	20.30	20.30	20.31	20.31	20.32	20.31	20.30	20.30	20.29	(88)

Utilisation factor for gains for rest of dwelling n2,m

	1.00	0.99	0.98	0.92	0.76	0.53	0.36	0.41	0.68	0.94	0.99	1.00	(89)

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

	19.41	19.54	19.78	20.08	20.26	20.31	20.31	20.31	20.29	20.09	19.71	19.39	(90)

Living area fraction — Living area ÷ (4) = 0.45 (91)

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

	19.84	19.95	20.15	20.41	20.57	20.62	20.63	20.63	20.61	20.42	20.09	19.82	(92)

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

	19.84	19.95	20.15	20.41	20.57	20.62	20.63	20.63	20.61	20.42	20.09	19.82	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.98	0.92	0.78	0.56	0.39	0.44	0.71	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	318.87	338.35	354.81	358.81	317.30	222.73	149.75	156.61	236.58	293.94	301.50	307.17	(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]	603.01	582.26	526.48	437.04	335.76	224.18	149.85	156.82	243.77	371.40	494.80	598.63	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	211.40	163.90	127.72	56.33	13.73	0.00	0.00	0.00	0.00	57.63	139.17	216.85	

∑(98)1...5, 10...12 = 986.74 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.39 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.33	(303a)
Fraction of community heat from heat pump		0.67	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.33	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.67	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	986.74		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	433.08	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	879.29	(307b)

Water heating

Annual water heating requirement	1500.82		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	658.71	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1337.38	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	33.08	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	102.81		(330a)
Total electricity for the above, kWh/year		102.81	(331)
Electricity for lighting (Appendix L)		247.99	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3568.00	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	433.08	x	4.24	x 0.01 =	18.36	(340a)
Space heating from heat pump	879.29	x	4.24	x 0.01 =	37.28	(340b)
Water heating from boilers	658.71	x	4.24	x 0.01 =	27.93	(342a)
Water heating from heat pump	1337.38	x	4.24	x 0.01 =	56.71	(342b)
Pumps and fans	102.81	x	13.19	x 0.01 =	13.56	(349)
Electricity for lighting	247.99	x	13.19	x 0.01 =	32.71	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		306.55	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.34	(357)
SAP value	81.27	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1219.88	x	0.216	=	263.49	(367)
Efficiency of heat pump	260.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	852.57	x	0.519	=	442.48	(368)
Electrical energy for community heat distribution	33.08	x	0.519	=	17.17	(372)
Total CO2 associated with community systems					723.15	(373)
Total CO2 associated with space and water heating					723.15	(376)
Pumps and fans	102.81	x	0.519	=	53.36	(378)
Electricity for lighting	247.99	x	0.519	=	128.71	(379)
Energy saving/generation technologies						
pv savings	-91.26	x	0.519	=	-47.36	(380)

Total CO_2, kg/year	(376)..(382) =	857.85	(383)
Dwelling CO_2 emission rate	(383) ÷ (4) =	16.86	(384)
EI value		88.01	
EI rating (section 14)		88	(385)
EI band		B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1219.88	x	1.22	=	1488.25	(367)
Efficiency of heat pump	260.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	852.57	x	3.07	=	2617.37	(368)
Electrical energy for community heat distribution	33.08	x	3.07	=	101.57	(372)
Total primary energy associated with community systems					4207.20	(373)
Total primary energy associated with space and water heating					4207.20	(376)
Pumps and fans	102.81	x	3.07	=	315.62	(378)
Electricity for lighting	247.99	x	3.07	=	761.32	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					5003.98	(383)
Dwelling primary energy rate kWh/m2/year					98.35	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	26/10/2020
Address	1B2P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		50.32	(1a) x	2.50	(2a) =	125.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	50.32	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	125.80	(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		0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(24a)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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	
Window			7.86	x	1.24	=	9.71			(27)
Door			1.80	x	0.60	=	1.08			(26)
External wall			14.32	x	0.17	=	2.43			(29a)
Party wall			34.43	x	0.00	=	0.00			(32)
External wall			16.50	x	0.20	=	3.30			(29a)
Roof			50.32	x	0.13	=	6.54			(30)
Total area of external elements ∑A, m²			90.80							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.07 (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		6.77 (36)
Total fabric heat loss	(33) + (36) =	29.84 (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	
11.80	11.67	11.54	10.88	10.74	10.08	10.08	9.95	10.35	10.74	11.01	11.27	(38)

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

41.64	41.51	41.38	40.72	40.58	39.92	39.92	39.79	40.19	40.58	40.85	41.11	

Average = ∑(39)1...12/12 = 40.68 (39)

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

0.83	0.82	0.82	0.81	0.81	0.79	0.79	0.79	0.80	0.81	0.81	0.82	

Average = ∑(40)1...12/12 = 0.81 (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		1.70 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		74.56 (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	
82.02	79.04	76.06	73.07	70.09	67.11	67.11	70.09	73.07	76.06	79.04	82.02	

∑(44)1...12 = 894.76 (44)

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

121.63	106.38	109.78	95.71	91.83	79.24	73.43	84.26	85.27	99.37	108.47	117.80	

∑(45)1...12 = 1173.18 (45)

Distribution loss 0.15 x (45)m

18.25	15.96	16.47	14.36	13.77	11.89	11.01	12.64	12.79	14.91	16.27	17.67	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00 (47)
Water storage loss:	
b) Manufacturer's declared loss factor is not known	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)
Enter (50) or (54) in (55)	0.13 (55)
Water storage loss calculated for each month (55) x (41)m	

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

148.94	131.04	137.08	122.13	119.14	105.67	100.73	111.57	111.69	126.68	134.90	145.10	(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

148.94	131.04	137.08	122.13	119.14	105.67	100.73	111.57	111.69	126.68	134.90	145.10	

∑(64)1...12 = 1494.66 (64)

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

62.29	55.10	58.34	52.96	52.38	47.49	46.26	49.86	49.49	54.88	57.21	61.01	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.84	12.29	10.00	7.57	5.66	4.78	5.16	6.71	9.00	11.43	13.34	14.22	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	148.07	149.60	145.73	137.49	127.08	117.30	110.77	109.23	113.11	121.35	131.75	141.53	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	(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)	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	(71)
Water heating gains (Table 5)	83.72	82.00	78.42	73.56	70.40	65.95	62.18	67.02	68.74	73.77	79.45	82.00	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	294.11	292.38	282.64	267.10	251.63	236.53	226.60	231.45	239.34	255.04	273.04	286.25	(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	7.86	x	19.64	x 0.9 x	0.45	x	0.70	=	33.70	(80)

Solar gains in watts ∑(74)m...(82)m

33.70	65.92	108.56	158.33	194.04	198.64	189.11	162.44	126.26	78.22	42.02	27.71	(83)

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

327.81	358.30	391.20	425.44	445.67	435.16	415.71	393.90	365.60	333.26	315.06	313.96	(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)

	1.00	0.99	0.98	0.92	0.79	0.58	0.42	0.46	0.73	0.95	0.99	1.00	(86)

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

	20.27	20.38	20.57	20.80	20.95	20.99	21.00	21.00	20.98	20.79	20.49	20.25	(87)

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

	20.23	20.23	20.23	20.25	20.25	20.26	20.26	20.26	20.25	20.25	20.24	20.24	(88)

Utilisation factor for gains for rest of dwelling n2,m

	1.00	0.99	0.97	0.90	0.74	0.52	0.35	0.39	0.66	0.93	0.99	1.00	(89)

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

	19.25	19.41	19.69	20.02	20.20	20.26	20.26	20.26	20.24	20.01	19.59	19.23	(90)

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

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

	19.81	19.94	20.17	20.45	20.61	20.66	20.66	20.66	20.64	20.43	20.08	19.79	(92)

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

	19.81	19.94	20.17	20.45	20.61	20.66	20.66	20.66	20.64	20.43	20.08	19.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.91	0.76	0.55	0.39	0.43	0.70	0.93	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	325.95	354.36	380.06	386.99	340.74	239.90	162.03	169.34	254.35	311.59	311.08	312.58	(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]	645.68	624.31	565.55	470.12	361.50	241.86	162.19	169.64	262.84	399.12	530.20	640.78	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	237.88	181.41	138.01	59.85	15.45	0.00	0.00	0.00	0.00	65.12	157.77	244.18	

∑(98)1...5, 10...12 = 1099.65 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 21.85 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.33	(303a)
Fraction of community heat from heat pump		0.67	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.33	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.67	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1099.65		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	482.64	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	979.90	(307b)

Water heating

Annual water heating requirement	1494.66		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	656.00	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1331.89	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	34.50	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	101.68		(330a)
Total electricity for the above, kWh/year		101.68	(331)
Electricity for lighting (Appendix L)		244.38	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3705.23	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	482.64	x	4.24	x 0.01 =	20.46	(340a)
Space heating from heat pump	979.90	x	4.24	x 0.01 =	41.55	(340b)
Water heating from boilers	656.00	x	4.24	x 0.01 =	27.81	(342a)
Water heating from heat pump	1331.89	x	4.24	x 0.01 =	56.47	(342b)
Pumps and fans	101.68	x	13.19	x 0.01 =	13.41	(349)
Electricity for lighting	244.38	x	13.19	x 0.01 =	32.23	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		311.94	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.37	(357)
SAP value	80.83	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1272.23	x	0.216	=	274.80	(367)
Efficiency of heat pump	260.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	889.15	x	0.519	=	461.47	(368)
Electrical energy for community heat distribution	34.50	x	0.519	=	17.91	(372)
Total CO2 associated with community systems					754.18	(373)
Total CO2 associated with space and water heating					754.18	(376)
Pumps and fans	101.68	x	0.519	=	52.77	(378)
Electricity for lighting	244.38	x	0.519	=	126.83	(379)
Energy saving/generation technologies						
pv savings	-91.26	x	0.519	=	-47.36	(380)

Total CO_2, kg/year	(376)..(382) =	886.42	(383)
Dwelling CO_2 emission rate	(383) ÷ (4) =	17.62	(384)
EI value		87.54	
EI rating (section 14)		88	(385)
EI band		B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1272.23	x	1.22	=	1552.12	(367)
Efficiency of heat pump	260.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	889.15	x	3.07	=	2729.69	(368)
Electrical energy for community heat distribution	34.50	x	3.07	=	105.93	(372)
Total primary energy associated with community systems					4387.74	(373)
Total primary energy associated with space and water heating					4387.74	(376)
Pumps and fans	101.68	x	3.07	=	312.15	(378)
Electricity for lighting	244.38	x	3.07	=	750.24	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					5169.96	(383)
Dwelling primary energy rate kWh/m2/year					102.74	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	26/10/2020
Address	2B3P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		64.62	(1a) x	2.50	(2a) =	161.55	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	64.62	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	161.55	(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		0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	74.80	(23c)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(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	
Window			15.04	x	1.24	=	18.59			(27)
Door			1.80	x	0.60	=	1.08			(26)
External wall			31.51	x	0.17	=	5.36			(29a)
Party wall			14.88	x	0.00	=	0.00			(32)
External wall			22.05	x	0.20	=	4.41			(29a)
Roof			64.62	x	0.13	=	8.40			(30)
Total area of external elements ∑A, m²			135.02							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	37.83 (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		15.57 (36)
Total fabric heat loss	(33) + (36) =	53.41 (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	
15.38	15.21	15.04	14.19	14.02	13.17	13.17	13.00	13.51	14.02	14.36	14.70	(38)

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

68.79	68.62	68.45	67.60	67.43	66.58	66.58	66.41	66.92	67.43	67.77	68.11	

Average = ∑(39)1...12/12 = 67.56 (39)

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

1.06	1.06	1.06	1.05	1.04	1.03	1.03	1.03	1.04	1.04	1.05	1.05	

Average = ∑(40)1...12/12 = 1.05 (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		2.11 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		84.28 (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	
92.71	89.34	85.97	82.60	79.23	75.86	75.86	79.23	82.60	85.97	89.34	92.71	

∑(44)1...12 = 1011.41 (44)

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

137.49	120.25	124.09	108.18	103.80	89.57	83.00	95.25	96.39	112.33	122.61	133.15	

∑(45)1...12 = 1326.12 (45)

Distribution loss 0.15 x (45)m

20.62	18.04	18.61	16.23	15.57	13.44	12.45	14.29	14.46	16.85	18.39	19.97	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		3.00 (47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02 (51)
Volume factor from Table 2a		3.42 (52)
Temperature factor from Table 2b		0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)		0.13 (54)
Enter (50) or (54) in (55)		0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

164.79	144.91	151.39	134.60	131.11	116.00	110.31	122.55	122.81	139.63	149.04	160.46	(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

164.79	144.91	151.39	134.60	131.11	116.00	110.31	122.55	122.81	139.63	149.04	160.46	

∑(64)1...12 = 1647.59 (64)

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

67.56	59.71	63.10	57.11	56.36	50.92	49.44	53.51	53.19	59.19	61.91	66.12	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	16.44	14.60	11.88	8.99	6.72	5.67	6.13	7.97	10.70	13.58	15.85	16.90	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	184.43	186.34	181.52	171.25	158.29	146.11	137.98	136.06	140.88	151.15	164.11	176.29	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	(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)	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	(71)
Water heating gains (Table 5)	90.80	88.86	84.81	79.32	75.75	70.72	66.45	71.93	73.87	79.56	85.98	88.87	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	346.31	344.44	332.84	314.20	295.40	277.14	265.19	270.59	280.08	298.93	320.58	336.69	(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	8.20	x	10.63	x 0.9 x	0.45	x	0.70	=	19.03	(74)
East	0.77	x	6.84	x	19.64	x 0.9 x	0.45	x	0.70	=	29.33	(76)

Solar gains in watts ∑(74)m...(82)m

48.36	93.74	156.29	237.07	302.61	316.04	298.24	247.42	184.19	111.37	60.05	39.98	(83)

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

394.67	438.18	489.13	551.27	598.00	593.18	563.44	518.01	464.28	410.30	380.63	376.67	(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)													
	1.00	1.00	0.99	0.96	0.86	0.68	0.51	0.58	0.84	0.98	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	19.89	20.01	20.25	20.57	20.84	20.97	20.99	20.99	20.90	20.55	20.17	19.86	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.03	20.03	20.03	20.05	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.04	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.98	0.94	0.82	0.60	0.41	0.47	0.77	0.97	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	18.54	18.73	19.07	19.54	19.89	20.04	20.06	20.06	19.97	19.52	18.96	18.52	(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

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

19.10	19.26	19.56	19.97	20.28	20.42	20.45	20.44	20.36	19.95	19.46	19.08	(92)

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

19.10	19.26	19.56	19.97	20.28	20.42	20.45	20.44	20.36	19.95	19.46	19.08	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	1.00	0.99	0.98	0.94	0.83	0.63	0.45	0.51	0.80	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	393.15	435.00	480.26	519.08	496.62	373.90	254.27	265.09	370.74	395.52	377.71	375.53	(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]													
	1018.15	985.60	894.04	748.23	578.72	387.77	256.12	268.62	418.59	630.70	837.84	1013.28	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	465.01	370.00	307.86	164.98	61.08	0.00	0.00	0.00	0.00	174.97	331.30	474.48	

∑(98)1...5, 10...12 = 2349.68 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 36.36 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.33	(303a)
Fraction of community heat from heat pump		0.67	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.33	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.67	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	2349.68		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1031.27	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	2093.80	(307b)

Water heating

Annual water heating requirement	1647.59		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	723.13	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1468.17	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	53.16	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	147.82		(330a)
Total electricity for the above, kWh/year		147.82	(331)
Electricity for lighting (Appendix L)		290.37	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5663.30	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1031.27	x	4.24	x 0.01 =	43.73	(340a)
Space heating from heat pump	2093.80	x	4.24	x 0.01 =	88.78	(340b)
Water heating from boilers	723.13	x	4.24	x 0.01 =	30.66	(342a)
Water heating from heat pump	1468.17	x	4.24	x 0.01 =	62.25	(342b)
Pumps and fans	147.82	x	13.19	x 0.01 =	19.50	(349)
Electricity for lighting	290.37	x	13.19	x 0.01 =	38.30	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		403.21	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.54	(357)
SAP value	78.45	
SAP rating (section 13)	78	(358)
SAP band	C	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1960.23	x	0.216	=	423.41	(367)
Efficiency of heat pump	260.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1369.99	x	0.519	=	711.02	(368)
Electrical energy for community heat distribution	53.16	x	0.519	=	27.59	(372)
Total CO2 associated with community systems					1162.02	(373)
Total CO2 associated with space and water heating					1162.02	(376)
Pumps and fans	147.82	x	0.519	=	76.72	(378)
Electricity for lighting	290.37	x	0.519	=	150.70	(379)
Energy saving/generation technologies						

pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	1342.08	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	20.77	(384)
EI value					83.59	
EI rating (section 14)					84	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1960.23	x	1.22	=	2391.48	(367)
Efficiency of heat pump	260.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1369.99	x	3.07	=	4205.86	(368)
Electrical energy for community heat distribution	53.16	x	3.07	=	163.21	(372)
Total primary energy associated with community systems					6760.55	(373)
Total primary energy associated with space and water heating					6760.55	(376)
Pumps and fans	147.82	x	3.07	=	453.80	(378)
Electricity for lighting	290.37	x	3.07	=	891.45	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					7825.63	(383)
Dwelling primary energy rate kWh/m2/year					121.10	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	26/10/2020
Address	2B4P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		73.74	(1a) x	2.50	(2a) =	184.35	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	73.74	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	184.35	(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		0	x 10 = 0	(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) =	0	÷ (5) = 0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(24a)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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	
Window			15.42	x	1.24	=	19.06			(27)
Door			1.80	x	0.70	=	1.26			(26)
External wall			29.58	x	0.17	=	5.03			(29a)
Party wall			15.83	x	0.00	=	0.00			(32)
External wall			29.63	x	0.20	=	5.93			(29a)
Total area of external elements ∑A, m²			76.43							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	31.27 (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		9.45 (36)
Total fabric heat loss	(33) + (36) =	40.72 (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	
17.30	17.10	16.91	15.94	15.74	14.78	14.78	14.58	15.16	15.74	16.13	16.52	(38)

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

58.02	57.82	57.63	56.66	56.47	55.50	55.50	55.30	55.88	56.47	56.85	57.24	

Average = ∑(39)1...12/12 = 56.61 (39)

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

0.79	0.78	0.78	0.77	0.77	0.75	0.75	0.75	0.76	0.77	0.77	0.78	

Average = ∑(40)1...12/12 = 0.77 (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		2.33 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		89.62 (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	
98.58	95.00	91.41	87.83	84.24	80.66	80.66	84.24	87.83	91.41	95.00	98.58	

∑(44)1...12 = 1075.42 (44)

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

146.19	127.86	131.94	115.03	110.37	95.24	88.26	101.28	102.49	119.44	130.37	141.58	

∑(45)1...12 = 1410.04 (45)

Distribution loss 0.15 x (45)m

21.93	19.18	19.79	17.25	16.56	14.29	13.24	15.19	15.37	17.92	19.56	21.24	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel		3.00 (47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02 (51)
Volume factor from Table 2a		3.42 (52)
Temperature factor from Table 2b		0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)		0.13 (54)
Enter (50) or (54) in (55)		0.13 (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

173.49	152.52	159.24	141.45	137.68	121.67	115.56	128.58	128.91	146.74	156.80	168.88	(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

173.49	152.52	159.24	141.45	137.68	121.67	115.56	128.58	128.91	146.74	156.80	168.88	

∑(64)1...12 = 1731.52 (64)

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

70.45	62.24	65.71	59.39	58.54	52.81	51.19	55.52	55.21	61.56	64.49	68.92	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.41	16.35	13.30	10.07	7.53	6.35	6.86	8.92	11.98	15.21	17.75	18.92	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	205.86	208.00	202.62	191.16	176.69	163.09	154.01	151.87	157.26	168.72	183.18	196.78	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	(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)	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	(71)
Water heating gains (Table 5)	94.69	92.62	88.32	82.48	78.69	73.34	68.80	74.62	76.69	82.74	89.57	92.63	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	376.97	374.97	362.24	341.70	320.90	300.79	287.68	293.42	303.92	324.66	348.50	366.33	(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	10.90	x	19.64	x 0.9 x	0.45	x	0.70	=	46.73	(76)
South	0.77	x	2.22	x	46.75	x 0.9 x	0.45	x	0.70	=	22.66	(78)
West	0.77	x	2.30	x	19.64	x 0.9 x	0.45	x	0.70	=	9.86	(80)

Solar gains in watts ∑(74)m...(82)m

79.25	147.81	229.59	319.33	381.54	387.17	369.94	323.64	261.42	171.39	97.42	66.12	(83)

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

456.22	522.79	591.83	661.03	702.45	687.96	657.61	617.06	565.34	496.05	445.92	432.45	(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)													
	1.00	0.99	0.97	0.89	0.72	0.51	0.37	0.41	0.67	0.94	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.30	20.44	20.64	20.87	20.97	21.00	21.00	21.00	20.99	20.83	20.52	20.28	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.26	20.27	20.27	20.28	20.28	20.29	20.29	20.30	20.29	20.28	20.28	20.27	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.96	0.86	0.67	0.46	0.31	0.35	0.60	0.91	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.32	19.52	19.82	20.13	20.26	20.29	20.29	20.30	20.28	20.10	19.66	19.30	(90)

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

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
	19.72	19.90	20.16	20.43	20.55	20.58	20.58	20.58	20.57	20.40	20.01	19.69	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.72	19.90	20.16	20.43	20.55	20.58	20.58	20.58	20.57	20.40	20.01	19.69	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	1.00	0.99	0.96	0.87	0.69	0.48	0.34	0.37	0.63	0.92	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	454.04	516.36	569.05	575.27	485.76	330.94	220.90	231.19	355.95	455.33	440.49	430.96	(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]													
	894.62	867.13	787.03	653.42	499.76	331.87	220.96	231.32	361.53	553.11	734.12	886.92	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	327.79	235.72	162.18	56.27	10.42	0.00	0.00	0.00	0.00	72.75	211.41	339.24	

∑(98)1...5, 10...12 = 1415.77 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.20 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.33	(303a)
Fraction of community heat from heat pump		0.67	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.33	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.67	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1415.77		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	621.38	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1261.59	(307b)

Water heating

Annual water heating requirement	1731.52		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	759.96	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1542.96	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	41.86	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	149.00		(330a)
Total electricity for the above, kWh/year		149.00	(331)
Electricity for lighting (Appendix L)		325.11	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4568.74	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	621.38	x	4.24	x 0.01 =	26.35	(340a)
Space heating from heat pump	1261.59	x	4.24	x 0.01 =	53.49	(340b)
Water heating from boilers	759.96	x	4.24	x 0.01 =	32.22	(342a)
Water heating from heat pump	1542.96	x	4.24	x 0.01 =	65.42	(342b)
Pumps and fans	149.00	x	13.19	x 0.01 =	19.65	(349)
Electricity for lighting	325.11	x	13.19	x 0.01 =	42.88	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		360.02	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.27	(357)
SAP value	82.24	
SAP rating (section 13)	82	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1543.40	x	0.216	=	333.37	(367)
Efficiency of heat pump	260.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1078.67	x	0.519	=	559.83	(368)
Electrical energy for community heat distribution	41.86	x	0.519	=	21.72	(372)
Total CO2 associated with community systems					914.93	(373)
Total CO2 associated with space and water heating					914.93	(376)
Pumps and fans	149.00	x	0.519	=	77.33	(378)
Electricity for lighting	325.11	x	0.519	=	168.73	(379)
Energy saving/generation technologies						

pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	1113.63	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	15.10	(384)
EI value					87.43	
EI rating (section 14)					87	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1543.40	x	1.22	=	1882.95	(367)
Efficiency of heat pump	260.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1078.67	x	3.07	=	3311.52	(368)
Electrical energy for community heat distribution	41.86	x	3.07	=	128.51	(372)
Total primary energy associated with community systems					5322.98	(373)
Total primary energy associated with space and water heating					5322.98	(376)
Pumps and fans	149.00	x	3.07	=	457.43	(378)
Electricity for lighting	325.11	x	3.07	=	998.08	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					6498.32	(383)
Dwelling primary energy rate kWh/m2/year					88.12	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	26/10/2020
Address	2B3P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		74.00	(1a) x	2.50	(2a) =	185.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	74.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	185.00	(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		0	x 10 =	0 (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) =	0	÷ (5) =	0.00 (8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (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) =	0.13 (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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	74.80 (23c)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(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	
Window			17.96	x	1.24	=	22.19			(27)
Door			1.80	x	0.70	=	1.26			(26)
External wall			30.44	x	0.17	=	5.17			(29a)
Party wall			32.15	x	0.00	=	0.00			(32)
External wall			2.65	x	0.20	=	0.53			(29a)
Total area of external elements ∑A, m²			52.85							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.16 (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		7.34 (36)
Total fabric heat loss	(33) + (36) =	36.49 (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)	17.62	17.42	17.23	16.25	16.06	15.09	15.09	14.89	15.48	16.06	16.45	16.84	(38)
Heat transfer coefficient, W/K (37)m + (38)m	54.11	53.92	53.72	52.75	52.55	51.58	51.58	51.39	51.97	52.55	52.94	53.33	

Average = ∑(39)1...12/12 = 52.70 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.73	0.73	0.73	0.71	0.71	0.70	0.70	0.69	0.70	0.71	0.72	0.72	
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 = 0.71 (40)

4. Water heating energy requirement

Assumed occupancy, N	2.34 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.76 (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)	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55	95.14	98.73	

∑(44)1...12 = 1077.07 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	146.42	128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62	130.57	141.80	

∑(45)1...12 = 1412.21 (45)

Distribution loss 0.15 x (45)m	21.96	19.21	19.82	17.28	16.58	14.31	13.26	15.21	15.40	17.94	19.59	21.27	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00 (47)
Water storage loss:	
b) Manufacturer's declared loss factor is not known	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)
Enter (50) or (54) in (55)	0.13 (55)

Water storage loss calculated for each month (55) x (41)m	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

173.72	152.72	159.45	141.63	137.85	121.81	115.70	128.74	129.07	146.92	157.00	169.10	(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

173.72	152.72	159.45	141.63	137.85	121.81	115.70	128.74	129.07	146.92	157.00	169.10	

∑(64)1...12 = 1733.69 (64)

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

70.53	62.31	65.78	59.44	58.60	52.86	51.23	55.57	55.27	61.62	64.55	68.99	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.40	16.35	13.29	10.06	7.52	6.35	6.86	8.92	11.97	15.20	17.74	18.92	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	206.45	208.59	203.19	191.70	177.19	163.56	154.45	152.30	157.70	169.20	183.70	197.34	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	(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)	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
Water heating gains (Table 5)	94.79	92.72	88.41	82.56	78.76	73.41	68.86	74.69	76.76	82.82	89.66	92.73	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	377.73	375.74	362.99	342.41	321.56	301.41	288.26	294.00	304.52	325.31	349.19	367.07	(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	
North	0.77	x	6.10	x	10.63	x 0.9 x	0.45	x	0.70	=	14.16	(74)
NorthEast	0.77	x	3.20	x	11.28	x 0.9 x	0.45	x	0.70	=	7.88	(75)
West	0.77	x	8.66	x	19.64	x 0.9 x	0.45	x	0.70	=	37.13	(80)

Solar gains in watts ∑(74)m...(82)m

59.17	115.73	194.50	295.78	377.09	393.39	371.44	308.60	229.62	138.00	73.68	48.77	(83)

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

436.90	491.48	557.49	638.19	698.66	694.80	659.70	602.61	534.14	463.31	422.87	415.84	(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)													
	1.00	0.99	0.97	0.88	0.68	0.47	0.34	0.39	0.66	0.94	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.36	20.48	20.68	20.90	20.99	21.00	21.00	21.00	20.99	20.85	20.56	20.34	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.31	20.32	20.32	20.33	20.33	20.34	20.34	20.35	20.34	20.33	20.33	20.32	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.97	0.86	0.64	0.43	0.29	0.34	0.60	0.92	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.45	19.62	19.91	20.21	20.32	20.34	20.34	20.35	20.33	20.16	19.76	19.43	(90)

Living area fraction — Living area ÷ (4) = 0.48 (91)

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

19.89	20.04	20.28	20.54	20.64	20.66	20.66	20.66	20.65	20.49	20.15	19.87	(92)

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

19.89	20.04	20.28	20.54	20.64	20.66	20.66	20.66	20.65	20.49	20.15	19.87	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	1.00	0.99	0.97	0.86	0.66	0.45	0.32	0.36	0.63	0.93	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	435.20	486.72	538.75	551.86	461.84	312.23	209.46	218.96	336.37	429.41	418.62	414.67	(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]													
	843.43	816.12	740.27	614.24	469.92	312.61	209.48	219.02	340.50	519.94	690.86	835.56	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	303.72	221.36	149.93	44.92	6.01	0.00	0.00	0.00	0.00	67.35	196.02	313.15	

∑(98)1...5, 10...12 = 1302.45 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 17.60 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.33	(303a)
Fraction of community heat from heat pump		0.67	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.33	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.67	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1302.45		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	571.65	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1160.61	(307b)

Water heating

Annual water heating requirement	1733.69		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	760.92	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1544.89	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	40.38	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	169.28		(330a)
Total electricity for the above, kWh/year		169.28	(331)
Electricity for lighting (Appendix L)		325.04	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	4441.11	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	571.65	x	4.24	x 0.01 =	24.24	(340a)
Space heating from heat pump	1160.61	x	4.24	x 0.01 =	49.21	(340b)
Water heating from boilers	760.92	x	4.24	x 0.01 =	32.26	(342a)
Water heating from heat pump	1544.89	x	4.24	x 0.01 =	65.50	(342b)
Pumps and fans	169.28	x	13.19	x 0.01 =	22.33	(349)
Electricity for lighting	325.04	x	13.19	x 0.01 =	42.87	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		356.41	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.26	(357)
SAP value	82.45	
SAP rating (section 13)	82	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1488.89	x	0.216	=	321.60	(367)
Efficiency of heat pump	260.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1040.58	x	0.519	=	540.06	(368)
Electrical energy for community heat distribution	40.38	x	0.519	=	20.96	(372)
Total CO2 associated with community systems					882.62	(373)
Total CO2 associated with space and water heating					882.62	(376)
Pumps and fans	169.28	x	0.519	=	87.85	(378)
Electricity for lighting	325.04	x	0.519	=	168.69	(379)
Energy saving/generation technologies						

pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	1091.80	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	14.75	(384)
EI value					87.71	
EI rating (section 14)					88	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1488.89	x	1.22	=	1816.45	(367)
Efficiency of heat pump	260.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1040.58	x	3.07	=	3194.57	(368)
Electrical energy for community heat distribution	40.38	x	3.07	=	123.97	(372)
Total primary energy associated with community systems					5134.99	(373)
Total primary energy associated with space and water heating					5134.99	(376)
Pumps and fans	169.28	x	3.07	=	519.67	(378)
Electricity for lighting	325.04	x	3.07	=	997.86	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					6372.36	(383)
Dwelling primary energy rate kWh/m2/year					86.11	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	26/10/2020
Address	3B4P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		72.42	(1a) x	2.50	(2a) =	181.05	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	72.42	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	181.05	(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		0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(24a)

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

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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	
Window			15.02	x	1.24	=	18.56			(27)
Door			1.80	x	0.70	=	1.26			(26)
External wall			30.08	x	0.17	=	5.11			(29a)
Party wall			32.93	x	0.00	=	0.00			(32)
External wall			10.38	x	0.20	=	2.08			(29a)
Roof			72.42	x	0.13	=	9.41			(30)
Total area of external elements ∑A, m²			129.70							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	36.43 (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		12.44 (36)
Total fabric heat loss	(33) + (36) =	48.87 (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	
16.99	16.80	16.61	15.65	15.46	14.51	14.51	14.32	14.89	15.46	15.84	16.22	(38)

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

65.85	65.66	65.47	64.52	64.33	63.38	63.38	63.19	63.76	64.33	64.71	65.09	

Average = ∑(39)1...12/12 = 64.47 (39)

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

0.91	0.91	0.90	0.89	0.89	0.88	0.88	0.87	0.88	0.89	0.89	0.90	

Average = ∑(40)1...12/12 = 0.89 (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	2.30	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	88.91	(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	
97.80	94.24	90.68	87.13	83.57	80.02	80.02	83.57	87.13	90.68	94.24	97.80	

∑(44)1...12 = 1066.87 (44)

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

145.03	126.84	130.89	114.11	109.50	94.49	87.56	100.47	101.67	118.49	129.34	140.45	

∑(45)1...12 = 1398.84 (45)

Distribution loss 0.15 x (45)m

21.75	19.03	19.63	17.12	16.42	14.17	13.13	15.07	15.25	17.77	19.40	21.07	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	3.42	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13	(54)
Enter (50) or (54) in (55)	0.13	(55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

172.33	151.51	158.20	140.54	136.80	120.91	114.86	127.77	128.09	145.79	155.76	167.76	(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

172.33	151.51	158.20	140.54	136.80	120.91	114.86	127.77	128.09	145.79	155.76	167.76	

∑(64)1...12 = 1720.32 (64)

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

70.07	61.90	65.36	59.08	58.25	52.55	50.96	55.25	54.94	61.24	64.14	68.54	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.15	16.12	13.11	9.93	7.42	6.26	6.77	8.80	11.81	15.00	17.50	18.66	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	202.88	204.98	199.68	188.38	174.13	160.73	151.78	149.67	154.98	166.27	180.53	193.93	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	(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)	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	(71)
Water heating gains (Table 5)	94.17	92.12	87.86	82.06	78.29	72.99	68.49	74.26	76.31	82.31	89.09	92.13	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	372.76	370.78	358.20	337.92	317.39	297.54	284.59	290.28	300.65	321.13	344.67	362.26	(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	10.54	x	19.64	x 0.9 x	0.45	x	0.70	=	45.19	(80)
South	0.77	x	4.48	x	46.75	x 0.9 x	0.45	x	0.70	=	45.72	(78)

Solar gains in watts ∑(74)m...(82)m

90.91	163.28	240.97	320.13	372.55	374.48	359.22	320.42	268.96	185.66	110.54	76.67	(83)

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

463.67	534.06	599.16	658.05	689.94	672.02	643.81	610.70	569.61	506.79	455.21	438.93	(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)													
	1.00	0.99	0.98	0.92	0.79	0.59	0.43	0.47	0.73	0.95	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.14	20.28	20.51	20.76	20.93	20.99	21.00	21.00	20.97	20.74	20.39	20.11	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.16	20.16	20.16	20.18	20.18	20.19	20.19	20.19	20.18	20.18	20.17	20.17	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	0.99	0.97	0.90	0.74	0.52	0.35	0.39	0.66	0.93	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.00	19.22	19.54	19.91	20.11	20.18	20.19	20.19	20.16	19.89	19.39	18.97	(90)

Living area fraction — Living area ÷ (4) = 0.38 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
	19.43	19.62	19.90	20.23	20.42	20.49	20.49	20.49	20.46	20.21	19.76	19.40	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate													
	19.43	19.62	19.90	20.23	20.42	20.49	20.49	20.49	20.46	20.21	19.76	19.40	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.99	0.99	0.97	0.90	0.76	0.55	0.38	0.42	0.69	0.93	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	461.31	527.58	579.47	593.51	523.53	368.87	246.32	257.97	390.45	471.88	449.78	437.28	(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]													
	996.17	966.53	877.50	730.87	560.91	373.02	246.69	258.64	405.71	618.19	819.39	989.23	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	397.94	294.98	221.73	98.90	27.82	0.00	0.00	0.00	0.00	108.86	266.12	410.65	

∑(98)1...5, 10...12 = 1827.00 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 25.23 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.33	(303a)
Fraction of community heat from heat pump		0.67	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.33	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.67	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	1827.00		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	801.87	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	1628.04	(307b)

Water heating

Annual water heating requirement	1720.32		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	755.05	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1532.97	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	47.18	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	146.33		(330a)
Total electricity for the above, kWh/year		146.33	(331)
Electricity for lighting (Appendix L)		320.59	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	5093.59	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	801.87	x	4.24	x 0.01 =	34.00	(340a)
Space heating from heat pump	1628.04	x	4.24	x 0.01 =	69.03	(340b)
Water heating from boilers	755.05	x	4.24	x 0.01 =	32.01	(342a)
Water heating from heat pump	1532.97	x	4.24	x 0.01 =	65.00	(342b)
Pumps and fans	146.33	x	13.19	x 0.01 =	19.30	(349)
Electricity for lighting	320.59	x	13.19	x 0.01 =	42.29	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		381.63	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.37	(357)
SAP value	80.96	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1739.57	x	0.216	=	375.75	(367)
Efficiency of heat pump	260.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1215.77	x	0.519	=	630.99	(368)
Electrical energy for community heat distribution	47.18	x	0.519	=	24.49	(372)
Total CO2 associated with community systems					1031.22	(373)
Total CO2 associated with space and water heating					1031.22	(376)
Pumps and fans	146.33	x	0.519	=	75.95	(378)
Electricity for lighting	320.59	x	0.519	=	166.39	(379)
Energy saving/generation technologies						

pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	1226.19	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	16.93	(384)
EI value					86.01	
EI rating (section 14)					86	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	1739.57	x	1.22	=	2122.28	(367)
Efficiency of heat pump	260.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1215.77	x	3.07	=	3732.43	(368)
Electrical energy for community heat distribution	47.18	x	3.07	=	144.84	(372)
Total primary energy associated with community systems					5999.54	(373)
Total primary energy associated with space and water heating					5999.54	(376)
Pumps and fans	146.33	x	3.07	=	449.24	(378)
Electricity for lighting	320.59	x	3.07	=	984.22	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					7152.84	(383)
Dwelling primary energy rate kWh/m2/year					98.77	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	26/10/2020
Address	3B5P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		104.07	(1a) x	2.50	(2a) =	260.18	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	104.07	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	260.18	(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		0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	74.80	(23c)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(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	
Window			18.08	x	1.24	=	22.34			(27)
Door			1.80	x	1.30	=	2.34			(26)
Ground floor			104.07	x	0.10	=	10.41			(28a)
External wall			38.90	x	0.17	=	6.61			(29a)
Party wall			24.13	x	0.00	=	0.00			(32)
External wall			26.50	x	0.20	=	5.30			(29a)
Total area of external elements ∑A, m²			189.35							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	47.00 (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		13.64 (36)
Total fabric heat loss	(33) + (36) =	60.64 (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)													
	24.78	24.50	24.23	22.86	22.59	21.22	21.22	20.94	21.76	22.59	23.13	23.68	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	85.42	85.14	84.87	83.50	83.23	81.86	81.86	81.58	82.41	83.23	83.77	84.32	
Average = ∑(39)1...12/12 =												83.43	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	0.82	0.82	0.82	0.80	0.80	0.79	0.79	0.78	0.79	0.80	0.80	0.81	
Average = ∑(40)1...12/12 =												0.80	(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	2.77 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	100.09 (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)													
	110.09	106.09	102.09	98.08	94.08	90.08	90.08	94.08	98.08	102.09	106.09	110.09	
∑(44)1...12 =												1201.03	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	163.27	142.79	147.35	128.46	123.26	106.37	98.57	113.11	114.46	133.39	145.60	158.12	
∑(45)1...12 =												1574.74	(45)
Distribution loss 0.15 x (45)m													
	24.49	21.42	22.10	19.27	18.49	15.96	14.78	16.97	17.17	20.01	21.84	23.72	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00 (47)
Water storage loss:	
b) Manufacturer's declared loss factor is not known	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)
Enter (50) or (54) in (55)	0.13 (55)
Water storage loss calculated for each month (55) x (41)m	

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

190.57	167.46	174.65	154.89	150.57	132.79	125.87	140.41	140.88	160.69	172.03	185.42	(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

190.57	167.46	174.65	154.89	150.57	132.79	125.87	140.41	140.88	160.69	172.03	185.42	

∑(64)1...12 = 1896.22 (64)

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

76.13	67.21	70.84	63.85	62.83	56.51	54.62	59.45	59.19	66.19	69.55	74.42	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.07	21.38	17.38	13.16	9.84	8.31	8.97	11.66	15.66	19.88	23.20	24.73	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.74	265.47	258.60	243.97	225.51	208.16	196.56	193.84	200.71	215.33	233.80	251.15	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	(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)	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	(71)
Water heating gains (Table 5)	102.32	100.01	95.21	88.68	84.45	78.48	73.41	79.91	82.22	88.97	96.60	100.02	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	453.75	451.47	435.81	410.43	384.41	359.55	343.56	350.02	363.19	388.80	418.21	440.52	(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	6.86	x	10.63	x 0.9 x	0.45	x	0.70	=	15.92	(74)
NorthEast	0.77	x	2.18	x	11.28	x 0.9 x	0.45	x	0.70	=	5.37	(75)
East	0.77	x	6.78	x	19.64	x 0.9 x	0.45	x	0.70	=	29.07	(76)
SouthEast	0.77	x	2.26	x	36.79	x 0.9 x	0.45	x	0.70	=	18.15	(77)

Solar gains in watts ∑(74)m...(82)m

68.51	129.14	207.35	304.39	381.45	395.76	374.51	314.91	240.89	151.23	84.39	57.10	(83)

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

522.26	580.61	643.16	714.82	765.86	755.31	718.06	664.93	604.08	540.02	502.60	497.62	(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)	1.00	1.00	0.99	0.97	0.88	0.68	0.50	0.56	0.84	0.98	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.13	20.24	20.43	20.69	20.90	20.99	21.00	21.00	20.94	20.68	20.36	20.12	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.24	20.24	20.24	20.25	20.25	20.26	20.26	20.27	20.26	20.25	20.25	20.24	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	0.99	0.96	0.84	0.61	0.42	0.47	0.79	0.98	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	19.06	19.22	19.50	19.88	20.15	20.26	20.26	20.27	20.21	19.86	19.40	19.04	(90)

Living area fraction | Living area ÷ (4) = | 0.32 | (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.40	19.54	19.80	20.14	20.39	20.49	20.50	20.50	20.45	20.12	19.71	19.38	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.40	19.54	19.80	20.14	20.39	20.49	20.50	20.50	20.45	20.12	19.71	19.38	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	0.99	0.96	0.85	0.63	0.44	0.50	0.80	0.98	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	521.49	578.70	636.59	684.18	647.54	473.96	318.52	333.02	484.39	526.64	500.84	497.08	(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]	1289.74	1246.75	1128.37	938.66	723.49	482.13	319.18	334.48	523.04	792.69	1056.33	1280.28	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	571.57	448.93	365.88	183.23	56.51	0.00	0.00	0.00	0.00	197.94	399.95	582.70	

∑(98)1...5, 10...12 = | 2806.71 | (98)

Space heating requirement kWh/m²/year | (98) ÷ (4) | 26.97 | (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.33	(303a)
Fraction of community heat from heat pump		0.67	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.33	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.67	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement | 2806.71 | (98)

Space heat from boilers | (98) x (304a) x (305) x (306) = | 1231.87 | (307a)

Space heat from heat pump	(98) x (304b) x (305) x (306) =	2501.06	(307b)

Water heating

Annual water heating requirement	1896.22		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	832.25	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1689.72	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	62.55	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	238.06		(330a)
Total electricity for the above, kWh/year		238.06	(331)
Electricity for lighting (Appendix L)		425.01	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	6826.71	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1231.87	x	4.24	x 0.01 =	52.23	(340a)
Space heating from heat pump	2501.06	x	4.24	x 0.01 =	106.04	(340b)
Water heating from boilers	832.25	x	4.24	x 0.01 =	35.29	(342a)
Water heating from heat pump	1689.72	x	4.24	x 0.01 =	71.64	(342b)
Pumps and fans	238.06	x	13.19	x 0.01 =	31.40	(349)
Electricity for lighting	425.01	x	13.19	x 0.01 =	56.06	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		472.67	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.33	(357)
SAP value	81.42	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2306.28	x	0.216	=	498.16	(367)
Efficiency of heat pump	260.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1611.84	x	0.519	=	836.54	(368)
Electrical energy for community heat distribution	62.55	x	0.519	=	32.46	(372)
Total CO2 associated with community systems					1367.16	(373)
Total CO2 associated with space and water heating					1367.16	(376)
Pumps and fans	238.06	x	0.519	=	123.55	(378)

Electricity for lighting	425.01	x	0.519	=	220.58	(379)
Energy saving/generation technologies						
pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	1663.93	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	15.99	(384)
EI value					85.04	
EI rating (section 14)					85	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2306.28	x	1.22	=	2813.66	(367)
Efficiency of heat pump	260.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1611.84	x	3.07	=	4948.35	(368)
Electrical energy for community heat distribution	62.55	x	3.07	=	192.03	(372)
Total primary energy associated with community systems					7954.03	(373)
Total primary energy associated with space and water heating					7954.03	(376)
Pumps and fans	238.06	x	3.07	=	730.84	(378)
Electricity for lighting	425.01	x	3.07	=	1304.79	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					9709.49	(383)
Dwelling primary energy rate kWh/m2/year					93.30	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	26/10/2020
Address	3B6P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		94.73	(1a) x	2.50	(2a) =	236.83	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	94.73	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	236.83	(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		0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	74.80	(23c)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)

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

	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(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	
Window			14.86	x	1.24	=	18.36			(27)
Door			1.80	x	0.60	=	1.08			(26)
External wall			36.28	x	0.17	=	6.17			(29a)
Party wall			15.15	x	0.00	=	0.00			(32)
External wall			34.68	x	0.20	=	6.94			(29a)
Roof			94.73	x	0.13	=	12.31			(30)
Total area of external elements ∑A, m²			182.35							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	44.86 (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		14.02 (36)
Total fabric heat loss	(33) + (36) =	58.88 (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	
22.55	22.30	22.05	20.81	20.56	19.31	19.31	19.06	19.81	20.56	21.06	21.56	(38)

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

81.44	81.19	80.94	79.69	79.44	78.20	78.20	77.95	78.70	79.44	79.94	80.44	

Average = ∑(39)1...12/12 = 79.63 (39)

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

0.86	0.86	0.85	0.84	0.84	0.83	0.83	0.82	0.83	0.84	0.84	0.85	

Average = ∑(40)1...12/12 = 0.84 (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	2.69	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	97.97	(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	
107.77	103.85	99.93	96.01	92.09	88.17	88.17	92.09	96.01	99.93	103.85	107.77	

∑(44)1...12 = 1175.65 (44)

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

159.82	139.78	144.24	125.75	120.66	104.12	96.48	110.72	112.04	130.57	142.53	154.77	

∑(45)1...12 = 1541.46 (45)

Distribution loss 0.15 x (45)m

23.97	20.97	21.64	18.86	18.10	15.62	14.47	16.61	16.81	19.59	21.38	23.22	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	3.42	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13	(54)
Enter (50) or (54) in (55)	0.13	(55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss 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

187.12	164.44	171.54	152.17	147.96	130.54	123.79	138.02	138.46	157.87	168.95	182.08	(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

187.12	164.44	171.54	152.17	147.96	130.54	123.79	138.02	138.46	157.87	168.95	182.08	

∑(64)1...12 = 1862.94 (64)

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

74.98	66.20	69.80	62.95	61.96	55.76	53.92	58.66	58.39	65.26	68.53	73.31	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.11	20.53	16.69	12.64	9.45	7.98	8.62	11.20	15.04	19.09	22.28	23.75	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.52	250.08	243.61	229.83	212.44	196.09	185.17	182.60	189.08	202.85	220.25	236.59	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	(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)	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	(71)
Water heating gains (Table 5)	100.78	98.52	93.82	87.43	83.28	77.44	72.48	78.84	81.10	87.71	95.18	98.53	(72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

434.69	432.41	417.40	393.18	368.45	344.79	329.54	335.92	348.49	372.93	400.98	422.15	(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	10.44	x	19.64	x 0.9 x	0.45	x	0.70	=	44.76	(76)
South	0.77	x	4.42	x	46.75	x 0.9 x	0.45	x	0.70	=	45.11	(78)

Solar gains in watts ∑(74)m...(82)m

89.87	161.44	238.31	316.67	368.57	370.50	355.40	316.98	266.02	183.58	109.28	75.79	(83)

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

524.56	593.85	655.71	709.85	737.02	715.29	684.95	652.90	614.50	556.51	510.27	497.94	(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)													
	1.00	1.00	0.99	0.96	0.87	0.68	0.50	0.54	0.81	0.97	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
	20.12	20.25	20.45	20.70	20.90	20.98	21.00	21.00	20.95	20.70	20.37	20.10	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)													
	20.20	20.20	20.21	20.22	20.22	20.23	20.23	20.23	20.23	20.22	20.22	20.21	(88)
Utilisation factor for gains for rest of dwelling n2,m													
	1.00	1.00	0.99	0.95	0.83	0.61	0.41	0.46	0.74	0.96	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
	19.02	19.20	19.50	19.86	20.12	20.22	20.23	20.23	20.19	19.87	19.38	19.00	(90)

Living area fraction — Living area ÷ (4) = 0.33 (91)

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

19.38	19.55	19.81	20.14	20.37	20.47	20.48	20.48	20.44	20.14	19.71	19.36	(92)

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

19.38	19.55	19.81	20.14	20.37	20.47	20.48	20.48	20.44	20.14	19.71	19.36	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	1.00	0.99	0.98	0.94	0.84	0.63	0.44	0.49	0.76	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	523.24	590.34	644.84	670.52	616.23	450.06	302.87	316.93	468.83	534.66	507.20	497.03	(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]													
	1228.32	1189.33	1077.28	895.73	689.03	459.16	303.66	318.33	498.88	758.06	1007.88	1219.55	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	524.58	402.52	321.74	162.15	54.16	0.00	0.00	0.00	0.00	166.21	360.49	537.56	

∑(98)1...5, 10...12 = 2529.40 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 26.70 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.33	(303a)
Fraction of community heat from heat pump		0.67	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.33	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.67	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement	2529.40		(98)
Space heat from boilers	(98) x (304a) x (305) x (306) =	1110.15	(307a)
Space heat from heat pump	(98) x (304b) x (305) x (306) =	2253.95	(307b)

Water heating

Annual water heating requirement	1862.94		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	817.65	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1660.07	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	58.42	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	216.69		(330a)
Total electricity for the above, kWh/year		216.69	(331)
Electricity for lighting (Appendix L)		408.17	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	6375.42	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1110.15	x	4.24	x 0.01 =	47.07	(340a)
Space heating from heat pump	2253.95	x	4.24	x 0.01 =	95.57	(340b)
Water heating from boilers	817.65	x	4.24	x 0.01 =	34.67	(342a)
Water heating from heat pump	1660.07	x	4.24	x 0.01 =	70.39	(342b)
Pumps and fans	216.69	x	13.19	x 0.01 =	28.58	(349)
Electricity for lighting	408.17	x	13.19	x 0.01 =	53.84	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		450.11	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.35	(357)
SAP value	81.13	
SAP rating (section 13)	81	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2153.97	x	0.216	=	465.26	(367)
Efficiency of heat pump	260.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1505.39	x	0.519	=	781.30	(368)
Electrical energy for community heat distribution	58.42	x	0.519	=	30.32	(372)
Total CO2 associated with community systems					1276.87	(373)
Total CO2 associated with space and water heating					1276.87	(376)
Pumps and fans	216.69	x	0.519	=	112.46	(378)
Electricity for lighting	408.17	x	0.519	=	211.84	(379)
Energy saving/generation technologies						

pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	1553.82	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	16.40	(384)
EI value					85.10	
EI rating (section 14)					85	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2153.97	x	1.22	=	2627.84	(367)
Efficiency of heat pump	260.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1505.39	x	3.07	=	4621.55	(368)
Electrical energy for community heat distribution	58.42	x	3.07	=	179.34	(372)
Total primary energy associated with community systems					7428.74	(373)
Total primary energy associated with space and water heating					7428.74	(376)
Pumps and fans	216.69	x	3.07	=	665.25	(378)
Electricity for lighting	408.17	x	3.07	=	1253.08	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					9066.90	(383)
Dwelling primary energy rate kWh/m2/year					95.71	(384)

DER 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	Miss Nimco Ali	Assessor number	9526
Client		Last modified	26/10/2020
Address	4B8P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		72.24	(1a)	x	2.50	(2a)	=	180.60	(3a)
+1		57.20	(1b)	x	2.50	(2b)	=	143.00	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	129.44	(4)						
Dwelling volume						(3a) + (3b) + (3c) + (3d)...(3n) =		323.60	(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	0	x 10 =	0	(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) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(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) = 0.13	(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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	73.10	(23c)

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

	0.30	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28	(24a)

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

0.30	0.29	0.29	0.27	0.27	0.26	0.26	0.25	0.26	0.27	0.28	0.28 (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	
Window			23.72	x	1.24	=	29.31			(27)
Door			1.80	x	1.30	=	2.34			(26)
Ground floor			72.24	x	0.10	=	7.22			(28a)
External wall			64.31	x	0.17	=	10.93			(29a)
Party wall			79.95	x	0.00	=	0.00			(32)
Roof			15.04	x	0.13	=	1.96			(30)
Roof			2.58	x	0.16	=	0.41			(30)
Total area of external elements ∑A, m²			179.69							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	52.18 (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		14.96 (36)
Total fabric heat loss	(33) + (36) =	67.14 (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)	31.72	31.38	31.04	29.34	29.00	27.30	27.30	26.96	27.98	29.00	29.68	30.36	(38)
Heat transfer coefficient, W/K (37)m + (38)m	98.86	98.52	98.18	96.48	96.14	94.43	94.43	94.09	95.11	96.14	96.82	97.50	
Average = ∑(39)1...12/12 =												96.39	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.76	0.76	0.76	0.75	0.74	0.73	0.73	0.73	0.73	0.74	0.75	0.75	
Average = ∑(40)1...12/12 =												0.74	(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	2.89 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	102.92 (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)	113.21	109.10	104.98	100.86	96.75	92.63	92.63	96.75	100.86	104.98	109.10	113.21	
∑(44)1...12 =												1235.05	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	167.89	146.84	151.53	132.10	126.76	109.38	101.36	116.31	117.70	137.17	149.73	162.59	
∑(45)1...12 =												1619.35	(45)
Distribution loss 0.15 x (45)m	25.18	22.03	22.73	19.82	19.01	16.41	15.20	17.45	17.65	20.57	22.46	24.39	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	3.00 (47)
Water storage loss:	
b) Manufacturer's declared loss factor is not known	
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02 (51)
Volume factor from Table 2a	3.42 (52)
Temperature factor from Table 2b	0.60 (53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	0.13 (54)

Enter (50) or (54) in (55) | 0.13 | (55)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04 (56)

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

4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04 (57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (59)

Combi loss 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

195.20	171.50	178.83	158.53	154.06	135.80	128.66	143.61	144.12	164.47	176.15	189.90 (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

195.20	171.50	178.83	158.53	154.06	135.80	128.66	143.61	144.12	164.47	176.15	189.90

∑(64)1...12 = 1940.83 (64)

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

77.67	68.55	72.22	65.06	63.99	57.51	55.54	60.52	60.27	67.45	70.92	75.91 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.97	23.96	19.48	14.75	11.03	9.31	10.06	13.07	17.55	22.28	26.00	27.72	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.04	300.13	292.36	275.82	254.95	235.33	222.22	219.14	226.91	243.45	264.32	283.94	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	(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)	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	(71)
Water heating gains (Table 5)	104.39	102.01	97.08	90.36	86.01	79.87	74.66	81.34	83.71	90.66	98.50	102.02	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	494.81	492.50	475.32	447.34	418.38	390.91	373.34	379.96	394.57	422.79	455.23	480.09	(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	
South	0.77	x	9.04	x	46.75	x 0.9 x	0.50	x	0.70	=	102.51	(78)
East	0.77	x	10.68	x	19.64	x 0.9 x	0.45	x	0.70	=	45.79	(76)
SouthEast	0.77	x	4.00	x	36.79	x 0.9 x	0.50	x	0.70	=	35.70	(77)

Solar gains in watts ∑(74)m...(82)m

184.00	318.27	444.57	559.93	631.00	626.93	604.31	552.00	485.05	354.57	221.36	156.78 (83)

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

678.81	810.77	919.89	1007.27	1049.38	1017.84	977.65	931.96	879.62	777.36	676.59	636.87 (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)	1.00	1.00	0.98	0.93	0.80	0.59	0.42	0.46	0.72	0.96	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.24	20.39	20.59	20.82	20.96	21.00	21.00	21.00	20.98	20.80	20.47	20.22	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.28	20.29	20.29	20.30	20.30	20.31	20.31	20.32	20.31	20.30	20.30	20.29	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.98	0.91	0.75	0.53	0.36	0.40	0.66	0.94	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	19.25	19.48	19.77	20.09	20.26	20.31	20.31	20.32	20.30	20.07	19.61	19.23	(90)

Living area fraction | Living area ÷ (4) = | 0.30 | (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.55	19.75	20.02	20.31	20.47	20.52	20.52	20.52	20.50	20.29	19.87	19.52	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.55	19.75	20.02	20.31	20.47	20.52	20.52	20.52	20.50	20.29	19.87	19.52	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.98	0.91	0.76	0.55	0.38	0.42	0.68	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	677.47	805.20	897.89	920.24	802.43	555.80	370.14	387.58	595.71	732.56	672.54	636.04	(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]	1507.74	1463.21	1327.29	1101.17	843.21	558.90	370.32	387.94	609.16	931.85	1236.13	1494.12	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	617.72	442.19	319.47	130.26	30.34	0.00	0.00	0.00	0.00	148.28	405.78	638.41	

∑(98)1...5, 10...12 = | 2732.45 | (98)

Space heating requirement kWh/m²/year | (98) ÷ (4) | 21.11 | (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		0.33	(303a)
Fraction of community heat from heat pump		0.67	(303b)
Fraction of total space heat from community boilers	(302) x (303a) =	0.33	(304a)
Fraction of total space heat from community heat pump	(302) x (303b) =	0.67	(304b)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.33	(306)

Space heating

Annual space heating requirement | 2732.45 | (98)

Space heat from boilers | (98) x (304a) x (305) x (306) = | 1199.27 | (307a)

Space heat from heat pump	(98) x (304b) x (305) x (306) =	2434.88	(307b)

Water heating

Annual water heating requirement	1940.83		(64)
Water heat from boilers	(64) x (303a) x (305a) x (306) =	851.83	(310a)
Water heat from heat pump	(64) x (303b) x (305a) x (306) =	1729.47	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	62.15	(313)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside	350.38		(330a)
Total electricity for the above, kWh/year		350.38	(331)
Electricity for lighting (Appendix L)		476.33	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-91.26	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	6950.91	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1199.27	x	4.24	x 0.01 =	50.85	(340a)
Space heating from heat pump	2434.88	x	4.24	x 0.01 =	103.24	(340b)
Water heating from boilers	851.83	x	4.24	x 0.01 =	36.12	(342a)
Water heating from heat pump	1729.47	x	4.24	x 0.01 =	73.33	(342b)
Pumps and fans	350.38	x	13.19	x 0.01 =	46.21	(349)
Electricity for lighting	476.33	x	13.19	x 0.01 =	62.83	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-91.26	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		492.58	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.19	(357)
SAP value	83.46	
SAP rating (section 13)	83	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2291.73	x	0.216	=	495.01	(367)
Efficiency of heat pump	260.00					(367b)
CO2 emissions from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1601.68	x	0.519	=	831.27	(368)
Electrical energy for community heat distribution	62.15	x	0.519	=	32.26	(372)
Total CO2 associated with community systems					1358.54	(373)
Total CO2 associated with space and water heating					1358.54	(376)
Pumps and fans	350.38	x	0.519	=	181.85	(378)

Electricity for lighting	476.33	x	0.519	=	247.22	(379)
Energy saving/generation technologies						
pv savings	-91.26	x	0.519	=	-47.36	(380)
Total CO_2, kg/year				(376)..(382) =	1740.24	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	13.44	(384)
EI value					86.63	
EI rating (section 14)					87	(385)
EI band					B	

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers [(307a)+(310a)] x 100 ÷ (367a) =	2291.73	x	1.22	=	2795.91	(367)
Efficiency of heat pump	260.00					(367b)
Primary energy from heat pump [(307b)+(310b)] x 100 ÷ (367b) =	1601.68	x	3.07	=	4917.14	(368)
Electrical energy for community heat distribution	62.15	x	3.07	=	190.81	(372)
Total primary energy associated with community systems					7903.87	(373)
Total primary energy associated with space and water heating					7903.87	(376)
Pumps and fans	350.38	x	3.07	=	1075.66	(378)
Electricity for lighting	476.33	x	3.07	=	1462.34	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-91.26	x	3.07	=	-280.17	(380)
Primary energy kWh/year					10161.71	(383)
Dwelling primary energy rate kWh/m2/year					78.51	(384)

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